ETSITS 138 331 V15.18.0 (2022-08)



5G; NR;

Radio Resource Control (RRC);
Protocol specification
(3GPP TS 38.331 version 15.18.0 Release 15)



Reference
RTS/TSGR-0238331vfi0

Keywords
5G

ETSI

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Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
 - 1 presented to TSG for information;
 - 2 presented to TSG for approval;
 - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document specifies the Radio Resource Control protocol for the radio interface between UE and NG-RAN.

The scope of the present document also includes:

- the radio related information transported in a transparent container between source gNB and target gNB upon inter gNB handover;
- the radio related information transported in a transparent container between a source or target gNB and another system upon inter RAT handover.
- the radio related information transported in a transparent container between a source eNB and target gNB during E-UTRA-NR Dual Connectivity.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1]	3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
[2]	3GPP TS 38.300: "NR; Overall description; Stage 2".
[3]	3GPP TS 38.321: "NR; Medium Access Control (MAC); Protocol specification".
[4]	3GPP TS 38.322: "NR; Radio Link Control (RLC) protocol specification".
[5]	3GPP TS 38.323: "NR; Packet Data Convergence Protocol (PDCP) protocol specification".
[6]	ITU-T Recommendation X.680 (08/2015) "Information Technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation" (Same as the ISO/IEC International Standard 8824-1).
[7]	ITU-T Recommendation X.681 (08/2015) "Information Technology – Abstract Syntax Notation One (ASN.1): Information object specification" (Same as the ISO/IEC International Standard 8824-2).
[8]	ITU-T Recommendation X.691 (08/2015) "Information technology – ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)" (Same as the ISO/IEC International Standard 8825-2).
[9]	3GPP TS 38.215: "NR; Physical layer measurements".
[10]	3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA) Radio Resource Control (RRC); Protocol Specification".
[11]	3GPP TS 33.501: "Security Architecture and Procedures for 5G System".
[12]	3GPP TS 38.104: "NR; Base Station (BS) radio transmission and reception".

[13]	3GPP TS 38.213: "NR; Physical layer procedures for control".
[14]	3GPP TS 38.133: "NR; Requirements for support of radio resource management".
[15]	3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".
[16]	3GPP TS 38.211: "NR; Physical channels and modulation".
[17]	3GPP TS 38.212: "NR; Multiplexing and channel coding".
[18]	ITU-T Recommendation X.683 (08/2015) "Information Technology – Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications" (Same as the ISO/IEC International Standard 8824-4).
[19]	3GPP TS 38.214: "NR; Physical layer procedures for data".
[20]	3GPP TS 38.304: "NR; User Equipment (UE) procedures in Idle mode and RRC Inactive state".
[21]	3GPP TS 23.003: "Numbering, addressing and identification".
[22]	3GPP TS 36.101: "E-UTRA; User Equipment (UE) radio transmission and reception".
[23]	3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".
[24]	3GPP TS 37.324: "Service Data Adaptation Protocol (SDAP) specification".
[25]	3GPP TS 22.261: "Service requirements for the 5G System".
[26]	3GPP TS 38.306: "User Equipment (UE) radio access capabilities".
[27]	3GPP TS 36.304: "E-UTRA; User Equipment (UE) procedures in idle mode".
[28]	ATIS 0700041: "WEA 3.0: Device-Based Geo-Fencing".
[29]	3GPP TS 23.041: "Technical realization of Cell Broadcast Service (CBS)".
[30]	3GPP TS 33.401: "3GPP System Architecture Evolution (SAE); Security architecture".
[31]	3GPP TS 36.211: "E-UTRA; Physical channels and modulation".
[32]	3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".
[33]	3GPP TS 36.104:"E-UTRA; Base Station (BS) radio transmission and reception".
[34]	3GPP TS 38.101-3 "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".
[35]	3GPP TS 38.423: "NG-RAN, Xn application protocol (XnAP)".
[36]	3GPP TS 38.473: "NG-RAN; F1 application protocol (F1AP)".
[37]	3GPP TS 36.423: "E-UTRA; X2 application protocol (X2AP)".
[38]	3GPP TS 24.008: "Mobile radio interface layer 3 specification; Core network protocols; Stage 3".
[39]	3GPP TS 38.101-2 "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".
[40]	3GPP TS 36.133:"E-UTRA; Requirements for support of radio resource management".
[41]	3GPP TS 37.340: "E-UTRA and NR; Multi-connectivity; Stage 2".
[42]	3GPP TS 38.413: "NG-RAN, NG Application Protocol (NGAP)".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

CEIL: Mathematical function used to 'round up' i.e. to the nearest integer having a higher or equal value.

Dedicated signalling: Signalling sent on DCCH logical channel between the network and a single UE.

Field: The individual contents of an information element are referred to as fields.

FLOOR: Mathematical function used to 'round down' i.e. to the nearest integer having a lower or equal value.

Information element: A structural element containing single or multiple fields is referred as information element.

Primary Cell: The MCG cell, operating on the primary frequency, in which the UE either performs the initial connection establishment procedure or initiates the connection re-establishment procedure.

Primary SCG Cell: For dual connectivity operation, the SCG cell in which the UE performs random access when performing the Reconfiguration with Sync procedure.

Primary Timing Advance Group: Timing Advance Group containing the SpCell.

PUCCH SCell: An SCell configured with PUCCH.

PUSCH-Less SCell: An SCell configured without PUSCH.

RLC bearer configuration: The lower layer part of the radio bearer configuration comprising the RLC and logical channel configurations.

Secondary Cell: For a UE configured with CA, a cell providing additional radio resources on top of Special Cell.

Secondary Cell Group: For a UE configured with dual connectivity, the subset of serving cells comprising of the PSCell and zero or more secondary cells.

Serving Cell: For a UE in RRC_CONNECTED not configured with CA/DC there is only one serving cell comprising of the primary cell. For a UE in RRC_CONNECTED configured with CA/DC the term 'serving cells' is used to denote the set of cells comprising of the Special Cell(s) and all secondary cells.

Special Cell: For Dual Connectivity operation the term Special Cell refers to the PCell of the MCG or the PSCell of the SCG, otherwise the term Special Cell refers to the PCell.

Split SRB: In MR-DC, an SRB that supports transmission via MCG and SCG as well as duplication of RRC PDUs as defined in TS 37.340 [41].

SSB Frequency: Frequency referring to the position of resource element RE=#0 (subcarrier #0) of resource block RB#10 of the SS block.

UE Inactive AS Context: UE Inactive AS Context is stored when the connection is suspended and restored when the connection is resumed. It includes information as defined in clause 5.3.8.3.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

5GC 5G Core Network
ACK Acknowledgement
AM Acknowledged Mode
ARQ Automatic Repeat Request

AS Access Stratum

ASN.1 Abstract Syntax Notation One

BLER Block Error Rate
BWP Bandwidth Part
CA Carrier Aggregation
CCCH Common Control Channel

CG Cell Group

CMAS Commercial Mobile Alert Service

CP Control Plane C-RNTI Cell RNTI

CSI Channel State Information

DC Dual Connectivity

DCCH Dedicated Control Channel
DCI Downlink Control Information

DL Downlink

DL-SCH Downlink Shared Channel
DM-RS Demodulation Reference Signal
DRB (user) Data Radio Bearer
DRX Discontinuous Reception
DTCH Dedicated Traffic Channel

EN-DC E-UTRA NR Dual Connectivity with E-UTRA connected to EPC

EPC Evolved Packet Core EPS Evolved Packet System

ETWS Earthquake and Tsunami Warning System
E-UTRA Evolved Universal Terrestrial Radio Access

E-UTRA/5GC E-UTRA connected to 5GC E-UTRA/EPC E-UTRA connected to EPC

E-UTRAN Evolved Universal Terrestrial Radio Access Network

FDD Frequency Division Duplex

FFS For Further Study

GERAN GSM/EDGE Radio Access Network
GNSS Global Navigation Satellite System

GSM Global System for Mobile Communications

HARQ Hybrid Automatic Repeat Request

IE Information element

IMSI International Mobile Subscriber Identity

kB Kilobyte (1000 bytes)

L1 Layer 1 L2 Layer 2 L3 Layer 3

MAC Medium Access Control
MCG Master Cell Group
MIB Master Information Block
MR-DC Multi-Radio Dual Connectivity

N/A Not Applicable

NE-DC NR E-UTRA Dual Connectivity

(NG)EN-DC E-UTRA NR Dual Connectivity (covering E-UTRA connected to EPC or 5GC)

NGEN-DC E-UTRA NR Dual Connectivity with E-UTRA connected to 5GC

NR-DC NR-NR Dual Connectivity NR/5GC NR connected to 5GC

PCell Primary Cell

PDCP Packet Data Convergence Protocol

PDU Protocol Data Unit

PLMN Public Land Mobile Network

PSCell Primary SCG Cell
PWS Public Warning System
QoS Quality of Service
RAN Radio Access Network
RAT Radio Access Technology
RLC Radio Link Control

RNA RAN-based Notification Area
RNTI Radio Network Temporary Identifier

ROHC Robust Header Compression
RRC Radio Resource Control
RS Reference Signal
SCell Secondary Cell
SCG Secondary Cell Group
SFN System Frame Number

SFTD SFN and Frame Timing Difference

SI System Information
SIB System Information Block

SpCell Special Cell

SRB Signalling Radio Bearer
SSB Synchronization Signal Block
TAG Timing Advance Group
TDD Time Division Duplex
TM Transparent Mode
UE User Equipment

UL Uplink

UM Unacknowledged Mode

UP User Plane

In the ASN.1, lower case may be used for some (parts) of the above abbreviations e.g. c-RNTI.

4 General

4.1 Introduction

This specification is organised as follows:

- clause 4.2 describes the RRC protocol model;
- clause 4.3 specifies the services provided to upper layers as well as the services expected from lower layers;
- clause 4.4 lists the RRC functions:
- clause 5 specifies RRC procedures, including UE state transitions;
- clause 6 specifies the RRC messages in ASN.1 and description;
- clause 7 specifies the variables (including protocol timers and constants) and counters to be used by the UE;
- clause 8 specifies the encoding of the RRC messages;
- clause 9 specifies the specified and default radio configurations;
- clause 10 specifies generic error handling;
- clause 11 specifies the RRC messages transferred across network nodes;
- clause 12 specifies the UE capability related constraints and performance requirements.

4.2 Architecture

4.2.1 UE states and state transitions including inter RAT

A UE is either in RRC_CONNECTED state or in RRC_INACTIVE state when an RRC connection has been established. If this is not the case, i.e. no RRC connection is established, the UE is in RRC_IDLE state. The RRC states can further be characterised as follows:

- RRC IDLE:

- A UE specific DRX may be configured by upper layers;
- UE controlled mobility based on network configuration;
- The UE:
 - Monitors Short Messages transmitted with P-RNTI over DCI (see clause 6.5);
 - Monitors a Paging channel for CN paging using 5G-S-TMSI;
 - Performs neighbouring cell measurements and cell (re-)selection;
 - Acquires system information and can send SI request (if configured).

RRC_INACTIVE:

- A UE specific DRX may be configured by upper layers or by RRC layer;
- UE controlled mobility based on network configuration;
- The UE stores the UE Inactive AS context;
- A RAN-based notification area is configured by RRC layer;

The UE:

- Monitors Short Messages transmitted with P-RNTI over DCI (see clause 6.5);
- Monitors a Paging channel for CN paging using 5G-S-TMSI and RAN paging using fullI-RNTI;
- Performs neighbouring cell measurements and cell (re-)selection;
- Performs RAN-based notification area updates periodically and when moving outside the configured RAN-based notification area;
- Acquires system information and can send SI request (if configured).

- RRC CONNECTED:

- The UE stores the AS context;
- Transfer of unicast data to/from UE;
- At lower layers, the UE may be configured with a UE specific DRX;
- For UEs supporting CA, use of one or more SCells, aggregated with the SpCell, for increased bandwidth;
- For UEs supporting DC, use of one SCG, aggregated with the MCG, for increased bandwidth;
- Network controlled mobility within NR and to/from E-UTRA;
- The UE:
 - Monitors Short Messages transmitted with P-RNTI over DCI (see clause 6.5), if configured;
 - Monitors control channels associated with the shared data channel to determine if data is scheduled for it;
 - Provides channel quality and feedback information;
 - Performs neighbouring cell measurements and measurement reporting;
 - Acquires system information.

Figure 4.2.1-1 illustrates an overview of UE RRC state machine and state transitions in NR. A UE has only one RRC state in NR at one time.

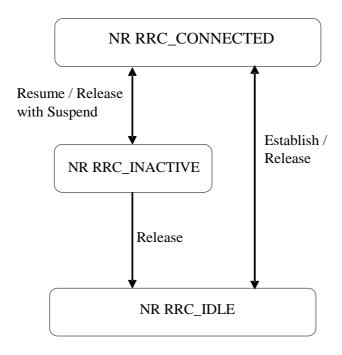


Figure 4.2.1-1: UE state machine and state transitions in NR

Figure 4.2.1-2 illustrates an overview of UE state machine and state transitions in NR as well as the mobility procedures supported between NR/5GC E-UTRA/EPC and E-UTRA/5GC.

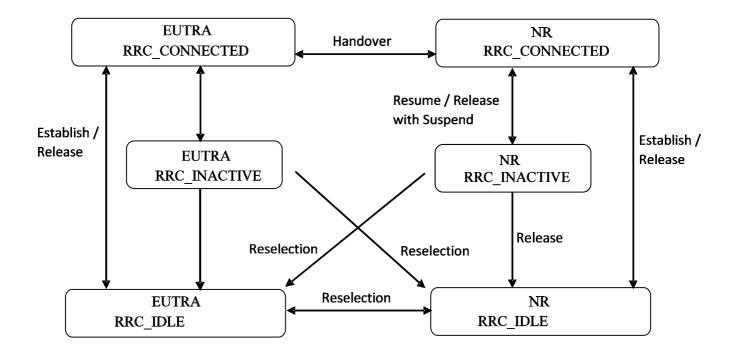


Figure 4.2.1-2: UE state machine and state transitions between NR/5GC, E-UTRA/EPC and E-UTRA/5GC

4.2.2 Signalling radio bearers

"Signalling Radio Bearers" (SRBs) are defined as Radio Bearers (RBs) that are used only for the transmission of RRC and NAS messages. More specifically, the following SRBs are defined:

- SRB0 is for RRC messages using the CCCH logical channel;

- SRB1 is for RRC messages (which may include a piggybacked NAS message) as well as for NAS messages prior to the establishment of SRB2, all using DCCH logical channel;
- SRB2 is for NAS messages, all using DCCH logical channel. SRB2 has a lower priority than SRB1 and may be configured by the network after AS security activation;
- SRB3 is for specific RRC messages when UE is in (NG)EN-DC or NR-DC, all using DCCH logical channel.

In downlink, piggybacking of NAS messages is used only for one dependant (i.e. with joint success/failure) procedure: bearer establishment/modification/release. In uplink piggybacking of NAS message is used only for transferring the initial NAS message during connection setup and connection resume.

NOTE 1: The NAS messages transferred via SRB2 are also contained in RRC messages, which however do not include any RRC protocol control information.

Once AS security is activated, all RRC messages on SRB1, SRB2 and SRB3, including those containing NAS messages, are integrity protected and ciphered by PDCP. NAS independently applies integrity protection and ciphering to the NAS messages, see TS 24.501 [23].

Split SRB is supported for all the MR-DC options in both SRB1 and SRB2 (split SRB is not supported for SRB0 and SRB3).

4.3 Services

4.3.1 Services provided to upper layers

The RRC protocol offers the following services to upper layers:

- Broadcast of common control information;
- Notification of UEs in RRC_IDLE, e.g. about a mobile terminating call;
- Notification of UEs about ETWS and/or CMAS
- Transfer of dedicated signalling.

4.3.2 Services expected from lower layers

In brief, the following are the main services that RRC expects from lower layers:

- Integrity protection, ciphering and loss-less in-sequence delivery of information without duplication;

4.4 Functions

The RRC protocol includes the following main functions:

- Broadcast of system information:
 - Including NAS common information;
 - Information applicable for UEs in RRC_IDLE and RRC_INACTIVE (e.g. cell (re-)selection parameters, neighbouring cell information) and information (also) applicable for UEs in RRC_CONNECTED (e.g. common channel configuration information);
 - Including ETWS notification, CMAS notification.
- RRC connection control:
 - Paging;

- Establishment/modification/suspension/resumption/release of RRC connection, including e.g. assignment/modification of UE identity (C-RNTI, fullI-RNTI, etc.), establishment/modification/suspension/resumption/release of SRBs (except for SRB0);
- Access barring;
- Initial AS security activation, i.e. initial configuration of AS integrity protection (SRBs, DRBs) and AS ciphering (SRBs, DRBs);
- RRC connection mobility including e.g. intra-frequency and inter-frequency handover, associated AS security handling, i.e. key/algorithm change, specification of RRC context information transferred between network nodes;
- Establishment/modification/suspension/resumption/release of RBs carrying user data (DRBs);
- Radio configuration control including e.g. assignment/modification of ARQ configuration, HARQ configuration, DRX configuration;
- In case of DC, cell management including e.g. change of PSCell, addition/modification/release of SCG cell(s);
- In case of CA, cell management including e.g. addition/modification/release of SCell(s);
- QoS control including assignment/ modification of semi-persistent scheduling (SPS) configuration and configured grant configuration for DL and UL respectively, assignment/ modification of parameters for UL rate control in the UE, i.e. allocation of a priority and a prioritised bit rate (PBR) for each RB.
- Recovery from radio link failure.
- Inter-RAT mobility including e.g. AS security activation, transfer of RRC context information;
- Measurement configuration and reporting:
 - Establishment/modification/release of measurement configuration (e.g. intra-frequency, inter-frequency and inter- RAT measurements);
 - Setup and release of measurement gaps;
 - Measurement reporting.
- Other functions including e.g. generic protocol error handling, transfer of dedicated NAS information, transfer of UE radio access capability information.

5 Procedures

5.1 General

5.1.1 Introduction

This clause covers the general requirements.

5.1.2 General requirements

The UE shall:

1> process the received messages in order of reception by RRC, i.e. the processing of a message shall be completed before starting the processing of a subsequent message;

NOTE: Network may initiate a subsequent procedure prior to receiving the UE's response of a previously initiated procedure.

- 1> within a clause execute the steps according to the order specified in the procedural description;
- 1> consider the term 'radio bearer' (RB) to cover SRBs and DRBs unless explicitly stated otherwise;
- 1> set the *rrc-TransactionIdentifier* in the response message, if included, to the same value as included in the message received from the network that triggered the response message;
- 1> upon receiving a choice value set to *setup*:
 - 2> apply the corresponding received configuration and start using the associated resources, unless explicitly specified otherwise;
- 1> upon receiving a choice value set to release:
 - 2> clear the corresponding configuration and stop using the associated resources;
- 1> in case the size of a list is extended, upon receiving an extension field comprising the entries in addition to the ones carried by the original field (regardless of whether the network signals more entries in total); apply the following generic behaviour unless explicitly stated otherwise:
 - 2> create a combined list by concatenating the additional entries included in the extension field to the original field while maintaining the order among both the original and the additional entries;
 - 2> for the combined list, created according to the previous, apply the same behaviour as defined for the original field.

5.1.3 Requirements for UE in MR-DC

In this specification, the UE considers itself to be in:

- EN-DC, if and only if it is configured with *nr-SecondaryCellGroupConfig* according to TS 36.331[10], and it is connected to EPC,
- NGEN-DC, if and only if it is configured with *nr-SecondaryCellGroupConfig* according to TS 36.331[10], and it is connected to 5GC,
- NE-DC, if and only if it is configured with mrdc-SecondaryCellGroup set to eutra-SCG,
- NR-DC, if and only if it is configured with mrdc-SecondaryCellGroup set to nr-SCG,
- MR-DC, if and only if it is in (NG)EN-DC, NE-DC or NR-DC.

NOTE: This use of these terms deviates from the definition in TS 37.340 [41] and other specifications. In TS 37.340, these terms include also the case where the UE is configured with E-UTRA or NR MCG only (i.e. no NR or E-UTRA SCG) but with one or more bearers terminated in a secondary node (i.e. using NR PDCP).

The UE in (NG)EN-DC only executes a clause of clause 5 in this specification when the subclause:

- is referred to from a subclause under execution, either in this specification or in TS 36.331 [10]; or
- applies to a message received on SRB3 (if SRB3 is established); or
- applies to field(s), IE(s), UE variable(s) or timer(s) in this specification that the UE is configured with.

When executing a subclause of clause 5 in this specification, the UE follows the requirements in clause 5.1.2 and in all subclauses of this specification applicable to the messages (including processing time requirements), fields, IEs, timers and UE variables indicated in the subclause under execution.

5.2 System information

5.2.1 Introduction

System Information (SI) is divided into the MIB and a number of SIBs where:

- the *MIB* is always transmitted on the BCH with a periodicity of 80 ms and repetitions made within 80 ms (TS 38.212 [17], clause 7.1) and it includes parameters that are needed to acquire *SIB1* from the cell. The first transmission of the *MIB* is scheduled in subframes as defined in TS 38.213 [13], clause 4.1 and repetitions are scheduled according to the period of SSB;
- the *SIB1* is transmitted on the DL-SCH with a periodicity of 160 ms and variable transmission repetition periodicity within 160 ms as specified in TS 38.213 [13], clause 13. The default transmission repetition periodicity of *SIB1* is 20 ms but the actual transmission repetition periodicity is up to network implementation. For SSB and CORESET multiplexing pattern 1, *SIB1* repetition transmission period is 20 ms. For SSB and CORESET multiplexing pattern 2/3, *SIB1* transmission repetition period is the same as the SSB period (TS 38.213 [13], clause 13). *SIB1* includes information regarding the availability and scheduling (e.g. mapping of SIBs to SI message, periodicity, SI-window size) of other SIBs with an indication whether one or more SIBs are only provided on-demand and, in that case, the configuration needed by the UE to perform the SI request. *SIB1* is cell-specific SIB;
- SIBs other than SIB1 are carried in SystemInformation (SI) messages, which are transmitted on the DL-SCH. Only SIBs having the same periodicity can be mapped to the same SI message. Each SI message is transmitted within periodically occurring time domain windows (referred to as SI-windows with same length for all SI messages). Each SI message is associated with an SI-window and the SI-windows of different SI messages do not overlap. That is, within one SI-window only the corresponding SI message is transmitted. An SI message may be transmitted a number of times within the SI-window. Any SIB except SIB1 can be configured to be cell specific or area specific, using an indication in SIB1. The cell specific SIB is applicable only within a cell that provides the SIB while the area specific SIB is applicable within an area referred to as SI area, which consists of one or several cells and is identified by systemInformationAreaID;
- The mapping of SIBs to SI messages is configured in *schedulingInfoList* with restrictions that each SIB is contained only in a single SI message and each SIB is contained at most once in that SI message;
- For a UE in RRC_CONNECTED, the network can provide system information through dedicated signalling using the *RRCReconfiguration* message, e.g. if the UE has an active BWP with no common search space configured to monitor system information or paging.
- For PSCell and SCells, the network provides the required SI by dedicated signalling, i.e. within an *RRCReconfiguration* message. Nevertheless, the UE shall acquire *MIB* of the PSCell to get SFN timing of the SCG (which may be different from MCG). Upon change of relevant SI for SCell, the network releases and adds the concerned SCell. For PSCell, the required SI can only be changed with Reconfiguration with Sync.

NOTE: The physical layer imposes a limit to the maximum size a SIB can take. The maximum *SIB1* or *SI message* size is 2976 bits.

5.2.2 System information acquisition

5.2.2.1 General UE requirements

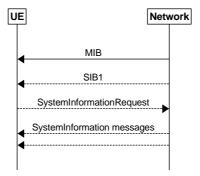


Figure 5.2.2.1-1: System information acquisition

The UE applies the SI acquisition procedure to acquire the AS- and NAS information. The procedure applies to UEs in RRC_IDLE, in RRC_INACTIVE and in RRC_CONNECTED.

The UE in RRC_IDLE and RRC_INACTIVE shall ensure having a valid version of (at least) the *MIB*, *SIB1* through *SIB4* and *SIB5* (if the UE supports E-UTRA).

5.2.2.2 SIB validity and need to (re)-acquire SIB

5.2.2.2.1 SIB validity

The UE shall apply the SI acquisition procedure as defined in clause 5.2.2.3 upon cell selection (e.g. upon power on), cell-reselection, return from out of coverage, after reconfiguration with sync completion, after entering the network from another RAT, upon receiving an indication that the system information has changed, upon receiving a PWS notification; and whenever the UE does not have a valid version of a stored SIB.

When the UE acquires a *MIB* or a *SIB1* or an SI message in a serving cell as described in clause 5.2.2.3, and if the UE stores the acquired SIB, then the UE shall store the associated *areaScope*, if present, the first *PLMN-Identity* in the *PLMN-IdentityInfoList*, the *cellIdentity*, the *systemInformationAreaID*, if present, and the *valueTag*, if present, as indicated in the *si-SchedulingInfo* for the SIB. The UE may use a valid stored version of the SI except *MIB*, *SIB1*, *SIB6*, *SIB7* or *SIB8* e.g. after cell re-selection, upon return from out of coverage or after the reception of SI change indication.

NOTE: The storage and management of the stored SIBs in addition to the SIBs valid for the current serving cell is left to UE implementation.

The UE shall:

- 1> delete any stored version of a SIB after 3 hours from the moment it was successfully confirmed as valid;
- 1> for each stored version of a SIB:
 - 2> if the *areaScope* is associated and its value for the stored version of the SIB is the same as the value received in the *si-SchedulingInfo* for that SIB from the serving cell:
 - 3> if the first *PLMN-Identity* included in the *PLMN-IdentityInfoList*, the *systemInformationAreaID* and the *valueTag* that are included in the *si-SchedulingInfo* for the SIB received from the serving cell are identical to the *PLMN-Identity*, the *systemInformationAreaID* and the *valueTag* associated with the stored version of that SIB:
 - 4> consider the stored SIB as valid for the cell;
 - 2> if the *areaScope* is not present for the stored version of the SIB and the *areaScope* value is not included in the *si-SchedulingInfo* for that SIB from the serving cell:
 - 3> if the first *PLMN-Identity* in the *PLMN-IdentityInfoList*, the *cellIdentity* and *valueTag* that are included in the *si-SchedulingInfo* for the SIB received from the serving cell are identical to the *PLMN-Identity*, the *cellIdentity* and the *valueTag* associated with the stored version of that SIB:
 - 4> consider the stored SIB as valid for the cell;

5.2.2.2.2 SI change indication and PWS notification

A modification period is used, i.e. updated SI (other than for ETWS and CMAS) is broadcasted in the modification period following the one where SI change indication is transmitted. The modification period boundaries are defined by SFN values for which SFN mod m=0, where m is the number of radio frames comprising the modification period. The modification period is configured by system information. The UE receives indications about SI modifications and/or PWS notifications using Short Message transmitted with P-RNTI over DCI (see clause 6.5). Repetitions of SI change indication may occur within preceding modification period.

UEs in RRC_IDLE or in RRC_INACTIVE shall monitor for SI change indication in its own paging occasion every DRX cycle. UEs in RRC_CONNECTED shall monitor for SI change indication in any paging occasion at least once per modification period if the UE is provided with common search space on the active BWP to monitor paging, as specified in TS 38.213 [13], clause 13.

ETWS or CMAS capable UEs in RRC_IDLE or in RRC_INACTIVE shall monitor for indications about PWS notification in its own paging occasion every DRX cycle. ETWS or CMAS capable UEs in RRC_CONNECTED shall monitor for indication about PWS notification in any paging occasion at least once every *defaultPagingCycle* if the UE is provided with common search space on the active BWP to monitor paging.

For Short Message reception in a paging occasion, the UE monitors the PDCCH monitoring occasion(s) for paging as specified in TS 38.304 [20] and TS 38.213 [13].

If the UE receives a Short Message, the UE shall:

- 1> if the UE is ETWS capable or CMAS capable, the *etwsAndCmasIndication* bit of Short Message is set, and the UE is provided with *searchSpaceOtherSystemInformation* on the active BWP or the initial BWP:
 - 2> immediately re-acquire the SIB1;
 - 2> if the UE is ETWS capable and si-SchedulingInfo includes scheduling information for SIB6:
 - 3> acquire SIB6, as specified in clause 5.2.2.3.2, immediately;
 - 2> if the UE is ETWS capable and si-SchedulingInfo includes scheduling information for SIB7:
 - 3> acquire SIB7, as specified in clause 5.2.2.3.2, immediately;
 - 2> if the UE is CMAS capable and si-SchedulingInfo includes scheduling information for SIB8:
 - 3> acquire SIB8, as specified in clause 5.2.2.3.2, immediately;
- NOTE: In case *SIB6*, *SIB7*, or *SIB8* overlap with a measurement gap it is left to UE implementation how to immediately acquire *SIB6*, *SIB7*, or *SIB8*.
- 1> if the systemInfoModification bit of Short Message is set:
 - 2> apply the SI acquisition procedure as defined in clause 5.2.2.3 from the start of the next modification period.

5.2.2.3 Acquisition of System Information

5.2.2.3.1 Acquisition of *MIB* and *SIB1*

The UE shall:

- 1> apply the specified BCCH configuration defined in 9.1.1.1;
- 1> if the UE is in RRC_IDLE or in RRC_INACTIVE; or
- 1> if the UE is in RRC_CONNECTED while T311 is running:
 - 2> acquire the MIB, which is scheduled as specified in TS 38.213 [13];
 - 2> if the UE is unable to acquire the MIB;
 - 3> perform the actions as specified in clause 5.2.2.5;
 - 2> else:
 - 3> perform the actions specified in clause 5.2.2.4.1.
- 1> if the UE is in RRC_CONNECTED with an active BWP with common search space configured by searchSpaceSIB1 and pagingSearchSpace and has received an indication about change of system information; or
- 1> if the UE is in RRC_IDLE or in RRC_INACTIVE; or
- 1> if the UE is in RRC_CONNECTED while T311 is running:
 - 2> if *ssb-SubcarrierOffset* indicates *SIB1* is transmitted in the cell (TS 38.213 [13]) and if *SIB1* acquisition is required for the UE:
 - 3> acquire the SIB1, which is scheduled as specified in TS 38.213 [13];
 - 3> if the UE is unable to acquire the SIB1:
 - 4> perform the actions as specified in clause 5.2.2.5;

3> else:

- 4> upon acquiring SIB1, perform the actions specified in clause 5.2.2.4.2.
- 2> else if SIB1 acquisition is required for the UE and ssb-SubcarrierOffset indicates that SIB1 is not scheduled in the cell:
 - 3> perform the actions as specified in clause 5.2.2.5.

NOTE: The UE in RRC_CONNECTED is only required to acquire broadcasted *SIB1* if the UE can acquire it without disrupting unicast data reception, i.e. the broadcast and unicast beams are quasi co-located.

5.2.2.3.2 Acquisition of an SI message

For SI message acquisition PDCCH monitoring occasion(s) are determined according to *searchSpaceOtherSystemInformation*. If *searchSpaceOtherSystemInformation* is set to zero, PDCCH monitoring occasions for SI message reception in SI-window are same as PDCCH monitoring occasions for *SIB1* where the mapping between PDCCH monitoring occasions and SSBs is specified in TS 38.213[13]. If *searchSpaceOtherSystemInformation* is not set to zero, PDCCH monitoring occasions for SI message are determined based on search space indicated by *searchSpaceOtherSystemInformation*. PDCCH monitoring occasions for SI message which are not overlapping with UL symbols (determined according to *tdd-UL-DL-ConfigurationCommon*) are sequentially numbered from one in the SI window. The [x×N+K]th PDCCH monitoring occasion (s) for SI message in SI-window corresponds to the Kth transmitted SSB, where x = 0, 1, ...X-1, K = 1, 2, ...N, N is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in *SIB1* and X is equal to CEIL(number of PDCCH monitoring occasions in SI-window/N). The actual transmitted SSBs are sequentially numbered from one in ascending order of their SSB indexes. The UE assumes that, in the SI window, PDCCH for an SI message is transmitted in at least one PDCCH monitoring occasion corresponding to each transmitted SSB and thus the selection of SSB for the reception SI messages is up to UE implementation.

When acquiring an SI message, the UE shall:

- 1> determine the start of the SI-window for the concerned SI message as follows:
 - 2> for the concerned SI message, determine the number *n* which corresponds to the order of entry in the list of SI messages configured by *schedulingInfoList* in *si-SchedulingInfo* in *SIB1*;
 - 2> determine the integer value $x = (n-1) \times w$, where w is the si-WindowLength;
 - 2> the SI-window starts at the slot #a, where $a = x \mod N$, in the radio frame for which SFN mod T = FLOOR(x/N), where T is the si-Periodicity of the concerned SI message and N is the number of slots in a radio frame as specified in TS 38.213 [13];
- 1> receive the PDCCH containing the scheduling RNTI, i.e. SI-RNTI in the PDCCH monitoring occasion(s) for SI message acquisition, from the start of the SI-window and continue until the end of the SI-window whose absolute length in time is given by *si-WindowLength*, or until the SI message was received;
- 1> if the SI message was not received by the end of the SI-window, repeat reception at the next SI-window occasion for the concerned SI message in the current modification period;
- NOTE 1: The UE is only required to acquire broadcasted SI message if the UE can acquire it without disrupting unicast data reception, i.e. the broadcast and unicast beams are quasi co-located.
- NOTE 2: The UE is not required to monitor PDCCH monitoring occasion(s) corresponding to each transmitted SSB in SI-window.
- NOTE 3: If the concerned SI message was not received in the current modification period, handling of SI message acquisition is left to UE implementation.

1> perform the actions for the acquired SI message as specified in clause 5.2.2.4.

5.2.2.3.3 Request for on demand system information

The UE shall:

- 1> if SIB1 includes si-SchedulingInfo containing si-RequestConfigSUL and criteria to select supplementary uplink as defined in TS 38.321[13], clause 5.1.1 is met:
 - 2> trigger the lower layer to initiate the Random Access procedure on supplementary uplink in accordance with [3] using the PRACH preamble(s) and PRACH resource(s) in si-RequestConfigSUL corresponding to the SI message(s) that the UE requires to operate within the cell, and for which si-BroadcastStatus is set to notBroadcasting;
 - 2> if acknowledgement for SI request is received from lower layers:
 - 3> acquire the requested SI message(s) as defined in clause 5.2.2.3.2, immediately;
- 1> else if SIB1 includes si-SchedulingInfo containing si-RequestConfig and criteria to select normal uplink as defined in TS 38.321[13], clause 5.1.1 is met:
 - 2> trigger the lower layer to initiate the random access procedure on normal uplink in accordance with TS 38.321 [3] using the PRACH preamble(s) and PRACH resource(s) in *si-RequestConfig* corresponding to the SI message(s) that the UE requires to operate within the cell, and for which *si-BroadcastStatus* is set to *notBroadcasting*;
 - 2> if acknowledgement for SI request is received from lower layers:
 - 3> acquire the requested SI message(s) as defined in clause 5.2.2.3.2, immediately;

1> else:

- 2> apply the default L1 parameter values as specified in corresponding physical layer specifications except for the parameters for which values are provided in *SIB1*;
- 2> apply the default MAC Cell Group configuration as specified in 9.2.2;
- 2> apply the *timeAlignmentTimerCommon* included in *SIB1*;
- 2> apply the CCCH configuration as specified in 9.1.1.2;
- 2> initiate transmission of the RRCSystemInfoRequest message in accordance with 5.2.2.3.4;
- 2> if acknowledgement for RRCSystemInfoRequest message is received from lower layers:
 - 3> acquire the requested SI message(s) as defined in clause 5.2.2.3.2, immediately;
- 1> if cell reselection occurs while waiting for the acknowledgment for SI request from lower layers:
 - 2> reset MAC;
 - 2> if SI request is based on *RRCSystemInfoRequest* message:
 - 3> release RLC entity for SRB0.

NOTE: After RACH failure for SI request it is up to UE implementation when to retry the SI request.

5.2.2.3.4 Actions related to transmission of *RRCSystemInfoRequest* message

The UE shall set the contents of RRCSystemInfoRequest message as follows:

1> set the *requested-SI-List* to indicate the SI message(s) that the UE requires to operate within the cell, and for which *si-BroadcastStatus* is set to *notBroadcasting*.

The UE shall submit the RRCSystemInfoRequest message to lower layers for transmission.

5.2.2.4 Actions upon receipt of System Information

5.2.2.4.1 Actions upon reception of the *MIB*

Upon receiving the MIB the UE shall:

- 1> store the acquired MIB;
- 1> if the UE is in RRC_IDLE or in RRC_INACTIVE, or if the UE is in RRC_CONNECTED while *T311* is running:
 - 2> if the *cellBarred* in the acquired *MIB* is set to *barred*:
 - 3> consider the cell as barred in accordance with TS 38.304 [20];
 - 3> if intraFreqReselection is set to notAllowed:
 - 4> consider cell re-selection to other cells on the same frequency as the barred cell as not allowed, as specified in TS 38.304 [20].
 - 3> else:
 - 4> consider cell re-selection to other cells on the same frequency as the barred cell as allowed, as specified in TS 38.304 [20].
 - 2> else:
 - 3> apply the received systemFrameNumber, pdcch-ConfigSIB1, subCarrierSpacingCommon, ssb-SubcarrierOffset and dmrs-TypeA-Position.

5.2.2.4.2 Actions upon reception of the SIB1

Upon receiving the SIB1 the UE shall:

- 1> store the acquired SIB1;
- 1> if the cellAccessRelatedInfo contains an entry with the PLMN-Identity of the selected PLMN:
 - 2> in the remainder of the procedures use *plmn-IdentityList*, *trackingAreaCode*, and *cellIdentity* for the cell as received in the corresponding *PLMN-IdentityInfo* containing the selected PLMN;
- 1> if in RRC CONNECTED while T311 is not running:
 - 2> disregard the *frequencyBandList*, if received, while in RRC_CONNECTED;
 - 2> forward the *cellIdentity* to upper layers;
 - 2> forward the *trackingAreaCode* to upper layers;
 - 2> apply the configuration included in the *servingCellConfigCommon*;
- 1> else:
 - 2> if the UE supports one or more of the frequency bands indicated in the *frequencyBandList* for downlink for TDD, or one or more of the frequency bands indicated in the *frequencyBandList* for uplink for FDD, and they are not downlink only bands, and
 - 2> if the UE supports at least one *additionalSpectrumEmission* in the *NR-NS-PmaxList* for a supported band in the downlink for TDD, or a supported band in uplink for FDD, and
 - 2> if the UE supports an uplink channel bandwidth with a maximum transmission bandwidth configuration (see TS 38.101-1 [15] and TS 38.101-2 [39]) which
 - is smaller than or equal to the *carrierBandwidth* (indicated in *uplinkConfigCommon* for the SCS of the initial uplink BWP), and which
 - is wider than or equal to the bandwidth of the initial uplink BWP, and
 - 2> if the UE supports a downlink channel bandwidth with a maximum transmission bandwidth configuration (see TS 38.101-1 [15] and TS 38.101-2 [39]) which
 - is smaller than or equal to the *carrierBandwidth* (indicated in *downlinkConfigCommon* for the SCS of the initial downlink BWP), and which
 - is wider than or equal to the bandwidth of the initial downlink BWP:

- 3> if *trackingAreaCode* is not provided for the selected PLMN nor the registered PLMN nor PLMN of the equivalent PLMN list:
 - 4> consider the cell as barred in accordance with TS 38.304 [20];
 - 4> if *intraFreqReselection* is set to notAllowed:
 - 5> consider cell re-selection to other cells on the same frequency as the barred cell as not allowed, as specified in TS 38.304 [20];
 - 4> else:
 - 5> consider cell re-selection to other cells on the same frequency as the barred cell as allowed, as specified in TS 38.304 [20];

3> else:

- 4> apply a supported uplink channel bandwidth with a maximum transmission bandwidth which
- is contained within the *carrierBandwidth* indicated in *uplinkConfigCommon* for the SCS of the initial uplink BWP, and which
- is wider than or equal to the bandwidth of the initial BWP for the uplink;
- 4> apply a supported downlink channel bandwidth with a maximum transmission bandwidth which
 - is contained within the *carrierBandwidth* indicated in *downlinkConfigCommon* for the SCS of the initial downlink BWP, and which
 - is wider than or equal to the bandwidth of the initial BWP for the downlink;
- 4> select the first frequency band in the *frequencyBandList*, for FDD from *frequencyBandList* for uplink, or for TDD from *frequencyBandList* for downlink, which the UE supports and for which the UE supports at least one of the *additionalSpectrumEmission* values in *nr-NS-PmaxList*, if present;
- 4> forward the *cellIdentity* to upper layers;
- 4> forward the *trackingAreaCode* to upper layers;
- 4> forward the PLMN identity to upper layers;
- 4> if in RRC_INACTIVE and the forwarded information does not trigger message transmission by upper layers:
 - 5> if the serving cell does not belong to the configured ran-NotificationAreaInfo:
 - 6> initiate an RNA update as specified in 5.3.13.8;
- 4> forward the *ims-EmergencySupport* to upper layers, if present;
- 4> forward the uac-AccessCategory1-SelectionAssistanceInfo to upper layers, if present;
- 4> apply the configuration included in the *servingCellConfigCommon*;
- 4> apply the specified PCCH configuration defined in 9.1.1.3;
- 4> if the UE has a stored valid version of a SIB, in accordance with clause 5.2.2.2.1, that the UE requires to operate within the cell in accordance with clause 5.2.2.1:
 - 5> use the stored version of the required SIB;
- 4> if the UE has not stored a valid version of a SIB, in accordance with clause 5.2.2.2.1, of one or several required SIB(s), in accordance with clause 5.2.2.1:
 - 5> for the SI message(s) that, according to the *si-SchedulingInfo*, contain at least one required SIB and for which *si-BroadcastStatus* is set to broadcasting:
 - 6> acquire the SI message(s) as defined in clause 5.2.2.3.2;

- 5> for the SI message(s) that, according to the *si-SchedulingInfo*, contain at least one required SIB and for which *si-BroadcastStatus* is set to *notBroadcasting*:
 - 6> trigger a request to acquire the SI message(s) as defined in clause 5.2.2.3.3;
- 4> apply the first listed *additionalSpectrumEmission* which it supports among the values included in *NR-NS-PmaxList* within *frequencyBandList* in *uplinkConfigCommon* for FDD or in *downlinkConfigCommon* for TDD;
- 4> if the *additionalPmax* is present in the same entry of the selected *additionalSpectrumEmission* within *NR-NS-PmaxList*:
 - 5> apply the *additionalPmax* for UL;
- 4> else:
 - 5> apply the *p-Max* in *uplinkConfigCommon* for UL;
- 4> if supplementaryUplink is present in servingCellConfigCommon; and
- 4> if the UE supports one or more of the frequency bands indicated in the *frequencyBandList* for the *supplementaryUplink*; and
- 4> if the UE supports at least one *additionalSpectrumEmission* in the *NR-NS-PmaxList* for a supported supplementary uplink band; and
- 4> if the UE supports an uplink channel bandwidth with a maximum transmission bandwith configuration (see TS 38.101-1 [15] and TS 38.101-2 [39]) which
 - is smaller than or equal to the *carrierBandwidth* (indicated in *supplementaryUplink* for the SCS of the initial uplink BWP), and which
 - is wider than or equal to the bandwidth of the initial uplink BWP of the SUL:
 - 5> consider supplementary uplink as configured in the serving cell;
 - 5> select the first frequency band in the *frequencyBandList* for the *supplementaryUplink* which the UE supports and for which the UE supports at least one of the *additionalSpectrumEmission* values in *nr-NS-PmaxList*, if present;
 - 5> apply a supported supplementary uplink channel bandwidth with a maximum transmission bandwidth which
 - is contained within the *carrierBandwidth* (indicated in *supplementaryUplink* for the SCS of the initial uplink BWP), and which
 - is wider than or equal to the bandwidth of the initial BWP of the SUL;
 - 5> apply the first listed *additionalSpectrumEmission* which it supports among the values included in *NR-NS-PmaxList* within *frequencyBandList* for the *supplementaryUplink*;
 - 5> if the *additionalPmax* is present in the same entry of the selected *additionalSpectrumEmission* within *NR-NS-PmaxList* for the *supplementaryUplink*:
 - 6> apply the additionalPmax in supplementaryUplink for SUL;
 - 5> else:
 - 6> apply the *p-Max* in *supplementaryUplink* for SUL;
- 2> else:
 - 3> consider the cell as barred in accordance with TS 38.304 [20]; and
 - 3> perform barring as if *intraFreqReselection* is set to *notAllowed*;

5.2.2.4.3 Actions upon reception of SIB2

Upon receiving SIB2, the UE shall:

- 1> if in RRC_IDLE or in RRC_INACTIVE or in RRC_CONNECTED while T311 is running:
 - 2> if, for the entry in *frequencyBandList* with the same index as the frequency band selected in clause 5.2.2.4.2, the UE supports at least one *additionalSpectrumEmission* in the *NR-NS-PmaxList* within the *frequencyBandList*:
 - 3> apply the first listed *additionalSpectrumEmission* which it supports among the values included in *NR-NS-PmaxList* within *frequencyBandList*;
 - 3> if the *additionalPmax* is present in the same entry of the selected *additionalSpectrumEmission* within *NR-NS-PmaxList*:
 - 4> apply the additionalPmax;
 - 3> else:
 - 4> apply the p-Max;
 - 3> if the UE selects a frequency band (from the procedure in clause 5.2.2.4.2) for the supplementary uplink:
 - 4> if, for the entry in *frequencyBandListSUL* with the same index as the frequency band selected in clause 5.2.2.4.2, the UE supports at least one *additionalSpectrumEmission* in the *NR-NS-PmaxList* within the *frequencyBandListSUL*:
 - 5> apply the first listed *additionalSpectrumEmission* which it supports among the values included in *NR-NS-PmaxList* within *frequencyBandListSUL*;
 - 5> if the *additionalPmax* is present in the same entry of the selected *additionalSpectrumEmission* within *NR-NS-PmaxList*:
 - 6> apply the additionalPmax;
 - 5> else:
 - 6 > apply the p-Max;
 - 4> else:
 - 5> apply the *p-Max*.
 - 2> else:
 - 3> apply the p-Max;

5.2.2.4.4 Actions upon reception of SIB3

No UE requirements related to the contents of this *SIB3* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

5.2.2.4.5 Actions upon reception of *SIB4*

Upon receiving SIB4 the UE shall:

- 1> if in RRC_IDLE, or in RRC_INACTIVE or in RRC_CONNECTED while T311 is running:
 - 2> for each entry in the *interFreqCarrierFreqList*:
 - 3> select the first frequency band in the *frequencyBandList*, and *frequencyBandListSUL*, if present, which the UE supports and for which the UE supports at least one of the *additionalSpectrumEmission* values in *NR-NS-PmaxList*, if present:

- 3> if, the frequency band selected by the UE in *frequencyBandList* to represent a non-serving NR carrier frequency is not a downlink only band:
 - 4> if, for the selected frequency band, the UE supports at least one *additionalSpectrumEmission* in the *NR-NS-PmaxList* within the *frequencyBandList*:
 - 5> apply the first listed *additionalSpectrumEmission* which it supports among the values included in *NR-NS-PmaxList* within *frequencyBandList*;
 - 5> if the *additionalPmax* is present in the same entry of the selected *additionalSpectrumEmission* within *NR-NS-PmaxList*:
 - 6> apply the additionalPmax;
 - 5> else:
 - 6> apply the *p-Max*;
 - 5> if frequencyBandListSUL is present in SIB4 and, for the frequency band selected in frequencyBandListSUL, the UE supports at least one additionalSpectrumEmission in the NR-NS-PmaxList within FrequencyBandListSUL:
 - 6> apply the first listed *additionalSpectrumEmission* which it supports among the values inlcuded in *NR-NS-PmaxList* within *frequencyBandListSUL*;
 - 6> if the *additionalPmax* is present in the same entry of the selected *additionalSpectrumEmission* within *NR-NS-PmaxList*:
 - 7> apply the *additionalPmax*;
 - 6> else:
 - 7> apply the *p-Max*;
 - 5> else:
 - 6> apply the *p-Max*;
 - 4> else:
 - 5> apply the p-Max;

5.2.2.4.6 Actions upon reception of SIB5

No UE requirements related to the contents of this *SIB5* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

5.2.2.4.7 Actions upon reception of SIB6

Upon receiving the SIB6 the UE shall:

1> forward the received warning Type, message Identifier and serial Number to upper layers;

5.2.2.4.8 Actions upon reception of SIB7

Upon receiving the SIB7 the UE shall:

- 1> if there is no current value for messageIdentifier and serialNumber for SIB7; or
- 1> if either the received value of *messageIdentifier* or of serialNumber, or of both *messageIdentifier* and serialNumber are different from the current values of *messageIdentifier* and serialNumber for SIB7:
 - 2> use the received values of *messageIdentifier* and *serialNumber* for *SIB7* as the current values of *messageIdentifier* and *serialNumber* for *SIB7*;
 - 2> discard any previously buffered warningMessageSegment;

- 2> if all segments of a warning message have been received:
 - 3> assemble the warning message from the received warningMessageSegment(s);
 - 3> forward the received warning message, *messageIdentifier*, *serialNumber* and *dataCodingScheme* to upper layers;
 - 3> stop reception of SIB7;
 - 3> discard the current values of *messageIdentifier* and *serialNumber* for *SIB7*;
- 2> else:
 - 3> store the received warningMessageSegment;
 - 3> continue reception of SIB7;
- 1> else if all segments of a warning message have been received:
 - 2> assemble the warning message from the received *warningMessageSegment(s)*;
 - 2> forward the received complete warning message, *messageIdentifier*, *serialNumber* and *dataCodingScheme* to upper layers;
 - 2> stop reception of SIB7;
 - 2> discard the current values of *messageIdentifier* and *serialNumber* for *SIB7*;
- 1> else:
 - 2> store the received warningMessageSegment;
 - 2> continue reception of SIB7;

The UE should discard any stored *warningMessageSegment* and the current value of *messageIdentifier* and *serialNumber* for *SIB7* if the complete warning message has not been assembled within a period of 3 hours.

5.2.2.4.9 Actions upon reception of SIB8

Upon receiving the SIB8 the UE shall:

- 1> if the SIB8 contains a complete warning message and the complete geographical area coordinates (if any):
 - 2> forward the received warning message, *messageIdentifier*, *serialNumber*, *dataCodingScheme* and the geographical area coordinates (if any) to upper layers;
 - 2> continue reception of SIB8;
- 1> else:
 - 2> if the received values of *messageIdentifier* and *serialNumber* are the same (each value is the same) as a pair for which a warning message and the geographical area coordinates (if any) are currently being assembled:
 - 3> store the received warningMessageSegment;
 - 3> store the received warningAreaCoordinatesSegment (if any);
 - 3> if all segments of a warning message and geographical area coordinates (if any) have been received:
 - 4> assemble the warning message from the received warningMessageSegment;
 - 4> assemble the geographical area coordinates from the received warningAreaCoordinatesSegment (if any);
 - 4> forward the received warning message, *messageIdentifier*, *serialNumber*, *dataCodingScheme* and geographical area coordinates (if any) to upper layers;

- 4> stop assembling a warning message and geographical area coordinates (if any) for this *messageIdentifier* and *serialNumber* and delete all stored information held for it;
- 3> continue reception of SIB8;
- 2> else if the received values of *messageIdentifier* and/or *serialNumber* are not the same as any of the pairs for which a warning message is currently being assembled:
 - 3> start assembling a warning message for this messageIdentifier and serialNumber pair;
 - 3> start assembling the geographical area coordinates (if any) for this *messageIdentifier* and *serialNumber* pair;
 - 3> store the received warningMessageSegment;
 - 3> store the received warningAreaCoordinatesSegment (if any);
 - 3> continue reception of SIB8;

The UE should discard warningMessageSegment and warningAreaCoordinatesSegment (if any) and the associated values of messageIdentifier and serialNumber for SIB8 if the complete warning message and the geographical area coordinates (if any) have not been assembled within a period of 3 hours.

NOTE: The number of warning messages that a UE can re-assemble simultaneously is a function of UE implementation.

5.2.2.4.10 Actions upon reception of SIB9

No UE requirements related to the contents of this *SIB9* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

5.2.2.5 Essential system information missing

- 1> if in RRC_IDLE or in RRC_INACTIVE or in RRC_CONNECTED while T311 is running:
 - 2> if the UE is unable to acquire the MIB:
 - 3> consider the cell as barred in accordance with TS 38.304 [20]; and
 - 3> perform barring as if *intraFreqReselection* is set to allowed;
 - 2> else if the UE is unable to acquire the SIB1:
 - 3> consider the cell as barred in accordance with TS 38.304 [20].
 - 3> if intraFreqReselection in MIB is set to notAllowed:
 - 4> consider cell re-selection to other cells on the same frequency as the barred cell as not allowed, as specified in TS 38.304 [20].
 - 3> else:
 - 4> consider cell re-selection to other cells on the same frequency as the barred cell as allowed, as specified in TS 38.304 [20].

5.3 Connection control

5.3.1 Introduction

5.3.1.1 RRC connection control

RRC connection establishment involves the establishment of SRB1. The network completes RRC connection establishment prior to completing the establishment of the NG connection, i.e. prior to receiving the UE context information from the 5GC. Consequently, AS security is not activated during the initial phase of the RRC connection. During this initial phase of the RRC connection, the network may configure the UE to perform measurement reporting, but the UE only sends the corresponding measurement reports after successful AS security activation. However, the UE only accepts a re-configuration with sync message when AS security has been activated.

Upon receiving the UE context from the 5GC, the RAN activates AS security (both ciphering and integrity protection) using the initial AS security activation procedure. The RRC messages to activate AS security (command and successful response) are integrity protected, while ciphering is started only after completion of the procedure. That is, the response to the message used to activate AS security is not ciphered, while the subsequent messages (e.g. used to establish SRB2 and DRBs) are both integrity protected and ciphered. After having initiated the initial AS security activation procedure, the network may initiate the establishment of SRB2 and DRBs, i.e. the network may do this prior to receiving the confirmation of the initial AS security activation from the UE. In any case, the network will apply both ciphering and integrity protection for the RRC reconfiguration messages used to establish SRB2 and DRBs. The network should release the RRC connection if the initial AS security activation and/ or the radio bearer establishment fails. A configuration with SRB2 without DRB or with DRB without SRB2 is not supported (i.e., SRB2 and at least one DRB must be configured in the same RRC Reconfiguration message, and it is not allowed to release all the DRBs without releasing the RRC Connection).

The release of the RRC connection normally is initiated by the network. The procedure may be used to re-direct the UE to an NR frequency or an E-UTRA carrier frequency.

The suspension of the RRC connection is initiated by the network. When the RRC connection is suspended, the UE stores the UE Inactive AS context and any configuration received from the network, and transits to RRC_INACTIVE state. If the UE is configured with SCG, the UE releases the SCG configuration upon initiating a RRC Connection Resume procedure. The RRC message to suspend the RRC connection is integrity protected and ciphered.

The resumption of a suspended RRC connection is initiated by upper layers when the UE needs to transit from RRC_INACTIVE state to RRC_CONNECTED state or by RRC layer to perform a RNA update or by RAN paging from NG-RAN. When the RRC connection is resumed, network configures the UE according to the RRC connection resume procedure based on the stored UE Inactive AS context and any RRC configuration received from the network. The RRC connection resume procedure re-activates AS security and re-establishes SRB(s) and DRB(s).

In response to a request to resume the RRC connection, the network may resume the suspended RRC connection and send UE to RRC_CONNECTED, or reject the request to resume and send UE to RRC_INACTIVE (with a wait timer), or directly re-suspend the RRC connection and send UE to RRC_INACTIVE, or directly release the RRC connection and send UE to RRC_IDLE, or instruct the UE to initiate NAS level recovery (in this case the network sends an RRC setup message).

5.3.1.2 AS Security

AS security comprises of the integrity protection and ciphering of RRC signalling (SRBs) and user data (DRBs).

RRC handles the configuration of the AS security parameters which are part of the AS configuration: the integrity protection algorithm, the ciphering algorithm, if integrity protection and/or ciphering is enabled for a DRB and two parameters, namely the *keySetChangeIndicator* and the *nextHopChainingCount*, which are used by the UE to determine the AS security keys upon reconfiguration with sync (with key change), connection re-establishment and/or connection resume.

The integrity protection algorithm is common for SRB1, SRB2, SRB3 (if configured) and DRBs configured with integrity protection, with the same *keyToUse* value. The ciphering algorithm is common for SRB1, SRB2, SRB3 (if configured) and DRBs configured with the same *keyToUse* value. For MR-DC, integrity protection is not enabled for DRBs terminated in eNB. Neither integrity protection nor ciphering applies for SRB0.

NOTE 0: All DRBs related to the same PDU session have the same enable/disable setting for ciphering and the same enable/disable setting for integrity protection, as specified in TS 33.501 [11].

RRC integrity protection and ciphering are always activated together, i.e. in one message/procedure. RRC integrity protection and ciphering for SRBs are never de-activated. However, it is possible to switch to a 'NULL' ciphering algorithm (nea0).

The 'NULL' integrity protection algorithm (nia0) is used only for SRBs and for the UE in limited service mode, see TS 33.501 [11] and when used for SRBs, integrity protection is disabled for DRBs. In case the 'NULL' integrity protection algorithm is used, 'NULL' ciphering algorithm is also used.

NOTE 1: Lower layers discard RRC messages for which the integrity protection check has failed and indicate the integrity protection verification check failure to RRC.

The AS applies four different security keys: one for the integrity protection of RRC signalling (K_{RRCint}), one for the ciphering of RRC signalling (K_{RRCenc}), one for integrity protection of user data (K_{UPint}) and one for the ciphering of user data (K_{UPenc}). All four AS keys are derived from the K_{gNB} key. The K_{gNB} key is based on the K_{AMF} key (as specified in TS 33.501 [11]), which is handled by upper layers.

The integrity protection and ciphering algorithms can only be changed with reconfiguration with sync. The AS keys $(K_{gNB}, K_{RRCint}, K_{RRCenc}, K_{UPint})$ and K_{UPenc} change upon reconfiguration with sync (if *masterKeyUpdate* is included), and upon connection re-establishment and connection resume.

For each radio bearer an independent counter (*COUNT*, as specified in TS 38.323 [5]) is maintained for each direction. For each radio bearer, the *COUNT* is used as input for ciphering and integrity protection.

It is not allowed to use the same *COUNT* value more than once for a given security key. As specified in TS 33.501 [11], clause 6.9.4.1, the network is responsible for avoiding reuse of the *COUNT* with the same RB identity and with the same key, e.g. due to the transfer of large volumes of data, release and establishment of new RBs, and multiple termination point changes for RLC-UM bearers and multiple termination point changes for RLC-AM bearer with SN terminated PDCP re-establishment (COUNT reset) due to SN only full configuration whilst the key stream inputs (i.e. bearer ID, security key) at MN have not been updated. In order to avoid such re-use, the network may e.g. use different RB identities for RB establishments, change the AS security key, or an RRC_CONNECTED to RRC_IDLE/RRC_INACTIVE and then to RRC_CONNECTED transition.

In order to limit the signalling overhead, individual messages/ packets include a short sequence number (PDCP SN, as specified in TS 38.323 [5]). In addition, an overflow counter mechanism is used: the hyper frame number (*HFN*, as specified in TS 38.323 [5]). The HFN needs to be synchronized between the UE and the network.

For each SRB, the value provided by RRC to lower layers to derive the 5-bit BEARER parameter used as input for ciphering and for integrity protection is the value of the corresponding *srb-Identity* with the MSBs padded with zeroes.

For a UE provided with an sk-counter, keyToUse indicates whether the UE uses the master key (K_{gNB}) or the secondary key (S- K_{eNB} or S- K_{gNB}) for a particular DRB. The secondary key is derived from the master key and sk-Counter, as defined in TS 33.501[11]. Whenever there is a need to refresh the secondary key, e.g. upon change of MN with K_{gNB} change or to avoid COUNT reuse, the security key update is used (see 5.3.5.7). When the UE is in NR-DC, the network may provide a UE configured with an sk-Counter even when no DRB is setup using the secondary key (S- K_{gNB}) in order to allow the configuration of SRB3. The network can also provide the UE with an sk-Counter, even if no SCG is configured, when using SN terminated SN MCG bearers.

5.3.2 Paging

5.3.2.1 General

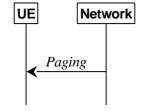


Figure 5.3.2.1-1: Paging

The purpose of this procedure is:

- to transmit paging information to a UE in RRC_IDLE or RRC_INACTIVE.

5.3.2.2 Initiation

The network initiates the paging procedure by transmitting the *Paging* message at the UE's paging occasion as specified in TS 38.304 [20]. The network may address multiple UEs within a *Paging* message by including one *PagingRecord* for each UE.

5.3.2.3 Reception of the *Paging message* by the UE

Upon receiving the Paging message, the UE shall:

- 1> if in RRC_IDLE, for each of the *PagingRecord*, if any, included in the *Paging* message:
 - 2> if the *ue-Identity* included in the *PagingRecord* matches the UE identity allocated by upper layers:
 - 3> forward the *ue-Identity* and *accessType* (if present) to the upper layers;
- 1> if in RRC_INACTIVE, for each of the *PagingRecord*, if any, included in the *Paging* message:
 - 2> if the *ue-Identity* included in the *PagingRecord* matches the UE's stored *fullI-RNTI*:
 - 3> if the UE is configured by upper layers with Access Identity 1:
 - 4> initiate the RRC connection resumption procedure according to 5.3.13 with *resumeCause* set to *mps- PriorityAccess*;
 - 3> else if the UE is configured by upper layers with Access Identity 2:
 - 4> initiate the RRC connection resumption procedure according to 5.3.13 with *resumeCause* set to *mcs-PriorityAccess*;
 - 3> else if the UE is configured by upper layers with one or more Access Identities equal to 11-15:
 - 4> initiate the RRC connection resumption procedure according to 5.3.13 with *resumeCause* set to *highPriorityAccess*;
 - 3> else:
 - 4> initiate the RRC connection resumption procedure according to 5.3.13 with *resumeCause* set to *mt-Access*;
 - 2> else if the *ue-Identity* included in the *PagingRecord* matches the UE identity allocated by upper layers:
 - 3> forward the *ue-Identity* to upper layers and *accessType* (if present) to the upper layers;
 - 3> perform the actions upon going to RRC_IDLE as specified in 5.3.11 with release cause 'other'.

5.3.3 RRC connection establishment

5.3.3.1 General

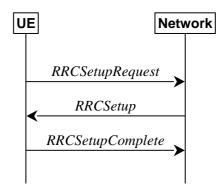


Figure 5.3.3.1-1: RRC connection establishment, successful

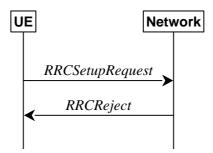


Figure 5.3.3.1-2: RRC connection establishment, network reject

The purpose of this procedure is to establish an RRC connection. RRC connection establishment involves SRB1 establishment. The procedure is also used to transfer the initial NAS dedicated information/ message from the UE to the network.

The network applies the procedure e.g.as follows:

- When establishing an RRC connection;
- When UE is resuming or re-establishing an RRC connection, and the network is not able to retrieve or verify the UE context. In this case, UE receives *RRCSetup* and responds with *RRCSetupComplete*.

5.3.3.2 Initiation

The UE initiates the procedure when upper layers request establishment of an RRC connection while the UE is in RRC_IDLE and it has acquired essential system information.

The UE shall ensure having valid and up to date essential system information as specified in clause 5.2.2.2 before initiating this procedure.

Upon initiation of the procedure, the UE shall:

- 1> if the upper layers provide an Access Category and one or more Access Identities upon requesting establishment of an RRC connection:
 - 2> perform the unified access control procedure as specified in 5.3.14 using the Access Category and Access Identities provided by upper layers;
 - 3> if the access attempt is barred, the procedure ends;
- 1> apply the default L1 parameter values as specified in corresponding physical layer specifications except for the parameters for which values are provided in *SIB1*;

- 1> apply the default MAC Cell Group configuration as specified in 9.2.2;
- 1> apply the CCCH configuration as specified in 9.1.1.2;
- 1> apply the *timeAlignmentTimerCommon* included in *SIB1*;
- 1> start timer T300;
- 1> initiate transmission of the RRCSetupRequest message in accordance with 5.3.3.3;

5.3.3.3 Actions related to transmission of *RRCSetupRequest* message

The UE shall set the contents of RRCSetupRequest message as follows:

- 1> set the *ue-Identity* as follows:
 - 2> if upper layers provide a 5G-S-TMSI:
 - 3> set the *ue-Identity* to *ng-5G-S-TMSI-Part1*;
 - 2> else:
 - 3> draw a 39-bit random value in the range $0..2^{39}$ -1 and set the *ue-Identity* to this value;
- NOTE 1: Upper layers provide the 5G-S-TMSI if the UE is registered in the TA of the current cell.
- 1> set the establishmentCause in accordance with the information received from upper layers;

The UE shall submit the RRCSetupRequest message to lower layers for transmission.

The UE shall continue cell re-selection related measurements as well as cell re-selection evaluation. If the conditions for cell re-selection are fulfilled, the UE shall perform cell re-selection as specified in 5.3.3.6.

5.3.3.4 Reception of the *RRCSetup* by the UE

The UE shall perform the following actions upon reception of the RRCSetup:

- 1> if the RRCSetup is received in response to an RRCReestablishmentRequest; or
- 1> if the RRCSetup is received in response to an RRCResumeRequest or RRCResumeRequest1:
 - 2> discard any stored UE Inactive AS context and suspendConfig;
 - 2> discard any current AS security context including the K_{RRCenc} key, the K_{RRCint} key, the K_{UPint} key and the K_{UPenc} key;
 - 2> release radio resources for all established RBs except SRB0, including release of the RLC entities, of the associated PDCP entities and of SDAP;
 - 2> release the RRC configuration except for the default L1 parameter values, default MAC Cell Group configuration and CCCH configuration;
 - 2> indicate to upper layers fallback of the RRC connection;
 - 2> stop timer T380, if running;
- 1> perform the cell group configuration procedure in accordance with the received *masterCellGroup* and as specified in 5.3.5.5;
- 1> perform the radio bearer configuration procedure in accordance with the received *radioBearerConfig* and as specified in 5.3.5.6;
- 1> if stored, discard the cell reselection priority information provided by the *cellReselectionPriorities* or inherited from another RAT;
- 1> stop timer T300, T301 or T319 if running;

- 1> if T390 is running:
 - 2> stop timer T390 for all access categories;
 - 2> perform the actions as specified in 5.3.14.4;
- 1> if T302 is running:
 - 2> stop timer T302;
 - 2> perform the actions as specified in 5.3.14.4;
- 1> stop timer T320, if running;
- 1> if the RRCSetup is received in response to an RRCResumeRequest, RRCResumeRequest1 or RRCSetupRequest:
 - 2> enter RRC_CONNECTED;
 - 2> stop the cell re-selection procedure;
- 1> consider the current cell to be the PCell;
- 1> set the content of *RRCSetupComplete* message as follows:
 - 2> if upper layers provide a 5G-S-TMSI:
 - 3> if the RRCSetup is received in response to an RRCSetupRequest:
 - 4> set the *ng-5G-S-TMSI-Value* to *ng-5G-S-TMSI-Part2*;
 - 3> else:
 - 4> set the *ng-5G-S-TMSI-Value* to *ng-5G-S-TMSI*;
 - 2> set the *selectedPLMN-Identity* to the PLMN selected by upper layers (TS 24.501 [23]) from the PLMN(s) included in the *plmn-IdentityInfoList* in *SIB1*;
 - 2> if upper layers provide the 'Registered AMF':
 - 3> include and set the registeredAMF as follows:
 - 4> if the PLMN identity of the 'Registered AMF' is different from the PLMN selected by the upper layers:
 - 5> include the *plmnIdentity* in the *registeredAMF* and set it to the value of the PLMN identity in the 'Registered AMF' received from upper layers;
 - 4> set the *amf-Identifier* to the value received from upper layers;
 - 3> include and set the *guami-Type* to the value provided by the upper layers;
 - 2> if upper layers provide one or more S-NSSAI (see TS 23.003 [21]):
 - 3> include the s-NSSAI-List and set the content to the values provided by the upper layers;
 - 2> set the *dedicatedNAS-Message* to include the information received from upper layers;
- 1> submit the RRCSetupComplete message to lower layers for transmission, upon which the procedure ends.

5.3.3.5 Reception of the *RRCReject* by the UE

The UE shall:

1> perform the actions as specified in 5.3.15;

5.3.3.6 Cell re-selection or cell selection while T390, T300 or T302 is running (UE in RRC_IDLE)

The UE shall:

- 1> if cell reselection occurs while T300 or T302 is running:
 - 2> perform the actions upon going to RRC_IDLE as specified in 5.3.11 with release cause 'RRC connection failure';
- 1> else if cell selection or reselection occurs while T390 is running:
 - 2> stop T390 for all access categories;
 - 2> perform the actions as specified in 5.3.14.4.

5.3.3.7 T300 expiry

The UE shall:

- 1> if timer T300 expires:
 - 2> reset MAC, release the MAC configuration and re-establish RLC for all RBs that are established;
 - 2> if the UE supports RRC Connection Establishment failure with temporary offset and the T300 has expired a consecutive *connEstFailCount* times on the same cell for which *connEstFailureControl* is included in *SIB1*:
 - 3> for a period as indicated by *connEstFailOffsetValidity*:
 - 4> use *connEstFailOffset* for the parameter *Qoffsettemp* for the concerned cell when performing cell selection and reselection according to TS 38.304 [20] and TS 36.304 [27];
- NOTE: When performing cell selection, if no suitable or acceptable cell can be found, it is up to UE implementation whether to stop using *connEstFailOffset* for the parameter *Qoffsettemp* during *connEstFailOffsetValidity* for the concerned cell.
 - 2> inform upper layers about the failure to establish the RRC connection, upon which the procedure ends;

5.3.3.8 Abortion of RRC connection establishment

If upper layers abort the RRC connection establishment procedure, due to a NAS procedure being aborted as specified in TS 24.501 [23], while the UE has not yet entered RRC_CONNECTED, the UE shall:

- 1> stop timer T300, if running;
- 1> reset MAC, release the MAC configuration and re-establish RLC for all RBs that are established.

5.3.4 Initial AS security activation

5.3.4.1 General

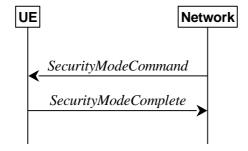


Figure 5.3.4.1-1: Security mode command, successful

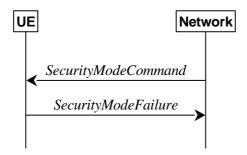


Figure 5.3.4.1-2: Security mode command, failure

The purpose of this procedure is to activate AS security upon RRC connection establishment.

5.3.4.2 Initiation

The network initiates the security mode command procedure to a UE in RRC_CONNECTED. Moreover, the network applies the procedure as follows:

- when only SRB1 is established, i.e. prior to establishment of SRB2 and/ or DRBs.

5.3.4.3 Reception of the SecurityModeCommand by the UE

The UE shall:

- 1> derive the K_{gNB} key, as specified in TS 33.501 [11];
- 1> derive the K_{RRCint} key associated with the *integrityProtAlgorithm* indicated in the *SecurityModeCommand* message, as specified in TS 33.501 [11];
- 1> request lower layers to verify the integrity protection of the *SecurityModeCommand* message, using the algorithm indicated by the *integrityProtAlgorithm* as included in the *SecurityModeCommand* message and the K_{RRCint} key;
- 1> if the SecurityModeCommand message passes the integrity protection check:
 - 2> derive the K_{RRCenc} key and the K_{UPenc} key associated with the *cipheringAlgorithm* indicated in the *SecurityModeCommand* message, as specified in TS 33.501 [11];
 - 2> derive the K_{UPint} key associated with the *integrityProtAlgorithm* indicated in the *SecurityModeCommand* message, as specified in TS 33.501 [11];
 - 2> configure lower layers to apply SRB integrity protection using the indicated algorithm and the K_{RRCint} key immediately, i.e. integrity protection shall be applied to all subsequent messages received and sent by the UE, including the *SecurityModeComplete* message;
 - 2> configure lower layers to apply SRB ciphering using the indicated algorithm, the K_{RRCenc} keyafter completing the procedure, i.e. ciphering shall be applied to all subsequent messages received and sent by the UE, except for the *SecurityModeComplete* message which is sent unciphered;
 - 2> consider AS security to be activated;
 - 2> submit the SecurityModeComplete message to lower layers for transmission, upon which the procedure ends;

1> else:

- 2> continue using the configuration used prior to the reception of the *SecurityModeCommand* message, i.e. neither apply integrity protection nor ciphering.
- 2> submit the SecurityModeFailure message to lower layers for transmission, upon which the procedure ends.

5.3.5 RRC reconfiguration

5.3.5.1 General

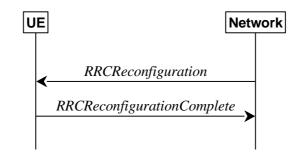


Figure 5.3.5.1-1: RRC reconfiguration, successful

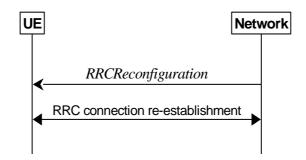


Figure 5.3.5.1-2: RRC reconfiguration, failure

The purpose of this procedure is to modify an RRC connection, e.g. to establish/modify/release RBs, to perform reconfiguration with sync, to setup/modify/release measurements, to add/modify/release SCells and cell groups. As part of the procedure, NAS dedicated information may be transferred from the Network to the UE.

RRC reconfiguration to perform reconfiguration with sync includes, but is not limited to, the following cases:

- reconfiguration with sync and security key refresh, involving RA to the PCell/PSCell, MAC reset, refresh of security and re-establishment of RLC and PDCP triggered by explicit L2 indicators;
- reconfiguration with sync but without security key refresh, involving RA to the PCell/PSCell, MAC reset and RLC re-establishment and PDCP data recovery (for AM DRB) triggered by explicit L2 indicators.

In (NG)EN-DC and NR-DC, SRB3 can be used for measurement configuration and reporting, to (re-)configure MAC, RLC, physical layer and RLF timers and constants of the SCG configuration, and to reconfigure PDCP for DRBs associated with the S-K_{gNB} or SRB3, and to reconfigure SDAP for DRBs associated with S-K_{gNB} in NGEN-DC and NR-DC, provided that the (re-)configuration does not require any MN involvement. In (NG)EN-DC and NR-DC, only *measConfig, radioBearerConfig* and/or *secondaryCellGroup* are included in *RRCReconfiguration* received via SRB3.

5.3.5.2 Initiation

The Network may initiate the RRC reconfiguration procedure to a UE in RRC_CONNECTED. The Network applies the procedure as follows:

- the establishment of RBs (other than SRB1, that is established during RRC connection establishment) is performed only when AS security has been activated;
- the addition of Secondary Cell Group and SCells is performed only when AS security has been activated;
- the *reconfigurationWithSync* is included in *secondaryCellGroup* only when at least one RLC bearer is setup in SCG;
- the *reconfigurationWithSync* is included in *masterCellGroup* only when AS security has been activated, and SRB2 with at least one DRB are setup and not suspended.

5.3.5.3 Reception of an *RRCReconfiguration* by the UE

The UE shall perform the following actions upon reception of the RRCReconfiguration:

- 1> if the RRCReconfiguration is received via other RAT (i.e., inter-RAT handover to NR):
 - 2> if the *RRCReconfiguration* does not include the *fullConfig* and the UE is connected to 5GC (i.e., delta signalling during intra 5GC handover):
 - 3> re-use the source RAT SDAP and PDCP configurations if available (i.e., current SDAP/PDCP configurations for all RBs from source E-UTRA RAT prior to the reception of the inter-RAT HO *RRCReconfiguration* message);

1> else:

- 2> if the RRCReconfiguration includes the fullConfig:
 - 3> perform the full configuration procedure as specified in 5.3.5.11;
- 1> if the *RRCReconfiguration* includes the *masterCellGroup*:
 - 2> perform the cell group configuration for the received masterCellGroup according to 5.3.5.5;
- 1> if the *RRCReconfiguration* includes the *masterKeyUpdate*:
 - 2> perform AS security key update procedure as specified in 5.3.5.7;
- 1> if the RRCReconfiguration includes the sk-Counter:
 - 2> perform security key update procedure as specified in 5.3.5.7;
- 1> if the *RRCReconfiguration* includes the *secondaryCellGroup*:
 - 2> perform the cell group configuration for the SCG according to 5.3.5.5;
- 1> if the RRCReconfiguration includes the mrdc-SecondaryCellGroupConfig:
 - 2> if the *mrdc-SecondaryCellGroupConfig* is set to *setup*:
 - 3> if the mrdc-SecondaryCellGroupConfig includes mrdc-ReleaseAndAdd:
 - 4> perform MR-DC release as specified in clause 5.3.5.10;
 - 3> if the received *mrdc-SecondaryCellGroup* is set to *nr-SCG*:
 - 4> perform the RRC reconfiguration according to 5.3.5.3 for the *RRCReconfiguration* message included in *nr-SCG*;
 - 3> if the received *mrdc-SecondaryCellGroup* is set to *eutra-SCG*:
 - 4> perform the RRC connection reconfiguration as specified in TS 36.331 [10], clause 5.3.5.3 for the *RRCConnectionReconfiguration* message included in *eutra-SCG*;
 - 2> else (*mrdc-SecondaryCellGroupConfig* is set to *release*):
 - 3> perform MR-DC release as specified in clause 5.3.5.10;
- 1> if the *RRCReconfiguration* message includes the *radioBearerConfig*:
 - 2> perform the radio bearer configuration according to 5.3.5.6;
- 1> if the RRCReconfiguration message includes the radioBearerConfig2:
 - 2> perform the radio bearer configuration according to 5.3.5.6;
- 1> if the RRCReconfiguration message includes the measConfig:
 - 2> perform the measurement configuration procedure as specified in 5.5.2;

- 1> if the RRCReconfiguration message includes the dedicatedNAS-MessageList:
 - 2> forward each element of the dedicatedNAS-MessageList to upper layers in the same order as listed;
- 1> if the RRCReconfiguration message includes the dedicatedSIB1-Delivery:
 - 2> perform the action upon reception of SIB1 as specified in 5.2.2.4.2;
- 1> if the RRCReconfiguration message includes the dedicatedSystemInformationDelivery:
 - 2> perform the action upon reception of System Information as specified in 5.2.2.4;
- 1> if the RRCReconfiguration message includes the otherConfig:
 - 2> perform the other configuration procedure as specified in 5.3.5.9;
- 1> set the content of the *RRCReconfigurationComplete* message as follows:
 - 2> if the RRCReconfiguration includes the masterCellGroup containing the reportUplinkTxDirectCurrent:
 - 3> include the *uplinkTxDirectCurrentList* for each MCG serving cell with UL;
 - 3> include *uplinkDirectCurrentBWP-SUL* for each MCG serving cell configured with SUL carrier, if any, within the *uplinkTxDirectCurrentList*;
 - 2> if the RRCReconfiguration includes the secondaryCellGroup containing the reportUplinkTxDirectCurrent:
 - 3> include the *uplinkTxDirectCurrentList* for each SCG serving cell with UL;
 - 3> include *uplinkDirectCurrentBWP-SUL* for each SCG serving cell configured with SUL carrier, if any, within the *uplinkTxDirectCurrentList*;
 - 2> if the RRCReconfiguration message includes the mrdc-SecondaryCellGroupConfig with mrdc-SecondaryCellGroup set to eutra-SCG:
 - 3> include in the *eutra-SCG-Response* the E-UTRA *RRCConnectionReconfigurationComplete* message in accordance with TS 36.331 [10] clause 5.3.5.3;
 - 2> if the RRCReconfiguration message includes the mrdc-SecondaryCellGroupConfig with mrdc-SecondaryCellGroup set to nr-SCG:
 - 3> include in the *nr-SCG-Response* the *RRCReconfigurationComplete* message;
- 1> if the UE is configured with E-UTRA *nr-SecondaryCellGroupConfig* (UE in (NG)EN-DC):
 - 2> if the RRCReconfiguration message was received via E-UTRA SRB1 as specified in TS 36.331 [10]:
 - 3> submit the *RRCReconfigurationComplete* via E-UTRA embedded in E-UTRA RRC message *RRCConnectionReconfigurationComplete* as specified in TS 36.331 [10];
 - 3> if reconfigurationWithSync was included in spCellConfig of an SCG:
 - 4> initiate the Random Access procedure on the SpCell, as specified in TS 38.321 [3];
 - 3> else:
 - 4> the procedure ends;
- NOTE 1: The order the UE sends the *RRCConnectionReconfigurationComplete* message and performs the Random Access procedure towards the SCG is left to UE implementation.
 - 2> else (*RRCReconfiguration* was received via SRB3):
 - 3> submit the *RRCReconfigurationComplete* message via SRB3 to lower layers for transmission using the new configuration;

- NOTE 2: In (NG)EN-DC and NR-DC, in the case *RRCReconfiguration* is received via SRB1, the random access is triggered by RRC layer itself as there is not necessarily other UL transmission. In the case *RRCReconfiguration* is received via SRB3, the random access is triggered by the MAC layer due to arrival of *RRCReconfigurationComplete*.
- 1> else if the *RRCReconfiguration* message was received within the *nr-SCG* within *mrdc-SecondaryCellGroup* (UE in NR-DC, *mrdc-SecondaryCellGroup* was received in *RRCReconfiguration* via SRB1):
 - 2> if reconfigurationWithSync was included in spCellConfig in nr-SCG:
 - 3> initiate the Random Access procedure on the PSCell, as specified in TS 38.321 [3];
 - 2> else
 - 3> the procedure ends;
- NOTE 2a: The order in which the UE sends the *RRCReconfigurationComplete* message and performs the Random Access procedure towards the SCG is left to UE implementation.
- 1> else if the RRCReconfiguration message was received via SRB3 (UE in NR-DC):
 - 2> submit the *RRCReconfigurationComplete* message via SRB3 to lower layers for transmission using the new configuration;
- 1> else (*RRCReconfiguration* was received via SRB1):
 - 2> submit the RRCReconfigurationComplete message via SRB1 to lower layers for transmission using the new configuration;
 - 2> if this is the first *RRCReconfiguration* message after successful completion of the RRC re-establishment procedure:
 - 3> resume SRB2 and DRBs that are suspended;
- 1> if *reconfigurationWithSync* was included in *spCellConfig* of an MCG or SCG, and when MAC of an NR cell group successfully completes a Random Access procedure triggered above;
 - 2> stop timer T304 for that cell group;
 - 2> apply the parts of the CSI reporting configuration, the scheduling request configuration and the sounding RS configuration that do not require the UE to know the SFN of the respective target SpCell, if any;
 - 2> apply the parts of the measurement and the radio resource configuration that require the UE to know the SFN of the respective target SpCell (e.g. measurement gaps, periodic CQI reporting, scheduling request configuration, sounding RS configuration), if any, upon acquiring the SFN of that target SpCell;
 - 2> if the reconfigurationWithSync was included in spCellConfig of an MCG:
 - 3> if T390 is running:
 - 4> stop timer T390 for all access categories;
 - 4> perform the actions as specified in 5.3.14.4.
 - 3> if RRCReconfiguration does not include dedicatedSIB1-Delivery and
 - 3> if the active downlink BWP, which is indicated by the *firstActiveDownlinkBWP-Id* for the target SpCell of the MCG, has a common search space configured by *searchSpaceSIB1*:
 - 4> acquire the SIB1, which is scheduled as specified in TS 38.213 [13], of the target SpCell of the MCG;
 - 4> upon acquiring SIB1, perform the actions specified in clause 5.2.2.4.2;
 - 2> if reconfigurationWithSync was included in masterCellGroup; and
 - 2> if the UE initiated transmission of a *UEAssistanceInformation* message during the last 1 second, and the UE is still configured to provide the concerned UE assistance information:

- 3> initiate transmission of a *UEAssistanceInformation* message in accordance with clause 5.7.4.3 to provide the concerned UE assistance information;
- 3> start or restart the prohibit timer (if exists) associated with the concerned UE assistance information with the timer value set to the value in corresponding configuration;
- 2> the procedure ends.
- NOTE 3: The UE is only required to acquire broadcasted *SIB1* if the UE can acquire it without disrupting unicast data reception, i.e. the broadcast and unicast beams are quasi co-located.
- NOTE 4: The UE sets the content of *UEAssistanceInformation* according to latest configuration (i.e. the configuration after applying the *RRCReconfiguration* message) and latest UE preference. The UE may include more than the concerned UE assistance information within the *UEAssistanceInformation* according to 5.7.4.2. Therefore, the content of *UEAssistanceInformation* message might not be the same as the content of the previous *UEAssistanceInformation* message.

5.3.5.4 Secondary cell group release

The UE shall:

- 1> as a result of SCG release triggered by E-UTRA (i.e. (NG)EN-DC case) or NR (i.e. NR-DC case):
 - 2> reset SCG MAC, if configured;
 - 2> for each RLC bearer that is part of the SCG configuration:
 - 3> perform RLC bearer release procedure as specified in 5.3.5.5.3;
 - 2> release the SCG configuration;
 - 2> stop timer T310 for the corresponding SpCell, if running;
 - 2> stop timer T304 for the corresponding SpCell, if running.

NOTE: Release of cell group means only release of the lower layer configuration of the cell group but the *RadioBearerConfig* may not be released.

5.3.5.5 Cell Group configuration

5.3.5.5.1 General

The network configures the UE with Master Cell Group (MCG), and zero or one Secondary Cell Group (SCG). In (NG)EN-DC, the MCG is configured as specified in TS 36.331 [10], and for NE-DC, the SCG is configured as specified in TS 36.331 [10]. The network provides the configuration parameters for a cell group in the *CellGroupConfig* IE

The UE performs the following actions based on a received CellGroupConfig IE:

- 1> if the CellGroupConfig contains the spCellConfig with reconfigurationWithSync:
 - 2> perform Reconfiguration with sync according to 5.3.5.5.2;
 - 2> resume all suspended radio bearers and resume SCG transmission for all radio bearers, if suspended;
- 1> if the *CellGroupConfig* contains the *rlc-BearerToReleaseList*:
 - 2> perform RLC bearer release as specified in 5.3.5.5.3;
- 1> if the CellGroupConfig contains the rlc-BearerToAddModList:
 - 2> perform the RLC bearer addition/modification as specified in 5.3.5.5.4;
- 1> if the *CellGroupConfig* contains the *mac-CellGroupConfig*:

- 2> configure the MAC entity of this cell group as specified in 5.3.5.5.5;
- 1> if the *CellGroupConfig* contains the *sCellToReleaseList*:
 - 2> perform SCell release as specified in 5.3.5.5.8;
- 1> if the CellGroupConfig contains the spCellConfig:
 - 2> configure the SpCell as specified in 5.3.5.5.7;
- 1> if the CellGroupConfig contains the sCellToAddModList:
 - 2> perform SCell addition/modification as specified in 5.3.5.5.9.

5.3.5.5.2 Reconfiguration with sync

The UE shall perform the following actions to execute a reconfiguration with sync.

- 1> if the AS security is not activated, perform the actions upon going to RRC_IDLE as specified in 5.3.11 with the release cause '*other*' upon which the procedure ends;
- 1> stop timer T310 for the corresponding SpCell, if running;
- 1> start timer T304 for the corresponding SpCell with the timer value set to *t304*, as included in the *reconfigurationWithSync*;
- 1> if the *frequencyInfoDL* is included:
 - 2> consider the target SpCell to be one on the SSB frequency indicated by the *frequencyInfoDL* with a physical cell identity indicated by the *physCellId*;
- 1> else:
 - 2> consider the target SpCell to be one on the SSB frequency of the source SpCell with a physical cell identity indicated by the *physCellId*;
- 1> start synchronising to the DL of the target SpCell;
- 1> apply the specified BCCH configuration defined in 9.1.1.1;
- 1> acquire the MIB, which is scheduled as specified in TS 38.213 [13];
- NOTE 1: The UE should perform the reconfiguration with sync as soon as possible following the reception of the RRC message triggering the reconfiguration with sync, which could be before confirming successful reception (HARQ and ARQ) of this message.
- NOTE 2: The UE may omit reading the *MIB* if the UE already has the required timing information, or the timing information is not needed for random access.
- 1> reset the MAC entity of this cell group;
- 1> consider the SCell(s) of this cell group, if configured, to be in deactivated state;
- 1> apply the value of the *newUE-Identity* as the C-RNTI for this cell group;
- 1> configure lower layers in accordance with the received spCellConfigCommon;
- 1> configure lower layers in accordance with any additional fields, not covered in the previous, if included in the received *reconfigurationWithSync*.

5.3.5.5.3 RLC bearer release

The UE shall:

1> for each *logicalChannelIdentity* value included in the *rlc-BearerToReleaseList* that is part of the current UE configuration within the same cell group (LCH release); or

- 1> for each logicalChannelIdentity value that is to be released as the result of an SCG release according to 5.3.5.4:
 - 2> release the RLC entity or entities as specified in TS 38.322 [4], clause 5.1.3;
 - 2> release the corresponding logical channel.

5.3.5.5.4 RLC bearer addition/modification

For each RLC-BearerConfig received in the rlc-BearerToAddModList IE the UE shall:

- 1> if the UE's current configuration contains an RLC bearer with the received *logicalChannelIdentity* within the same cell group:
 - 2> if reestablishRLC is received:
 - 3> re-establish the RLC entity as specified in TS 38.322 [4];
 - 2> reconfigure the RLC entity or entities in accordance with the received *rlc-Config*;
 - 2> reconfigure the logical channel in accordance with the received *mac-LogicalChannelConfig*;
- NOTE: The network does not re-associate an already configured logical channel with another radio bearer. Hence *servedRadioBearer* is not present in this case.
- 1> else (a logical channel with the given *logicalChannelIdentity* is not configured within the same cell group, including the case when full configuration option is used):
 - 2> if the servedRadioBearer associates the logical channel with an SRB and rlc-Config is not included:
 - 3> establish an RLC entity in accordance with the default configuration defined in 9.2 for the corresponding SRB:
 - 2> else:
 - 3> establish an RLC entity in accordance with the received *rlc-Config*;
 - 2> if the *servedRadioBearer* associates the logical channel with an SRB and if *mac-LogicalChannelConfig* is not included:
 - 3> configure this MAC entity with a logical channel in accordance to the default configuration defined in 9.2 for the corresponding SRB;
 - 2> else:
 - 3> configure this MAC entity with a logical channel in accordance to the received *mac-LogicalChannelConfig*;
 - 2> associate this logical channel with the PDCP entity identified by *servedRadioBearer*.

5.3.5.5.5 MAC entity configuration

- 1> if SCG MAC is not part of the current UE configuration (i.e. SCG establishment):
 - 2> create an SCG MAC entity;
- 1> reconfigure the MAC main configuration of the cell group in accordance with the received mac-CellGroupConfig excluding tag-ToReleaseList and tag-ToAddModList;
- 1> if the received *mac-CellGroupConfig* includes the *tag-ToReleaseList*:
 - 2> for each TAG-Id value included in the tag-ToReleaseList that is part of the current UE configuration:
 - 3> release the TAG indicated by TAG-Id;
- 1> if the received mac-CellGroupConfig includes the tag-ToAddModList:

- 2> for each *tag-Id* value included in *tag-ToAddModList* that is not part of the current UE configuration (TAG addition):
 - 3> add the TAG, corresponding to the tag-Id, in accordance with the received timeAlignmentTimer;
- 2> for each *tag-Id* value included in *tag-ToAddModList* that is part of the current UE configuration (TAG modification):
 - 3> reconfigure the TAG, corresponding to the tag-Id, in accordance with the received timeAlignmentTimer.

5.3.5.5.6 RLF Timers & Constants configuration

The UE shall:

- 1> if the received *rlf-TimersAndConstants* is set to *release*:
 - 2> use values for timers T301, T310, T311 and constants N310, N311, as included in *ue-TimersAndConstants* received in *SIB1*;
- 1> else:
 - 2> (re-)configure the value of timers and constants in accordance with received rlf-TimersAndConstants;
 - 2> stop timer T310 for this cell group, if running;
 - 2> reset the counters N310 and N311.

5.3.5.5.7 SpCell Configuration

The UE shall:

- 1> if the *SpCellConfig* contains the *rlf-TimersAndConstants*:
 - 2> configure the RLF timers and constants for this cell group as specified in 5.3.5.5.6;
- 1> else if *rlf-TimersAndConstants* is not configured for this cell group:
 - 2> use values for timers T301, T310, T311 and constants N310, N311, as included in *ue-TimersAndConstants* received in *SIB1*;
- 1> if the SpCellConfig contains spCellConfigDedicated:
 - 2> configure the SpCell in accordance with the *spCellConfigDedicated*;
 - 2> consider the bandwidth part indicated in *firstActiveUplinkBWP-Id* if configured to be the active uplink bandwidth part;
 - 2> consider the bandwidth part indicated in *firstActiveDownlinkBWP-Id* if configured to be the active downlink bandwidth part;
 - 2> if any of the reference signal(s) that are used for radio link monitoring are reconfigured by the received *spCellConfigDedicated*:
 - 3> stop timer T310 for the corresponding SpCell, if running;
 - 3> reset the counters N310 and N311.

5.3.5.5.8 SCell Release

- 1> if the release is triggered by reception of the *sCellToReleaseList*:
 - 2> for each *sCellIndex* value included in the *sCellToReleaseList*:
 - 3> if the current UE configuration includes an SCell with value sCellIndex:

4> release the SCell.

5.3.5.5.9 SCell Addition/Modification

The UE shall:

- 1> for each *sCellIndex* value included in the *sCellToAddModList* that is not part of the current UE configuration (SCell addition):
 - 2> add the SCell, corresponding to the *sCellIndex*, in accordance with the *sCellConfigCommon* and *sCellConfigDedicated*;
 - 2> configure lower layers to consider the SCell to be in deactivated state;
 - 2> for each *measId* included in the *measIdList* within *VarMeasConfig*:
 - 3> if SCells are not applicable for the associated measurement; and
 - 3> if the concerned SCell is included in *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*:
 - 4> remove the concerned SCell from *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*:
- 1> for each *sCellIndex* value included in the *sCellToAddModList* that is part of the current UE configuration (SCell modification):
 - 2> modify the SCell configuration in accordance with the sCellConfigDedicated.

5.3.5.6 Radio Bearer configuration

5.3.5.6.1 General

The UE shall perform the following actions based on a received RadioBearerConfig IE:

- 1> if the *RadioBearerConfig* includes the *srb3-ToRelease*:
 - 2> perform the SRB release as specified in 5.3.5.6.2;
- 1> if the RadioBearerConfig includes the srb-ToAddModList:
 - 2> perform the SRB addition or reconfiguration as specified in 5.3.5.6.3;
- 1> if the *RadioBearerConfig* includes the *drb-ToReleaseList*:
 - 2> perform DRB release as specified in 5.3.5.6.4;
- 1> if the RadioBearerConfig includes the drb-ToAddModList:
 - 2> perform DRB addition or reconfiguration as specified in 5.3.5.6.5.
- 1> release all SDAP entities, if any, that have no associated DRB as specified in TS 37.324 [24] clause 5.1.2, and indicate the release of the user plane resources for PDU Sessions associated with the released SDAP entities to upper layers.

5.3.5.6.2 SRB release

The UE shall:

1> release the PDCP entity and the *srb-Identity* of the SRB3.

5.3.5.6.3 SRB addition/modification

- 1> for each *srb-Identity* value included in the *srb-ToAddModList* that is not part of the current UE configuration (SRB establishment or reconfiguration from E-UTRA PDCP to NR PDCP):
 - 2> establish a PDCP entity;
 - 2> if AS security has been activated:
 - 3> if target RAT of handover is E-UTRA/5GC; or
 - 3> if the UE is connected to E-UTRA/5GC:
 - 4> if the UE is capable of E-UTRA/5GC, but not capable of NGEN-DC:
 - 5> configure the PDCP entity with the security algorithms and keys (K_{RRCenc} and K_{RRCint}) configured/derived as specified in TS 36.331 [10];
 - 4> else (i.e., UE capable of NGEN-DC):
 - 5> configure the PDCP entity with the security algorithms according to *securityConfig* and apply the keys (K_{RRCenc} and K_{RRCint}) associated with the master key (K_{eNB}) or secondary key (S-K_{gNB}) as indicated in *keyToUse*, if applicable;
 - 3> else (i.e., UE connected to NR or UE connected to E-UTRA/EPC):
 - 4> configure the PDCP entity with the security algorithms according to securityConfig and apply the keys (K_{RRCenc} and K_{RRCint}) associated with the master key (K_{eNB}/ K_{gNB}) or secondary key (S-K_{gNB}) as indicated in keyToUse, if applicable;
 - 2> if the current UE configuration as configured by E-UTRA in TS 36.331 [10] includes an SRB identified with the same *srb-Identity* value:
 - 3> associate the E-UTRA RLC entity and DCCH of this SRB with the NR PDCP entity;
 - 3> release the E-UTRA PDCP entity of this SRB;
 - 2> if the *pdcp-Config* is included:
 - 3> configure the PDCP entity in accordance with the received *pdcp-Config*;
 - 2> else:
 - 3> configure the PDCP entity in accordance with the default configuration defined in 9.2.1 for the corresponding SRB;
- 1> for each srb-Identity value included in the srb-ToAddModList that is part of the current UE configuration:
 - 2> if the *reestablishPDCP* is set:
 - 3> if target RAT of handover is E-UTRA/5GC; or
 - 3> if the UE is connected to E-UTRA/5GC:
 - 4> if the UE is capable of E-UTRA/5GC, but not capable of NGEN-DC:
 - 5> configure the PDCP entity to apply the integrity protection algorithm and K_{RRCint} key configured/derived as specified in TS 36.331 [10], i.e. the integrity protection configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
 - 5> configure the PDCP entity to apply the ciphering algorithm and K_{RRCenc} key configured/derived as specified in TS 36.331 [10], i.e. the ciphering configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
 - 4> else (i.e., a UE capable of NGEN-DC):

- 5> configure the PDCP entity to apply the integrity protection algorithm and K_{RRCint} key associated with the master key (K_{eNB}) or secondary key (S-K_{gNB}), as indicated in *keyToUse*, i.e. the integrity protection configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
- 5> configure the PDCP entity to apply the ciphering algorithm and K_{RRCenc} key associated with the master key (K_{eNB}) or secondary key (S- K_{gNB}) as indicated in keyToUse, i.e. the ciphering configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
- 3> else (i.e., UE connected to NR or UE in EN-DC):
 - 4> configure the PDCP entity to apply the integrity protection algorithm and K_{RRCint} key associated with the master key (K_{eNB}/K_{gNB}) or secondary key ($S-K_{gNB}$), as indicated in keyToUse, i.e. the integrity protection configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
 - 4> configure the PDCP entity to apply the ciphering algorithm and K_{RRCenc} key associated with the master key (K_{eNB}/K_{gNB}) or secondary key (S-K_{gNB}) as indicated in *keyToUse*, i.e. the ciphering configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
- 3> re-establish the PDCP entity of this SRB as specified in TS 38.323 [5];
- 2> else, if the *discardOnPDCP* is set:
 - 3> trigger the PDCP entity to perform SDU discard as specified in TS 38.323 [5];
- 2> if the *pdcp-Config* is included:
 - 3> reconfigure the PDCP entity in accordance with the received *pdcp-Config*.

5.3.5.6.4 DRB release

The UE shall:

- 1> for each drb-Identity value included in the drb-ToReleaseList that is part of the current UE configuration; or
- 1> for each drb-Identity value that is to be released as the result of full configuration according to 5.3.5.11:
 - 2> release the PDCP entity and the *drb-Identity*;
 - 2> if SDAP entity associated with this DRB is configured:
 - 3> indicate the release of the DRB to SDAP entity associated with this DRB (TS 37.324 [24], clause 5.3.3);
 - 2> if the DRB is associated with an eps-BearerIdentity:
 - 3> if a new bearer is not added either with NR or E-UTRA with same *eps-BearerIdentity*:
 - 4> indicate the release of the DRB and the *eps-BearerIdentity* of the released DRB to upper layers.
- NOTE 1: The UE does not consider the message as erroneous if the *drb-ToReleaseList* includes any *drb-Identity* value that is not part of the current UE configuration.
- NOTE 2: Whether or not the RLC and MAC entities associated with this PDCP entity are reset or released is determined by the *CellGroupConfig*.

5.3.5.6.5 DRB addition/modification

- 1> for each *drb-Identity* value included in the *drb-ToAddModList* that is not part of the current UE configuration (DRB establishment including the case when full configuration option is used):
 - 2> establish a PDCP entity and configure it in accordance with the received *pdcp-Config*;

- 2> if the PDCP entity of this DRB is not configured with *cipheringDisabled*:
 - 3> if target RAT of handover is E-UTRA/5GC; or
 - 3> if the UE is connected to E-UTRA/5GC:
 - 4> if the UE is capable of E-UTRA/5GC but not capable of NGEN-DC:
 - 5> configure the PDCP entity with the ciphering algorithm and K_{UPenc} key configured/derived as specified in TS 36.331 [10];
 - 4> else (i.e., a UE capable of NGEN-DC):
 - 5> configure the PDCP entity with the ciphering algorithms according to *securityConfig* and apply the key (K_{UPenc}) associated with the master key (K_{eNB}) or secondary key (S- K_{gNB}) as indicated in *keyToUse*, if applicable;
 - 3> else (i.e., UE connected to NR or UE connected to E-UTRA/EPC):
 - 4> configure the PDCP entity with the ciphering algorithms according to *securityConfig* and apply the K_{UPenc} key associated with the master key (K_{eNB}/K_{gNB}) or the secondary key ($S-K_{gNB}/S-K_{eNB}$) as indicated in keyToUse;
- 2> if the PDCP entity of this DRB is configured with *integrityProtection*:
 - 3> configure the PDCP entity with the integrity protection algorithms according to *securityConfig* and apply the K_{UPint} key associated with the master (K_{gNB}) or the secondary key (S- K_{gNB}) as indicated in *keyToUse*;
- 2> if an sdap-Config is included:
 - 3> if an SDAP entity with the received *pdu-Session* does not exist:
 - 4> establish an SDAP entity as specified in TS 37.324 [24] clause 5.1.1;
 - 4> if an SDAP entity with the received *pdu-Session* did not exist prior to receiving this reconfiguration:
 - 5> indicate the establishment of the user plane resources for the *pdu-Session* to upper layers;
 - 3> configure the SDAP entity in accordance with the received *sdap-Config* as specified in TS 37.324 [24] and associate the DRB with the SDAP entity;
 - 3> for each QFI value added in *mappedQoS-FlowsToAdd*, if the QFI value is previously configured, the QFI value is released from the old DRB;
- 2> if the DRB is associated with an *eps-BearerIdentity*:
 - 3> if the DRB was configured with the same *eps-BearerIdentity* either by NR or E-UTRA prior to receiving this reconfiguration:
 - 4> associate the established DRB with the corresponding eps-BearerIdentity;
 - 3> else:
 - 4> indicate the establishment of the DRB(s) and the *eps-BearerIdentity* of the established DRB(s) to upper layers;
- 1> for each *drb-Identity* value included in the *drb-ToAddModList* that is part of the current UE configuration:
 - 2> if the *reestablishPDCP* is set:
 - 3> if target RAT of handover is E-UTRA/5GC; or
 - 3> if the UE is connected to E-UTRA/5GC:
 - 4> if the UE is capable of E-UTRA/5GC but not capable of NGEN-DC:
 - 5> if the PDCP entity of this DRB is not configured with *cipheringDisabled*:

- 6> configure the PDCP entity with the ciphering algorithm and K_{UPenc} key configured/derived as specified in TS 36.331 [10], clause 5.4.2.3, i.e. the ciphering configuration shall be applied to all subsequent PDCP PDUs received and sent by the UE;
- 4> else (i.e., a UE capable of NGEN-DC):
 - 5> if the PDCP entity of this DRB is not configured with cipheringDisabled:
 - 6> configure the PDCP entity with the ciphering algorithm and K_{UPenc} key associated with the master key (K_{eNB}) or the secondary key ($S-K_{gNB}$), as indicated in *keyToUse*, i.e. the ciphering configuration shall be applied to all subsequent PDCP PDUs received and sent by the UE;
- 3> else (i.e., UE connected to NR or UE in EN-DC):
 - 4> if the PDCP entity of this DRB is not configured with *cipheringDisabled*:
 - 5> configure the PDCP entity with the ciphering algorithm and K_{UPenc} key associated with the master key (K_{eNB}/K_{gNB}) or the secondary key ($S-K_{gNB}/S-K_{eNB}$), as indicated in *keyToUse*, i.e. the ciphering configuration shall be applied to all subsequent PDCP PDUs received and sent by the UE;
 - 4> if the PDCP entity of this DRB is configured with *integrityProtection*:
 - 5> configure the PDCP entity with the integrity protection algorithms according to *securityConfig* and apply the K_{UPint} key associated with the master key (K_{gNB}) or the secondary key ($S-K_{gNB}$) as indicated in keyToUse;
- 3> if *drb-ContinueROHC* is included in *pdcp-Config*:
 - 4> indicate to lower layer that *drb-ContinueROHC* is configured;
- 3> re-establish the PDCP entity of this DRB as specified in TS 38.323 [5], clause 5.1.2;
- 2> else, if the *recoverPDCP* is set:
 - 3> trigger the PDCP entity of this DRB to perform data recovery as specified in TS 38.323 [5];
- 2> if the *pdcp-Config* is included:
 - 3> reconfigure the PDCP entity in accordance with the received pdcp-Config.
- 2> if the *sdap-Config* is included:
 - 3> reconfigure the SDAP entity in accordance with the received sdap-Config as specified in TS37.324 [24];
 - 3> for each QFI value added in *mappedQoS-FlowsToAdd*, if the QFI value is previously configured, the QFI value is released from the old DRB;
- NOTE 1: Void.
- NOTE 2: When determining whether a *drb-Identity* value is part of the current UE configuration, the UE does not distinguish which *RadioBearerConfig* and *DRB-ToAddModList* that DRB was originally configured in. To re-associate a DRB with a different key (K_{eNB} to S-K_{gNB}, K_{gNB} to S-K_{eNB}, K_{gNB} to S-K_{gNB}, or vice versa), the network provides the *drb-Identity* value in the (target) *drb-ToAddModList* and sets the *reestablishPDCP* flag. The network does not list the *drb-Identity* in the (source) *drb-ToReleaseList*.
- NOTE 3: When setting the *reestablishPDCP* flag for a radio bearer, the network ensures that the RLC receiver entities do not deliver old PDCP PDUs to the re-established PDCP entity. It does that e.g. by triggering a reconfiguration with sync of the cell group hosting the old RLC entity or by releasing the old RLC entity.
- NOTE 4: In this specification, UE configuration refers to the parameters configured by NR RRC unless otherwise stated.
- NOTE 5: Ciphering and integrity protection can be enabled or disabled for a DRB. The enabling/disabling of ciphering or integrity protection can be changed only by releasing and adding the DRB.

5.3.5.7 AS Security key update

- 1> if UE is connected to E-UTRA/EPC or E-UTRA/5GC:
 - 2> upon reception of sk-Counter as specified in TS 36.331 [10]:
 - 3> update the S-K_{gNB} key based on the K_{eNB} key and using the received *sk-Counter* value, as specified in TS 33.401 [30] for EN-DC, or TS 33.501 [11] for NGEN-DC;
 - 3> derive the K_{RRCenc} and K_{UPenc} keys as specified in TS 33.401 [30] for EN-DC, or TS 33.501 [11] for NGEN-DC:
 - 3> derive the K_{RRCint} and K_{UPint} keys as specified in TS 33.401 [30] for EN-DC or TS 33.501 [11] for NGEN-DC.
- 1> else if this procedure was initiated due to reception of the *masterKeyUpdate*:
 - 2> if the *nas-Container* is included in the received *masterKeyUpdate*:
 - 3> forward the *nas-Container* to the upper layers;
 - 2> if the *keySetChangeIndicator* is set to *true*:
 - 3> derive or update the K_{gNB} key based on the K_{AMF} key, as specified in TS 33.501 [11];
 - 2> else:
 - 3> derive or update the K_{gNB} key based on the current K_{gNB} key or the NH, using the *nextHopChainingCount* value indicated in the received *masterKeyUpdate*, as specified in TS 33.501 [11];
 - 2> store the *nextHopChainingCount* value;
 - $2\!\!>$ derive the keys associated with the K_{gNB} key as follows:
 - 3> if the *securityAlgorithmConfig* is included in *SecurityConfig*:
 - 4> derive the K_{RRCenc} and K_{UPenc} keys associated with the *cipheringAlgorithm* indicated in the *securityAlgorithmConfig*, as specified in TS 33.501 [11];
 - 4> derive the K_{RRCint} and K_{UPint} keys associated with the *integrityProtAlgorithm* indicated in the *securityAlgorithmConfig*, as specified in TS 33.501 [11];
 - 3> else:
 - 4> derive the K_{RRCenc} and K_{UPenc} keys associated with the current *cipheringAlgorithm*, as specified in TS 33.501 [11];
 - 4> derive the K_{RRCint} and K_{UPint} keys associated with the current *integrityProtAlgorithm*, as specified in TS 33.501 [11].
- NOTE 1: Ciphering and integrity protection are optional to configure for the DRBs.
- 1> else if this procedure was initiated due to reception of the *sk-Counter* (UE is in NE-DC, or NR-DC, or is configured with SN terminated bearer(s)):
 - 2> derive or update the secondary key (S-K_{gNB} or S-KeNB) based on the KgNB key and using the received *sk-Counter* value, as specified in TS 33.501 [11];
 - 2> derive the K_{RRCenc} key and the K_{UPenc} key as specified in TS 33.501 [11] using the ciphering algorithms indicated in the *RadioBearerConfig* associated with the secondary key (S-K_{gNB} or S-KeNB) as indicated by *keyToUse*;
 - 2> derive the K_{RRCint} key and the K_{UPint} key as specified in TS 33.501 [11] using the integrity protection algorithms indicated in the RadioBearerConfig associated with the secondary key (S-K_{gNB} or S-KeNB) as indicated by keyToUse;

NOTE 2: If the UE has no radio bearer configured with *keyToUse* set to *secondary* and receives the *sk-Counter* without any *RadioBearerConfig* with *keyToUse* set to *secondary*, the UE does not consider it as an invalid reconfiguration.

5.3.5.8 Reconfiguration failure

5.3.5.8.1 Void

5.3.5.8.2 Inability to comply with *RRCReconfiguration*

- 1> if the UE is in (NG)EN-DC:
 - 2> if the UE is unable to comply with (part of) the configuration included in the *RRCReconfiguration* message received over SRB3;
 - 3> continue using the configuration used prior to the reception of RRCReconfiguration message;
 - 3> initiate the SCG failure information procedure as specified in clause 5.7.3 to report SCG reconfiguration error, upon which the connection reconfiguration procedure ends;
 - 2> else, if the UE is unable to comply with (part of) the configuration included in the *RRCReconfiguration* message received over SRB1;
 - 3> continue using the configuration used prior to the reception of RRCReconfiguration message;
 - 3> initiate the connection re-establishment procedure as specified in TS 36.331 [10], clause 5.3.7, upon which the connection reconfiguration procedure ends.
- 1> else if RRCReconfiguration is received via NR (i.e., NR standalone, NE-DC, or NR-DC):
 - 2> if the UE is unable to comply with (part of) the configuration included in the *RRCReconfiguration* message received over SRB3;
- NOTE 0: This case does not apply in NE-DC.
 - 3> continue using the configuration used prior to the reception of RRCReconfiguration message;
 - 3> initiate the SCG failure information procedure as specified in clause 5.7.3 to report SCG reconfiguration error, upon which the connection reconfiguration procedure ends;
 - 2> else if the UE is unable to comply with (part of) the configuration included in the *RRCReconfiguration* message received over the SRB1;
- NOTE 0a: The compliance also covers the SCG configuration carried within octet strings e.g. field *mrdc-SecondaryCellGroupConfig*. I.e. the failure behaviour defined also applies in case the UE cannot comply with the embedded SCG configuration or with the combination of (parts of) the MCG and SCG configurations.
 - 3> continue using the configuration used prior to the reception of RRCReconfiguration message;
 - 3> if AS security has not been activated:
 - 4> perform the actions upon going to RRC_IDLE as specified in 5.3.11, with release cause 'other'
 - 3> else if AS security has been activated but SRB2 and at least one DRB have not been setup:
 - 4> perform the actions upon going to RRC_IDLE as specified in 5.3.11, with release cause 'RRC connection failure';
 - 3> else:
 - 4> initiate the connection re-establishment procedure as specified in 5.3.7, upon which the reconfiguration procedure ends;

- 1> else if RRCReconfiguration is received via other RAT (Handover to NR failure):
 - 2> if the UE is unable to comply with any part of the configuration included in the *RRCReconfiguration* message:
 - 3> perform the actions defined for this failure case as defined in the specifications applicable for the other RAT.
- NOTE 1: The UE may apply above failure handling also in case the *RRCReconfiguration* message causes a protocol error for which the generic error handling as defined in clause 10 specifies that the UE shall ignore the message.
- NOTE 2: If the UE is unable to comply with part of the configuration, it does not apply any part of the configuration, i.e. there is no partial success/failure.

5.3.5.8.3 T304 expiry (Reconfiguration with sync Failure)

The UE shall:

- 1> if T304 of the MCG expires:
 - 2> release dedicated preambles provided in rach-ConfigDedicated if configured;
 - 2> revert back to the UE configuration used in the source PCell;
 - 2> initiate the connection re-establishment procedure as specified in clause 5.3.7.
- NOTE 1: In the context above, "the UE configuration" includes state variables and parameters of each radio bearer.
- 1> else if T304 of a secondary cell group expires:
 - 2> release dedicated preambles provided in rach-ConfigDedicated, if configured;
 - 2> initiate the SCG failure information procedure as specified in clause 5.7.3 to report SCG reconfiguration with sync failure, upon which the RRC reconfiguration procedure ends;
- 1> else if T304 expires when RRCReconfiguration is received via other RAT (HO to NR failure):
 - 2> reset MAC;
 - 2> perform the actions defined for this failure case as defined in the specifications applicable for the other RAT.

5.3.5.9 Other configuration

- 1> if the received *otherConfig* includes the *delayBudgetReportingConfig*:
 - 2> if *delayBudgetReportingConfig* is set to *setup*:
 - 3> consider itself to be configured to send delay budget reports in accordance with 5.7.4;
 - 2> else:
 - 3> consider itself not to be configured to send delay budget reports and stop timer T342, if running.
- 1> if the received *otherConfig* includes the *overheatingAssistanceConfig*:
 - 2> if overheatingAssistanceConfig is set to setup:
 - 3> consider itself to be configured to provide overheating assistance information in accordance with 5.7.4;
 - 2> else:
 - 3> consider itself not to be configured to provide overheating assistance information and stop timer T345, if running;

5.3.5.10 MR-DC release

The UE shall:

- 1> as a result of MR-DC release triggered by E-UTRA or NR:
 - 2> release SRB3, if established, as specified in 5.3.5.6.2;
 - 2> release measConfig associated with SCG;
 - 2> if the UE is configured with NR SCG:
 - 3> release the SCG configuration as specified in clause 5.3.5.4;
 - 2> else if the UE is configured with E-UTRA SCG:
 - 3> release the SCG configuration as specified in TS 36.331 [10], clause 5.3.10.19 to release the E-UTRA SCG;

5.3.5.11 Full configuration

- 1> release/ clear all current dedicated radio configurations except for the following:
 - the MCG C-RNTI;
 - the AS security configurations associated with the master key;
 - the SRB1/SRB2 configurations and DRB configurations as configured by *radioBearerConfig* or *radioBearerConfig*2.
- NOTE 1: Radio configuration is not just the resource configuration but includes other configurations like MeasConfig. Radio configuration also includes the RLC bearer configurations as configured by RLC-BearerConfig. In case NR-DC or NE-DC is configured, this also includes the entire NR or E-UTRA SCG configuration which are released according to the MR-DC release procedure as specified in 5.3.5.10.
- NOTE 1a: To establish the RLC bearer of SRB(s) after release due to *fullConfig*, the network can include the *srb-Identity* within *srb-ToAddModList* (i.e. the UE applies RLC default configuration) and/or provide *rlc-BearerToAddModList* of concerned SRB(s) explicitly.
- 1> if the spCellConfig in the masterCellGroup includes the reconfigurationWithSync (i.e., SpCell change):
 - 2> release/ clear all current common radio configurations;
 - 2> use the default values specified in 9.2.3 for timers T310, T311 and constants N310, N311;
- 1> else (full configuration after re-establishment or during RRC resume):
 - 2> use values for timers T301, T310, T311 and constants N310, N311, as included in *ue-TimersAndConstants* received in *SIB1*;
- 1> apply the default L1 parameter values as specified in corresponding physical layer specifications except for the following:
 - parameters for which values are provided in SIB1;
- 1> apply the default MAC Cell Group configuration as specified in 9.2.2;
- 1> for each *srb-Identity* value included in the *srb-ToAddModList* (SRB reconfiguration):
 - 2> establish an RLC entity for the corresponding SRB;
 - 2> apply the default SRB configuration defined in 9.2.1 for the corresponding SRB;

- NOTE 2: This is to get the SRBs (SRB1 and SRB2 for reconfiguration with sync and SRB2 for resume and reconfiguration after re-establishment) to a known state from which the reconfiguration message can do further configuration.
- 1> for each *pdu-Session* that is part of the current UE configuration:
 - 2> release the SDAP entity (clause 5.1.2 in TS 37.324 [24]);
 - 2> release each DRB associated to the *pdu-Session* as specified in 5.3.5.6.4;
- NOTE 3: This will retain the *pdu-Session* but remove the DRBs including *drb-identity* of these bearers from the current UE configuration. Setup of the DRBs within the AS is described in clause 5.3.5.6.5 using the new configuration. The *pdu-Session* acts as the anchor for associating the released and re-setup DRB. In the AS the DRB re-setup is equivalent with a new DRB setup (including new PDCP and logical channel configurations).
- 1> for each *pdu-Session* that is part of the current UE configuration but not added with same *pdu-Session* in the *drb-ToAddModList*:
 - 2> if the procedure was triggered due to reconfiguration with sync:
 - 3> indicate the release of the user plane resources for the *pdu-Session* to upper layers after successful reconfiguration with sync;
 - 2> else:
 - 3> indicate the release of the user plane resources for the *pdu-Session* to upper layers immediately;

5.3.6 Counter check

5.3.6.1 General

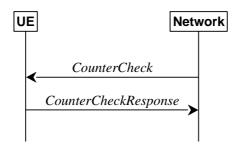


Figure 5.3.6.1-1: Counter check procedure

The counter check procedure is used by the network to request the UE to verify the amount of data sent/received on each DRB. More specifically, the UE is requested to check if, for each DRB, the most significant bits of the COUNT match with the values indicated by the network.

NOTE: The procedure enables the network to detect packet insertion by an intruder (a 'man in the middle').

5.3.6.2 Initiation

The network initiates the procedure by sending a CounterCheck message.

NOTE: The network may initiate the procedure when any of the COUNT values reaches a specific value.

5.3.6.3 Reception of the *CounterCheck* message by the UE

Upon receiving the *CounterCheck* message, the UE shall:

1> for each DRB that is established:

- 2> if no COUNT exists for a given direction (uplink or downlink) because it is a uni-directional bearer configured only for the other direction:
 - 3> assume the COUNT value to be 0 for the unused direction;
- 2> if the *drb-Identity* is not included in the *drb-CountMSB-InfoList*:
 - 3> include the DRB in the *drb-CountInfoList* in the *CounterCheckResponse* message by including the *drb-Identity*, the *count-Uplink* and the *count-Downlink* set to the value of TX_NEXT 1 and RX_NEXT 1 (specified in TS 38.323 [5]), respectively;
- 2> else if, for at least one direction, the most significant bits of the COUNT are different from the value indicated in the *drb-CountMSB-InfoList*:
 - 3> include the DRB in the *drb-CountInfoList* in the *CounterCheckResponse* message by including the *drb-Identity*, the *count-Uplink* and the *count-Downlink* set to the value of TX_NEXT 1 and RX_NEXT 1 (specified in TS 38.323 [5]), respectively;
- 1> for each DRB that is included in the *drb-CountMSB-InfoList* in the *CounterCheck* message that is not established:
 - 2> include the DRB in the *drb-CountInfoList* in the *CounterCheckResponse* message by including the *drb-Identity*, the *count-Uplink* and the *count-Downlink* with the most significant bits set identical to the corresponding values in the *drb-CountMSB-InfoList* and the least significant bits set to zero;
- 1> submit the CounterCheckResponse message to lower layers for transmission upon which the procedure ends.

5.3.7 RRC connection re-establishment

5.3.7.1 General

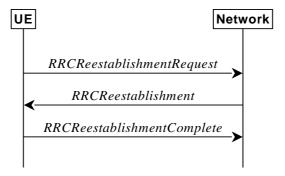


Figure 5.3.7.1-1: RRC connection re-establishment, successful

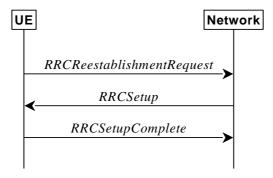


Figure 5.3.7.1-2: RRC re-establishment, fallback to RRC establishment, successful

The purpose of this procedure is to re-establish the RRC connection. A UE in RRC_CONNECTED, for which AS security has been activated with SRB2 and at least one DRB setup, may initiate the procedure in order to continue the

RRC connection. The connection re-establishment succeeds if the network is able to find and verify a valid UE context or, if the UE context cannot be retrieved, and the network responds with an *RRCSetup* according to clause 5.3.3.4.

The network applies the procedure e.g as follows:

- When AS security has been activated and the network retrieves or verifies the UE context:
 - to re-activate AS security without changing algorithms;
 - to re-establish and resume the SRB1;
- When UE is re-establishing an RRC connection, and the network is not able to retrieve or verify the UE context:
 - to discard the stored AS Context and release all RBs;
 - to fallback to establish a new RRC connection.

If AS security has not been activated, the UE shall not initiate the procedure but instead moves to RRC_IDLE directly, with release cause 'other'. If AS security has been activated, but SRB2 and at least one DRB are not setup, the UE does not initiate the procedure but instead moves to RRC_IDLE directly, with release cause 'RRC connection failure'.

5.3.7.2 Initiation

The UE initiates the procedure when one of the following conditions is met:

- 1> upon detecting radio link failure of the MCG, in accordance with 5.3.10; or
- 1> upon re-configuration with sync failure of the MCG, in accordance with clause 5.3.5.8.3; or
- 1> upon mobility from NR failure, in accordance with clause 5.4.3.5; or
- 1> upon integrity check failure indication from lower layers concerning SRB1 or SRB2, except if the integrity check failure is detected on the *RRCReestablishment* message; or
- 1> upon an RRC connection reconfiguration failure, in accordance with clause 5.3.5.8.2.

Upon initiation of the procedure, the UE shall:

- 1> stop timer T310, if running;
- 1> stop timer T304, if running;
- 1> start timer T311;
- 1> suspend all RBs, except SRB0;
- 1> reset MAC;
- 1> release the MCG SCell(s), if configured;
- 1> release *spCellConfig*, if configured;
- 1> if MR-DC is configured:
 - 2> perform MR-DC release, as specified in clause 5.3.5.10;
- 1> release delayBudgetReportingConfig, if configured, and stop timer T342, if running;
- 1> release overheating Assistance Config, if configured, and stop timer T345, if running;
- 1> perform cell selection in accordance with the cell selection process as specified in TS 38.304 [20].

5.3.7.3 Actions following cell selection while T311 is running

Upon selecting a suitable NR cell, the UE shall:

1> ensure having valid and up to date essential system information as specified in clause 5.2.2.2;

- 1> stop timer T311;
- 1> start timer T301;
- 1> if T390 is running:
 - 2> stop timer T390 for all access categories;
 - 2> perform the actions as specified in 5.3.14.4;
- 1> apply the default L1 parameter values as specified in corresponding physical layer specifications except for the parameters for which values are provided in *SIB1*;
- 1> apply the default MAC Cell Group configuration as specified in 9.2.2;
- 1> apply the CCCH configuration as specified in 9.1.1.2;
- 1> apply the *timeAlignmentTimerCommon* included in *SIB1*;
- 1> initiate transmission of the RRCReestablishmentRequest message in accordance with 5.3.7.4;

NOTE: This procedure applies also if the UE returns to the source PCell.

Upon selecting an inter-RAT cell, the UE shall:

1> perform the actions upon going to RRC_IDLE as specified in 5.3.11, with release cause 'RRC connection failure'.

5.3.7.4 Actions related to transmission of RRCReestablishmentRequest message

The UE shall set the contents of RRCReestablishmentRequest message as follows:

- 1> set the *ue-Identity* as follows:
 - 2> set the *c-RNTI* to the C-RNTI used in the source PCell (reconfiguration with sync or mobility from NR failure) or used in the PCell in which the trigger for the re-establishment occurred (other cases);
 - 2> set the *physCellId* to the physical cell identity of the source PCell (reconfiguration with sync or mobility from NR failure) or of the PCell in which the trigger for the re-establishment occurred (other cases);
 - 2> set the shortMAC-I to the 16 least significant bits of the MAC-I calculated:
 - 3> over the ASN.1 encoded as per clause 8 (i.e., a multiple of 8 bits) VarShortMAC-Input;
 - 3> with the K_{RRCint} key and integrity protection algorithm that was used in the source PCell (reconfiguration with sync or mobility from NR failure) or of the PCell in which the trigger for the re-establishment occurred (other cases); and
 - 3> with all input bits for COUNT, BEARER and DIRECTION set to binary ones;
- 1> set the *reestablishmentCause* as follows:
 - 2> if the re-establishment procedure was initiated due to reconfiguration failure as specified in 5.3.5.8.2:
 - 3> set the *reestablishmentCause* to the value *reconfigurationFailure*;
 - 2> else if the re-establishment procedure was initiated due to reconfiguration with sync failure as specified in 5.3.5.8.3 (intra-NR handover failure) or 5.4.3.5 (inter-RAT mobility from NR failure):
 - 3> set the reestablishmentCause to the value handoverFailure;
 - 2> else:
 - 3> set the *reestablishmentCause* to the value *otherFailure*;
- 1> re-establish PDCP for SRB1;

- 1> re-establish RLC for SRB1;
- 1> apply the default configuration defined in 9.2.1 for SRB1;
- 1> configure lower layers to suspend integrity protection and ciphering for SRB1;
- NOTE: Ciphering is not applied for the subsequent *RRCReestablishment* message used to resume the connection. An integrity check is performed by lower layers, but merely upon request from RRC.
- 1> resume SRB1;
- 1> submit the RRCReestablishmentRequest message to lower layers for transmission.

5.3.7.5 Reception of the RRCReestablishment by the UE

The UE shall:

- 1> stop timer T301;
- 1> consider the current cell to be the PCell;
- 1> store the nextHopChainingCount value indicated in the RRCReestablishment message;
- 1> update the K_{gNB} key based on the current K_{gNB} key or the NH, using the stored *nextHopChainingCount* value, as specified in TS 33.501 [11];
- 1> derive the K_{RRCenc} and K_{UPenc} keys associated with the previously configured *cipheringAlgorithm*, as specified in TS 33.501 [11];
- 1> derive the K_{RRCint} and K_{UPint} keys associated with the previously configured *integrityProtAlgorithm*, as specified in TS 33.501 [11].
- 1> request lower layers to verify the integrity protection of the *RRCReestablishment* message, using the previously configured algorithm and the K_{RRCint} key;
- 1> if the integrity protection check of the RRCReestablishment message fails:
 - 2> perform the actions upon going to RRC_IDLE as specified in 5.3.11, with release cause 'RRC connection failure', upon which the procedure ends;
- 1> configure lower layers to resume integrity protection for SRB1 using the previously configured algorithm and the K_{RRCint} key immediately, i.e., integrity protection shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
- 1> configure lower layers to resume ciphering for SRB1 using the previously configured algorithm and, the K_{RRCenc} key immediately, i.e., ciphering shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
- 1> release the measurement gap configuration indicated by the measGapConfig, if configured;
- 1> submit the RRCReestablishmentComplete message to lower layers for transmission;
- 1> the procedure ends.

5.3.7.6 T311 expiry

Upon T311 expiry, the UE shall:

1> perform the actions upon going to RRC_IDLE as specified in 5.3.11, with release cause 'RRC connection failure'.

5.3.7.7 T301 expiry or selected cell no longer suitable

- 1> if timer T301 expires; or
- 1> if the selected cell becomes no longer suitable according to the cell selection criteria as specified in TS 38.304 [20]:
 - 2> perform the actions upon going to RRC_IDLE as specified in 5.3.11, with release cause 'RRC connection failure'

5.3.7.8 Reception of the *RRCSetup* by the UE

The UE shall:

1> perform the RRC connection establishment procedure as specified in 5.3.3.4.

5.3.8 RRC connection release

5.3.8.1 General

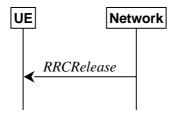


Figure 5.3.8.1-1: RRC connection release, successful

The purpose of this procedure is:

- to release the RRC connection, which includes the release of the established radio bearers as well as all radio resources; or
- to suspend the RRC connection only if SRB2 and at least one DRB are setup, which includes the suspension of the established radio bearers.

5.3.8.2 Initiation

The network initiates the RRC connection release procedure to transit a UE in RRC_CONNECTED to RRC_IDLE; or to transit a UE in RRC_CONNECTED to RRC_INACTIVE only if SRB2 and at least one DRB is setup in RRC_CONNECTED; or to transit a UE in RRC_INACTIVE back to RRC_INACTIVE when the UE tries to resume; or to transit a UE in RRC_INACTIVE to RRC_IDLE when the UE tries to resume. The procedure can also be used to release and redirect a UE to another frequency.

5.3.8.3 Reception of the *RRCRelease* by the UE

- 1> delay the following actions defined in this clause 60 ms from the moment the *RRCRelease* message was received or optionally when lower layers indicate that the receipt of the *RRCRelease* message has been successfully acknowledged, whichever is earlier;
- 1> stop timer T380, if running;
- 1> stop timer T320, if running;
- 1> if the AS security is not activated:
 - 2> ignore any field included in RRCRelease message except waitTime;
 - 2> perform the actions upon going to RRC_IDLE as specified in 5.3.11 with the release cause 'other' upon which the procedure ends;

- 1> if the RRCRelease message includes redirectedCarrierInfo indicating redirection to eutra:
 - 2> if *cnType* is included:
 - 3> after the cell selection, indicate the available CN Type(s) and the received cnType to upper layers;
- NOTE 1: Handling the case if the E-UTRA cell selected after the redirection does not support the core network type specified by the *cnType*, is up to UE implementation.
- 1> if the RRCRelease message includes the cellReselectionPriorities:
 - 2> store the cell reselection priority information provided by the *cellReselectionPriorities*;
 - 2> if the t320 is included:
 - 3> start timer T320, with the timer value set according to the value of t320;
- 1> else:
 - 2> apply the cell reselection priority information broadcast in the system information;
- 1> if deprioritisationReq is included and the UE supports RRC connection release with deprioritisation:
 - 2> start or restart timer T325 with the timer value set to the *deprioritisationTimer* signalled;
 - 2> store the deprioritisationReq until T325 expiry;
- NOTE 2: The UE stores the deprioritisation request irrespective of any cell reselection absolute priority assignments (by dedicated or common signalling) and regardless of RRC connections in NR or other RATs unless specified otherwise.
- 1> if the RRCRelease includes suspendConfig:
 - 2> apply the received *suspendConfig*;
 - 2> reset MAC and release the default MAC Cell Group configuration, if any;
 - 2> re-establish RLC entities for SRB1;
 - 2> if the RRCRelease message with suspendConfig was received in response to an RRCResumeRequest or an RRCResumeRequest1:
 - 3> stop the timer T319 if running;
 - 3> in the stored UE Inactive AS context:
 - 4> replace the K_{gNB} and K_{RRCint} keys with the current K_{gNB} and K_{RRCint} keys;
 - 4> replace the C-RNTI with the temporary C-RNTI in the cell the UE has received the *RRCRelease* message;
 - 4> replace the cellIdentity with the cellIdentity of the cell the UE has received the RRCRelease message;
 - 4> replace the physical cell identity with the physical cell identity of the cell the UE has received the *RRCRelease* message;
 - 2> else:
 - 3> store in the UE Inactive AS Context the current K_{gNB} and K_{RRCint} keys, the ROHC state, the stored QoS flow to DRB mapping rules, the C-RNTI used in the source PCell, the *cellIdentity* and the physical cell identity of the source PCell, and all other parameters configured except for the ones within *ReconfigurationWithSync* and *servingCellConfigCommonSIB*;
 - 2> suspend all SRB(s) and DRB(s), except SRB0;
 - 2> indicate PDCP suspend to lower layers of all DRBs;
 - 2> if the t380 is included:

- 3> start timer T380, with the timer value set to t380;
- 2> if the RRCRelease message is including the waitTime:
 - 3> start timer T302 with the value set to the *waitTime*;
 - 3> inform upper layers that access barring is applicable for all access categories except categories '0' and '2';
- 2> if T390 is running:
 - 3> stop timer T390 for all access categories;
 - 3> perform the actions as specified in 5.3.14.4;
- 2> indicate the suspension of the RRC connection to upper layers;
- 2> enter RRC_INACTIVE and perform cell selection as specified in TS 38.304 [20];
- 1> else
 - 2> perform the actions upon going to RRC IDLE as specified in 5.3.11, with the release cause 'other'.

5.3.8.4 T320 expiry

The UE shall:

- 1> if T320 expires:
 - 2> if stored, discard the cell reselection priority information provided by the *cellReselectionPriorities* or inherited from another RAT;
 - 2> apply the cell reselection priority information broadcast in the system information.

5.3.8.5 UE actions upon the expiry of *DataInactivityTimer*

Upon receiving the expiry of DataInactivityTimer from lower layers while in RRC_CONNECTED, the UE shall:

1> perform the actions upon going to RRC_IDLE as specified in 5.3.11, with release cause 'RRC connection failure'.

5.3.9 RRC connection release requested by upper layers

5.3.9.1 General

The purpose of this procedure is to release the RRC connection. Access to the current PCell may be barred as a result of this procedure.

5.3.9.2 Initiation

The UE initiates the procedure when upper layers request the release of the RRC connection as specified in TS 24.501 [23]. The UE shall not initiate the procedure for power saving purposes.

- 1> if the upper layers indicate barring of the PCell:
 - 2> treat the PCell used prior to entering RRC_IDLE as barred according to TS 38.304 [20];
- 1> perform the actions upon going to RRC_IDLE as specified in 5.3.11, with release cause 'other'.

5.3.10 Radio link failure related actions

5.3.10.1 Detection of physical layer problems in RRC_CONNECTED

The UE shall:

- 1> upon receiving N310 consecutive "out-of-sync" indications for the SpCell from lower layers while neither T300, T301, T304, T311 nor T319 are running:
 - 2> start timer T310 for the corresponding SpCell.

5.3.10.2 Recovery of physical layer problems

Upon receiving N311 consecutive "in-sync" indications for the SpCell from lower layers while T310 is running, the UE shall:

- 1> stop timer T310 for the corresponding SpCell.
- NOTE 1: In this case, the UE maintains the RRC connection without explicit signalling, i.e. the UE maintains the entire radio resource configuration.
- NOTE 2: Periods in time where neither "in-sync" nor "out-of-sync" is reported by L1 do not affect the evaluation of the number of consecutive "in-sync" or "out-of-sync" indications.

5.3.10.3 Detection of radio link failure

The UE shall:

- 1> upon T310 expiry in PCell; or
- 1> upon random access problem indication from MCG MAC while neither T300, T301, T304, T311 nor T319 are running; or
- 1> upon indication from MCG RLC that the maximum number of retransmissions has been reached:
 - 2> if the indication is from MCG RLC and CA duplication is configured and activated, and for the corresponding logical channel *allowedServingCells* only includes SCell(s):
 - 3> initiate the failure information procedure as specified in 5.7.5 to report RLC failure.
 - 2> else:
 - 3> consider radio link failure to be detected for the MCG, i.e. MCG RLF;
 - 3> if AS security has not been activated:
 - 4> perform the actions upon going to RRC_IDLE as specified in 5.3.11, with release cause 'other';-
 - 3> else if AS security has been activated but SRB2 and at least one DRB have not been setup:
 - 4> perform the actions upon going to RRC_IDLE as specified in 5.3.11, with release cause 'RRC connection failure':
 - 3> else:
 - 4> initiate the connection re-establishment procedure as specified in 5.3.7.

- 1> upon T310 expiry in PSCell; or
- 1> upon random access problem indication from SCG MAC; or
- 1> upon indication from SCG RLC that the maximum number of retransmissions has been reached:

- 2> if the indication is from SCG RLC and CA duplication is configured and activated, and for the corresponding logical channel *allowedServingCells* only includes SCell(s):
 - 3> initiate the failure information procedure as specified in 5.7.5 to report RLC failure.
- 2> else:
 - 3> consider radio link failure to be detected for the SCG, i.e. SCG RLF;
 - 3> initiate the SCG failure information procedure as specified in 5.7.3 to report SCG radio link failure.

5.3.11 UE actions upon going to RRC_IDLE

- 1> reset MAC;
- 1> set the variable *pendingRNA-Update* to *false*, if that is set to *true*;
- 1> if going to RRC_IDLE was triggered by reception of the RRCRelease message including a waitTime:
 - 2> if T302 is running:
 - 3> stop timer T302;
 - 2> start timer T302 with the value set to the waitTime;
 - 2> inform upper layers that access barring is applicable for all access categories except categories '0' and '2'.
- 1> else:
 - 2> if T302 is running:
 - 3> stop timer T302;
 - 3> perform the actions as specified in 5.3.14.4;
- 1> if T390 is running:
 - 2> stop timer T390 for all access categories;
 - 2> perform the actions as specified in 5.3.14.4;
- 1> if the UE is leaving RRC_INACTIVE:
 - 2> if going to RRC_IDLE was not triggered by reception of the RRCRelease message:
 - 3> if stored, discard the cell reselection priority information provided by the cellReselectionPriorities;
 - 3> stop the timer T320, if running;
- 1> stop all timers that are running except T302, T320 and T325;
- 1> discard the UE Inactive AS context, if any;
- 1> release the *suspendConfig*, if configured;
- 1> discard the K_{gNB} key, the S- K_{gNB} key, the S- K_{eNB} key, the K_{RRCenc} key, the K_{RRCint} key, the K_{UPint} key and the K_{UPenc} key, if any;
- 1> release all radio resources, including release of the RLC entity, the MAC configuration and the associated PDCP entity and SDAP for all established RBs;
- 1> indicate the release of the RRC connection to upper layers together with the release cause;
- 1> except if going to RRC_IDLE was triggered by inter-RAT cell reselection while the UE is in RRC_INACTIVE or RRC_IDLE or when selecting an inter-RAT cell while T311 was running:

2> enter RRC_IDLE and perform cell selection as specified in TS 38.304 [20];

5.3.12 UE actions upon PUCCH/SRS release request

Upon receiving a PUCCH release request from lower layers, for all bandwidth parts of an indicated serving cell the UE shall:

- 1> release PUCCH-CSI-Resources configured in CSI-ReportConfig;
- 1> release SchedulingRequestResourceConfig instances configured in PUCCH-Config.

Upon receiving an SRS release request from lower layers, for all bandwidth parts of an indicated serving cell the UE shall:

1> release SRS-Resource instances configured in SRS-Config.

5.3.13 RRC connection resume

5.3.13.1 General

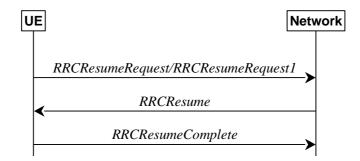


Figure 5.3.13.1-1: RRC connection resume, successful

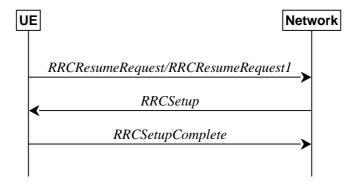


Figure 5.3.13.1-2: RRC connection resume fallback to RRC connection establishment, successful

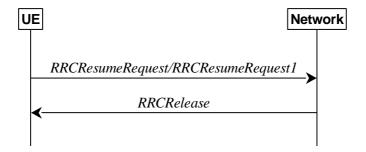


Figure 5.3.13.1-3: RRC connection resume followed by network release, successful

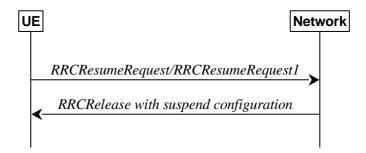


Figure 5.3.13.1-4: RRC connection resume followed by network suspend, successful

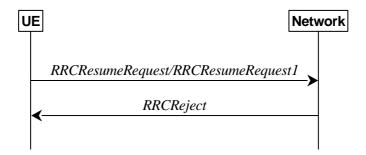


Figure 5.3.13.1-5: RRC connection resume, network reject

The purpose of this procedure is to resume a suspended RRC connection, including resuming SRB(s) and DRB(s) or perform an RNA update.

5.3.13.2 Initiation

The UE initiates the procedure when upper layers or AS (when responding to RAN paging or upon triggering RNA updates while the UE is in RRC_INACTIVE) requests the resume of a suspended RRC connection.

The UE shall ensure having valid and up to date essential system information as specified in clause 5.2.2.2 before initiating this procedure.

Upon initiation of the procedure, the UE shall:

- 1> if the resumption of the RRC connection is triggered by response to NG-RAN paging:
 - 2> select '0' as the Access Category;
 - 2> perform the unified access control procedure as specified in 5.3.14 using the selected Access Category and one or more Access Identities provided by upper layers;
 - 3> if the access attempt is barred, the procedure ends;
- 1> else if the resumption of the RRC connection is triggered by upper layers:
 - 2> if the upper layers provide an Access Category and one or more Access Identities:
 - 3> perform the unified access control procedure as specified in 5.3.14 using the Access Category and Access Identities provided by upper layers;
 - 4> if the access attempt is barred, the procedure ends;
 - 2> set the resumeCause in accordance with the information received from upper layers;
- 1> else if the resumption of the RRC connection is triggered due to an RNA update as specified in 5.3.13.8:
 - 2> if an emergency service is ongoing:
- NOTE: How the RRC layer in the UE is aware of an ongoing emergency service is up to UE implementation.
 - 3> select '2' as the Access Category;

- 3> set the resumeCause to emergency;
- 2> else:
 - 3> select '8' as the Access Category;
- 2> perform the unified access control procedure as specified in 5.3.14 using the selected Access Category and one or more Access Identities to be applied as specified in TS 24.501 [23];
 - 3> if the access attempt is barred:
 - 4> set the variable *pendingRNA-Update* to *true*;
 - 4> the procedure ends;
- 1> if the UE is in NE-DC or NR-DC:
 - 2> release the MR-DC related configurations (i.e., as specified in 5.3.5.10) from the UE Inactive AS context, if stored;
- 1> release the MCG SCell(s) from the UE Inactive AS context, if stored;
- 1> apply the default L1 parameter values as specified in corresponding physical layer specifications, except for the parameters for which values are provided in *SIB1*;
- 1> apply the default SRB1 configuration as specified in 9.2.1;
- 1> apply the default MAC Cell Group configuration as specified in 9.2.2;
- 1> release delayBudgetReportingConfig from the UE Inactive AS context, if stored;
- 1> stop timer T342, if running;
- 1> release overheating Assistance Config from the UE Inactive AS context, if stored;
- 1> stop timer T345, if running;
- 1> apply the CCCH configuration as specified in 9.1.1.2;
- 1> apply the *timeAlignmentTimerCommon* included in *SIB1*;
- 1> start timer T319;
- 1> set the variable *pendingRNA-Update* to *false*;
- 1> initiate transmission of the RRCResumeRequest message or RRCResumeRequest1 in accordance with 5.3.13.3.

5.3.13.3 Actions related to transmission of *RRCResumeRequest* or *RRCResumeRequest1* message

The UE shall set the contents of RRCResumeRequest or RRCResumeRequest1 message as follows:

- 1> if field *useFullResumeID* is signalled in *SIB1*:
 - 2> select RRCResumeRequest1 as the message to use;
 - 2> set the resumeIdentity to the stored fullI-RNTI value;
- 1> else:
 - 2> select RRCResumeRequest as the message to use;
 - 2> set the resumeIdentity to the stored shortI-RNTI value;
- 1> restore the RRC configuration, RoHC state, the stored QoS flow to DRB mapping rules and the K_{gNB} and K_{RRCint} keys from the stored UE Inactive AS context except the *masterCellGroup* and *pdcp-Config*;

- 1> set the *resumeMAC-I* to the 16 least significant bits of the MAC-I calculated:
 - 2> over the ASN.1 encoded as per clause 8 (i.e., a multiple of 8 bits) VarResumeMAC-Input;
 - 2> with the K_{RRCint} key in the UE Inactive AS Context and the previously configured integrity protection algorithm; and
 - 2> with all input bits for COUNT, BEARER and DIRECTION set to binary ones;
- 1> derive the K_{gNB} key based on the current K_{gNB} key or the NH, using the stored *nextHopChainingCount* value, as specified in TS 33.501 [11];
- 1> derive the K_{RRCenc} key, the K_{RRCint} key, the K_{UPint} key and the K_{UPenc} key;
- 1> configure lower layers to apply integrity protection for all radio bearers except SRB0 using the configured algorithm and the K_{RRCint} key and K_{UPint} key derived in this clause immediately, i.e., integrity protection shall be applied to all subsequent messages received and sent by the UE;
- NOTE 1: Only DRBs with previously configured UP integrity protection shall resume integrity protection.
- 1> configure lower layers to apply ciphering for all radio bearers except SRB0 and to apply the configured ciphering algorithm, the K_{RRCenc} key and the K_{UPenc} key derived in this clause, i.e. the ciphering configuration shall be applied to all subsequent messages received and sent by the UE;
- 1> re-establish PDCP entities for SRB1;
- 1> resume SRB1:
- 1> submit the selected message RRCResumeRequest or RRCResumeRequest1 for transmission to lower layers.
- NOTE 2: Only DRBs with previously configured UP ciphering shall resume ciphering.

If lower layers indicate an integrity check failure while T319 is running, perform actions specified in 5.3.13.5.

The UE shall continue cell re-selection related measurements as well as cell re-selection evaluation. If the conditions for cell re-selection are fulfilled, the UE shall perform cell re-selection as specified in 5.3.13.6.

5.3.13.4 Reception of the *RRCResume* by the UE

- 1> stop timer T319;
- 1> stop timer T380, if running;
- 1> if the *RRCResume* includes the *fullConfig*:
 - 2> perform the full configuration procedure as specified in 5.3.5.11;
- 1> else:
 - 2> restore the masterCellGroup and pdcp-Config from the UE Inactive AS context;
- 1> discard the UE Inactive AS context;
- 1> release the *suspendConfig* except the *ran-NotificationAreaInfo*;
- 1> if the *RRCResume* includes the *masterCellGroup*:
 - 2> perform the cell group configuration for the received masterCellGroup according to 5.3.5.5;
- 1> if the RRCResume includes the radioBearerConfig:
 - 2> perform the radio bearer configuration according to 5.3.5.6;
- 1> if the *RRCResume* message includes the *sk-Counter*:

- 2> perform security key update procedure as specified in 5.3.5.7;
- 1> if the RRCResume message includes the radioBearerConfig2:
 - 2> perform the radio bearer configuration according to 5.3.5.6;
- 1> resume SRB2 and all DRBs;
- 1> if stored, discard the cell reselection priority information provided by the *cellReselectionPriorities* or inherited from another RAT;
- 1> stop timer T320, if running;
- 1> if the *RRCResume* message includes the *measConfig*:
 - 2> perform the measurement configuration procedure as specified in 5.5.2;
- 1> resume measurements if suspended;
- 1> if T390 is running:
 - 2> stop timer T390 for all access categories;
 - 2> perform the actions as specified in 5.3.14.4;
- 1> if T302 is running:
 - 2> stop timer T302;
 - 2> perform the actions as specified in 5.3.14.4;
- 1> enter RRC CONNECTED;
- 1> indicate to upper layers that the suspended RRC connection has been resumed;
- 1> stop the cell re-selection procedure;
- 1> consider the current cell to be the PCell;
- 1> set the content of the of RRCResumeComplete message as follows:
 - 2> if the upper layer provides NAS PDU, set the *dedicatedNAS-Message* to include the information received from upper layers;
 - 2> if the upper layer provides a PLMN, set the *selectedPLMN-Identity* to PLMN selected by upper layers (TS 24.501 [23]) from the PLMN(s) included in the *plmn-IdentityInfoList* in *SIB1*;
 - 2> if the *masterCellGroup* contains the *reportUplinkTxDirectCurrent*:
 - 3> include the *uplinkTxDirectCurrentList* for each MCG serving cell with UL;
 - 3> include *uplinkDirectCurrentBWP-SUL* for each MCG serving cell configured with SUL carrier, if any, within the *uplinkTxDirectCurrentList*;
- $1 \gt \text{submit the } \textit{RRCResumeComplete} \text{ message to lower layers for transmission;}$
- 1> the procedure ends.

5.3.13.5 T319 expiry or Integrity check failure from lower layers while T319 is running

- 1> if timer T319 expires or upon receiving Integrity check failure indication from lower layers while T319 is running:
 - 2> perform the actions upon going to RRC_IDLE as specified in 5.3.11 with release cause 'RRC Resume failure'.

5.3.13.6 Cell re-selection or cell selection while T390, T319 or T302 is running (UE in RRC_INACTIVE)

The UE shall:

- 1> if cell reselection occurs while T319 or T302 is running:
 - 2> perform the actions upon going to RRC_IDLE as specified in 5.3.11 with release cause 'RRC Resume failure';
- 1> else if cell selection or reselection occurs while T390 is running:
 - 2> stop T390 for all access categories;
 - 2> perform the actions as specified in 5.3.14.4.

5.3.13.7 Reception of the *RRCSetup* by the UE

The UE shall:

1> perform the RRC connection setup procedure as specified in 5.3.3.4.

5.3.13.8 RNA update

In RRC_INACTIVE state, the UE shall:

- 1> if T380 expires; or
- 1> if RNA Update is triggered at reception of SIB1, as specified in 5.2.2.4.2:
 - 2> initiate RRC connection resume procedure in 5.3.13.2 with resume Cause set to rna-Update;
- 1> if barring is alleviated for Access Category '8', as specified in 5.3.14.4:
 - 2> if upper layers do not request RRC the resumption of an RRC connection, and
 - 2> if the variable *pendingRNA-Update* is set to *true*:
 - 3> initiate RRC connection resume procedure in 5.3.13.2 with resumeCause value set to rna-Update.

If the UE in RRC_INACTIVE state fails to find a suitable cell and camps on the acceptable cell to obtain limited service as defined in TS 38.304 [20], the UE shall:

1> perform the actions upon going to RRC_IDLE as specified in 5.3.11 with release cause 'other'.

NOTE: It is left to UE implementation how to behave when T380 expires while the UE is camped neither on a suitable nor on an acceptable cell.

5.3.13.9 Reception of the *RRCRelease* by the UE

The UE shall:

1> perform the actions as specified in 5.3.8.

5.3.13.10 Reception of the *RRCReject* by the UE

The UE shall:

1> perform the actions as specified in 5.3.15.

5.3.13.11 Inability to comply with *RRCResume*

- 1> if the UE is unable to comply with (part of) the configuration included in the RRCResume message;
 - 2> perform the actions upon going to RRC_IDLE as specified in 5.3.11 with release cause 'RRC Resume failure'.
- NOTE 1: The UE may apply above failure handling also in case the *RRCResume* message causes a protocol error for which the generic error handling as defined in 10 specifies that the UE shall ignore the message.
- NOTE 2: If the UE is unable to comply with part of the configuration, it does not apply any part of the configuration, i.e. there is no partial success/failure.

5.3.13.12 Inter RAT cell reselection

Upon reselecting to an inter-RAT cell, the UE shall:

1> perform the actions upon going to RRC_IDLE as specified in 5.3.11, with release cause 'other'.

5.3.14 Unified Access Control

5.3.14.1 General

The purpose of this procedure is to perform access barring check for an access attempt associated with a given Access Category and one or more Access Identities upon request from upper layers according to TS 24.501 [23] or the RRC layer.

After a PCell change in RRC_CONNECTED the UE shall defer access barring checks until it has obtained *SIB1* (as specified in 5.2.2.2) from the target cell.

5.3.14.2 Initiation

Upon initiation of the procedure, the UE shall:

- 1> if timer T390 is running for the Access Category:
 - 2> consider the access attempt as barred;
- 1> else if timer T302 is running and the Access Category is neither '2' nor '0':
 - 2> consider the access attempt as barred;
- 1> else:
 - 2> if the Access Category is '0':
 - 3> consider the access attempt as allowed;
 - 2> else:
 - 3> if SIB1 includes uac-BarringPerPLMN-List and the uac-BarringPerPLMN-List contains an UAC-BarringPerPLMN entry with the plmn-IdentityIndex corresponding to the PLMN selected by upper layers (see TS 24.501 [23]):
 - 4> select the *UAC-BarringPerPLMN* entry with the *plmn-IdentityIndex* corresponding to the PLMN selected by upper layers;
 - 4> in the remainder of this procedure, use the selected *UAC-BarringPerPLMN* entry (i.e. presence or absence of access barring parameters in this entry) irrespective of the *uac-BarringForCommon* included in *SIB1*;
 - 3> else if SIB1 includes *uac-BarringForCommon*:
 - 4> in the remainder of this procedure use the *uac-BarringForCommon* (i.e. presence or absence of these parameters) included in *SIB1*;

- 3> else:
 - 4> consider the access attempt as allowed;
- 3> if *uac-BarringForCommon* is applicable or the *uac-ACBarringListType* indicates that *uac-ExplicitACBarringList* is used:
 - 4> if the corresponding *UAC-BarringPerCatList* contains a *UAC-BarringPerCat* entry corresponding to the Access Category:
 - 5> select the *UAC-BarringPerCat* entry;
 - 5> if the *uac-BarringInfoSetList* contains a *UAC-BarringInfoSet* entry corresponding to the selected *uac-barringInfoSetIndex* in the *UAC-BarringPerCat*:
 - 6> select the *UAC-BarringInfoSet* entry;
 - 6> perform access barring check for the Access Category as specified in 5.3.14.5, using the selected *UAC-BarringInfoSet* as "UAC barring parameter";
 - 5> else:
 - 6> consider the access attempt as allowed;
 - 4> else:
 - 5> consider the access attempt as allowed;
- 3> else if the *uac-ACBarringListType* indicates that *uac-ImplicitACBarringList* is used:
 - 4> select the uac-BarringInfoSetIndex corresponding to the Access Category in the uac-ImplicitACBarringList;
 - 4> if the *uac-BarringInfoSetList* contains the *UAC-BarringInfoSet* entry corresponding to the selected *uac-BarringInfoSetIndex*:
 - 5> select the *UAC-BarringInfoSet* entry;
 - 5> perform access barring check for the Access Category as specified in 5.3.14.5, using the selected *UAC-BarringInfoSet* as "UAC barring parameter";
 - 4> else:
 - 5> consider the access attempt as allowed;
- 3> else:
 - 4> consider the access attempt as allowed;
- 1> if the access barring check was requested by upper layers:
 - 2> if the access attempt is considered as barred:
 - 3> if timer T302 is running:
 - 4> if timer T390 is running for Access Category '2':
 - 5> inform the upper layer that access barring is applicable for all access categories except categories '0', upon which the procedure ends;
 - 4> else
 - 5> inform the upper layer that access barring is applicable for all access categories except categories '0' and '2', upon which the procedure ends;
 - 3> else:

4> inform upper layers that the access attempt for the Access Category is barred, upon which the procedure ends;

2> else:

3> inform upper layers that the access attempt for the Access Category is allowed, upon which the procedure ends;

1> else:

2> the procedure ends.

5.3.14.3 Void

5.3.14.4 T302, T390 expiry or stop (Barring alleviation)

The UE shall:

- 1> if timer T302 expires or is stopped:
 - 2> for each Access Category for which T390 is not running:
 - 3> consider the barring for this Access Category to be alleviated:
- 1> else if timer T390 corresponding to an Access Category other than '2' expires or is stopped, and if timer T302 is not running:
 - 2> consider the barring for this Access Category to be alleviated;
- 1> else if timer T390 corresponding to the Access Category '2' expires or is stopped:
 - 2> consider the barring for this Access Category to be alleviated;
- 1> when barring for an Access Category is considered being alleviated:
 - 2> if the Access Category was informed to upper layers as barred:
 - 3> inform upper layers about barring alleviation for the Access Category.
 - 2> if barring is alleviated for Access Category '8':
 - 3> perform actions specified in 5.3.13.8;

5.3.14.5 Access barring check

The UE shall:

- 1> if one or more Access Identities are indicated according to TS 24.501 [23], and
- 1> if for at least one of these Access Identities the corresponding bit in the *uac-BarringForAccessIdentity* contained in "UAC barring parameter" is set to *zero*:
 - 2> consider the access attempt as allowed;

1> else:

- 2> draw a random number 'rand' uniformly distributed in the range: $0 \le rand < 1$;
- 2> if 'rand' is lower than the value indicated by uac-BarringFactor included in "UAC barring parameter":
 - 3> consider the access attempt as allowed;
- 2> else:
 - 3> consider the access attempt as barred;

- 1> if the access attempt is considered as barred:
 - 2> draw a random number 'rand' that is uniformly distributed in the range $0 \le rand < 1$;
 - 2> start timer T390 for the Access Category with the timer value calculated as follows, using the *uac-BarringTime* included in "UAC barring parameter":

T390 = (0.7 + 0.6 * rand) * uac-BarringTime.

5.3.15 RRC connection reject

5.3.15.1 Initiation

The UE initiates the procedure upon the reception of *RRCReject* when the UE tries to establish or resume an RRC connection.

5.3.15.2 Reception of the RRCReject by the UE

The UE shall:

- 1> stop timer T300, if running;
- 1> stop timer T319, if running;
- 1> stop timer T302, if running;
- 1> reset MAC and release the default MAC Cell Group configuration;
- 1> if waitTime is configured in the RRCReject:
 - 2> start timer T302, with the timer value set to the waitTime;
- 1> if *RRCReject* is received in response to a request from upper layers:
 - 2> inform the upper layer that access barring is applicable for all access categories except categories '0' and '2';
- 1> if RRCReject is received in response to an RRCSetupRequest:
 - 2> inform upper layers about the failure to setup the RRC connection, upon which the procedure ends;
- 1> else if RRCReject is received in response to an RRCResumeRequest or an RRCResumeRequest1:
 - 2> if resume is triggered by upper layers:
 - 3> inform upper layers about the failure to resume the RRC connection;
 - 2> if resume is triggered due to an RNA update:
 - 3> set the variable *pendingRNA-Update* to *true*;
 - 2> discard the current K_{gNB} key, the K_{RRCenc} key, the K_{RRCint} key, the K_{UPint} key and the K_{UPenc} key derived in accordance with 5.3.13.3;
 - 2> suspend SRB1, upon which the procedure ends;

The RRC_INACTIVE UE shall continue to monitor paging while the timer T302 is running.

5.4 Inter-RAT mobility

5.4.1 Introduction

Network controlled inter-RAT mobility between NR and E-UTRA is supported, where E-UTRA can be connected to either EPC or 5GC.

5.4.2 Handover to NR

5.4.2.1 General

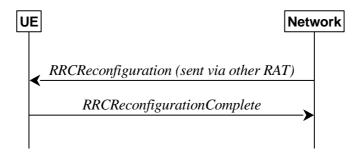


Figure 5.4.2.1-1: Handover to NR, successful

The purpose of this procedure is to, under the control of the network, transfer a connection between the UE and another Radio Access Network (e.g. E-UTRAN) to NR.

The handover to NR procedure applies when SRBs, possibly in combination with DRBs, are established in another RAT. Handover from E-UTRA to NR applies only after integrity has been activated in E-UTRA.

5.4.2.2 Initiation

The RAN using another RAT initiates the handover to NR procedure, in accordance with the specifications applicable for the other RAT, by sending the *RRCReconfiguration* message via the radio access technology from which the inter-RAT handover is performed.

The network applies the procedure as follows:

- to activate ciphering, possibly using NULL algorithm, if not yet activated in the other RAT;
- to re-establish SRBs and one or more DRBs;

5.4.2.3 Reception of the *RRCReconfiguration* by the UE

The UE shall:

- 1> apply the default L1 parameter values as specified in corresponding physical layer specifications except for the parameters for which values are provided in *SIB1*;
- 1> apply the default MAC Cell Group configuration as specified in 9.2.2;
- 1> perform RRC reconfiguration procedure as specified in 5.3.5;

NOTE: If the UE is connected to 5GC of the source E-UTRA cell, the delta configuration for PDCP and SDAP can be used for intra-system inter-RAT handover. For other cases, source RAT configuration is not considered when the UE applies the reconfiguration message of target RAT.

5.4.3 Mobility from NR

5.4.3.1 General



Figure 5.4.3.1-1: Mobility from NR, successful

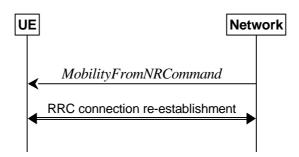


Figure 5.4.3.1-2: Mobility from NR, failure

The purpose of this procedure is to move a UE in RRC_CONNECTED to a cell using other RAT, e.g. E-UTRA. The mobility from NR procedure covers the following type of mobility:

- handover, i.e. the *MobilityFromNRCommand* message includes radio resources that have been allocated for the UE in the target cell;

5.4.3.2 Initiation

The network initiates the mobility from NR procedure to a UE in RRC_CONNECTED, possibly in response to a *MeasurementReport* message, by sending a *MobilityFromNRCommand* message. The network applies the procedure as follows:

- the procedure is initiated only when AS security has been activated, and SRB2 with at least one DRB are setup and not suspended.

5.4.3.3 Reception of the *MobilityFromNRCommand* by the UE

- 1> stop timer T310, if running;
- 1> if T390 is running:
 - 2> stop timer T390 for all access categories;
 - 2> perform the actions as specified in 5.3.14.4;
- 1> if the *targetRAT-Type* is set to *eutra*:
 - 2> consider inter-RAT mobility as initiated towards E-UTRA;
 - 2> forward the nas-SecurityParamFromNR to the upper layers, if included;
- 1> access the target cell indicated in the inter-RAT message in accordance with the specifications of the target RAT.

5.4.3.4 Successful completion of the mobility from NR

Upon successfully completing the handover, at the source side the UE shall:

- 1> reset MAC;
- 1> stop all timers that are running except T325;
- 1> release ran-NotificationAreaInfo, if stored;
- 1> release the AS security context including the K_{RRCenc} key, the K_{RRCint} key, the K_{UPint} key and the K_{UPenc} key, if stored:
- 1> release all radio resources, including release of the RLC entity and the MAC configuration;
- 1> release the associated PDCP entity and SDAP entity for all established RBs;
- NOTE: PDCP and SDAP configured by the source RAT prior to the handover that are reconfigured and re-used by target RAT when delta signalling (i.e., during inter-RAT intra-system handover when *fullConfig* is not present) is used, are not released as part of this procedure.
- 1> if the targetRAT-Type is set to eutra and the nas-SecurityParamFromNR is included:
 - 2> indicate the release of the RRC connection to upper layers together with the release cause 'other'.

5.4.3.5 Mobility from NR failure

The UE shall:

- 1> if the UE does not succeed in establishing the connection to the target radio access technology; or
- 1> if the UE is unable to comply with any part of the configuration included in the *MobilityFromNRCommand* message; or
- 1> if there is a protocol error in the inter RAT information included in the *MobilityFromNRCommand* message, causing the UE to fail the procedure according to the specifications applicable for the target RAT:
 - 2> revert back to the configuration used in the source PCell;
 - 2> initiate the connection re-establishment procedure as specified in clause 5.3.7.

5.5 Measurements

5.5.1 Introduction

The network may configure an RRC_CONNECTED UE to perform measurements and report them in accordance with the measurement configuration. The measurement configuration is provided by means of dedicated signalling i.e. using the *RRCReconfiguration* or *RRCResume*.

The network may configure the UE to perform the following types of measurements:

- NR measurements;
- Inter-RAT measurements of E-UTRA frequencies.

The network may configure the UE to report the following measurement information based on SS/PBCH block(s):

- Measurement results per SS/PBCH block;
- Measurement results per cell based on SS/PBCH block(s);
- SS/PBCH block(s) indexes.

The network may configure the UE to report the following measurement information based on CSI-RS resources:

- Measurement results per CSI-RS resource;
- Measurement results per cell based on CSI-RS resource(s);
- CSI-RS resource measurement identifiers.

The measurement configuration includes the following parameters:

- 1. Measurement objects: A list of objects on which the UE shall perform the measurements.
 - For intra-frequency and inter-frequency measurements a measurement object indicates the frequency/time location and subcarrier spacing of reference signals to be measured. Associated with this measurement object, the network may configure a list of cell specific offsets, a list of 'blacklisted' cells and a list of 'whitelisted' cells. Blacklisted cells are not applicable in event evaluation or measurement reporting. Whitelisted cells are the only ones applicable in event evaluation or measurement reporting.
 - The *measObjectId* of the MO which corresponds to each serving cell is indicated by *servingCellMO* within the serving cell configuration.
 - For inter-RAT E-UTRA measurements a measurement object is a single E-UTRA carrier frequency. Associated with this E-UTRA carrier frequency, the network can configure a list of cell specific offsets and a list of 'blacklisted' cells. Blacklisted cells are not applicable in event evaluation or measurement reporting.
- **2. Reporting configurations:** A list of reporting configurations where there can be one or multiple reporting configurations per measurement object. Each reporting configuration consists of the following:
 - Reporting criterion: The criterion that triggers the UE to send a measurement report. This can either be periodical or a single event description.
 - RS type: The RS that the UE uses for beam and cell measurement results (SS/PBCH block or CSI-RS).
 - Reporting format: The quantities per cell and per beam that the UE includes in the measurement report (e.g. RSRP) and other associated information such as the maximum number of cells and the maximum number beams per cell to report.
- **3. Measurement identities:** A list of measurement identities where each measurement identity links one measurement object with one reporting configuration. By configuring multiple measurement identities, it is possible to link more than one measurement object to the same reporting configuration, as well as to link more than one reporting configuration to the same measurement object. The measurement identity is also included in the measurement report that triggered the reporting, serving as a reference to the network.
- **4. Quantity configurations:** The quantity configuration defines the measurement filtering configuration used for all event evaluation and related reporting, and for periodical reporting of that measurement. For NR measurements, the network may configure up to 2 quantity configurations with a reference in the NR measurement object to the configuration that is to be used. In each configuration, different filter coefficients can be configured for different measurement quantities, for different RS types, and for measurements per cell and per beam
- **5. Measurement gaps:** Periods that the UE may use to perform measurements.

A UE in RRC_CONNECTED maintains a measurement object list, a reporting configuration list, and a measurement identities list according to signalling and procedures in this specification. The measurement object list possibly includes NR measurement object(s) and inter-RAT objects. Similarly, the reporting configuration list includes NR and inter-RAT reporting configurations. Any measurement object can be linked to any reporting configuration of the same RAT type. Some reporting configurations may not be linked to a measurement object. Likewise, some measurement objects may not be linked to a reporting configuration.

The measurement procedures distinguish the following types of cells:

- 1. The NR serving cell(s) these are the SpCell and one or more SCells.
- 2. Listed cells these are cells listed within the measurement object(s).
- 3. Detected cells these are cells that are not listed within the measurement object(s) but are detected by the UE on the SSB frequency(ies) and subcarrier spacing(s) indicated by the measurement object(s).

For NR measurement object(s), the UE measures and reports on the serving cell(s), listed cells and/or detected cells. For inter-RAT measurements object(s) of E-UTRA, the UE measures and reports on listed cells and detected cells.

Whenever the procedural specification, other than contained in clause 5.5.2, refers to a field it concerns a field included in the *VarMeasConfig* unless explicitly stated otherwise i.e. only the measurement configuration procedure covers the direct UE action related to the received *measConfig*.

In NR-DC, the UE may receive two independent *measConfig*:

- a measConfig, associated with MCG, that is included in the RRCReconfiguration message received via SRB1;
 and
- a measConfig, associated with SCG, that is included in the RRCReconfiguration message received via SRB3, or, alternatively, included within a RRCReconfiguration message embedded in a RRCReconfiguration message received via SRB1.

In this case, the UE maintains two independent *VarMeasConfig* and *VarMeasReportList*, one associated with each *measConfig*, and independently performs all the procedures in clause 5.5 for each *measConfig* and the associated *VarMeasConfig* and *VarMeasReportList*, unless explicitly stated otherwise.

5.5.2 Measurement configuration

5.5.2.1 General

The network applies the procedure as follows:

- to ensure that, whenever the UE has a *measConfig* associated with a CG, it includes a *measObject* for the SpCell and for each NR SCell of the CG to be measured;
- to configure at most one measurement identity across all CGs using a reporting configuration with the *reportType* set to *reportCGI*;
- to ensure that, in the *measConfig* associated with a CG:
 - for all SSB based measurements there is at most one measurement object with the same *ssbFrequency*;
 - an *smtc1* included in any measurement object with the same *ssbFrequency* has the same value and that an *smtc2* included in any measurement object with the same *ssbFrequency* has the same value;
- to ensure that all measurement objects configured in this specification and in TS 36.331 [10] with the same *ssbFrequency* have the same *ssbSubcarrierSpacing*;
- to ensure that, if a measurement object associated with the MCG has the same *ssbFrequency* as a measurement object associated with the SCG:
 - for that *ssbFrequency*, the measurement window according to the *smtc1* configured by the MCG includes the measurement window according to the *smtc1* configured by the SCG, or vice-versa, with an accuracy of the maximum receive timing difference specified in TS 38.133 [14].
 - if both measurement objects are used for RSSI measurements, bits in *measurementSlots* in both objects corresponding to the same slot are set to the same value. Also, the *endSymbol* is the same in both objects.
- to ensure that, if a measurement object has the same *ssbFrequency* as a measurement object configured in TS 36.331 [10]:
 - for that *ssbFrequency*, the measurement window according to the *smtc* configured in TS 36.331 [10] includes the measurement window according to the *smtc1* configured in TS 38.331, or vice-versa, with an accuracy of the maximum receive timing difference specified in TS 38.133 [14].
 - if both measurement objects are used for RSSI measurements, bits in *measurementSlots* in both objects corresponding to the same slot are set to the same value. Also, the *endSymbol* is the same in both objects.
- when the UE is in NE-DC, NR-DC, or NR standalone, to configure at most one measurement identity across all CGs using a reporting configuration with the *reportType* set to *reportSFTD*;

For CSI-RS resources, the network applies the procedure as follows:

- to ensure that all CSI-RS resources configured in each measurement object have the same center frequency, (startPRB+floor(nrofPRBs/2))

The UE shall:

- 1> if the received *measConfig* includes the *measObjectToRemoveList*:
 - 2> perform the measurement object removal procedure as specified in 5.5.2.4;
- 1> if the received *measConfig* includes the *measObjectToAddModList*:
 - 2> perform the measurement object addition/modification procedure as specified in 5.5.2.5;
- 1> if the received *measConfig* includes the *reportConfigToRemoveList*:
 - 2> perform the reporting configuration removal procedure as specified in 5.5.2.6;
- 1> if the received *measConfig* includes the *reportConfigToAddModList*:
 - 2> perform the reporting configuration addition/modification procedure as specified in 5.5.2.7;
- 1> if the received *measConfig* includes the *quantityConfig*:
 - 2> perform the quantity configuration procedure as specified in 5.5.2.8;
- 1> if the received *measConfig* includes the *measIdToRemoveList*:
 - 2> perform the measurement identity removal procedure as specified in 5.5.2.2;
- 1> if the received *measConfig* includes the *measIdToAddModList*:
 - 2> perform the measurement identity addition/modification procedure as specified in 5.5.2.3;
- 1> if the received *measConfig* includes the *measGapConfig*:
 - 2> perform the measurement gap configuration procedure as specified in 5.5.2.9;
- 1> if the received *measConfig* includes the *measGapSharingConfig*:
 - 2> perform the measurement gap sharing configuration procedure as specified in 5.5.2.11;
- 1> if the received *measConfig* includes the *s-MeasureConfig*:
 - 2> if *s-MeasureConfig* is set to *ssb-RSRP*, set parameter *ssb-RSRP* of *s-MeasureConfig* within *VarMeasConfig* to the lowest value of the RSRP ranges indicated by the received value of *s-MeasureConfig*;
 - 2> else, set parameter *csi-RSRP* of *s-MeasureConfig* within *VarMeasConfig* to the lowest value of the RSRP ranges indicated by the received value of *s-MeasureConfig*.

5.5.2.2 Measurement identity removal

- 1> for each *measId* included in the received *measIdToRemoveList* that is part of the current UE configuration in *VarMeasConfig*:
 - 2> remove the entry with the matching measId from the measIdList within the VarMeasConfig;
 - 2> remove the measurement reporting entry for this measId from the VarMeasReportList, if included;
 - 2> stop the periodical reporting timer or timer T321 or timer T322, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*.
- NOTE: The UE does not consider the message as erroneous if the *measIdToRemoveList* includes any *measId* value that is not part of the current UE configuration.

5.5.2.3 Measurement identity addition/modification

The network applies the procedure as follows:

- configure a *measId* only if the corresponding measurement object, the corresponding reporting configuration and the corresponding quantity configuration, are configured.

The UE shall:

- 1> for each measId included in the received measIdToAddModList:
 - 2> if an entry with the matching *measId* exists in the *measIdList* within the *VarMeasConfig*:
 - 3> replace the entry with the value received for this *measId*;
 - 2> else:
 - 3> add a new entry for this *measId* within the *VarMeasConfig*;
 - 2> remove the measurement reporting entry for this measId from the VarMeasReportList, if included;
 - 2> stop the periodical reporting timer or timer T321 or timer T322, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*;
 - 2> if the reportType is set to reportCGI in the reportConfig associated with this measId:
 - 3> if the measObject associated with this measId concerns E-UTRA:
 - 4> start timer T321 with the timer value set to 1 second for this *measId*;
 - 3> if the *measObject* associated with this *measId* concerns NR:
 - 4> if the *measObject* associated with this *measId* concerns FR1:
 - 5> start timer T321 with the timer value set to 2 seconds for this *measId*;
 - 4> if the *measObject* associated with this *measId* concerns FR2:
 - 5> start timer T321 with the timer value set to 16 seconds for this *measId*.
 - 2> if the *reportType* is set to *reportSFTD* in the *reportConfigNR* associated with this *measId* and the *drx-SFTD-NeighMeas* is included:
 - 3> if the *measObject* associated with this *measId* concerns FR1:
 - 4> start timer T322 with the timer value set to 3 seconds for this *measId*;
 - 3> if the *measObject* associated with this *measId* concerns FR2:
 - 4> start timer T322 with the timer value set to 24 seconds for this measId.

5.5.2.4 Measurement object removal

- 1> for each *measObjectId* included in the received *measObjectToRemoveList* that is part of *measObjectList* in *VarMeasConfig*:
 - 2> remove the entry with the matching measObjectId from the measObjectList within the VarMeasConfig;
 - 2> remove all measId associated with this measObjectId from the measIdList within the VarMeasConfig, if any;
 - 2> if a *measId* is removed from the *measIdList*:
 - 3> remove the measurement reporting entry for this measId from the VarMeasReportList, if included;

3> stop the periodical reporting timer or timer T321 or timer T322, whichever is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*.

NOTE: The UE does not consider the message as erroneous if the *measObjectToRemoveList* includes any *measObjectId* value that is not part of the current UE configuration.

5.5.2.5 Measurement object addition/modification

- 1> for each measObjectId included in the received measObjectToAddModList:
 - 2> if an entry with the matching *measObjectId* exists in the *measObjectList* within the *VarMeasConfig*, for this entry:
 - 3> reconfigure the entry with the value received for this *measObject*, except for the fields *cellsToAddModList*, *blackCellsToAddModList*, *whiteCellsToAddModList*, *cellsToRemoveList*, *blackCellsToRemoveList* and *whiteCellsToRemoveList*;
 - 3> if the received *measObject* includes the *cellsToRemoveList*:
 - 4> for each *physCellId* included in the *cellsToRemoveList*:
 - 5> remove the entry with the matching *physCellId* from the *cellsToAddModList*;
 - 3> if the received *measObject* includes the *cellsToAddModList*:
 - 4> for each *physCellId* value included in the *cellsToAddModList*:
 - 5> if an entry with the matching *physCellId* exists in the *cellsToAddModList*:
 - 6> replace the entry with the value received for this *physCellId*;
 - 5> else:
 - 6> add a new entry for the received *physCellId* to the *cellsToAddModList*;
 - 3> if the received *measObject* includes the *blackCellsToRemoveList*:
 - 4> for each *pci-RangeIndex* included in the *blackCellsToRemoveList*:
 - 5> remove the entry with the matching *pci-RangeIndex* from the *blackCellsToAddModList*;
- NOTE 1: For each *pci-RangeIndex* included in the *blackCellsToRemoveList* that concerns overlapping ranges of cells, a cell is removed from the blacklist of cells only if all PCI ranges containing it are removed.
 - 3> if the received *measObject* includes the *blackCellsToAddModList*:
 - 4> for each *pci-RangeIndex* included in the *blackCellsToAddModList*:
 - 5> if an entry with the matching pci-RangeIndex is included in the blackCellsToAddModList:
 - 6> replace the entry with the value received for this *pci-RangeIndex*;
 - 5> else:
 - 6> add a new entry for the received *pci-RangeIndex* to the *blackCellsToAddModList*;
 - 3> if the received *measObject* includes the *whiteCellsToRemoveList*:
 - 4> for each *pci-RangeIndex* included in the whiteCellsToRemoveList:
 - 5> remove the entry with the matching *pci-RangeIndex* from the *whiteCellsToAddModList*;
- NOTE2: For each *pci-RangeIndex* included in the *whiteCellsToRemoveList* that concerns overlapping ranges of cells, a cell is removed from the whitelist of cells only if all PCI ranges containing it are removed.

- 3> if the received *measObject* includes the *whiteCellsToAddModList*:
 - 4> for each *pci-RangeIndex* included in the *whiteCellsToAddModList*:
 - 5> if an entry with the matching pci-RangeIndex is included in the whiteCellsToAddModList:
 - 6> replace the entry with the value received for this *pci-RangeIndex*;
 - 5> else:
 - 6> add a new entry for the received pci-RangeIndex to the whiteCellsToAddModList
- 3> for each measId associated with this measObjectId in the measIdList within the VarMeasConfig, if any:
 - 4> remove the measurement reporting entry for this measId from the VarMeasReportList, if included;
 - 4> stop the periodical reporting timer or timer T321 or timer T322, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*;

2> else:

3> add a new entry for the received measObject to the measObjectList within VarMeasConfig.

5.5.2.6 Reporting configuration removal

The UE shall:

- 1> for each *reportConfigId* included in the received *reportConfigToRemoveList* that is part of the current UE configuration in *VarMeasConfig*:
 - 2> remove the entry with the matching reportConfigId from the reportConfigList within the VarMeasConfig;
 - 2> remove all measId associated with the reportConfigId from the measIdList within the VarMeasConfig, if any;
 - 2> if a *measId* is removed from the *measIdList*:
 - 3> remove the measurement reporting entry for this measId from the VarMeasReportList, if included;
 - 3> stop the periodical reporting timer or timer T321 or timer T322, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*.

NOTE: The UE does not consider the message as erroneous if the *reportConfigToRemoveList* includes any *reportConfigId* value that is not part of the current UE configuration.

5.5.2.7 Reporting configuration addition/modification

The UE shall:

- 1> for each reportConfigId included in the received reportConfigToAddModList:
 - 2> if an entry with the matching *reportConfigId* exists in the *reportConfigList* within the *VarMeasConfig*, for this entry:
 - 3> reconfigure the entry with the value received for this *reportConfig*;
 - 3> for each *measId* associated with this *reportConfigId* included in the *measIdList* within the *VarMeasConfig*, if any:
 - 4> remove the measurement reporting entry for this measId from the VarMeasReportList, if included;
 - 4> stop the periodical reporting timer or timer T321 or timer T322, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*;

2> else:

3> add a new entry for the received reportConfig to the reportConfigList within the VarMeasConfig.

5.5.2.8 Quantity configuration

The UE shall:

- 1> for each RAT for which the received *quantityConfig* includes parameter(s):
 - 2> set the corresponding parameter(s) in *quantityConfig* within *VarMeasConfig* to the value of the received *quantityConfig* parameter(s);
- 1> for each *measId* included in the *measIdList* within *VarMeasConfig*:
 - 2> remove the measurement reporting entry for this measId from the VarMeasReportList, if included;
 - 2> stop the periodical reporting timer or timer T321 or timer T322, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*.

5.5.2.9 Measurement gap configuration

- 1> if *gapFR1* is set to *setup*:
 - 2> if an FR1 measurement gap configuration is already setup, release the FR1 measurement gap configuration;
 - 2> setup the FR1 measurement gap configuration indicated by the *measGapConfig* in accordance with the received *gapOffset*, i.e., the first subframe of each gap occurs at an SFN and subframe meeting the following condition:

```
SFN mod T = \text{FLOOR}(gapOffset/10);
subframe = gapOffset \mod 10;
with T = \text{MGRP}/10 as defined in TS 38.133 [14];
```

- 2> apply the specified timing advance *mgta* to the gap occurrences calculated above (i.e. the UE starts the measurement *mgta* ms before the gap subframe occurrences);
- 1> else if *gapFR1* is set to *release*:
 - 2> release the FR1 measurement gap configuration;
- 1> if *gapFR2* is set to *setup*:
 - 2> if an FR2 measurement gap configuration is already setup, release the FR2 measurement gap configuration;
 - 2> setup the FR2 measurement gap configuration indicated by the *measGapConfig* in accordance with the received *gapOffset*, i.e., the first subframe of each gap occurs at an SFN and subframe meeting the following condition:

```
SFN mod T = \text{FLOOR}(gapOffset/10);
subframe = gapOffset \mod 10;
with T = \text{MGRP}/10 as defined in TS 38.133 [14];
```

- 2> apply the specified timing advance *mgta* to the gap occurrences calculated above (i.e. the UE starts the measurement *mgta* ms before the gap subframe occurrences);
- 1> else if *gapFR2* is set to *release*:
 - 2> release the FR2 measurement gap configuration;
- 1> if *gapUE* is set to *setup*:
 - 2> if a per UE measurement gap configuration is already setup, release the per UE measurement gap configuration;

2> setup the per UE measurement gap configuration indicated by the *measGapConfig* in accordance with the received *gapOffset*, i.e., the first subframe of each gap occurs at an SFN and subframe meeting the following condition:

```
SFN mod T = \text{FLOOR}(gapOffset/10);
subframe = gapOffset \mod 10;
with T = \text{MGRP}/10 as defined in TS 38.133 [14];
```

- 2> apply the specified timing advance *mgta* to the gap occurrences calculated above (i.e. the UE starts the measurement *mgta* ms before the gap subframe occurrences);
- 1> else if *gapUE* is set to *release*:
 - 2> release the per UE measurement gap configuration.
- NOTE 1: For *gapFR2* configuration, for the UE in NE-DC or NR-DC, the SFN and subframe of the serving cell indicated by the *refServCellIndicator* in *gapFR2* is used in the gap calculation. Otherwise, the SFN and subframe of a serving cell on FR2 frequency is used in the gap calculation
- NOTE 2: For *gapFR1* or *gapUE* configuration, for the UE in NE-DC or NR-DC, the SFN and subframe of the serving cell indicated by the *refServCellIndicator* in corresponding *gapFR1* or *gapUE* is used in the gap calculation. Otherwise, the SFN and subframe of the PCell is used in the gap calculation.

5.5.2.10 Reference signal measurement timing configuration

The UE shall setup the first SS/PBCH block measurement timing configuration (SMTC) in accordance with the received *periodicityAndOffset* parameter (providing *Periodicity* and *Offset* value for the following condition) in the *smtc1* configuration. The first subframe of each SMTC occasion occurs at an SFN and subframe of the NR SpCell meeting the following condition:

```
SFN mod T = (FLOOR (Offset/10));
if the Periodicity is larger than sf5:
subframe = Offset \mod 10;
else:
subframe = Offset or (Offset + 5);
with T = CEIL(Periodicity/10).
```

If *smtc2* is present, for cells indicated in the *pci-List* parameter in *smtc2* in the same *MeasObjectNR*, the UE shall setup an additional SS/PBCH block measurement timing configuration (SMTC) in accordance with the received *periodicity* parameter in the *smtc2* configuration and use the *Offset* (derived from parameter *periodicityAndOffset*) and *duration* parameter from the *smtc1* configuration. The first subframe of each SMTC occasion occurs at an SFN and subframe of the NR SpCell meeting the above condition.

On the indicated *ssbFrequency*, the UE shall not consider SS/PBCH block transmission in subframes outside the SMTC occasion for RRM measurements based on SS/PBCH blocks and for RRM measurements based on CSI-RS except for SFTD measurement (see TS 38.133 [14], clause 9.3.8).

5.5.2.11 Measurement gap sharing configuration

The UE shall:

```
1> if gapSharingFR1 is set to setup:
```

2> if an FR1 measurement gap sharing configuration is already setup:

3> release the FR1 measurement gap sharing configuration;

- 2> setup the FR1 measurement gap sharing configuration indicated by the *measGapSharingConfig* in accordance with the received *gapSharingFR1* as defined in TS 38.133 [14];
- 1> else if *gapSharingFR1* is set to *release*:
 - 2> release the FR1 measurement gap sharing configuration;
- 1> if *gapSharingFR2* is set to *setup*:
 - 2> if an FR2 measurement gap sharing configuration is already setup:
 - 3> release the FR2 measurement gap sharing configuration;
 - 2> setup the FR2 measurement gap sharing configuration indicated by the *measGapSharingConfig* in accordance with the received *gapSharingFR2* as defined in TS 38.133 [14];
- 1> else if *gapSharingFR2* is set to *release*:
 - 2> release the FR2 measurement gap sharing configuration.
- 1> if *gapSharingUE* is set to *setup*:
 - 2> if a per UE measurement gap sharing configuration is already setup:
 - 3> release the per UE measurement gap sharing configuration;
 - 2> setup the per UE measurement gap sharing configuration indicated by the *measGapSharingConfig* in accordance with the received *gapSharingUE* as defined in TS 38.133 [14];
- 1> else if *gapSharingUE* is set to *release*:
 - 2> release the per UE measurement gap sharing configuration.

5.5.3 Performing measurements

5.5.3.1 General

An RRC_CONNECTED UE shall derive cell measurement results by measuring one or multiple beams associated per cell as configured by the network, as described in 5.5.3.3. For all cell measurement results in RRC_CONNECTED the UE applies the layer 3 filtering as specified in 5.5.3.2, before using the measured results for evaluation of reporting criteria and measurement reporting. For cell measurements, the network can configure RSRP, RSRQ or SINR as trigger quantity. Reporting quantities can be any combination of quantities (i.e. only RSRP; only RSRQ; only SINR; RSRP and RSRQ; RSRP and SINR; RSRQ and SINR; RSRQ and SINR), irrespective of the trigger quantity.

The network may also configure the UE to report measurement information per beam (which can either be measurement results per beam with respective beam identifier(s) or only beam identifier(s)), derived as described in 5.5.3.3a. If beam measurement information is configured to be included in measurement reports, the UE applies the layer 3 beam filtering as specified in 5.5.3.2. On the other hand, the exact L1 filtering of beam measurements used to derive cell measurement results is implementation dependent.

- 1> whenever the UE has a *measConfig*, perform RSRP and RSRQ measurements for each serving cell for which *servingCellMO* is configured as follows:
 - 2> if the reportConfig associated with at least one measId included in the measIdList within VarMeasConfig contains an rsType set to ssb and ssb-ConfigMobility is configured in the measObject indicated by the servingCellMO:
 - 3> if the reportConfig associated with at least one measId included in the measIdList within VarMeasConfig contains a reportQuantityRS-Indexes and maxNrofRS-IndexesToReport and contains an rsType set to ssb:
 - 4> derive layer 3 filtered RSRP and RSRQ per beam for the serving cell based on SS/PBCH block, as described in 5.5.3.3a;

- 3> derive serving cell measurement results based on SS/PBCH block, as described in 5.5.3.3;
- 2> if the *reportConfig* associated with at least one *measId* included in the *measIdList* within *VarMeasConfig* contains an *rsType* set to *csi-rs* and *CSI-RS-ResourceConfigMobility* is configured in the *measObject* indicated by the *servingCellMO*:
 - 3> if the *reportConfig* associated with at least one *measId* included in the *measIdList* within *VarMeasConfig* contains a *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport* and contains an *rsType* set to *csirs*:
 - 4> derive layer 3 filtered RSRP and RSRQ per beam for the serving cell based on CSI-RS, as described in 5.5.3.3a;
 - 3> derive serving cell measurement results based on CSI-RS, as described in 5.5.3.3;
- 1> for each serving cell for which *servingCellMO* is configured, if the *reportConfig* associated with at least one *measId* included in the *measIdList* within *VarMeasConfig* contains SINR as trigger quantity and/or reporting quantity:
 - 2> if the reportConfig contains rsType set to ssb and ssb-ConfigMobility is configured in the servingCellMO:
 - 3> if the reportConfigcontains a reportQuantityRS-Indexes and maxNrofRS-IndexesToReport:
 - 4> derive layer 3 filtered SINR per beam for the serving cell based on SS/PBCH block, as described in 5.5.3.3a;
 - 3> derive serving cell SINR based on SS/PBCH block, as described in 5.5.3.3;
 - 2> if the reportConfig contains rsType set to csi-rs and CSI-RS-ResourceConfigMobility is configured in the servingCellMO:
 - 3> if the reportConfigcontains a reportQuantityRS-Indexes and maxNrofRS-IndexesToReport:
 - 4> derive layer 3 filtered SINR per beam for the serving cell based on CSI-RS, as described in 5.5.3.3a;
 - 3> derive serving cell SINR based on CSI-RS, as described in 5.5.3.3;
- 1> for each *measId* included in the *measIdList* within *VarMeasConfig*:
 - 2> if the reportType for the associated reportConfig is set to reportCGI and timer T321 is running:
 - 3> perform the corresponding measurements on the frequency and RAT indicated in the associated *measObject* using available idle periods;
 - 3> if the cell indicated by *reportCGI* field for the associated *measObject* is an NR cell and that indicated cell is broadcasting *SIB1* (see TS 38.213 [13], clause 13):
 - 4> try to acquire SIB1 in the concerned cell;
 - 3> if the cell indicated by *reportCGI* field is an E-UTRA cell:
 - 4> try to acquire *SystemInformationBlockType1* in the concerned cell;
 - 2> if the *reportType* for the associated *reportConfig* is *periodical* or *eventTriggered*:
 - 3> if a measurement gap configuration is setup, or
 - 3> if the UE does not require measurement gaps to perform the concerned measurements:
 - 4> if s-MeasureConfig is not configured, or
 - 4> if *s-MeasureConfig* is set to *ssb-RSRP* and the NR SpCell RSRP based on SS/PBCH block, after layer 3 filtering, is lower than *ssb-RSRP*, or
 - 4> if *s-MeasureConfig* is set to *csi-RSRP* and the NR SpCell RSRP based on CSI-RS, after layer 3 filtering, is lower than *csi-RSRP*:

- 5> if the *measObject* is associated to NR and the *rsType* is set to *csi-rs*:
 - 6> if reportQuantityRS-Indexes and maxNrofRS-IndexesToReport for the associated reportConfig are configured:
 - 7> derive layer 3 filtered beam measurements only based on CSI-RS for each measurement quantity indicated in *reportQuantityRS-Indexes*, as described in 5.5.3.3a;
 - 6> derive cell measurement results based on CSI-RS for the trigger quantity and each measurement quantity indicated in *reportQuantityCell* using parameters from the associated *measObject*, as described in 5.5.3.3;
- 5> if the *measObject* is associated to NR and the *rsType* is set to *ssb*:
 - 6> if reportQuantityRS-Indexes and maxNrofRS-IndexesToReport for the associated reportConfig are configured:
 - 7> derive layer 3 beam measurements only based on SS/PBCH block for each measurement quantity indicated in *reportQuantityRS-Indexes*, as described in 5.5.3.3a;
 - 6> derive cell measurement results based on SS/PBCH block for the trigger quantity and each measurement quantity indicated in *reportQuantityCell* using parameters from the associated *measObject*, as described in 5.5.3.3;
- 5> if the *measObject* is associated to E-UTRA:
 - 6> perform the corresponding measurements associated to neighbouring cells on the frequencies indicated in the concerned *measObject*, as described in 5.5.3.2;
- 2> if the *reportType* for the associated *reportConfig* is set to *reportSFTD* and the *numberOfReportsSent* as defined within the *VarMeasReportList* for this *measId* is less than one:
 - 3> if the reportSFTD-Meas is set to true:
 - 4> if the *measObject* is associated to E-UTRA:
 - 5> perform SFTD measurements between the PCell and the E-UTRA PSCell;
 - 5> if the *reportRSRP* is set to *true*;
 - 6> perform RSRP measurements for the E-UTRA PSCell;
 - 4> else if the *measObject* is associated to NR:
 - 5> perform SFTD measurements between the PCell and the NR PSCell;
 - 5> if the *reportRSRP* is set to *true*;
 - 6> perform RSRP measurements for the NR PSCell based on SSB;
 - 3> else if the reportSFTD-NeighMeas is included:
 - 4> if the *measObject* is associated to NR:
 - 5> if the *drx-SFTD-NeighMeas* is included:
 - 6> perform SFTD measurements between the PCell and the NR neighbouring cell(s) detected based on parameters in the associated *measObject* using available idle periods;
 - 5> else:
 - 6> perform SFTD measurements between the PCell and the NR neighbouring cell(s) detected based on parameters in the associated *measObject*;
 - 5> if the *reportRSRP* is set to *true*:

6> perform RSRP measurements based on SSB for the NR neighbouring cell(s) detected based on parameters in the associated *measObject*;

2> perform the evaluation of reporting criteria as specified in 5.5.4.

5.5.3.2 Layer 3 filtering

The UE shall:

- 1> for each cell measurement quantity and for each beam measurement quantity that the UE performs measurements according to 5.5.3.1:
 - 2> filter the measured result, before using for evaluation of reporting criteria or for measurement reporting, by the following formula:

$$F_{\rm n} = (1-a)*F_{\rm n-1} + a*M_{\rm n}$$

where

 M_n is the latest received measurement result from the physical layer;

 F_n is the updated filtered measurement result, that is used for evaluation of reporting criteria or for measurement reporting;

- F_{n-1} is the old filtered measurement result, where F_0 is set to M_1 when the first measurement result from the physical layer is received; and for NR, $a = 1/2^{(ki/4)}$, where k_i is the filterCoefficient for the corresponding measurement quantity of the i:th QuantityConfigNR in quantityConfigNR-List, and i is indicated by quantityConfigIndex in MeasObjectNR; for E-UTRA, $a = 1/2^{(k/4)}$, where k is the filterCoefficient for the corresponding measurement quantity received by quantityConfigEUTRA in the quantityConfig;
- 2> adapt the filter such that the time characteristics of the filter are preserved at different input rates, observing that the *filterCoefficient k* assumes a sample rate equal to X ms; The value of X is equivalent to one intrafrequency L1 measurement period as defined in TS 38.133 [14] assuming non-DRX operation, and depends on frequency range.
- NOTE 1: If k is set to 0, no layer 3 filtering is applicable.
- NOTE 2: The filtering is performed in the same domain as used for evaluation of reporting criteria or for measurement reporting, i.e., logarithmic filtering for logarithmic measurements.
- NOTE 3: The filter input rate is implementation dependent, to fulfil the performance requirements set in TS 38.133 [14]. For further details about the physical layer measurements, see TS 38.133 [14].

5.5.3.3 Derivation of cell measurement results

The network may configure the UE to derive RSRP, RSRQ and SINR measurement results per cell associated to NR measurement objects based on parameters configured in the *measObject* (e.g. maximum number of beams to be averaged and beam consolidation thresholds) and in the *reportConfig* (*rsType* to be measured, SS/PBCH block or CSI-RS).

- 1> for each cell measurement quantity to be derived based on SS/PBCH block:
 - 2> if nrofSS-BlocksToAverage in the associated measObject is not configured; or
 - 2> if absThreshSS-BlocksConsolidation in the associated measObject is not configured; or
 - 2> if the highest beam measurement quantity value is below or equal to absThreshSS-BlocksConsolidation:
 - 3> derive each cell measurement quantity based on SS/PBCH block as the highest beam measurement quantity value, where each beam measurement quantity is described in TS 38.215 [9];
 - 2> else:

- 3> derive each cell measurement quantity based on SS/PBCH block as the linear power scale average of the highest beam measurement quantity values above *absThreshSS-BlocksConsolidation* where the total number of averaged beams shall not exceed *nrofSS-BlocksToAverage*;
- 2> apply layer 3 cell filtering as described in 5.5.3.2;
- 1> for each cell measurement quantity to be derived based on CSI-RS:
 - 2> consider a CSI-RS resource to be applicable for deriving cell measurements when the concerned CSI-RS resource is included in the csi-rs-CellMobility including the physCellId of the cell in the CSI-RS-ResourceConfigMobility in the associated measObject;
 - 2> if nrofCSI-RS-ResourcesToAverage in the associated measObject is not configured; or
 - 2> if absThreshCSI-RS-Consolidation in the associated measObject is not configured; or
 - 2> if the highest beam measurement quantity value is below or equal to absThreshCSI-RS-Consolidation:
 - 3> derive each cell measurement quantity based on applicable CSI-RS resources for the cell as the highest beam measurement quantity value, where each beam measurement quantity is described in TS 38.215 [9];

2> else:

- 3> derive each cell measurement quantity based on CSI-RS as the linear power scale average of the highest beam measurement quantity values above *absThreshCSI-RS-Consolidation* where the total number of averaged beams shall not exceed *nrofCSI-RS-ResourcesToAverage*;
- 2> apply layer 3 cell filtering as described in 5.5.3.2.

5.5.3.3a Derivation of layer 3 beam filtered measurement

The UE shall:

- 1> for each layer 3 beam filtered measurement quantity to be derived based on SS/PBCH block;
 - 2> derive each configured beam measurement quantity based on SS/PBCH block as described in TS 38.215[9], and apply layer 3 beam filtering as described in 5.5.3.2;
- 1> for each layer 3 beam filtered measurement quantity to be derived based on CSI-RS;
 - 2> derive each configured beam measurement quantity based on CSI-RS as described in TS 38.215 [9], and apply layer 3 beam filtering as described in 5.5.3.2.

5.5.4 Measurement report triggering

5.5.4.1 General

If AS security has been activated successfully, the UE shall:

- 1> for each *measId* included in the *measIdList* within *VarMeasConfig*:
 - 2> if the corresponding reportConfig includes a reportType set to eventTriggered or periodical:
 - 3> if the corresponding *measObject* concerns NR:
 - 4> if the *eventA1* or *eventA2* is configured in the corresponding *reportConfig*:
 - 5> consider only the serving cell to be applicable;
 - 4> if the eventA3 or eventA5 is configured in the corresponding reportConfig:
 - 5> if a serving cell is associated with a *measObjectNR* and neighbours are associated with another *measObjectNR*, consider any serving cell associated with the other *measObjectNR* to be a neighbouring cell as well;

- 4> if corresponding reportConfig includes reportType set to periodical; or
- 4> for measurement events other than eventA1 or eventA2:
 - 5> if *useWhiteCellList* is set to *true*:
 - 6> consider any neighbouring cell detected based on parameters in the associated *measObjectNR* to be applicable when the concerned cell is included in the *whiteCellsToAddModList* defined within the *VarMeasConfig* for this *measId*;
 - 5> else:
 - 6> consider any neighbouring cell detected based on parameters in the associated *measObjectNR* to be applicable when the concerned cell is not included in the *blackCellsToAddModList* defined within the *VarMeasConfig* for this *measId*;
- 3> else if the corresponding measObject concerns E-UTRA:
 - 4> if eventB1 or eventB2 is configured in the corresponding reportConfig:
 - 5> consider a serving cell, if any, on the associated E-UTRA frequency as neighbour cell;
 - 4> consider any neighbouring cell detected on the associated frequency to be applicable when the concerned cell is not included in the *blackCellsToAddModListEUTRAN* defined within the *VarMeasConfig* for this *measId*;
- 2> else if the corresponding reportConfig includes a reportType set to reportCGI:
 - 3> consider the cell detected on the associated *measObject* which has a physical cell identity matching the value of the *cellForWhichToReportCGI* included in the corresponding *reportConfig* within the *VarMeasConfig* to be applicable;
- 2> else if the corresponding reportConfig includes a reportType set to reportSFTD:
 - 3> if the corresponding *measObject* concerns NR:
 - 4> if the *reportSFTD-Meas* is set to *true*:
 - 5> consider the NR PSCell to be applicable;
 - 4> else if the *reportSFTD-NeighMeas* is included:
 - 5> if cellsForWhichToReportSFTD is configured in the corresponding reportConfig:
 - 6> consider any NR neighbouring cell detected on the associated *measObjectNR* which has a physical cell identity that is included in the *cellsForWhichToReportSFTD* to be applicable;
 - 5> else:
 - 6> consider up to 3 strongest NR neighbouring cells detected based on parameters in the associated *measObjectNR* to be applicable when the concerned cells are not included in the *blackCellsToAddModList* defined within the *VarMeasConfig* for this *measId*;
 - 3> else if the corresponding *measObject* concerns E-UTRA:
 - 4> if the reportSFTD-Meas is set to true:
 - 5> consider the E-UTRA PSCell to be applicable;
- 2> if the reportType is set to eventTriggered and if the entry condition applicable for this event, i.e. the event corresponding with the eventId of the corresponding reportConfig within VarMeasConfig, is fulfilled for one or more applicable cells for all measurements after layer 3 filtering taken during timeToTrigger defined for this event within the VarMeasConfig, while the VarMeasReportList does not include a measurement reporting entry for this measId (a first cell triggers the event):
 - 3> include a measurement reporting entry within the *VarMeasReportList* for this *measId*;

- 3> set the numberOfReportsSent defined within the VarMeasReportList for this measId to 0;
- 3> include the concerned cell(s) in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*:
- 3> initiate the measurement reporting procedure, as specified in 5.5.5;
- 2> else if the *reportType* is set to *eventTriggered* and if the entry condition applicable for this event, i.e. the event corresponding with the *eventId* of the corresponding *reportConfig* within *VarMeasConfig*, is fulfilled for one or more applicable cells not included in the *cellsTriggeredList* for all measurements after layer 3 filtering taken during *timeToTrigger* defined for this event within the *VarMeasConfig* (a subsequent cell triggers the event):
 - 3> set the numberOfReportsSent defined within the VarMeasReportList for this measId to 0;
 - 3> include the concerned cell(s) in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;
 - 3> initiate the measurement reporting procedure, as specified in 5.5.5;
- 2> else if the *reportType* is set to *eventTriggered* and if the leaving condition applicable for this event is fulfilled for one or more of the cells included in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId* for all measurements after layer 3 filtering taken during *timeToTrigger* defined within the *VarMeasConfig* for this event:
 - 3> remove the concerned cell(s) in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;
 - 3> if reportOnLeave is set to true for the corresponding reporting configuration:
 - 4> initiate the measurement reporting procedure, as specified in 5.5.5;
 - 3> if the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId* is empty:
 - 4> remove the measurement reporting entry within the VarMeasReportList for this measId;
 - 4> stop the periodical reporting timer for this *measId*, if running;
- 2> if reportType is set to periodical and if a (first) measurement result is available:
 - 3> include a measurement reporting entry within the *VarMeasReportList* for this *measId*;
 - 3> set the numberOfReportsSent defined within the VarMeasReportList for this measId to 0;
 - 3> if the *reportAmount* exceeds 1:
 - 4> initiate the measurement reporting procedure, as specified in 5.5.5, immediately after the quantity to be reported becomes available for the NR SpCell;
 - 3> else (i.e. the *reportAmount* is equal to 1):
 - 4> initiate the measurement reporting procedure, as specified in 5.5.5, immediately after the quantity to be reported becomes available for the NR SpCell and for the strongest cell among the applicable cells;
- 2> upon expiry of the periodical reporting timer for this *measId*:
 - 3> initiate the measurement reporting procedure, as specified in 5.5.5.
- 2> if the corresponding *reportConfig* includes a *reportType* is set to *reportSFTD*:
 - 3> if the corresponding *measObject* concerns NR:
 - 4> if the *drx-SFTD-NeighMeas* is included:
 - 5> if the quantity to be reported becomes available for each requested pair of PCell and NR cell:
 - 6> stop timer T322;

6> initiate the measurement reporting procedure, as specified in 5.5.5;

- 4> else
 - 5> initiate the measurement reporting procedure, as specified in 5.5.5, immediately after the quantity to be reported becomes available for each requested pair of PCell and NR cell or the maximal measurement reporting delay as specified in TS 38.133 [14];
- 3> else if the corresponding *measObject* concerns E-UTRA:
 - 4> initiate the measurement reporting procedure, as specified in 5.5.5, immediately after the quantity to be reported becomes available for the pair of PCell and E-UTRA PSCell or the maximal measurement reporting delay as specified in TS 38.133 [14];
- 2> if *reportType* is set to *reportCGI*:
 - 3> if the UE acquired the SIB1 or SystemInformationBlockType1 for the requested cell; or
 - 3> if the UE detects that the requested NR cell is not transmitting SIB1 (see TS 38.213 [13], clause 13):
 - 4> stop timer T321;
 - 4> include a measurement reporting entry within the VarMeasReportList for this measId;
 - 4> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;
 - 4> initiate the measurement reporting procedure, as specified in 5.5.5;
- 2> upon the expiry of T321 for this *measId*:
 - 3> include a measurement reporting entry within the *VarMeasReportList* for this *measId*;
 - 3> set the numberOfReportsSent defined within the VarMeasReportList for this measId to 0;
 - 3> initiate the measurement reporting procedure, as specified in 5.5.5.
- 2> upon the expiry of T322 for this *measId*:
 - 3> initiate the measurement reporting procedure, as specified in 5.5.5;

5.5.4.2 Event A1 (Serving becomes better than threshold)

The UE shall:

- 1> consider the entering condition for this event to be satisfied when condition A1-1, as specified below, is fulfilled;
- 1> consider the leaving condition for this event to be satisfied when condition A1-2, as specified below, is fulfilled;
- 1> for this measurement, consider the NR serving cell corresponding to the associated *measObjectNR* associated with this event.

Inequality A1-1 (Entering condition)

Ms - Hys > Thresh

Inequality A1-2 (Leaving condition)

Ms + Hys < Thresh

The variables in the formula are defined as follows:

Ms is the measurement result of the serving cell, not taking into account any offsets.

Hys is the hysteresis parameter for this event (i.e. hysteresis as defined within reportConfigNR for this event).

Thresh is the threshold parameter for this event (i.e. *a1-Threshold* as defined within *reportConfigNR* for this event).

Ms is expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

Hys is expressed in dB.

Thresh is expressed in the same unit as Ms.

5.5.4.3 Event A2 (Serving becomes worse than threshold)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A2-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A2-2, as specified below, is fulfilled;

1> for this measurement, consider the serving cell indicated by the measObjectNR associated to this event.

Inequality A2-1 (Entering condition)

Ms + Hys < Thresh

Inequality A2-2 (Leaving condition)

Ms - Hys > Thresh

The variables in the formula are defined as follows:

Ms is the measurement result of the serving cell, not taking into account any offsets.

Hys is the hysteresis parameter for this event (i.e. hysteresis as defined within reportConfigNR for this event).

Thresh is the threshold parameter for this event (i.e. *a2-Threshold* as defined within *reportConfigNR* for this event).

Ms is expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

Hys is expressed in dB.

Thresh is expressed in the same unit as Ms.

5.5.4.4 Event A3 (Neighbour becomes offset better than SpCell)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A3-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A3-2, as specified below, is fulfilled;

1> use the SpCell for Mp, Ofp and Ocp.

NOTE The cell(s) that triggers the event has reference signals indicated in the *measObjectNR* associated to this event which may be different from the NR SpCell *measObjectNR*.

Inequality A3-1 (Entering condition)

$$Mn + Ofn + Ocn - Hys > Mp + Ofp + Ocp + Off$$

Inequality A3-2 (Leaving condition)

$$Mn + Ofn + Ocn + Hys < Mp + Ofp + Ocp + Off$$

The variables in the formula are defined as follows:

Mn is the measurement result of the neighbouring cell, not taking into account any offsets.

Ofn is the measurement object specific offset of the reference signal of the neighbour cell (i.e. *offsetMO* as defined within *measObjectNR* corresponding to the neighbour cell).

Ocn is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectNR* corresponding to the frequency of the neighbour cell), and set to zero if not configured for the neighbour cell.

Mp is the measurement result of the SpCell, not taking into account any offsets.

Ofp is the measurement object specific offset of the SpCell (i.e. *offsetMO* as defined within *measObjectNR* corresponding to the SpCell).

Ocp is the cell specific offset of the SpCell (i.e. *cellIndividualOffset* as defined within *measObjectNR* corresponding to the SpCell), and is set to zero if not configured for the SpCell.

Hys is the hysteresis parameter for this event (i.e. hysteresis as defined within reportConfigNR for this event).

Off is the offset parameter for this event (i.e. a3-Offset as defined within reportConfigNR for this event).

Mn, Mp are expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

Ofn, Ocn, Ofp, Ocp, Hys, Off are expressed in dB.

5.5.4.5 Event A4 (Neighbour becomes better than threshold)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A4-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A4-2, as specified below, is fulfilled.

Inequality A4-1 (Entering condition)

Mn + Ofn + Ocn - Hys > Thresh

Inequality A4-2 (Leaving condition)

Mn + Ofn + Ocn + Hys < Thresh

The variables in the formula are defined as follows:

Mn is the measurement result of the neighbouring cell, not taking into account any offsets.

Ofn is the measurement object specific offset of the neighbour cell (i.e. *offsetMO* as defined within *measObjectNR* corresponding to the neighbour cell).

Ocn is the measurement object specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectNR* corresponding to the neighbour cell), and set to zero if not configured for the neighbour cell.

Hys is the hysteresis parameter for this event (i.e. hysteresis as defined within reportConfigNR for this event).

Thresh is the threshold parameter for this event (i.e. *a4-Threshold* as defined within *reportConfigNR* for this event).

Mn is expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

Ofn, Ocn, Hys are expressed in dB.

Thresh is expressed in the same unit as Mn.

5.5.4.6 Event A5 (SpCell becomes worse than threshold1 and neighbour becomes better than threshold2)

The UE shall:

- 1> consider the entering condition for this event to be satisfied when both condition A5-1 and condition A5-2, as specified below, are fulfilled;
- 1> consider the leaving condition for this event to be satisfied when condition A5-3 or condition A5-4, i.e. at least one of the two, as specified below, is fulfilled;

1> use the SpCell for Mp.

NOTE: The parameters of the reference signal(s) of the cell(s) that triggers the event are indicated in the *measObjectNR* associated to the event which may be different from the *measObjectNR* of the NR SpCell.

Inequality A5-1 (Entering condition 1)

Mp + Hys < Thresh1

Inequality A5-2 (Entering condition 2)

Mn + Ofn + Ocn - Hys > Thresh2

Inequality A5-3 (Leaving condition 1)

Mp - Hys > Thresh1

Inequality A5-4 (Leaving condition 2)

Mn + Ofn + Ocn + Hys < Thresh2

The variables in the formula are defined as follows:

Mp is the measurement result of the NR SpCell, not taking into account any offsets.

Mn is the measurement result of the neighbouring cell, not taking into account any offsets.

Ofn is the measurement object specific offset of the neighbour cell (i.e. *offsetMO* as defined within *measObjectNR* corresponding to the neighbour cell).

Ocn is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectNR* corresponding to the neighbour cell), and set to zero if not configured for the neighbour cell.

Hys is the hysteresis parameter for this event (i.e. hysteresis as defined within reportConfigNR for this event).

Thresh1 is the threshold parameter for this event (i.e. *a5-Threshold1* as defined within *reportConfigNR* for this event).

Thresh2 is the threshold parameter for this event (i.e. *a5-Threshold2* as defined within *reportConfigNR* for this event).

Mn, *Mp* are expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

Ofn, Ocn, Hys are expressed in dB.

Thresh1 is expressed in the same unit as *Mp*.

Thresh2 is expressed in the same unit as *Mn*.

5.5.4.7 Event A6 (Neighbour becomes offset better than SCell)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A6-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A6-2, as specified below, is fulfilled;

1> for this measurement, consider the (secondary) cell corresponding to the *measObjectNR* associated to this event to be the serving cell.

NOTE: The reference signal(s) of the neighbour(s) and the reference signal(s) of the SCell are both indicated in the associated *measObjectNR*.

Inequality A6-1 (Entering condition)

Mn + Ocn - Hys > Ms + Ocs + Off

Inequality A6-2 (Leaving condition)

$$Mn + Ocn + Hys < Ms + Ocs + Off$$

The variables in the formula are defined as follows:

Mn is the measurement result of the neighbouring cell, not taking into account any offsets.

Ocn is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within the associated *measObjectNR*), and set to zero if not configured for the neighbour cell.

Ms is the measurement result of the serving cell, not taking into account any offsets.

Ocs is the cell specific offset of the serving cell (i.e. cellIndividualOffset as defined within the associated measObjectNR), and is set to zero if not configured for the serving cell.

Hys is the hysteresis parameter for this event (i.e. hysteresis as defined within reportConfigNR for this event).

Off is the offset parameter for this event (i.e. a6-Offset as defined within reportConfigNR for this event).

Mn, Ms are expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

Ocn, Ocs, Hys, Off are expressed in dB.

5.5.4.8 Event B1 (Inter RAT neighbour becomes better than threshold)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition B1-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition B1-2, as specified below, is fulfilled.

Inequality B1-1 (Entering condition)

Mn + Ofn + Ocn - Hys > Thresh

Inequality B1-2 (Leaving condition)

$$Mn + Ofn + Ocn + Hys < Thresh$$

The variables in the formula are defined as follows:

Mn is the measurement result of the inter-RAT neighbour cell, not taking into account any offsets.

Ofn is the measurement object specific offset of the frequency of the inter-RAT neighbour cell (i.e. *eutra-Q-OffsetRange* as defined within the *measObjectEUTRA* corresponding to the frequency of the neighbour inter-RAT cell).

Ocn is the cell specific offset of the inter-RAT neighbour cell (i.e. *cellIndividualOffset* as defined within the *measObjectEUTRA* corresponding to the neighbour inter-RAT cell), and set to zero if not configured for the neighbour cell.

Hys is the hysteresis parameter for this event (i.e. hysteresis as defined within reportConfigInterRAT for this event).

Thresh is the threshold parameter for this event (i.e. b1-ThresholdEUTRA as defined within reportConfigInterRAT for this event).

Mn is expressed in dBm or in dB, depending on the measurement quantity of the inter-RAT neighbour cell.

Ofn, Ocn, Hys are expressed in dB.

Thresh is expressed in the same unit as **Mn**.

5.5.4.9 Event B2 (PCell becomes worse than threshold1 and inter RAT neighbour becomes better than threshold2)

- 1> consider the entering condition for this event to be satisfied when both condition B2-1 and condition B2-2, as specified below, are fulfilled;
- 1> consider the leaving condition for this event to be satisfied when condition B2-3 or condition B2-4, i.e. at least one of the two, as specified below, is fulfilled;

Inequality B2-1 (Entering condition 1)

Mp + Hys < Thresh1

Inequality B2-2 (Entering condition 2)

Mn + Ofn + Ocn - Hys > Thresh2

Inequality B2-3 (Leaving condition 1)

Mp - Hys > Thresh1

Inequality B2-4 (Leaving condition 2)

Mn + Ofn + Ocn + Hys < Thresh2

The variables in the formula are defined as follows:

Mp is the measurement result of the PCell, not taking into account any offsets.

Mn is the measurement result of the inter-RAT neighbour cell, not taking into account any offsets.

Ofn is the measurement object specific offset of the frequency of the inter-RAT neighbour cell (i.e. *eutra-Q-OffsetRange* as defined within the *measObjectEUTRA* corresponding to the frequency of the inter-RAT neighbour cell).

Ocn is the cell specific offset of the inter-RAT neighbour cell (i.e. *cellIndividualOffset* as defined within the *measObjectEUTRA* corresponding to the neighbour inter-RAT cell), and set to zero if not configured for the neighbour cell.

Hys is the hysteresis parameter for this event (i.e. hysteresis as defined within reportConfigInterRAT for this event).

Thresh1 is the threshold parameter for this event (i.e. b2-*Threshold1* as defined within *reportConfigInterRAT* for this event).

Thresh2 is the threshold parameter for this event (i.e. b2-Threshold2EUTRA as defined within reportConfigInterRAT for this event).

Mp is expressed in dBm in case of RSRP, or in dB in case of RSRQ and SINR.

Mn is expressed in dBm or dB, depending on the measurement quantity of the inter-RAT neighbour cell.

Ofn, Ocn, Hys are expressed in dB.

Thresh1 is expressed in the same unit as *Mp*.

Thresh2 is expressed in the same unit as *Mn*.

5.5.5 Measurement reporting

5.5.5.1 General



Figure 5.5.5.1-1: Measurement reporting

The purpose of this procedure is to transfer measurement results from the UE to the network. The UE shall initiate this procedure only after successful AS security activation.

For the *measId* for which the measurement reporting procedure was triggered, the UE shall set the *measResults* within the *MeasurementReport* message as follows:

- 1> set the *measId* to the measurement identity that triggered the measurement reporting;
- 1> for each serving cell configured with *servingCellMO*:
 - 2> if the reportConfig associated with the measId that triggered the measurement reporting includes rsType:
 - 3> if the serving cell measurements based on the *rsType* included in the *reportConfig* that triggered the measurement report are available:
 - 4> set the *measResultServingCell* within *measResultServingMOList* to include RSRP, RSRQ and the available SINR of the serving cell, derived based on the *rsType* included in the *reportConfig* that triggered the measurement report;

2> else:

- 3> if SSB based serving cell measurements are available:
 - 4> set the *measResultServingCell* within *measResultServingMOList* to include RSRP, RSRQ and the available SINR of the serving cell, derived based on SSB;
- 3> else if CSI-RS based serving cell measurements are available:
 - 4> set the *measResultServingCell* within *measResultServingMOList* to include RSRP, RSRQ and the available SINR of the serving cell, derived based on CSI-RS;
- 1> set the *servCellId* within *measResultServingMOList* to include each NR serving cell that is configured with *servingCellMO*, if any;
- 1> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport*:
 - 2> for each serving cell configured with *servingCellMO*, include beam measurement information according to the associated *reportConfig* as described in 5.5.5.2;
- 1> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportAddNeighMeas*:
 - 2> for each *measObjectId* referenced in the *measIdList* which is also referenced with *servingCellMO*, other than the *measObjectId* corresponding with the *measId* that triggered the measurement reporting:
 - 3> if the *measObjectNR* indicated by the *servingCellMO* includes the RS resource configuration corresponding to the *rsType* indicated in the *reportConfig*:
 - 4> set the *measResultBestNeighCell* within *measResultServingMOList* to include the *physCellId* and the available measurement quantities based on the *reportQuantityCell* and *rsType* indicated in

- reportConfig of the non-serving cell corresponding to the concerned measObjectNR with the highest measured RSRP if RSRP measurement results are available for cells corresponding to this measObjectNR, otherwise with the highest measured RSRQ if RSRQ measurement results are available for cells corresponding to this measObjectNR, otherwise with the highest measured SINR;
- 4> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport*:
 - 5> for each best non-serving cell included in the measurement report:
 - 6> include beam measurement information according to the associated *reportConfig* as described in 5.5.5.2;
- 1> if the *reportConfig* associated with the *measId* that triggered the measurement reporting is set to *eventTriggered* and *eventID* is set to *eventA3*, or *eventA4*, or *eventA5*, or *eventB1*, or *eventB2*:
 - 2> if the UE is in NE-DC and the measurement configuration that triggered this measurement report is associated with the MCG:
 - 3> set the *measResultServFreqListEUTRA-SCG* to include an entry for each E-UTRA SCG serving frequency with the following:
 - 4> include *carrierFreq* of the E-UTRA serving frequency;
 - 4> set the *measResultServingCell* to include the available measurement quantities that the UE is configured to measure by the measurement configuration associated with the SCG;
 - 4> if *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportAddNeighMeas*:
 - 5> set the *measResultServFreqListEUTRA-SCG* to include within *measResultBestNeighCell* the quantities of the best non-serving cell, based on RSRP, on the concerned serving frequency;
- 1> if reportConfig associated with the measId that triggered the measurement reporting is set to eventTriggered and eventID is set to eventA3, or eventA4, or eventA5:
 - 2> if the UE is in NR-DC and the measurement configuration that triggered this measurement report is associated with the MCG:
 - 3> set the *measResultServFreqListNR-SCG* to include for each NR SCG serving cell that is configured with *servingCellMO*, if any, the following:
 - 4> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *rsType*:
 - 5> if the serving cell measurements based on the *rsType* included in the *reportConfig* that triggered the measurement report are available according to the measurement configuration associated with the SCG:
 - 6> set the *measResultServingCell* within *measResultServFreqListNR-SCG* to include RSRP, RSRQ and the available SINR of the serving cell, derived based on the *rsType* included in the *reportConfig* that triggered the measurement report;

4> else:

- 5> if SSB based serving cell measurements are available according to the measurement configuration associated with the SCG:
 - 6> set the *measResultServingCell* within *measResultServFreqListNR-SCG* to include RSRP, RSRQ and the available SINR of the serving cell, derived based on SSB;
- 5> else if CSI-RS based serving cell measurements are available according to the measurement configuration associated with the SCG:
 - 6> set the *measResultServingCell* within *measResultServFreqListNR-SCG* to include RSRP, RSRQ and the available SINR of the serving cell, derived based on CSI-RS;

- 4> if results for the serving cell derived based on SSB are included:
 - 5> include the *ssbFrequency* to the value indicated by *ssbFrequency* as included in the *MeasObjectNR* of the serving cell;
- 4> if results for the serving cell derived based on CSI-RS are included:
 - 5> include the *refFreqCSI-RS* to the value indicated by *refFreqCSI-RS* as included in the *MeasObjectNR* of the serving cell;
- 4> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport*:
 - 5> for each serving cell configured with *servingCellMO*, include beam measurement information according to the associated *reportConfig* as described in 5.5.5.2, where availability is considered according to the measurement configuration associated with the SCG;
- 4> if *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportAddNeighMeas*:
 - 5> if the *measObjectNR* indicated by the *servingCellMO* includes the RS resource configuration corresponding to the *rsType* indicated in the *reportConfig*:
 - 6> set the measResultBestNeighCellListNR within measResultServFreqListNR-SCG to include one entry with the physCellId and the available measurement quantities based on the reportQuantityCell and rsType indicated in reportConfig of the non-serving cell corresponding to the concerned measObjectNR with the highest measured RSRP if RSRP measurement results are available for cells corresponding to this measObjectNR, otherwise with the highest measured RSRQ if RSRQ measurement results are available for cells corresponding to this measObjectNR, otherwise with the highest measured SINR, where availability is considered according to the measurement configuration associated with the SCG;
 - 7> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport*:
 - 8> for each best non-serving cell included in the measurement report:
 - 9> include beam measurement information according to the associated *reportConfig* as described in 5.5.5.2, where availability is considered according to the measurement configuration associated with the SCG;
- 1> if there is at least one applicable neighbouring cell to report:
 - 2> if the *reportType* is set to *eventTriggered* or *periodical*:
 - 3> set the *measResultNeighCells* to include the best neighbouring cells up to *maxReportCells* in accordance with the following:
 - 4> if the *reportType* is set to *eventTriggered*:
 - 5> include the cells included in the *cellsTriggeredList* as defined within the *VarMeasReportList* for this *measId*;
 - 4> else:
 - 5> include the applicable cells for which the new measurement results became available since the last periodical reporting or since the measurement was initiated or reset;
 - 4> for each cell that is included in the *measResultNeighCells*, include the *physCellId*;
 - 4> if the *reportType* is set to *eventTriggered* or *periodical*:
 - 5> for each included cell, include the layer 3 filtered measured results in accordance with the *reportConfig* for this *measId*, ordered as follows:
 - 6> if the *measObject* associated with this *measId* concerns NR:

- 7> if rsType in the associated reportConfig is set to ssb:
 - 8> set *resultsSSB-Cell* within the *measResult* to include the SS/PBCH block based quantity(ies) indicated in the *reportQuantityCell* within the concerned *reportConfig*, in decreasing order of the sorting quantity, determined as specified in 5.5.5.3, i.e. the best cell is included first;
 - 8> if reportQuantityRS-Indexes and maxNrofRS-IndexesToReport are configured, include beam measurement information as described in 5.5.5.2;
- 7> else if *rsType* in the associated *reportConfig* is set to *csi-rs*:
 - 8> set resultsCSI-RS-Cell within the measResult to include the CSI-RS based quantity(ies) indicated in the reportQuantityCell within the concerned reportConfig, in decreasing order of the sorting quantity, determined as specified in 5.5.5.3, i.e. the best cell is included first;
 - 8> if reportQuantityRS-Indexes and maxNrofRS-IndexesToReport are configured, include beam measurement information as described in 5.5.5.2;
- 6> if the *measObject* associated with this *measId* concerns E-UTRA:
 - 7> set the *measResult* to include the quantity(ies) indicated in the *reportQuantity* within the concerned *reportConfigInterRAT* in decreasing order of the sorting quantity, determined as specified in 5.5.5.3, i.e. the best cell is included first;

2> else:

- 3> if the cell indicated by *cellForWhichToReportCGI* is an NR cell:
 - 4> if *plmn-IdentityInfoList* of the *cgi-Info* for the concerned cell has been obtained:
 - 5> include the *plmn-IdentityInfoList* including *plmn-IdentityList*, *trackingAreaCode* (if available), *ranac* (if available), *cellIdentity* and *cellReservedForOperatorUse* for each entry of the *plmn-IdentityInfoList*;
 - 5> include *frequencyBandList* if available;
 - 4> else if MIB indicates the SIB1 is not broadcast:
 - 5> include the *noSIB1* including the *ssb-SubcarrierOffset* and *pdcch-ConfigSIB1* obtained from *MIB* of the concerned cell:
- 3> if the cell indicated by *cellForWhichToReportCGI* is an E-UTRA cell:
 - 4> if all mandatory fields of the cgi-Info-EPC for the concerned cell have been obtained:
 - 5> include in the *cgi-Info-EPC* the fields broadcasted in E-UTRA *SystemInformationBlockType1* associated to EPC;
 - 4> if the UE is E-UTRA/5GC capable and all mandatory fields of the *cgi-Info-5GC* for the concerned cell have been obtained:
 - 5> include in the *cgi-Info-5GC* the fields broadcasted in E-UTRA *SystemInformationBlockType1* associated to 5GC;
 - 4> if the mandatory present fields of the *cgi-Info* for the cell indicated by the *cellForWhichToReportCGI* in the associated *measObject* have been obtained:
 - 5> include the *freqBandIndicator*;
 - 5> if the cell broadcasts the *multiBandInfoList*, include the *multiBandInfoList*;
 - 5> if the cell broadcasts the *freqBandIndicatorPriority*, include the *freqBandIndicatorPriority*;
- 1> if the corresponding *measObject* concerns NR:

- 2> if the reportSFTD-Meas is set to true within the corresponding reportConfigNR for this measId:
 - 3> set the *measResultSFTD-NR* in accordance with the following:
 - 4> set sfn-OffsetResult and frameBoundaryOffsetResult to the measurement results provided by lower layers;
 - 4> if the reportRSRP is set to true;
 - 5> set rsrp-Result to the RSRP of the NR PSCell derived based on SSB;
- 2> else if the reportSFTD-NeighMeas is included within the corresponding reportConfigNR for this measId:
 - 3> for each applicable cell which measurement results are available, include an entry in the *measResultCellListSFTD-NR* and set the contents as follows:
 - 4> set *physCellId* to the physical cell identity of the concered NR neighbour cell.
 - 4> set sfn-OffsetResult and frameBoundaryOffsetResult to the measurement results provided by lower layers;
 - 4> if the *reportRSRP* is set to *true*:
 - 5> set rsrp-Result to the RSRP of the concerned cell derived based on SSB;
- 1> else if the corresponding *measObject* concerns E-UTRA:
 - 2> if the reportSFTD-Meas is set to true within the corresponding reportConfigInterRAT for this measId:
 - 3> set the *measResultSFTD-EUTRA* in accordance with the following:
 - 4> set *sfn-OffsetResult* and *frameBoundaryOffsetResult* to the measurement results provided by lower layers;
 - 4> if the *reportRSRP* is set to *true*;
 - 5> set *rsrpResult-EUTRA* to the RSRP of the EUTRA PSCell;
- 1> increment the *numberOfReportsSent* as defined within the *VarMeasReportList* for this *measId* by 1;
- 1> stop the periodical reporting timer, if running;
- 1> if the *numberOfReportsSent* as defined within the *VarMeasReportList* for this *measId* is less than the *reportAmount* as defined within the corresponding *reportConfig* for this *measId*:
 - 2> start the periodical reporting timer with the value of *reportInterval* as defined within the corresponding *reportConfig* for this *measId*;
- 1> else:
 - 2> if the *reportType* is set to *periodical*:
 - 3> remove the entry within the *VarMeasReportList* for this *measId*;
 - 3> remove this *measId* from the *measIdList* within *VarMeasConfig*;
- 1> if the UE is in (NG)EN-DC:
 - 2> if SRB3 is configured:
 - 3> submit the *MeasurementReport* message via SRB3 to lower layers for transmission, upon which the procedure ends;
 - 2> else:
 - 3> submit the *MeasurementReport* message via E-UTRA embedded in E-UTRA RRC message *ULInformationTransferMRDC* as specified in TS 36.331 [10].

- 1> else if the UE is in NR-DC:
 - 2> if the measurement configuration that triggered this measurement report is associated with the SCG:
 - 3> if SRB3 is configured:
 - 4> submit the *MeasurementReport* message via SRB3 to lower layers for transmission, upon which the procedure ends;
 - 3> else:
 - 4> submit the *MeasurementReport* message via SRB1 embedded in NR RRC message *ULInformationTransferMRDC* as specified in 5.7.2a.3;
 - 2> else:
 - 3> submit the *MeasurementReport* message via SRB1 to lower layers for transmission, upon which the procedure ends;
- 1> else:
 - 2> submit the *MeasurementReport* message to lower layers for transmission, upon which the procedure ends.

5.5.5.2 Reporting of beam measurement information

For beam measurement information to be included in a measurement report the UE shall:

- 1> if reportType is set to eventTriggered:
 - 2> consider the trigger quantity as the sorting quantity if available, otherwise RSRP as sorting quantity if available, otherwise RSRQ as sorting quantity if available, otherwise SINR as sorting quantity;
- 1> if *reportType* is set to *periodical*:
 - 2> if a single reporting quantity is set to true in reportQuantityRS-Indexes;
 - 3> consider the configured single quantity as the sorting quantity;
 - 2> else:
 - 3> if *rsrp* is set to *true*;
 - 4> consider RSRP as the sorting quantity;
 - 3> else:
 - 4> consider RSRQ as the sorting quantity;
- 1> set *rsIndexResults* to include up to *maxNrofRS-IndexesToReport* SS/PBCH block indexes or CSI-RS indexes in order of decreasing sorting quantity as follows:
 - 2> if the measurement information to be included is based on SS/PBCH block:
 - 3> include within *resultsSSB-Indexes* the index associated to the best beam for that SS/PBCH block sorting quantity and if *absThreshSS-BlocksConsolidation* is included in the *VarMeasConfig* for the *measObject* associated to the cell for which beams are to be reported, the remaining beams whose sorting quantity is above *absThreshSS-BlocksConsolidation*;
 - 3> if *includeBeamMeasurements* is configured, include the SS/PBCH based measurement results for the quantities in *reportQuantityRS-Indexes* set to *true* for each SS/PBCH block index;
 - 2> else if the beam measurement information to be included is based on CSI-RS:
 - 3> include within *resultsCSI-RS-Indexes* the index associated to the best beam for that CSI-RS sorting quantity and, if *absThreshCSI-RS-Consolidation* is included in the *VarMeasConfig* for the *measObject* associated to the cell for which beams are to be reported, the remaining beams whose sorting quantity is above *absThreshCSI-RS-Consolidation*;

3> if *includeBeamMeasurements* is configured, include the CSI-RS based measurement results for the quantities in *reportQuantityRS-Indexes* set to *true* for each CSI-RS index.

5.5.5.3 Sorting of cell measurement results

The UE shall determine the sorting quantity according to parameters of the *reportConfig* associated with the *measId* that triggered the reporting:

- 1> if the *reportType* is set to *eventTriggered*:
 - 2> for an NR cell, consider the quantity used in the *aN-Threshold* (for *eventA1*, *eventA2* and *eventA4*) or in the *a5-Threshold2* (for *eventA5*) or in the *aN-Offset* (for *eventA3* and *eventA6*) as the sorting quantity;
 - 2> for an E-UTRA cell, consider the quantity used in the bN-ThresholdEUTRA as the sorting quantity;
- 1> if the *reportType* is set to *periodical*:
 - 2> determine the sorting quantity according to *reportQuantityCell* for an NR cell, and according to *reportQuantity* for an E-UTRA cell, as below:
 - 3> if a single quantity is set to true:
 - 4> consider this quantity as the sorting quantity;
 - 3> else:
 - 4> if rsrp is set to true;
 - 5> consider RSRP as the sorting quantity;
 - 4> else:
 - 5> consider RSRQ as the sorting quantity.

5.5.6 Location measurement indication

5.5.6.1 General

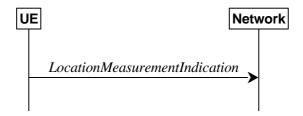


Figure 5.5.5.1-1: Location measurement indication

The purpose of this procedure is to indicate to the network that the UE is going to start/stop location related measurements (*eutra-RSTD*) which require measurement gaps or start/stop subframe and slot timing detection towards E-UTRA (*eutra-FineTimingDetection*) which requires measurement gaps. UE shall initiate this procedure only after successful AS security activation.

NOTE: It is a network decision to configure the measurement gap.

5.5.6.2 Initiation

The UE shall:

1> if and only if upper layers indicate to start performing location measurements or start subframe and slot timing detection towards E-UTRA, and the UE requires measurement gaps for these operations while measurement gaps are either not configured or not sufficient:

- 2> initiate the procedure to indicate start;
- NOTE 1: The UE verifies the measurement gap situation only upon receiving the indication from upper layers. If at this point in time sufficient gaps are available, the UE does not initiate the procedure. Unless it receives a new indication from upper layers, the UE is only allowed to further repeat the procedure in the same PCell once per frequency of the target RAT if the provided measurement gaps are insufficient.
- 1> if and only if upper layers indicate to stop performing location measurements or stop subframe and slot timing detection towards E-UTRA:
 - 2> initiate the procedure to indicate stop.
- NOTE 2: The UE may initiate the procedure to indicate stop even if it did not previously initiate the procedure to indicate start.

5.5.6.3 Actions related to transmission of LocationMeasurementIndication message

The UE shall set the contents of *LocationMeasurementIndication* message as follows:

- 1> if the procedure is initiated to indicate start of location related measurements:
 - 2> if the procedure is initiated for RSTD measurements towards E-UTRA:
 - 3> set the *measurementIndication* to the *eutra-RSTD* according to the information received from upper layers;
- 1> else if the procedure is initiated to indicate stop of location related measurements:
 - 2> set the *measurementIndication* to the value *release*:
- 1> if the procedure is initiated to indicate start of subframe and slot timing detection towards E-UTRA:
 - 2> set the *measurementIndication* to the value *eutra-FineTimingDetection*;
- 1> else if the procedure is initiated to indicate stop of subframe and slot timing detection towards E-UTRA:
 - 2> set the *measurementIndication* to the value *release*;
- 1> submit the LocationMeasurementIndication message to lower layers for transmission, upon which the procedure ends.

5.6 UE capabilities

5.6.1 UE capability transfer

5.6.1.1 General

This clause describes how the UE compiles and transfers its UE capability information upon receiving a UECapabilityEnquiry from the network.

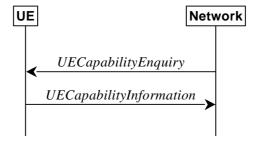


Figure 5.6.1.1-1: UE capability transfer

5.6.1.2 Initiation

The network initiates the procedure to a UE in RRC_CONNECTED when it needs (additional) UE radio access capability information. The network should retrieve UE capabilities only after AS security activation. Network does not forward UE capabilities that were retrieved before AS security activation to the CN.

5.6.1.3 Reception of the *UECapabilityEnquiry* by the UE

The UE shall set the contents of *UECapabilityInformation* message as follows:

- 1> if the ue-CapabilityRAT-RequestList contains a UE-CapabilityRAT-Request with rat-Type set to nr:
 - 2> include in the *ue-CapabilityRAT-ContainerList* a *UE-CapabilityRAT-Container* of the type *UE-NR-Capability* and with the *rat-Type* set to *nr*;
 - 2> include the *supportedBandCombinationList*, *featureSets* and *featureSetCombinations* as specified in clause 5.6.1.4;
- 1> if the *ue-CapabilityRAT-RequestList* contains a *UE-CapabilityRAT-Request* with *rat-Type* set to *eutra-nr*:
 - 2> if the UE supports (NG)EN-DC or NE-DC:
 - 3> include in the *ue-CapabilityRAT-ContainerList* a *UE-CapabilityRAT-Container* of the type *UE-MRDC-Capability* and with the *rat-Type* set to *eutra-nr*;
 - 3> include the supportedBandCombinationList and featureSetCombinations as specified in clause 5.6.1.4;
- 1> if the ue-CapabilityRAT-RequestList contains a UE-CapabilityRAT-Request with rat-Type set to eutra:
 - 2> if the UE supports E-UTRA:
 - 3> include in the *ue-CapabilityRAT-ContainerList* a *ue-CapabilityRAT-Container* of the type *UE-EUTRA-Capability* and with the *rat-Type* set to *eutra* as specified in TS 36.331 [10], clause 5.6.3.3, according to the *capabilityRequestFilter*, if received;
- 1> submit the UECapabilityInformation message to lower layers for transmission, upon which the procedure ends.

5.6.1.4 Setting band combinations, feature set combinations and feature sets supported by the UE

The UE invokes the procedures in this clause if the NR or E-UTRA network requests UE capabilities for *nr*, *eutra-nr* or *eutra*. This procedure is invoked once per requested *rat-Type* (see clause 5.6.1.3 for capability enquiry by the NR network; see TS 36.331 [10], clause 5.6.3.3 for capability enquiry by the E-UTRA network). The UE shall ensure that the feature set IDs are consistent across feature sets, feature set combinations and band combinations in all three UE capability containers that the network queries with the same fields with the same values, i.e. *UE-CapabilityRequestFilterNR*, *UE-CapabilityRequestFilterCommon* and fields in *UECapabilityEnquiry* message (i.e. *requestedFreqBandsNR-MRDC*, *requestedCapabilityNR*, *eutra-nr-only* flag, and *requestedCapabilityCommon*) as defined in TS 36.331, where applicable.

- NOTE 1: Capability enquiry without frequencyBandListFilter is not supported.
- NOTE 2: In EN-DC, the gNB needs the capabilities for RAT types *nr* and *eutra-nr* and it uses the *featureSets* in the *UE-NR-Capability* together with the *featureSetCombinations* in the *UE-MRDC-Capability* to determine the NR UE capabilities for the supported MRDC band combinations. Similarly, the eNB needs the capabilities for RAT types *eutra* and *eutra-nr* and it uses the *featureSetEUTRA* in the *UE-EUTRA-Capability* together with the *featureSetCombinations* in the *UE-MRDC-Capability* to determine the E-UTRA UE capabilities for the supported MRDC band combinations. Hence, the IDs used in the *featureSets* must match the IDs referred to in *featureSetCombinations* across all three containers. The requirement on consistency implies that there are no undefined feature sets and feature set combinations.
- NOTE 3: If the UE cannot include all feature sets and feature set combinations due to message size or list size constraints, it is up to UE implementation which feature sets and feature set combinations it prioritizes.

The UE shall:

- 1> compile a list of "candidate band combinations" according to the filter criteria in capabilityRequestFilterCommon (if included), only consisting of bands included in frequencyBandListFilter, and prioritized in the order of frequencyBandListFilter (i.e. first include band combinations containing the first-listed band, then include remaining band combinations containing the second-listed band, and so on), where for each band in the band combination, the parameters of the band do not exceed maxBandwidthRequestedDL, maxBandwidthRequestedUL, maxCarriersRequestedDL, maxCarriersRequestedUL, ca-BandwidthClassDL-EUTRA or ca-BandwidthClassUL-EUTRA, whichever are received;
- 1> for each band combination included in the list of "candidate band combinations":
 - 2> if the network (E-UTRA) included the *eutra-nr-only* field, or
 - 2> if the requested *rat-Type* is *eutra*:
 - 3> remove the NR-only band combination from the list of "candidate band combinations";
- NOTE 4: The (E-UTRA) network may request capabilities for *nr* but indicate with the *eutra-nr-only* flag that the UE shall not include any NR band combinations in the *UE-NR-Capability*. In this case the procedural text above removes all NR-only band combinations from the candidate list and thereby also avoids inclusion of corresponding feature set combinations and feature sets below.
 - 2> if it is regarded as a fallback band combination with the same capabilities of another band combination included in the list of "candidate band combinations", and
 - 2> if this fallback band combination is generated by releasing at least one SCell or uplink configuration of SCell or SUL according to TS 38.306 [26]:
 - 3> remove the band combination from the list of "candidate band combinations";
- NOTE 5: Even if the network requests (only) capabilities for *nr*, it may include E-UTRA band numbers in the *frequencyBandListFilter* to ensure that the UE includes all necessary feature sets needed for subsequently requested *eutra-nr* capabilities. At this point of the procedure the list of "candidate band combinations" contains all NR- and/or E-UTRA-NR band combinations that match the filter (*frequencyBandListFilter*) provided by the NW and that match the *eutra-nr-only* flag (if RAT-Type *nr* is requested by E-UTRA). In the following, this candidate list is used to derive the band combinations, feature set combinations and feature sets to be reported in the requested capability container.
- 1> if the requested *rat-Type* is *nr*:
 - 2> include into *supportedBandCombinationList* as many NR-only band combinations as possible from the list of "candidate band combinations", starting from the first entry;
 - 3> if *srs-SwitchingTimeRequest* is received:
 - 4> if SRS carrier switching is supported;
 - 5> include srs-SwitchingTimesListNR for each band combination;
 - 4> set srs-SwitchingTimeRequested to true;
 - 2> include, into *featureSetCombinations*, the feature set combinations referenced from the supported band combinations as included in *supportedBandCombinationList* according to the previous;
 - 2> compile a list of "candidate feature set combinations" referenced from the list of "candidate band combinations" excluding entries (rows in feature set combinations) with same or lower capabilities;
- NOTE 6: This list of "candidate feature set combinations" contains the feature set combinations used for NR-only as well as E-UTRA-NR band combinations. It is used to derive a list of NR feature sets referred to from the feature set combinations in the *UE-NR-Capability* and from the feature set combinations in a *UE-MRDC-Capability* container.
 - 2> include into featureSets the feature sets referenced from the "candidate feature set combinations" and may exclude the feature sets with the parameters that exceed any of maxBandwidthRequestedDL, maxBandwidthRequestedUL, maxCarriersRequestedDL or maxCarriersRequestedUL, whichever are received;

- 1> else, if the requested *rat-Type* is *eutra-nr*:
 - 2> include into supportedBandCombinationList and/or supportedBandCombinationListNEDC-Only as many E-UTRA-NR band combinations as possible from the list of "candidate band combinations", starting from the first entry;
 - 3> if *srs-SwitchingTimeRequest* is received:
 - 4> if SRS carrier switching is supported;
 - 5> include srs-SwitchingTimesListNR and srs-SwitchingTimesListEUTRA for each band combination;
 - 4> set srs-SwitchingTimeRequested to true;
 - 2> include, into *featureSetCombinations*, the feature set combinations referenced from the supported band combinations as included in *supportedBandCombinationList* according to the previous;
- 1> else (if the requested *rat-Type* is *eutra*):
 - 2> compile a list of "candidate feature set combinations" referenced from the list of "candidate band combinations" excluding entries (rows in feature set combinations) with same or lower capabilities;
- NOTE 7: This list of "candidate feature set combinations" contains the feature set combinations used for E-UTRA-NR band combinations. It is used to derive a list of E-UTRA feature sets referred to from the feature set combinations in a *UE-MRDC-Capability* container.
 - 2> include into *featureSetsEUTRA* (in the *UE-EUTRA-Capability*) the feature sets referenced from the "candidate feature set combinations" and may exclude the feature sets with the parameters that exceed *ca-BandwidthClassDL-EUTRA* or *ca-BandwidthClassUL-EUTRA*, whichever are received;
- 1> include the received *frequencyBandListFilter* in the field *appliedFreqBandListFilter* of the requested UE capability, except if the requested *rat-Type* is *nr* and the network included the *eutra-nr-only* field;
- 1> if the network included *ue-CapabilityEnquiryExt*:
 - 2> include the received *ue-CapabilityEnquiryExt* in the field *receivedFilters*;

5.6.1.5 Void

5.7 Other

5.7.1 DL information transfer

5.7.1.1 General



Figure 5.7.1.1-1: DL information transfer

The purpose of this procedure is to transfer NAS dedicated information from NG-RAN to a UE in RRC_CONNECTED.

5.7.1.2 Initiation

The network initiates the DL information transfer procedure whenever there is a need to transfer NAS dedicated information. The network initiates the DL information transfer procedure by sending the *DLInformationTransfer* message.

5.7.1.3 Reception of the *DLInformationTransfer* by the UE

Upon receiving *DLInformationTransfer* message, the UE shall:

- 1> if dedicatedNAS-Message is included:
 - 2> forward dedicatedNAS-Message to upper layers.

5.7.2 UL information transfer

5.7.2.1 General

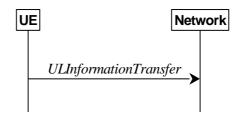


Figure 5.7.2.1-1: UL information transfer

The purpose of this procedure is to transfer NAS dedicated information from the UE to the network.

5.7.2.2 Initiation

A UE in RRC_CONNECTED initiates the UL information transfer procedure whenever there is a need to transfer NAS dedicated information. The UE initiates the UL information transfer procedure by sending the ULInformationTransfer message.

5.7.2.3 Actions related to transmission of ULInformationTransfer message

The UE shall set the contents of the ULInformationTransfer message as follows:

- 1> if the upper layer provides NAS PDU:
 - 2> set the dedicatedNAS-Message to include the information received from upper layers
- 1> submit the *ULInformationTransfer* message to lower layers for transmission, upon which the procedure ends.

5.7.2.4 Failure to deliver *ULInformationTransfer* message

The UE shall:

- 1> if AS security is not started and radio link failure occurs before the successful delivery of *ULInformationTransfer* messages has been confirmed by lower layers; or
- 1> if PDCP re-establishment or release/addition (e.g due to key refresh upon PCell or PSCell change, or RRC connection re-establishment) occurs on an SRB on which *ULInformationTransfer* messages were submitted for transmission but successful delivery of these messages was not confirmed by lower layers:
 - 2> inform upper layers about the possible failure to deliver the information contained in the concerned *ULInformationTransfer* messages.

5.7.2a UL information transfer for MR-DC

5.7.2a.1 General



Figure 5.7.2a.1-1: UL information transfer MR-DC

The purpose of this procedure is to transfer MR-DC dedicated information from the UE to the network e.g. the NR or E-UTRA RRC *MeasurementReport* and *FailureInformation* message.

5.7.2a.2 Initiation

A UE in RRC_CONNECTED initiates the UL information transfer for MR-DC procedure whenever there is a need to transfer MR-DC dedicated information. I.e. the procedure is not used during an RRC connection reconfiguration involving NR or E-UTRA connection reconfiguration, in which case the MR DC information is piggybacked to the *RRCReconfigurationComplete* message.

5.7.2a.3 Actions related to transmission of *ULInformationTransferMRDC* message

The UE shall set the contents of the *ULInformationTransferMRDC* message as follows:

- 1> if there is a need to transfer MR-DC dedicated information related to NR:
 - 2> set the *ul-DCCH-MessageNR* to include the NR MR-DC dedicated information to be transferred (e.g., NR RRC *MeasurementReport* and *FailureInformation* message);
- 1> else if there is a need to tranfer MR-DC dedicated information related to E-UTRA:
 - 2> set the *ul-DCCH-MessageEUTRA* to include the E-UTRA MR-DC dedicated information to be transferred (e.g., E-UTRA RRC *MeasurementReport*);
- 1> submit the *ULInformationTransferMRDC* message to lower layers for transmission, upon which the procedure ends;

5.7.3 SCG failure information

5.7.3.1 General

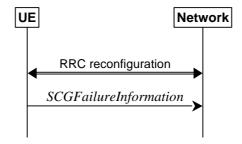


Figure 5.7.3.1-1: SCG failure information

The purpose of this procedure is to inform E-UTRAN or NR MN about an SCG failure the UE has experienced i.e. SCG radio link failure, failure of SCG reconfiguration with sync, SCG configuration failure for RRC message on SRB3 and SCG integrity check failure.

5.7.3.2 Initiation

A UE initiates the procedure to report SCG failures when SCG transmission is not suspended and when one of the following conditions is met:

- 1> upon detecting radio link failure for the SCG, in accordance with clause 5.3.10.3;
- 1> upon reconfiguration with sync failure of the SCG, in accordance with clause 5.3.5.8.3;
- 1> upon SCG configuration failure, in accordance with clause 5.3.5.8.2;
- 1> upon integrity check failure indication from SCG lower layers concerning SRB3.

Upon initiating the procedure, the UE shall:

- 1> suspend SCG transmission for all SRBs and DRBs;
- 1> reset SCG MAC;
- 1> stop T304 for the SCG, if running;
- 1> if the UE is in (NG)EN-DC:
 - 2> initiate transmission of the SCGFailureInformationNR message as specified in TS 36.331 [10], clause 5.6.13a.
- 1> else:
 - 2> initiate transmission of the SCGFailureInformation message in accordance with 5.7.3.5.

5.7.3.3 Failure type determination for (NG)EN-DC

The UE shall set the SCG failure type as follows:

- 1> if the UE initiates transmission of the SCGFailureInformationNR message due to T310 expiry:
 - 2> set the *failureType* as t310-Expiry;
- 1> else if the UE initiates transmission of the *SCGFailureInformationNR* message to provide reconfiguration with sync failure information for an SCG:
 - 2> set the failureType as synchReconfigFailure-SCG;
- 1> else if the UE initiates transmission of the *SCGFailureInformationNR* message to provide random access problem indication from SCG MAC:
 - 2> set the failureType as randomAccessProblem;
- 1> else if the UE initiates transmission of the *SCGFailureInformationNR* message to provide indication from SCG RLC that the maximum number of retransmissions has been reached:
 - 2> set the failureType as rlc-MaxNumRetx;
- 1> else if the UE initiates transmission of the *SCGFailureInformationNR* message due to SRB3 integrity check failure:
 - 2> set the *failureType* as *srb3-IntegrityFailure*;
- 1> else if the UE initiates transmission of the *SCGFailureInformationNR* message due to Reconfiguration failure of NR RRC reconfiguration message:
 - 2> set the *failureType* as *scg-reconfigFailure*.

5.7.3.4 Setting the contents of MeasResultSCG-Failure

The UE shall set the contents of the MeasResultSCG-Failure as follows:

- 1> for each *MeasObjectNR* configured on NR SCG for which a *measId* is configured and measurement results are available:
 - 2> include an entry in *measResultPerMOList*;
 - 2> if there is a measId configured with the MeasObjectNR and a reportConfig which has rsType set to ssb:
 - 3> set ssbFrequency to the value indicated by ssbFrequency as included in the MeasObjectNR;
 - 2> if there is a measId configured with the MeasObjectNR and a reportConfig which has rsType set to csi-rs:
 - 3> set *refFreqCSI-RS* to the value indicated by *refFreqCSI-RS* as included in the associated measurement object;
 - 2> if a serving cell is associated with the *MeasObjectNR*:
 - 3> set *measResultServingCell* to include the available quantities of the concerned cell and in accordance with the performance requirements in TS 38.133 [14];
 - 2> set the measResultNeighCellList to include the best measured cells, ordered such that the best cell is listed first, and based on measurements collected up to the moment the UE detected the failure, and set its fields as follows:
 - 3> ordering the cells with sorting as follows:
 - 4> based on SS/PBCH block if SS/PBCH block measurement results are available and otherwise based on CSI-RS;
 - 4> using RSRP if RSRP measurement results are available, otherwise using RSRQ if RSRQ measurement results are available, otherwise using SINR;
 - 3> for each neighbour cell included:
 - 4> include the optional fields that are available.
- NOTE: The measured quantities are filtered by the L3 filter as configured in the mobility measurement configuration. The measurements are based on the time domain measurement resource restriction, if configured. Blacklisted cells are not required to be reported.

5.7.3.5 Actions related to transmission of SCGFailureInformation message

The UE shall set the contents of the SCGFailureInformation message as follows:

- 1> if the UE initiates transmission of the SCGFailureInformation message due to T310 expiry:
 - 2> set the *failureType* as *t310-Expiry*;
- 1> else if the UE initiates transmission of the *SCGFailureInformation* message to provide reconfiguration with sync failure information for an SCG:
 - 2> set the failureType as synchReconfigFailure-SCG;
- 1> else if the UE initiates transmission of the *SCGFailureInformation* message to provide random access problem indication from SCG MAC:
 - 2> set the failureType as randomAccessProblem;
- 1> else if the UE initiates transmission of the *SCGFailureInformation* message to provide indication from SCG RLC that the maximum number of retransmissions has been reached:
 - 2> set the *failureType* as *rlc-MaxNumRetx*;
- 1> else if the UE initiates transmission of the SCGFailureInformation message due to SRB3 IP check failure:
 - 2> set the *failureType* as *srb3-IntegrityFailure*;

- 1> else if the UE initiates transmission of the *SCGFailureInformation* message due to Reconfiguration failure of NR RRC reconfiguration message:
 - 2> set the failureType as scg-reconfigFailure.
- 1> include and set *MeasResultSCG*-Failure in accordance with 5.7.3.4;
- 1> for each *MeasObjectNR* configured by a *MeasConfig* associated with the MCG, and for which measurement results are available:
 - 2> include an entry in measResultFreqList;
 - 2> if there is a *measId* configured with the *MeasObjectNR* and a *reportConfig* which has *rsType* set to *ssb*:
 - 3> set ssbFrequency in measResultFreqList to the value indicated by ssbFrequency as included in the MeasObjectNR;
 - 2> if there is a measId configured with the MeasObjectNR and a reportConfig which has rsType set to csi-rs:
 - 3> set refFreqCSI-RS in measResultFreqList to the value indicated by refFreqCSI-RS as included in the associated measurement object;
 - 2> if a serving cell is associated with the *MeasObjectNR*:
 - 3> set *measResultServingCell* in *measResultFreqList* to include the available quantities of the concerned cell and in accordance with the performance requirements in TS 38.133 [14];
 - 2> set the *measResultNeighCellList* in *measResultFreqList* to include the best measured cells, ordered such that the best cell is listed first, and based on measurements collected up to the moment the UE detected the failure, and set its fields as follows;
 - 3> ordering the cells with sorting as follows:
 - 4> based on SS/PBCH block if SS/PBCH block measurement results are available and otherwise based on CSI-RS:
 - 4> using RSRP if RSRP measurement results are available, otherwise using RSRQ if RSRQ measurement results are available, otherwise using SINR;
 - 3> for each neighbour cell included:
 - 4> include the optional fields that are available.
- NOTE 1: The measured quantities are filtered by the L3 filter as configured in the mobility measurement configuration. The measurements are based on the time domain measurement resource restriction, if configured. Blacklisted cells are not required to be reported.
- NOTE 2: Field *measResultSCG-Failure* is used to report available results for NR frequencies the UE is configured to measure by SCG RRC signalling.

The UE shall submit the SCGFailureInformation message to lower layers for transmission.

5.7.3a EUTRA SCG failure information

5.7.3a.1 General

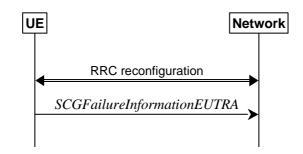


Figure 5.7.3a.1-1: EUTRA SCG failure information

The purpose of this procedure is to inform NR MN about an SCG failure on E-UTRA SN the UE has experienced (e.g. SCG radio link failure, SCG change failure), as specified in TS 36.331 [10] clause 5.6.13.2.

5.7.3a.2 Initiation

A UE initiates the procedure to report EUTRA SCG failures when EUTRA SCG transmission is not suspended and in accordance with TS 36.331 [10] clause 5.6.13.2. Actions the UE shall perform upon initiating the procedure, other than related to the transmission of the SCGFailureInformationEUTRA message are specified in TS 36.331 [10] clause 5.6.13.2.

5.7.3a.3 Actions related to transmission of SCGFailureInformationEUTRA message

The UE shall set the contents of the SCGFailureInformationEUTRA message as follows:

- 1> include *failureType* within *failureReportSCG-EUTRA* and set it to indicate the SCG failure in accordance with TS 36.331 [10] clause 5.6.13.4;
- 1> include and set measResultSCG-FailureMRDC in accordance with TS 36.331 [10] clause 5.6.13.5;
- 1> for each EUTRA frequency the UE is configured to measure by *measConfig* for which measurement results are available:
 - 2> set the measResultFreqListMRDC to include the best measured cells, ordered such that the best cell is listed first using RSRP to order if RSRP measurement results are available for cells on this frequency, otherwise using RSRQ to order if RSRQ measurement results are available for cells on this frequency, otherwise using SINR to order, and based on measurements collected up to the moment the UE detected the failure, and for each cell that is included, include the optional fields that are available;

NOTE: Field *measResultSCG-FailureMRDC* is used to report available results for E-UTRAN frequencies the UE is configured to measure by E-UTRA RRC signalling.

The UE shall submit the SCGFailureInformationEUTRA message to lower layers for transmission.

5.7.4 UE Assistance Information

5.7.4.1 General

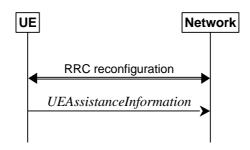


Figure 5.7.4.1-1: UE Assistance Information

The purpose of this procedure is to inform the network of the UE's delay budget report carrying desired increment/decrement in the connected mode DRX cycle length, or overheating assistance information.

5.7.4.2 Initiation

A UE capable of providing delay budget report in RRC_CONNECTED may initiate the procedure in several cases, including upon being configured to provide delay budget report and upon change of delay budget preference.

A UE capable of providing overheating assistance information in RRC_CONNECTED may initiate the procedure if it was configured to do so, upon detecting internal overheating, or upon detecting that it is no longer experiencing an overheating condition.

Upon initiating the procedure, the UE shall:

- 1> if configured to provide delay budget report:
 - 2> if the UE did not transmit a *UEAssistanceInformation* message with *delayBudgetReport* since it was configured to provide delay budget report; or
 - 2> if the current delay budget is different from the one indicated in the last transmission of the *UEAssistanceInformation* message including *delayBudgetReport* and timer T342 is not running:
 - 3> start or restart timer T342 with the timer value set to the delayBudgetReportingProhibitTimer;
 - 3> initiate transmission of the *UEAssistanceInformation* message in accordance with 5.7.4.3 to provide a delay budget report;
- 1> if configured to provide overheating assistance information:
 - 2> if the overheating condition has been detected and T345 is not running; or
 - 2> if the current overheating assistance information is different from the one indicated in the last transmission of the *UEAssistanceInformation* message including *overheatingAssistance* and timer T345 is not running:
 - 3> start timer T345 with the timer value set to the *overheatingIndicationProhibitTimer*;
 - 3> initiate transmission of the *UEAssistanceInformation* message in accordance with 5.7.4.3 to provide overheating assistance information;

5.7.4.3 Actions related to transmission of *UEAssistanceInformation* message

The UE shall set the contents of the UEAssistanceInformation message as follows:

- 1> if transmission of the *UEAssistanceInformation* message is initiated to provide a delay budget report according to 5.7.4.2 or 5.3.5.3;
 - 2> set delayBudgetReport to type1 according to a desired value;

- 1> if transmission of the *UEAssistanceInformation* message is initiated to provide overheating assistance information according to 5.7.4.2 or 5.3.5.3;
 - 2> if the UE experiences internal overheating:
 - 3> if the UE prefers to temporarily reduce the number of maximum secondary component carriers:
 - 4> include reducedMaxCCs in the OverheatingAssistance IE;
 - 4> set *reducedCcsDL* to the number of maximum SCells the UE prefers to be temporarily configured in downlink;
 - 4> set *reducedCCsUL* to the number of maximum SCells the UE prefers to be temporarily configured in uplink;
 - 3> if the UE prefers to temporarily reduce maximum aggregated bandwidth of FR1:
 - 4> include reducedMaxBW-FR1 in the OverheatingAssistance IE;
 - 4> set *reducedBW-FR1-DL* to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all downlink carriers of FR1;
 - 4> set reducedBW-FR1-UL to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all uplink carriers of FR1;
 - 3> if the UE prefers to temporarily reduce maximum aggregated bandwidth of FR2:
 - 4> include reducedMaxBW-FR2 in the OverheatingAssistance IE;
 - 4> set *reducedBW-FR2-DL* to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all downlink carriers of FR2;
 - 4> set *reducedBW-FR2-UL* to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all uplink carriers of FR2;
 - 3> if the UE prefers to temporarily reduce the number of maximum MIMO layers of each serving cell operating on FR1:
 - 4> include reducedMaxMIMO-LayersFR1 in the OverheatingAssistance IE;
 - 4> set *reducedMIMO-LayersFR1-DL* to the number of maximum MIMO layers of each serving cell operating on FR1 the UE prefers to be temporarily configured in downlink;
 - 4> set *reducedMIMO-LayersFR1-UL* to the number of maximum MIMO layers of each serving cell operating on FR1 the UE prefers to be temporarily configured in uplink;
 - 3> if the UE prefers to temporarily reduce the number of maximum MIMO layers of each serving cell operating on FR2:
 - 4> include reducedMaxMIMO-LayersFR2 in the OverheatingAssistance IE;
 - 4> set *reducedMIMO-LayersFR2-DL* to the number of maximum MIMO layers of each serving cell operating on FR2 the UE prefers to be temporarily configured in downlink;
 - 4> set reducedMIMO-LayersFR2-UL to the number of maximum MIMO layers of each serving cell operating on FR2 the UE prefers to be temporarily configured in uplink;
 - 2> else (if the UE no longer experiences an overheating condition):
 - 3> do not include reducedMaxCCs, reducedMaxBW-FR1, reducedMaxBW-FR2, reducedMaxMIMO-LayersFR1 and reducedMaxMIMO-LayersFR2 in OverheatingAssistance IE;

The UE shall submit the UEAssistanceInformation message to lower layers for transmission.

5.7.5 Failure information

5.7.5.1 General

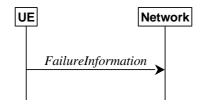


Figure 5.7.5.1-1: Failure information

The purpose of this procedure is to inform the network about a failure detected by the UE.

5.7.5.2 Initiation

A UE initiates the procedure when there is a need inform the network about a failure detected by the UE. In particular, the UE initiates the procedure when the following condition is met:

1> upon detecting failure for an RLC bearer, in accordance with 5.3.10.3;

Upon initiating the procedure, the UE shall:

1> initiate transmission of the *FailureInformation* message as specified in 5.7.5.3;

5.7.5.3 Actions related to transmission of *FailureInformation* message

The UE shall:

- 1> if initiated to provide RLC failure information, set FailureInfoRLC-Bearer as follows:
 - 2> set logicalChannelIdentity to the logical channel identity of the failing RLC bearer;
 - 2> set cellGroupId to the cell group identity of the failing RLC bearer;
 - 2> set the *failureType* as *rlc-failure*;
- 1> if used to inform the network about a failure for an MCG RLC bearer:
 - 2> submit the FailureInformation message to lower layers for transmission via SRB1;
- 1> else if used to inform the network about a failure for an SCG RLC bearer:
 - 2> if SRB3 is configured;
 - 3> submit the FailureInformation message to lower layers for transmission via SRB3;
 - 2> else;
 - 3> if the UE is in (NG)EN-DC:
 - 4> submit the *FailureInformation* message via E-UTRA embedded in E-UTRA RRC message *ULInformationTransferMRDC* as specified in TS 36.331 [10].
 - 3> else if the UE is in NR-DC:
 - 4> submit the *FailureInformation* message via SRB1 embedded in NR RRC message *ULInformationTransferMRDC* as specified in clause 5.7.2a.3.

6 Protocol data units, formats and parameters (ASN.1)

6.1 General

6.1.1 Introduction

The contents of each RRC message is specified in clause 6.2 using ASN.1 to specify the message syntax and using tables when needed to provide further detailed information about the fields specified in the message syntax. The syntax of the information elements that are defined as stand-alone abstract types is further specified in a similar manner in clause 6.3.

Usage of the text "Network always configures the UE with a value for this field" in the field description indicates that the network has to provide a value for the field in this or in a previous message based on delta configuration (for an optional field with Need M). It does not imply a mandatory presence of the field.

6.1.2 Need codes and conditions for optional downlink fields

The need for fields to be present in a message or an abstract type, i.e., the ASN.1 fields that are specified as OPTIONAL in the abstract notation (ASN.1), is specified by means of comment text tags attached to the OPTIONAL statement in the abstract syntax. All comment text tags are available for use in the downlink direction only. The meaning of each tag is specified in table 6.1.2-1.

If conditions are used, a conditional presence table is provided for the message or information element specifying the need of the field for each condition case. The table also specifies whether UE maintains or releases the value in case the field is absent. The conditions clarify what the UE may expect regarding the setting of the message by the network. Violation of conditions is regarded as invalid network behaviour, which the UE is not required to cope with. Hence the general error handling defined in 10.4 does not apply in case a field is absent although it is mandatory according to the CondC or CondM condition.

For guidelines on the use of need codes and conditions, see Annex A.6 and A.7.

Table 6.1.2-1: Meaning of abbreviations used to specify the need for fields to be present

Abbreviation	Meaning
Cond conditionTag	Conditionally present
	Presence of the field is specified in a tabular form following the ASN.1 segment.
CondC conditionTag	Configuration condition
	Presence of the field is conditional to other configuration settings.
CondM conditionTag	Message condition
	Presence of the field is conditional to other fields included in the message.
Need S	Specified
	Used for (configuration) fields, whose field description or procedure specifies the UE behavior performed upon receiving a
	message with the field absent (and not if field description or procedure specifies the UE behavior when field is not configured).
Need M	Maintain
	Used for (configuration) fields that are stored by the UE i.e. not one-shot. Upon receiving a message with the field absent, the UE
	maintains the current value.
Need N	No action (one-shot configuration that is not maintained)
	Used for (configuration) fields that are not stored and whose presence causes a one-time action by the UE. Upon receiving
	message with the field absent, the UE takes no action.
Need R	Release
	Used for (configuration) fields that are stored by the UE i.e. not one-shot. Upon receiving a message with the field absent, the UE
	releases the current value.

NOTE: In this version of the specification, the condition tags CondC and CondM are not used.

Any field with Need M or Need N in system information shall be interpreted as Need R.

The need code used within a CondX definition only applies for the case (part of the condition) where it is defined: A condition may have different need codes for different parts of the condition. In particular, the CondX definition may contain the following "otherwise the field is absent" parts:

- "Otherwise, the field is absent": The field is not relevant or should not be configured when this part of the condition applies. In particular, the UE behaviour is not defined when the field is configured via another part of the condition and is reconfigured to this part of the condition. A need code is not provided when the transition from another part of the condition to this part of the condition is not supported, when the field clearly is a one-shot or there is no difference whether UE maintains or releases the value (e.g., in case the field is mandatory present according to the other part of the condition).
- "Otherwise, the field is absent, Need R": The field is released if absent when this part of the condition applies. This handles UE behaviour in case the field is configured via another part of the condition and this part of the condition applies (which means that network can assume UE releases the field if this part of the condition is valid).
- "Otherwise, the field is absent, Need M": The UE retains the field if it was already configured when this part of the condition applies. This means the network cannot release the field, but UE retains the previously configured value.

Use of different Need codes in different parts of a condition should be avoided.

For downlink messages, the need codes, conditions and ASN.1 defaults specified for a particular (child) field only apply in case the (parent) field including the particular field is present. Thus, if the parent is absent the UE shall not release the field unless the absence of the parent field implies that.

For (parent) fields without need codes in downlink messages, if the parent field is absent, UE shall follow the need codes of the child fields. Thus, if parent field is absent, the need code of each child field is followed (i.e. Need R child fields are released, Need M child fields are not modified and the actions for Need S child fields depend on the specified conditions of each field). Examples of (parent) fields in downlink messages without need codes where this rule applies are:

- nonCriticalExtension fields at the end of a message using empty SEQUENCE extension mechanism,
- groups of non-critical extensions using double brackets (referred to as extension groups), and
- non-critical extensions at the end of a message or at the end of a structure, contained in a BIT STRING or OCTET STRING (referred to as parent extension fields).

The handling of need codes as specified in the previous is illustrated by means of an example, as shown in the following ASN.1.

```
-- /example/ ASN1START
RRCMessage-IEs ::=
                                  SEOUENCE {
    field1
                                      InformationElement1
                                                                     OPTIONAL, -- Need M
    field2
                                      InformationElement2
                                                                     OPTIONAL, -- Need R
    nonCriticalExtension
                                      RRCMessage-v1570-IEs
                                                                      OPTIONAL
RRCMessage-1570-IEs ::=
                                  SEOUENCE {
    field3
                                      InformationElement3
                                                                      OPTIONAL, -- Need M
    nonCriticalExtension
                                      RRCMessage-v1640-IEs
                                                                      OPTIONAL
RRCMessage-v1640-IEs ::=
                                  SEOUENCE {
    field4
                                      InformationElement4
                                                                      OPTIONAL, -- Need R
    nonCriticalExtension
                                      SEQUENCE {}
                                                                      OPTIONAL
InformationElement1 ::=
                                  SEQUENCE {
    field11
                                      InformationElement11
                                                                      OPTIONAL, -- Need M
    field12
                                      InformationElement12
                                                                      OPTIONAL, -- Need R
    . . . ,
    [ [
    field13
                                      InformationElement13
                                                                      OPTIONAL, -- Need R
                                      InformationElement14
                                                                      OPTIONAL -- Need M
    field14
    ]]
InformationElement2 ::=
                                  SEQUENCE {
    field21
                                      InformationElement11
                                                                      OPTIONAL, -- Need M
-- ASN1STOP
```

The handling of need codes as specified in the previous implies that:

- if field1 in RRCMessage-IEs is absent, UE does not modify any child fields configured within field1 (regardless of their need codes);

- if field2 in RRCMessage-IEs is absent, UE releases the field2 (and also its child field field21);
- if field1 or field2 in RRCMessage-IEs is present, UE retains or releases their child fields according to the child field presence conditions;
- if field1 in RRCMessage-IEs is present but the extension group containing field13 and field14 is absent, the UE releases field13 but does not modify field14;
- if nonCriticalExtension defined by IE RRCMessage-v1570-IEs is absent, the UE does not modify field3 but releases field4;

6.1.3 General rules

In the ASN.1 of this specification, the first bit of a bit string refers to the leftmost bit, unless stated otherwise.

Upon reception of a list not using ToAddModList and ToReleaseList structure, the UE shall delete all entries of the list currently in the UE configuration before applying the received list and shall consider each entry as newly created. This applies also to lists whose size is extended (i.e. with a second list structure in the ASN.1 comprising additional entries). This implies that Need M should not be used for fields in the entries of these lists; if used, UE will handle such fields equivalent to a Need R.

6.2 RRC messages

6.2.1 General message structure

NR-RRC-Definitions

This ASN.1 segment is the start of the NR RRC PDU definitions.

```
-- ASN1START
-- TAG-NR-RRC-DEFINITIONS-START

NR-RRC-Definitions DEFINITIONS AUTOMATIC TAGS ::=
BEGIN
-- TAG-NR-RRC-DEFINITIONS-STOP
-- ASN1STOP
```

BCCH-BCH-Message

The BCCH-BCH-Message class is the set of RRC messages that may be sent from the network to the UE via BCH on the BCCH logical channel.

```
-- ASN1START
-- TAG-BCCH-BCH-MESSAGE-START

BCCH-BCH-Message ::= SEQUENCE {
   message BCCH-BCH-MessageType
```

```
BCCH-BCH-MessageType ::= CHOICE {
    mib MIB,
    messageClassExtension SEQUENCE {}

-- TAG-BCCH-BCH-MESSAGE-STOP
-- ASN1STOP
```

BCCH-DL-SCH-Message

The BCCH-DL-SCH-Message class is the set of RRC messages that may be sent from the network to the UE via DL-SCH on the BCCH logical channel.

```
-- ASN1START
-- TAG-BCCH-DL-SCH-MESSAGE-START
BCCH-DL-SCH-Message ::=
                                SEOUENCE {
                                    BCCH-DL-SCH-MessageType
    message
                                CHOICE {
BCCH-DL-SCH-MessageType ::=
                                    CHOICE {
        systemInformation
                                        SystemInformation,
        systemInformationBlockType1
                                        SIB1
    messageClassExtension
                                    SEQUENCE {}
-- TAG-BCCH-DL-SCH-MESSAGE-STOP
-- ASN1STOP
```

DL-CCCH-Message

The *DL-CCCH-Message* class is the set of RRC messages that may be sent from the Network to the UE on the downlink CCCH logical channel.

```
-- ASN1START
-- TAG-DL-CCCH-MESSAGE-START
DL-CCCH-Message ::=
                                SEQUENCE {
    message
                                    DL-CCCH-MessageType
DL-CCCH-MessageType ::=
                                    CHOICE {
        rrcReject
                                        RRCReject,
        rrcSetup
                                        RRCSetup,
        spare2
                                        NULL,
        spare1
                                        NULL
```

DL-DCCH-Message

The DL-DCCH-Message class is the set of RRC messages that may be sent from the network to the UE on the downlink DCCH logical channel.

```
-- ASN1START
-- TAG-DL-DCCH-MESSAGE-START
DL-DCCH-Message ::=
                               SEOUENCE {
                                  DL-DCCH-MessageType
   message
                              CHOICE {
DL-DCCH-MessageType ::=
                                  CHOICE {
       rrcReconfiguration
                                      RRCReconfiguration,
       rrcResume
                                      RRCResume,
       rrcRelease
                                     RRCRelease,
       rrcReestablishment
                                     RRCReestablishment,
       securityModeCommand
                                      SecurityModeCommand,
                                      DLInformationTransfer,
       dlInformationTransfer
       ueCapabilityEnquiry
                                     UECapabilityEnquiry,
       counterCheck
                                      CounterCheck,
       mobilityFromNRCommand
                                      MobilityFromNRCommand,
       spare7 NULL,
       spare6 NULL, spare5 NULL, spare4 NULL,
       spare3 NULL, spare2 NULL, spare1 NULL
   -- TAG-DL-DCCH-MESSAGE-STOP
-- ASN1STOP
```

PCCH-Message

The *PCCH-Message* class is the set of RRC messages that may be sent from the Network to the UE on the PCCH logical channel.

```
-- ASN1START
-- TAG-PCCH-PCH-MESSAGE-START

PCCH-Message ::= SEQUENCE {
    message PCCH-MessageType
}
```

```
PCCH-MessageType ::= CHOICE {
    cl CHOICE {
        paging paging, sparel NULL
    }, messageClassExtension SEQUENCE {}
}

-- TAG-PCCH-PCH-MESSAGE-STOP
-- ASN1STOP
```

UL-CCCH-Message

The *UL-CCCH-Message* class is the set of 48-bits RRC messages that may be sent from the UE to the Network on the uplink CCCH logical channel.

```
-- ASN1START
-- TAG-UL-CCCH-MESSAGE-START
                                SEOUENCE {
UL-CCCH-Message ::=
    message
                                    UL-CCCH-MessageType
UL-CCCH-MessageType ::=
                                CHOICE {
                                    CHOICE {
        rrcSetupRequest
                                        RRCSetupRequest,
       rrcResumeRequest
                                        RRCResumeRequest,
        rrcReestablishmentRequest
                                        RRCReestablishmentRequest,
        rrcSystemInfoRequest
                                        RRCSystemInfoRequest
                                    SEQUENCE {}
    messageClassExtension
-- TAG-UL-CCCH-MESSAGE-STOP
-- ASN1STOP
```

UL-CCCH1-Message

The UL-CCCH1-Message class is the set of 64-bits RRC messages that may be sent from the UE to the Network on the uplink CCCH1 logical channel.

```
-- ASN1START
-- TAG-UL-CCCH1-MESSAGE-START

UL-CCCH1-Message ::= SEQUENCE {
message UL-CCCH1-MessageType
```

UL-DCCH-Message

The *UL-DCCH-Message* class is the set of RRC messages that may be sent from the UE to the network on the uplink DCCH logical channel.

```
-- ASN1START
-- TAG-UL-DCCH-MESSAGE-START
UL-DCCH-Message ::=
                                SEOUENCE {
                                    UL-DCCH-MessageType
    message
UL-DCCH-MessageType ::=
                                CHOICE {
    c1
                                    CHOICE {
                                        MeasurementReport,
       measurementReport
        rrcReconfigurationComplete
                                        RRCReconfigurationComplete,
        rrcSetupComplete
                                        RRCSetupComplete,
        rrcReestablishmentComplete
                                        RRCReestablishmentComplete,
        rrcResumeComplete
                                        RRCResumeComplete,
        securityModeComplete
                                        SecurityModeComplete,
        securityModeFailure
                                        SecurityModeFailure,
       ulInformationTransfer
                                        ULInformationTransfer,
        locationMeasurementIndication
                                        LocationMeasurementIndication,
                                        UECapabilityInformation,
       ueCapabilityInformation
        counterCheckResponse
                                        CounterCheckResponse,
       ueAssistanceInformation
                                        UEAssistanceInformation,
        failureInformation
                                        FailureInformation,
       ulInformationTransferMRDC
                                        ULInformationTransferMRDC,
        scgFailureInformation
                                        SCGFailureInformation,
        scgFailureInformationEUTRA
                                        SCGFailureInformationEUTRA
    messageClassExtension
                                    SEQUENCE {}
-- TAG-UL-DCCH-MESSAGE-STOP
-- ASN1STOP
```

6.2.2 Message definitions

CounterCheck

The *CounterCheck* message is used by the network to indicate the current COUNT MSB values associated to each DRB and to request the UE to compare these to its COUNT MSB values and to report the comparison results to the network.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

CounterCheck message

```
-- ASN1START
-- TAG-COUNTERCHECK-START
CounterCheck ::=
                            SEQUENCE {
   rrc-TransactionIdentifier RRC-TransactionIdentifier,
   criticalExtensionsFuture
                                   SEQUENCE {}
CounterCheck-IEs ::=
                            SEOUENCE {
   drb-CountMSB-InfoList
                                DRB-CountMSB-InfoList,
   lateNonCriticalExtension
                                OCTET STRING
                                                                OPTIONAL,
   nonCriticalExtension
                                SEQUENCE {}
                                                                 OPTIONAL
DRB-CountMSB-InfoList ::=
                            SEQUENCE (SIZE (1..maxDRB)) OF DRB-CountMSB-Info
DRB-CountMSB-Info ::=
                            SEQUENCE {
   drb-Identity
                                DRB-Identity,
   countMSB-Uplink
                                INTEGER (0..33554431),
   countMSB-Downlink
                                INTEGER(0..33554431)
-- TAG-COUNTERCHECK-STOP
-- ASN1STOP
```

CounterCheck-IEs field descriptions

drb-CountMSB-InfoList

Indicates the MSBs of the COUNT values of the DRBs.

DRB-CountMSB-Info field descriptions

countMSB-Downlink

Indicates the value of 25 MSBs from RX_NEXT - 1 (specified in TS 38.323 [5]) associated to this DRB.

countMSB-Uplink

Indicates the value of 25 MSBs from TX_NEXT - 1 (specified in TS 38.323 [5]) associated to this DRB.

CounterCheckResponse

The CounterCheckResponse message is used by the UE to respond to a CounterCheck message.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

CounterCheckResponse message

```
-- ASN1START
-- TAG-COUNTERCHECKRESPONSE-START
CounterCheckResponse ::=
                               SEOUENCE {
   rrc-TransactionIdentifier
                                   RRC-TransactionIdentifier,
    criticalExtensions
                                   CHOICE {
       counterCheckResponse
                                       CounterCheckResponse-IEs,
       criticalExtensionsFuture
                                       SEQUENCE {}
CounterCheckResponse-IEs ::=
                             SEQUENCE {
    drb-CountInfoList
                                   DRB-CountInfoList,
    lateNonCriticalExtension
                                   OCTET STRING
                                                                       OPTIONAL,
    nonCriticalExtension
                                   SEQUENCE {}
                                                                       OPTIONAL
DRB-CountInfoList ::=
                               SEQUENCE (SIZE (0..maxDRB)) OF DRB-CountInfo
DRB-CountInfo ::=
                               SEQUENCE {
   drb-Identity
                                   DRB-Identity,
    count-Uplink
                                   INTEGER (0..4294967295),
```

```
count-Downlink INTEGER(0..4294967295)
}
-- TAG-COUNTERCHECKRESPONSE-STOP
-- ASN1STOP
```

CounterCheckResponse-IEs field descriptions

drb-CountInfoList

Indicates the COUNT values of the DRBs.

DRB-CountInfo field descriptions

count-Downlink

Indicates the value of RX_NEXT - 1 (specified in TS 38.323 [5]) associated to this DRB.

count-Uplink

Indicates the value of TX_NEXT – 1 (specified in TS 38.323 [5]) associated to this DRB.

DLInformationTransfer

The DLInformationTransfer message is used for the downlink transfer of NAS dedicated information.

Signalling radio bearer: SRB2 or SRB1 (only if SRB2 not established yet. If SRB2 is suspended, the network does not send this message until SRB2 is resumed.)

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

${\it DLIn formation Transfer}\ {\it message}$

```
-- ASN1START
-- TAG-DLINFORMATIONTRANSFER-START
DLInformationTransfer ::=
                                  SEOUENCE {
   rrc-TransactionIdentifier
                                      RRC-TransactionIdentifier,
   criticalExtensions
                                      CHOICE {
       dlInformationTransfer
                                      DLInformationTransfer-IEs,
       criticalExtensionsFuture
                                          SEQUENCE {}
DLInformationTransfer-IEs ::= SEQUENCE {
   dedicatedNAS-Message
                                      DedicatedNAS-Message
                                                                         OPTIONAL, -- Need N
   lateNonCriticalExtension
                                      OCTET STRING
                                                                         OPTIONAL,
                                      SEQUENCE {} OPTIONAL
   nonCriticalExtension
```

```
-- TAG-DLINFORMATIONTRANSFER-STOP
-- ASN1STOP
```

FailureInformation

The FailureInformation message is used to inform the network about a failure detected by the UE.

Signalling radio bearer: SRB1 or SRB3

RLC-SAP: AM

-- ASN1START

Logical channel: DCCH

Direction: UE to network

FailureInformation message

```
-- TAG-FAILUREINFORMATION-START
FailureInformation ::=
                               SEQUENCE {
       ticalExtensions
failureInformation
    criticalExtensions
       failureInformation criticalExtensionsFuture
                                       FailureInformation-IEs,
                                       SEQUENCE {}
FailureInformation-IEs ::= SEQUENCE {
    failureInfoRLC-Bearer FailureInfoRLC-Bearer OPTIONAL,
   lateNonCriticalExtension nonCriticalExtension
                                  OCTET STRING
                                                            OPTIONAL,
                                  SEQUENCE {}
                                                            OPTIONAL
FailureInfoRLC-Bearer ::=
                               SEQUENCE {
    cellGroupId
                                   CellGroupId,
    logicalChannelIdentity
                                   LogicalChannelIdentity,
                                   ENUMERATED {rlc-failure, spare3, spare2, spare1}
    failureType
-- TAG-FAILUREINFORMATION-STOP
-- ASN1STOP
```

LocationMeasurementIndication

The LocationMeasurementIndication message is used to indicate that the UE is going to either start or stop location related measurement which requires measurement gaps.

```
Signalling radio bearer: SRB1
```

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

LocationMeasurementIndication message

```
-- ASN1START
-- TAG-LOCATIONMEASUREMENTINDICATION-START
LocationMeasurementIndication ::= SEQUENCE {
    criticalExtensions
                                           CHOICE {
       locationMeasurementIndication
                                                    LocationMeasurementIndication-IEs,
        criticalExtensionsFuture
                                                    SEQUENCE {}
LocationMeasurementIndication-IEs ::=
                                           SEQUENCE {
    measurementIndication
                                                SetupRelease {LocationMeasurementInfo},
                                                OCTET STRING
   lateNonCriticalExtension
    nonCriticalExtension
                                                SEQUENCE { }
-- TAG-LOCATIONMEASUREMENTINDICATION-STOP
-- ASN1STOP
```

MeasurementReport

The MeasurementReport message is used for the indication of measurement results.

Signalling radio bearer: SRB1, SRB3

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

MeasurementReport message

```
-- ASN1START
-- TAG-MEASUREMENTREPORT-START

MeasurementReport ::= SEQUENCE {
    criticalExtensions CHOICE {
```

OPTIONAL,

MIB

The MIB includes the system information transmitted on BCH.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: BCCH

Direction: Network to UE

MIB

```
-- ASN1START
-- TAG-MIB-START
MIB ::=
                                    SEQUENCE {
    systemFrameNumber
                                        BIT STRING (SIZE (6)),
                                        ENUMERATED {scs15or60, scs30or120},
    subCarrierSpacingCommon
    ssb-SubcarrierOffset
                                        INTEGER (0..15),
    dmrs-TypeA-Position
                                        ENUMERATED {pos2, pos3},
                                        PDCCH-ConfigSIB1,
    pdcch-ConfigSIB1
    cellBarred
                                        ENUMERATED {barred, notBarred},
    intraFreqReselection
                                        ENUMERATED {allowed, notAllowed},
                                        BIT STRING (SIZE (1))
    spare
-- TAG-MIB-STOP
-- ASN1STOP
```

OPTIONAL,

MIB field descriptions

cellBarred

Value barred means that the cell is barred, as defined in TS 38.304 [20].

dmrs-TypeA-Position

Position of (first) DM-RS for downlink (see TS 38.211 [16], clause 7.4.1.1.2) and uplink (see TS 38.211 [16], clause 6.4.1.1.3).

intraFreqReselection

Controls cell selection/reselection to intra-frequency cells when the highest ranked cell is barred, or treated as barred by the UE, as specified in TS 38.304 [20].

pdcch-ConfigSIB1

Determines a common *ControlResourceSet* (CORESET), a common search space and necessary PDCCH parameters. If the field *ssb-SubcarrierOffset* indicates that *SIB1* is absent, the field *pdcch-ConfigSIB1* indicates the frequency positions where the UE may find SS/PBCH block with *SIB1* or the frequency range where the network does not provide SS/PBCH block with *SIB1* (see TS 38.213 [13], clause 13).

ssb-SubcarrierOffset

Corresponds to k_{SSB} (see TS 38.213 [13]), which is the frequency domain offset between SSB and the overall resource block grid in number of subcarriers. (See TS 38.211 [16], clause 7.4.3.1).

The value range of this field may be extended by an additional most significant bit encoded within PBCH as specified in TS 38.213 [13].

This field may indicate that this cell does not provide *SIB1* and that there is hence no CORESET#0 configured in *MIB* (see TS 38.213 [13], clause 13). In this case, the field *pdcch-ConfigSIB1* may indicate the frequency positions where the UE may (not) find a SS/PBCH with a control resource set and search space for *SIB1* (see TS 38.213 [13], clause 13).

subCarrierSpacingCommon

Subcarrier spacing for SIB1, Msg.2/4 for initial access, paging and broadcast SI-messages. If the UE acquires this MIB on an FR1 carrier frequency, the value scs15or60 corresponds to 15 kHz and the value scs30or120 corresponds to 30 kHz. If the UE acquires this MIB on an FR2 carrier frequency, the value scs15or60 corresponds to 60 kHz and the value scs30or120 corresponds to 120 kHz.

systemFrameNumber

The 6 most significant bits (MSB) of the 10-bit System Frame Number (SFN). The 4 LSB of the SFN are conveyed in the PBCH transport block as part of channel coding (i.e. outside the *MIB* encoding), as defined in clause 7.1 in TS 38.212 [17].

MobilityFromNRCommand 4 6 1

The MobilityFromNRCommand message is used to command handover from NR to E-UTRA/EPC or E-UTRA/5GC.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

MobilityFromNRCommand message

```
-- ASN1START
-- TAG-MOBILITYFROMNRCOMMAND-START

MobilityFromNRCommand ::= SEQUENCE {
    rrc-TransactionIdentifier RRC-TransactionIdentifier,
    criticalExtensions CHOICE {
```

```
mobilityFromNRCommand
                                               MobilityFromNRCommand-IEs,
           criticalExtensionsFuture
                                                   SEQUENCE {}
MobilityFromNRCommand-IEs ::= SEQUENCE {
    targetRAT-Type
                                           ENUMERATED { eutra, spare3, spare2, spare1, ...},
    targetRAT-MessageContainer
                                           OCTET STRING.
   nas-SecurityParamFromNR
                                           OCTET STRING
                                                                                      OPTIONAL, -- Cond HO-ToEPC
                                           OCTET STRING
                                                                                      OPTIONAL,
   lateNonCriticalExtension
   nonCriticalExtension
                                           SEQUENCE {}
                                                                                      OPTIONAL
-- TAG-MOBILITYFROMNRCOMMAND-STOP
-- ASN1STOP
```

MobilityFromNRCommand-IEs field descriptions

nas-SecurityParamFromNR

This field is used to deliver the key synchronisation and Key freshness for the NR to LTE/EPC handovers and a part of the downlink NAS COUNT as specified in TS 33.501 [11].

targetRAT-MessageContainer

The field contains a message specified in another standard, as indicated by the *targetRAT-Type*, and carries information about the target cell identifier(s) and radio parameters relevant for the target radio access technology. A complete message is included, as specified in the other standard. See NOTE 1

targetRAT-Type

Indicates the target RAT type.

NOTE 1: The correspondence between the value of the *targetRAT-Type*, the standard to apply, and the message contained within the *targetRAT-MessageContainer* is shown in the table below:

targetRAT-Type	Standard to apply	targetRAT-MessageContainer
eutra	TS 36.331 [10] (clause 5.4.2)	DL-DCCH-Message including the RRCConnectionReconfiguration

Conditional Presence	Explanation
HO-ToEPC	This field is mandatory present in case of inter system handover. Otherwise it is absent.

– Paging

The Paging message is used for the notification of one or more UEs.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: PCCH

OPTIONAL, -- Need N

OPTIONAL,

OPTIONAL

Direction: Network to UE

Paging message

```
-- ASN1START
-- TAG-PAGING-START
Paging ::=
                                    SEQUENCE {
    pagingRecordList
                                            PagingRecordList
    lateNonCriticalExtension
                                            OCTET STRING
                                            SEQUENCE { }
    nonCriticalExtension
PagingRecordList ::=
                                    SEQUENCE (SIZE(1..maxNrofPageRec)) OF PagingRecord
PagingRecord ::=
                                    SEQUENCE {
                                        PagingUE-Identity,
    ue-Identity
                                        ENUMERATED {non3GPP}
    accessType
                                                                OPTIONAL, -- Need N
    . . .
PagingUE-Identity ::=
                                    CHOICE {
    ng-5G-S-TMSI
                                        NG-5G-S-TMSI,
    fullI-RNTI
                                        I-RNTI-Value,
-- TAG-PAGING-STOP
-- ASN1STOP
```

PagingRecord field descriptions

accessType

Indicates whether the Paging message is originated due to the PDU sessions from the non-3GPP access.

RRCReestablishment

The RRCReestablishment message is used to re-establish SRB1.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

RRCReestablishment message

```
-- ASN1START
-- TAG-RRCREESTABLISHMENT-START
RRCReestablishment ::=
                                 RRC-TransactionIdentifier,
   rrc-TransactionIdentifier
   criticalExtensions rrcReestablishment
                                      CHOICE {
                                          RRCReestablishment-IEs,
       criticalExtensionsFuture
                                          SEOUENCE {}
RRCReestablishment-IEs ::=
                                  SEOUENCE {
   nextHopChainingCount
                                      NextHopChainingCount,
   lateNonCriticalExtension
                                      OCTET STRING
                                                                         OPTIONAL,
   nonCriticalExtension
                                      SEQUENCE {}
                                                                         OPTIONAL
-- TAG-RRCREESTABLISHMENT-STOP
-- ASN1STOP
```

RRCReestablishmentComplete

The RRCReestablishmentComplete message is used to confirm the successful completion of an RRC connection re-establishment.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

RRCReestablishmentComplete message

```
-- ASN1START
-- TAG-RRCREESTABLISHMENTCOMPLETE-START
RRCReestablishmentComplete ::=
                                    SEQUENCE {
    rrc-TransactionIdentifier
                                       RRC-TransactionIdentifier,
    criticalExtensions
                                       CHOICE {
       rrcReestablishmentComplete
                                           RRCReestablishmentComplete-IEs,
       criticalExtensionsFuture
                                           SEQUENCE {}
RRCReestablishmentComplete-IEs ::= SEQUENCE {
    lateNonCriticalExtension
                                       OCTET STRING
                                                                        OPTIONAL,
                                       SEQUENCE {}
    nonCriticalExtension
                                                                        OPTIONAL
```

```
}
-- TAG-RRCREESTABLISHMENTCOMPLETE-STOP
-- ASN1STOP
```

RRCReestablishmentRequest

The RRCReestablishmentRequest message is used to request the reestablishment of an RRC connection.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: UE to Network

RRCReestablishmentRequest message

```
-- ASN1START
-- TAG-RRCREESTABLISHMENTREQUEST-START
RRCReestablishmentRequest ::=
                                    SEOUENCE {
    rrcReestablishmentRequest
                                        RRCReestablishmentRequest-IEs
RRCReestablishmentRequest-IEs ::= SEQUENCE {
    ue-Identity
                                        ReestabUE-Identity,
    reestablishmentCause
                                        ReestablishmentCause,
                                        BIT STRING (SIZE (1))
    spare
ReestabUE-Identity ::=
                                    SEQUENCE {
    c-RNTI
                                        RNTI-Value,
   physCellId
                                        PhysCellId,
    shortMAC-I
                                        ShortMAC-I
                                    ENUMERATED {reconfigurationFailure, handoverFailure, otherFailure, spare1}
ReestablishmentCause ::=
-- TAG-RRCREESTABLISHMENTREQUEST-STOP
-- ASN1STOP
```

ReestabUE-Identity field descriptions

physCellId

The Physical Cell Identity of the PCell the UE was connected to prior to the failure.

RRCReestablishmentRequest-IEs field descriptions

reestablishmentCause

Indicates the failure cause that triggered the re-establishment procedure. gNB is not expected to reject a RRCReestablishmentRequest due to unknown cause value being used by the UE.

ue-Identity

UE identity included to retrieve UE context and to facilitate contention resolution by lower layers.

RRCReconfiguration

The *RRCReconfiguration* message is the command to modify an RRC connection. It may convey information for measurement configuration, mobility control, radio resource configuration (including RBs, MAC main configuration and physical channel configuration) and AS security configuration.

Signalling radio bearer: SRB1 or SRB3

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

RRCReconfiguration message

```
-- ASN1START
-- TAG-RRCRECONFIGURATION-START
RRCReconfiguration ::=
                                   SEOUENCE {
   rrc-TransactionIdentifier
                                   RRC-TransactionIdentifier,
       ticalExtensions
rrcReconfiguration
    criticalExtensions
                                       CHOICE {
                                           RRCReconfiguration-IEs,
       criticalExtensionsFuture
                                           SEOUENCE {}
RRCReconfiguration-IEs ::=
                                   SEOUENCE {
    radioBearerConfig
                                           RadioBearerConfig
                                                                                                                 OPTIONAL, -- Need M
    secondaryCellGroup
                                           OCTET STRING (CONTAINING CellGroupConfig)
                                                                                                                 OPTIONAL, -- Need M
                                                                                                                 OPTIONAL, -- Need M
   measConfig
                                           MeasConfig
   lateNonCriticalExtension
                                           OCTET STRING
                                                                                                                 OPTIONAL,
    nonCriticalExtension
                                           RRCReconfiguration-v1530-IEs
                                                                                                                 OPTIONAL
RRCReconfiguration-v1530-IEs ::=
                                           SEQUENCE {
    masterCellGroup
                                           OCTET STRING (CONTAINING CellGroupConfig)
                                                                                                                 OPTIONAL, -- Need M
    fullConfig
                                                                                                                 OPTIONAL, -- Cond FullConfig
                                           ENUMERATED {true}
    dedicatedNAS-MessageList
                                           SEQUENCE (SIZE(1..maxDRB)) OF DedicatedNAS-Message
                                                                                                                 OPTIONAL, -- Cond nonHO
    masterKeyUpdate
                                           MasterKeyUpdate
                                                                                                                 OPTIONAL, -- Cond
MasterKeyChange
    dedicatedSIB1-Delivery
                                           OCTET STRING (CONTAINING SIB1)
                                                                                                                 OPTIONAL, -- Need N
    dedicatedSystemInformationDelivery
                                           OCTET STRING (CONTAINING SystemInformation)
                                                                                                                 OPTIONAL, -- Need N
```

```
otherConfig
                                            OtherConfig
                                                                                                                   OPTIONAL, -- Need M
    nonCriticalExtension
                                            RRCReconfiguration-v1540-IEs
                                                                                                                   OPTIONAL
RRCReconfiguration-v1540-IEs ::=
                                        SEOUENCE {
    otherConfig-v1540
                                            OtherConfig-v1540
                                                                                   OPTIONAL, -- Need M
    nonCriticalExtension
                                            RRCReconfiguration-v1560-IEs
                                                                                   OPTIONAL
RRCReconfiguration-v1560-IEs ::=
                                            SEQUENCE {
    mrdc-SecondaryCellGroupConfig
                                                SetupRelease { MRDC-SecondaryCellGroupConfig }
                                                                                                                  OPTIONAL, -- Need M
    radioBearerConfig2
                                                OCTET STRING (CONTAINING RadioBearerConfig)
                                                                                                                  OPTIONAL, -- Need M
                                                                                                                              -- Need N
    sk-Counter
                                                SK-Counter
                                                                                                                  OPTIONAL,
    nonCriticalExtension
                                                SEQUENCE {}
                                                                                                                  OPTIONAL
MRDC-SecondaryCellGroupConfig ::=
                                        SEQUENCE {
    mrdc-ReleaseAndAdd
                                        ENUMERATED {true}
                                                                                                                  OPTIONAL, -- Need N
    mrdc-SecondaryCellGroup
                                        CHOICE {
       nr-SCG
                                            OCTET STRING (CONTAINING RRCReconfiguration),
        eutra-SCG
                                            OCTET STRING
MasterKeyUpdate ::=
                                    SEQUENCE {
    keySetChangeIndicator
                                    BOOLEAN,
    nextHopChainingCount
                                    NextHopChainingCount,
    nas-Container
                                    OCTET STRING
                                                                                                     OPTIONAL,
                                                                                                                  -- Cond securityNASC
-- TAG-RRCRECONFIGURATION-STOP
-- ASN1STOP
```

RRCReconfiguration-IEs field descriptions

dedicatedNAS-MessageList

This field is used to transfer UE specific NAS layer information between the network and the UE. The RRC layer is transparent for each PDU in the list.

dedicatedSIB1-Delivery

This field is used to transfer SIB1 to the UE. The field has the same values as the corresponding configuration in servingCellConfigCommon.

dedicatedSystemInformationDelivery

This field is used to transfer SIB6, SIB7, SIB8 to the UE.

fullConfig

Indicates that the full configuration option is applicable for the *RRCReconfiguration* message for intra-system intra-RAT HO. For inter-RAT HO from E-UTRA to NR, *fullConfig* indicates whether or not delta signalling of SDAP/PDCP from source RAT is applicable. This field is absent when the *RRCReconfiguration* message is transmitted on SRB3, and in an *RRCReconfiguration* message contained in another *RRCReconfiguration* message (or *RRCConnectionReconfiguration* message, see TS 36.331 [10]) transmitted on SRB1.

keySetChangeIndicator

Indicates whether UE shall derive a new K_{gNB} . If reconfigurationWithSync is included, value true indicates that a K_{gNB} key is derived from a K_{gNB} key taken into use through the latest successful NAS SMC procedure, or N2 handover procedure with K_{AMF} change, as described in TS 33.501 [11] for K_{gNB} re-keying. Value false indicates that the new K_{gNB} key is obtained from the current K_{gNB} key or from the NH as described in TS 33.501 [11].

masterCellGroup

Configuration of master cell group.

mrdc-ReleaseAndAdd

This field indicates that the current SCG configuration is released and a new SCG is added at the same time.

mrdc-SecondaryCellGroup

Includes an RRC message for SCG configuration in NR-DC or NE-DC.

For NR-DC (nr-SCG), mrdc-SecondaryCellGroup contains the RRCReconfiguration message as generated (entirely) by SN gNB. In this version of the specification, the RRC message can only include fields secondaryCellGroup and measConfig.

For NE-DC (eutra-SCG), *mrdc-SecondaryCellGroup* includes the E-UTRA *RRCConnectionReconfiguration* message as specified in TS 36.331 [10]. In this version of the specification, the E-UTRA RRC message can only include the field *scg-Configuration*.

nas-Container

This field is used to transfer UE specific NAS layer information between the network and the UE. The RRC layer is transparent for this field, although it affects activation of AS security after inter-system handover to NR. The content is defined in TS 24.501 [23].

nextHopChainingCount

Parameter NCC: See TS 33.501 [11]

otherConfia

Contains configuration related to other configurations.

radioBearerConfig

Configuration of Radio Bearers (DRBs, SRBs) including SDAP/PDCP. In EN-DC this field may only be present if the RRCReconfiguration is transmitted over SRB3.

radioBearerConfig2

Configuration of Radio Bearers (DRBs, SRBs) including SDAP/PDCP. This field can only be used if the UE supports NR-DC or NE-DC.

secondaryCellGroup

Configuration of secondary cell group ((NG)EN-DC or NR-DC). This field can only be present in an *RRCReconfiguration* message is transmitted on SRB3, and in an *RRCReconfiguration* message contained in another *RRCReconfiguration* message, see TS 36.331 [10]) transmitted on SRB1.

sk-Counter

A counter used upon initial configuration of S-K_{gNB} or S-K_{eNB}, as well as upon refresh of S-K_{gNB} or S-K_{eNB}. This field is always included either upon initial configuration of an NR SCG or upon configuration of the first RB with *keyToUse* set to *secondary*, whichever happens first. This field is absent if there is neither any NR SCG nor any RB with *keyToUse* set to *secondary*.

Conditional Presence	Explanation
nonHO	The field is absent in case of reconfiguration with sync within NR or to NR; otherwise it is optionally present, need N.
securityNASC	This field is mandatory present in case of inter system handover. Otherwise the field is optionally present, need N.
MasterKeyChange	This field is mandatory present in case masterCellGroup includes ReconfigurationWithSync and RadioBearerConfig includes
	SecurityConfig with SecurityAlgorithmConfig, indicating a change of the AS security algorithms associated to the master key.
	If ReconfigurationWithSync is included for other cases, this field is optionally present, need N. Otherwise the field is absent.
FullConfig	The field is mandatory present in case of inter-system handover from E-UTRA/EPC to NR. It is optionally present, Need N, during reconfiguration with sync and also in first reconfiguration after reestablishment; or for intra-system handover from E-UTRA/5GC to NR. It is absent otherwise.

RRCReconfigurationComplete

The RRCReconfigurationComplete message is used to confirm the successful completion of an RRC connection reconfiguration.

Signalling radio bearer: SRB1 or SRB3

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

RRCReconfigurationComplete message

```
-- ASN1START
-- TAG-RRCRECONFIGURATIONCOMPLETE-START
RRCReconfigurationComplete ::=
                                            SEQUENCE {
   rrc-TransactionIdentifier
                                                RRC-TransactionIdentifier,
    criticalExtensions
                                                CHOICE {
        rrcReconfigurationComplete
                                                    RRCReconfigurationComplete-IEs,
        criticalExtensionsFuture
                                                    SEQUENCE {}
RRCReconfigurationComplete-IEs ::=
                                            SEQUENCE {
    lateNonCriticalExtension
                                                OCTET STRING
                                                                                                                         OPTIONAL,
    nonCriticalExtension
                                                RRCReconfigurationComplete-v1530-IEs
                                                                                                                         OPTIONAL
RRCReconfigurationComplete-v1530-IEs ::=
                                            SEOUENCE {
    uplinkTxDirectCurrentList
                                                UplinkTxDirectCurrentList
                                                                                                                         OPTIONAL,
    nonCriticalExtension
                                                RRCReconfigurationComplete-v1560-IEs
                                                                                                                         OPTIONAL
RRCReconfigurationComplete-v1560-IEs ::=
                                            SEQUENCE {
    scg-Response
                                                CHOICE {
                                                        OCTET STRING (CONTAINING RRCReconfigurationComplete),
       nr-SCG-Response
```

```
eutra-SCG-Response OCTET STRING

} OPTIONAL,
nonCriticalExtension SEQUENCE {}

-- TAG-RRCRECONFIGURATIONCOMPLETE-STOP
```

RRCReconfigurationComplete-IEs field descriptions

scg-Response

-- ASN1STOP

In case of NR-DC (nr-SCG-Response), this field includes the RRCReconfigurationComplete message. In case of NE-DC (eutra-SCG-Response), this field includes the E-UTRA RRCConnectionReconfigurationComplete message as specified in TS 36.331 [10].

uplinkTxDirectCurrentList

The Tx Direct Current locations for the configured serving cells and BWPs if requested by the NW (see reportUplinkTxDirectCurrent in CellGroupConfig).

- RRCReject

The RRCReject message is used to reject an RRC connection establishment or an RRC connection resumption.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: Network to UE

RRCReject message

```
-- ASN1START
-- TAG-RRCREJECT-START
   deject ::=
criticalExtensions
RRCReject ::=
                                    SEQUENCE {
                                        CHOICE {
                                            RRCReject-IEs,
                                           SEQUENCE {}
       criticalExtensionsFuture
RRCReject-IEs ::=
                                    SEQUENCE {
   waitTime
                                        RejectWaitTime
                                                                                                                OPTIONAL,
                                                                                                                            -- Need N
   lateNonCriticalExtension
                                        OCTET STRING
                                                                                                                OPTIONAL,
                                        SEQUENCE { }
    nonCriticalExtension
                                                                                                                OPTIONAL
-- TAG-RRCREJECT-STOP
-- ASN1STOP
```

RRCReject-IEs field descriptions

waitTime

Wait time value in seconds. The field is always included.

- RRCRelease

The RRCRelease message is used to command the release of an RRC connection or the suspension of the RRC connection.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

RRCRelease message

```
-- ASN1START
-- TAG-RRCRELEASE-START
RRCRelease ::=
                                       RRC-TransactionIdentifier,
   rrc-TransactionIdentifier
    criticalExtensions
                                       CHOICE {
       rrcRelease
                                           RRCRelease-IEs,
                                           SEQUENCE {}
       criticalExtensionsFuture
RRCRelease-IEs ::=
                                   SEQUENCE {
   redirectedCarrierInfo
                                       RedirectedCarrierInfo
                                                                                                               OPTIONAL, -- Need N
    cellReselectionPriorities
                                       CellReselectionPriorities
                                                                                                              OPTIONAL, -- Need R
                                                                                                                          -- Need R
    suspendConfig
                                       SuspendConfig
                                                                                                              OPTIONAL,
    deprioritisationReq
                                       SEQUENCE {
       deprioritisationType
                                           ENUMERATED {frequency, nr},
       deprioritisationTimer
                                           ENUMERATED {min5, min10, min15, min30}
                                                                                                               OPTIONAL,
                                                                                                                          -- Need N
    lateNonCriticalExtension
                                           OCTET STRING
                                                                                                              OPTIONAL,
    nonCriticalExtension
                                           RRCRelease-v1540-IEs
                                                                                                               OPTIONAL
RRCRelease-v1540-IEs ::=
                                   SEOUENCE {
    waitTime
                                      RejectWaitTime
                                                                    OPTIONAL, -- Need N
    nonCriticalExtension
                                      SEQUENCE {}
                                                                    OPTIONAL
RedirectedCarrierInfo ::=
                                   CHOICE {
```

```
CarrierInfoNR,
    nr
    eutra
                                        RedirectedCarrierInfo-EUTRA,
RedirectedCarrierInfo-EUTRA ::=
                                    SEOUENCE {
    eutraFrequency
                                            ARFCN-ValueEUTRA,
                                            ENUMERATED {epc,fiveGC}
    cnType
                                                                                                                 OPTIONAL
                                                                                                                           -- Need N
CarrierInfoNR ::=
                                    SEQUENCE {
    carrierFreq
                                        ARFCN-ValueNR,
    ssbSubcarrierSpacing
                                        SubcarrierSpacing,
    smtc
                                        SSB-MTC
                                                                                                                 OPTIONAL.
                                                                                                                                -- Need S
    . . .
SuspendConfig ::=
                                    SEOUENCE {
    fullI-RNTI
                                        I-RNTI-Value,
    shortI-RNTI
                                        ShortI-RNTI-Value,
    ran-PagingCycle
                                        PagingCycle,
    ran-NotificationAreaInfo
                                        RAN-NotificationAreaInfo
                                                                                                                 OPTIONAL, -- Need M
                                        PeriodicRNAU-TimerValue
                                                                                                                 OPTIONAL, -- Need R
    nextHopChainingCount
                                        NextHopChainingCount,
PeriodicRNAU-TimerValue ::=
                                    ENUMERATED { min5, min10, min20, min30, min60, min120, min360, min720}
CellReselectionPriorities ::=
                                    SEQUENCE {
    freqPriorityListEUTRA
                                        FreqPriorityListEUTRA
                                                                                                                 OPTIONAL,
                                                                                                                                 -- Need M
    freqPriorityListNR
                                        FreqPriorityListNR
                                                                                                                 OPTIONAL,
                                                                                                                                 -- Need M
                                        ENUMERATED {min5, min10, min20, min30, min60, min120, min180, spare1}
    t320
                                                                                                                OPTIONAL,
                                                                                                                                 -- Need R
    . . .
PagingCycle ::=
                                    ENUMERATED {rf32, rf64, rf128, rf256}
FreqPriorityListEUTRA ::=
                                    SEQUENCE (SIZE (1..maxFreq)) OF FreqPriorityEUTRA
FreqPriorityListNR ::=
                                    SEQUENCE (SIZE (1..maxFreq)) OF FreqPriorityNR
FreqPriorityEUTRA ::=
                                    SEOUENCE {
    carrierFreq
                                        ARFCN-ValueEUTRA,
    cellReselectionPriority
                                        CellReselectionPriority,
                                                                                                                 OPTIONAL
    cellReselectionSubPriority
                                        CellReselectionSubPriority
                                                                                                                                 -- Need R
FreqPriorityNR ::=
                                    SEOUENCE {
    carrierFreq
                                        ARFCN-ValueNR,
    cellReselectionPriority
                                        CellReselectionPriority,
    cellReselectionSubPriority
                                        CellReselectionSubPriority
                                                                                                                 OPTIONAL
                                                                                                                                 -- Need R
```

```
RAN-NotificationAreaInfo ::=
                                   CHOICE {
    cellList
                                       PLMN-RAN-AreaCellList,
   ran-AreaConfiqList
                                       PLMN-RAN-AreaConfigList,
PLMN-RAN-AreaCellList ::=
                                   SEQUENCE (SIZE (1.. maxPLMNIdentities)) OF PLMN-RAN-AreaCell
PLMN-RAN-AreaCell ::=
                                   SEQUENCE {
   plmn-Identity
                                       PLMN-Identity
                                                                                                              OPTIONAL, -- Need S
                                       SEQUENCE (SIZE (1..32)) OF CellIdentity
   ran-AreaCells
PLMN-RAN-AreaConfigList ::=
                                   SEQUENCE (SIZE (1..maxPLMNIdentities)) OF PLMN-RAN-AreaConfig
PLMN-RAN-AreaConfig ::=
                                   SEOUENCE {
   plmn-Identity
                                       PLMN-Identity
                                                                                                              OPTIONAL, -- Need S
                                       SEQUENCE (SIZE (1..16)) OF RAN-AreaConfig
   ran-Area
RAN-AreaConfig ::=
                                   SEQUENCE {
    trackingAreaCode
                               TrackingAreaCode,
    ran-AreaCodeList
                               SEQUENCE (SIZE (1..32)) OF RAN-AreaCode
                                                                              OPTIONAL
                                                                                         -- Need R
-- TAG-RRCRELEASE-STOP
-- ASN1STOP
```

RRCRelease-IEs field descriptions

cnType

Indicate that the UE is redirected to EPC or 5GC.

deprioritisationReg

Indicates whether the current frequency or RAT is to be de-prioritised.

deprioritisationTimer

Indicates the period for which either the current carrier frequency or NR is deprioritised. Value minN corresponds to N minutes.

suspendConfig

Indicates configuration for the RRC_INACTIVE state. The network does not configure suspendConfig when the network redirect the UE to an inter-RAT carrier frequency.

redirectedCarrierInfo

Indicates a carrier frequency (downlink for FDD) and is used to redirect the UE to an NR or an inter-RAT carrier frequency, by means of cell selection at transition to RRC_IDLE or RRC_INACTIVE as specified in TS 38.304 [20]. In this release of specification, redirectedCarrierInfo is not included in an RRCRelease message with suspendConfig if this message is in response to an RRCResumeRequest or an RRCResumeRequest1 which is triggered by the NAS layer.

CarrierInfoNR field descriptions

carrierFreq

Indicates the redirected NR frequency.

ssbSubcarrierSpacing

Subcarrier spacing of SSB in the redirected SSB frequency. Only the values 15 kHz or 30 kHz (FR1), and 120 kHz or 240 kHz (FR2) are applicable.

smtc

The SSB periodicity/offset/duration configuration for the redirected SSB frequency. It is based on timing reference of PCell. If the field is absent, the UE uses the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing.

RAN-NotificationAreaInfo field descriptions

cellList

A list of cells configured as RAN area.

ran-AreaConfigList

A list of RAN area codes or RA code(s) as RAN area.

PLMN-RAN-AreaConfig field descriptions

plmn-Identity

PLMN Identity to which the cells in ran-Area belong. If the field is absent the UE uses the ID of the registered PLMN.

ran-AreaCodeList

The total number of RAN-AreaCodes of all PLMNs does not exceed 32.

ran-Area

Indicates whether TA code(s) or RAN area code(s) are used for the RAN notification area. The network uses only TA code(s) or both TA code(s) and RAN area code(s) to configure a UE. The total number of TACs across all PLMNs does not exceed 16.

PLMN-RAN-AreaCell field descriptions

plmn-Identity

PLMN Identity to which the cells in ran-AreaCells belong. If the field is absent the UE uses the ID of the registered PLMN.

ran-AreaCells

The total number of cells of all PLMNs does not exceed 32.

SuspendConfig field descriptions

ran-NotificationAreaInfo

Network ensures that the UE in RRC INACTIVE always has a valid ran-NotificationAreaInfo.

ran-PagingCycle

Refers to the UE specific cycle for RAN-initiated paging. Value rf32 corresponds to 32 radio frames, value rf64 corresponds to 64 radio frames and so on.

t380

Refers to the timer that triggers the periodic RNAU procedure in UE. Value min5 corresponds to 5 minutes, value min10 corresponds to 10 minutes and so on.

RRCResume

The *RRCResume* message is used to resume the suspended RRC connection.

Signalling radio bearer: SRB1

RLC-SAP: AM

-- TAG-RRCRESUME-STOP

-- ASN1STOP

Logical channel: DCCH

Direction: Network to UE

RRCResume message

```
-- ASN1START
-- TAG-RRCRESUME-START
RRCResume ::=
                                    SEQUENCE {
    rrc-TransactionIdentifier
                                        RRC-TransactionIdentifier,
    criticalExtensions
                                        CHOICE {
                                            RRCResume-IEs,
        rrcResume
                                            SEQUENCE {}
        criticalExtensionsFuture
RRCResume-IEs ::=
                                    SEQUENCE {
   radioBearerConfig
                                        RadioBearerConfig
                                                                                                                 OPTIONAL, -- Need M
    masterCellGroup
                                        OCTET STRING (CONTAINING CellGroupConfig)
                                                                                                                 OPTIONAL, -- Need M
                                                                                                                 OPTIONAL, -- Need M
    measConfig
                                        MeasConfig
    fullConfig
                                        ENUMERATED {true}
                                                                                                                 OPTIONAL, -- Need N
    lateNonCriticalExtension
                                        OCTET STRING
                                                                                                                 OPTIONAL,
    nonCriticalExtension
                                        RRCResume-v1560-IEs
                                                                                                                 OPTIONAL
RRCResume-v1560-IEs ::=
                                    SEQUENCE {
    radioBearerConfig2
                                        OCTET STRING (CONTAINING RadioBearerConfig)
                                                                                                                 OPTIONAL, -- Need M
    sk-Counter
                                        SK-Counter
                                                                                                                 OPTIONAL, -- Need N
    nonCriticalExtension
                                        SEQUENCE { }
                                                                                                                 OPTIONAL
```

RRCResume-IEs field descriptions

masterCellGroup

Configuration of the master cell group.

radioBearerConfig

Configuration of Radio Bearers (DRBs, SRBs) including SDAP/PDCP.

radioBearerConfig2

Configuration of Radio Bearers (DRBs, SRBs) including SDAP/PDCP. This field can only be used if the UE supports NR-DC or NE-DC.

sk-Counter

A counter used to derive S-K_{gNB} or S-K_{eNB} based on the newly derived K_{gNB} during RRC Resume. The field is only included when there is one or more RB with *keyToUse* set to *secondary*.

RRCResumeComplete

The RRCResumeComplete message is used to confirm the successful completion of an RRC connection resumption.

Signalling radio bearer: SRB1

RLC-SAP: AM

-- ASN1STOP

Logical channel: DCCH

Direction: UE to Network

RRCResumeComplete message

```
-- ASN1START
-- TAG-RRCRESUMECOMPLETE-START
RRCResumeComplete ::=
                                        SEOUENCE {
    rrc-TransactionIdentifier
                                            RRC-TransactionIdentifier,
    criticalExtensions
                                            CHOICE {
                                                RRCResumeComplete-IEs,
       rrcResumeComplete
        criticalExtensionsFuture
                                                SEOUENCE {}
RRCResumeComplete-IEs ::=
                                        SEOUENCE {
    dedicatedNAS-Message
                                            DedicatedNAS-Message
    selectedPLMN-Identity
                                            INTEGER (1..maxPLMN)
    uplinkTxDirectCurrentList
                                            UplinkTxDirectCurrentList
   lateNonCriticalExtension
                                            OCTET STRING
    nonCriticalExtension
                                            SEQUENCE { }
-- TAG-RRCRESUMECOMPLETE-STOP
```

OPTIONAL, OPTIONAL, OPTIONAL, OPTIONAL

RRCResumeComplete-IEs field descriptions

selectedPLMN-Identity

Index of the PLMN selected by the UE from the plmn-IdentityInfoList fields included in SIB1.

uplinkTxDirectCurrentList

The Tx Direct Current locations for the configured serving cells and BWPs if requested by the NW (see reportUplinkTxDirectCurrent in CellGroupConfig).

– RRCResumeRequest

The RRCResumeRequest message is used to request the resumption of a suspended RRC connection or perform an RNA update.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: UE to Network

RRCResumeRequest message

```
-- ASN1START
-- TAG-RRCRESUMEREQUEST-START
RRCResumeRequest ::=
                                SEQUENCE {
       rrcResumeRequest
                                   RRCResumeRequest-IEs
RRCResumeRequest-IEs ::=
                               SEQUENCE {
    resumeIdentity
                                   ShortI-RNTI-Value,
    resumeMAC-I
                                   BIT STRING (SIZE (16)),
    resumeCause
                                   ResumeCause,
                                   BIT STRING (SIZE (1))
    spare
-- TAG-RRCRESUMEREQUEST-STOP
-- ASN1STOP
```

RRCResumeRequest-IEs field descriptions

resumeCause

Provides the resume cause for the RRC connection resume request as provided by the upper layers or RRC. The network is not expected to reject an *RRCResumeRequest* due to unknown cause value being used by the UE.

resumeldentity

UE identity to facilitate UE context retrieval at gNB.

resumeMAC-I

Authentication token to facilitate UE authentication at gNB. The 16 least significant bits of the MAC-I calculated using the AS security configuration as specified in 5.3.13.3.

– RRCResumeRequest1

The RRCResumeRequest1 message is used to request the resumption of a suspended RRC connection or perform an RNA update.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH1

Direction: UE to Network

RRCResumeRequest1 message

RRCResumeRequest1-IEs field descriptions

resumeCause

Provides the resume cause for the *RRCResumeRequest1* as provided by the upper layers or RRC. A gNB is not expected to reject an *RRCResumeRequest1* due to unknown cause value being used by the UE.

resumeldentity

UE identity to facilitate UE context retrieval at gNB.

resumeMAC-I

Authentication token to facilitate UE authentication at gNB. The 16 least significant bits of the MAC-I calculated using the AS security configuration as specified in 5.3.13.3.

RRCSetup

The *RRCSetup* message is used to establish SRB1.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: Network to UE

RRCSetup message

```
-- ASN1START
-- TAG-RRCSETUP-START
RRCSetup ::=
                                   SEQUENCE {
   rrc-TransactionIdentifier
                                       RRC-TransactionIdentifier,
   criticalExtensions
                                       CHOICE {
                                           RRCSetup-IEs,
       rrcSetup
       criticalExtensionsFuture
                                          SEQUENCE {}
RRCSetup-IEs ::=
                                   SEOUENCE {
    radioBearerConfig
                                       RadioBearerConfig,
   masterCellGroup
                                       OCTET STRING (CONTAINING CellGroupConfig),
   lateNonCriticalExtension
                                       OCTET STRING
                                                                                                              OPTIONAL,
    nonCriticalExtension
                                       SEQUENCE { }
                                                                                                              OPTIONAL
-- TAG-RRCSETUP-STOP
```

RRCSetup-IEs field descriptions

masterCellGroup

-- ASN1STOP

The network configures only the RLC bearer for the SRB1, mac-CellGroupConfig, physicalCellGroupConfig and spCellConfig.

radioBearerConfig

Only SRB1 can be configured in RRC setup.

RRCSetupComplete

The RRCSetupComplete message is used to confirm the successful completion of an RRC connection establishment.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

RRCSetupComplete message

```
-- ASN1START
-- TAG-RRCSETUPCOMPLETE-START
RRCSetupComplete ::=
   rrc-TransactionIdentifier
                                       RRC-TransactionIdentifier,
    criticalExtensions
                                       CHOICE {
       rrcSetupComplete
                                           RRCSetupComplete-IEs,
       criticalExtensionsFuture
                                           SEOUENCE {}
RRCSetupComplete-IEs ::=
                                   SEOUENCE {
    selectedPLMN-Identity
                                       INTEGER (1..maxPLMN),
    registeredAMF
                                       RegisteredAMF
                                                                                       OPTIONAL,
    guami-Type
                                       ENUMERATED {native, mapped}
                                                                                       OPTIONAL,
                                       SEQUENCE (SIZE (1..maxNrofS-NSSAI)) OF S-NSSAI OPTIONAL,
    s-NSSAI-List
    dedicatedNAS-Message
                                       DedicatedNAS-Message,
                                       CHOICE {
    ng-5G-S-TMSI-Value
       ng-5G-S-TMSI
                                           NG-5G-S-TMSI,
       ng-5G-S-TMSI-Part2
                                           BIT STRING (SIZE (9))
                                                                                       OPTIONAL,
    lateNonCriticalExtension
                                       OCTET STRING
                                                                                       OPTIONAL,
    nonCriticalExtension
                                       SEOUENCE { }
                                                                                       OPTIONAL
                                   SEQUENCE {
RegisteredAMF ::=
    plmn-Identity
                                       PLMN-Identity
                                                                                       OPTIONAL,
    amf-Identifier
                                       AMF-Identifier
-- TAG-RRCSETUPCOMPLETE-STOP
```

RRCSetupComplete-IEs field descriptions

guami-Type

-- ASN1STOP

This field is used to indicate whether the GUAMI included is native (derived from native 5G-GUTI) or mapped (from EPS, derived from EPS GUTI) as specified in TS 24.501 [23].

ng-5G-S-TMSI-Part2

The leftmost 9 bits of 5G-S-TMSI.

registeredAMF

This field is used to transfer the GUAMI of the AMF where the UE is registered, as provided by upper layers, see TS 23.003 [21].

selectedPLMN-Identity

Index of the PLMN selected by the UE from the plmn-IdentityInfoList fields included in SIB1.

RRCSetupRequest

The RRCSetupRequest message is used to request the establishment of an RRC connection.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: UE to Network

RRCSetupRequest message

```
-- ASN1START
-- TAG-RRCSETUPREQUEST-START
RRCSetupRequest ::=
                                    SEQUENCE {
    rrcSetupRequest
                                        RRCSetupRequest-IEs
RRCSetupRequest-IEs ::=
                                    SEOUENCE {
    ue-Identity
                                        InitialUE-Identity,
    establishmentCause
                                        EstablishmentCause,
                                        BIT STRING (SIZE (1))
    spare
                                    CHOICE {
InitialUE-Identity ::=
   ng-5G-S-TMSI-Part1
                                       BIT STRING (SIZE (39)),
   randomValue
                                        BIT STRING (SIZE (39))
EstablishmentCause ::=
                                    ENUMERATED {
                                        emergency, highPriorityAccess, mt-Access, mo-Signalling,
                                        mo-Data, mo-VoiceCall, mo-VideoCall, mo-SMS, mps-PriorityAccess, mcs-PriorityAccess,
                                        spare6, spare5, spare4, spare3, spare2, spare1}
-- TAG-RRCSETUPREQUEST-STOP
```

RRCSetupRequest-IEs field descriptions

establishmentCause

Provides the establishment cause for the *RRCSetupRequest* in accordance with the information received from upper layers. gNB is not expected to reject an *RRCSetupRequest* due to unknown cause value being used by the UE.

ue-Identity

-- ASN1STOP

UE identity included to facilitate contention resolution by lower layers.

InitialUE-Identity field descriptions

ng-5G-S-TMSI-Part1

The rightmost 39 bits of 5G-S-TMSI.

randomValue

Integer value in the range 0 to $2^{39} - 1$.

RRCSystemInfoRequest

The RRCSystemInfoRequest message is used to request SI message(s) required by the UE as specified in clause 5.2.2.3.3.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: UE to Network

RRCSystemInfoRequest message

```
-- ASNISTART
-- TAG-RRCSYSTEMINFOREQUEST-START

RRCSystemInfoRequest ::= SEQUENCE {
    criticalExtensions CHOICE {
        rrcSystemInfoRequest SEQUENCE {
        criticalExtensionsFuture SEQUENCE {
        requested-SI-List BIT STRING (SIZE (maxSI-Message)), --32bits spare BIT STRING (SIZE (12))
}

-- TAG-RRCSYSTEMINFOREQUEST-STOP -- ASNISTOP
```

RRCSystemInfoRequest-IEs field descriptions

requested-SI-List

Contains a list of requested SI messages. According to the order of entry in the list of SI messages configured by *schedulingInfoList* in si-*SchedulingInfo* in *SIB1*, first bit corresponds to first/leftmost listed SI message, second bit corresponds to second listed SI message, and so on.

SCGFailureInformation

The SCGFailureInformation message is used to provide information regarding NR SCG failures detected by the UE.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

SCGFailureInformation message

```
-- ASN1START
-- TAG-SCGFAILUREINFORMATION-START
SCGFailureInformation ::=
                                         SEQUENCE {
                                         CHOICE {
    criticalExtensions
                                                 SCGFailureInformation-IEs,
       scgFailureInformation
                                                SEQUENCE {}
       criticalExtensionsFuture
SCGFailureInformation-IEs ::=
                                         SEOUENCE {
    failureReportSCG
                                                 FailureReportSCG
                                                                                        OPTIONAL,
                                                SCGFailureInformation-v1590-IEs OPTIONAL
    nonCriticalExtension
SCGFailureInformation-v1590-IEs ::= SEQUENCE {
    lateNonCriticalExtension
                                         OCTET STRING
                                                                   OPTIONAL,
                                         SEQUENCE {}
    nonCriticalExtension
                                                                   OPTIONAL
FailureReportSCG ::=
                                          SEQUENCE {
    failureType
                                                  ENUMERATED {
                                                          t310-Expiry, randomAccessProblem,
                                                          rlc-MaxNumRetx,
                                                          synchReconfigFailureSCG, scg-ReconfigFailure,
                                                          srb3-IntegrityFailure, spare2, spare1},
                                                MeasResultFreqList
                                                                                         OPTIONAL.
    measResultFreqList
    measResultSCG-Failure
                                               OCTET STRING (CONTAINING MeasResultSCG-Failure)
                                                                                                                            OPTIONAL,
MeasResultFreqList ::=
                                    SEQUENCE (SIZE (1..maxFreq)) OF MeasResult2NR
-- TAG-SCGFAILUREINFORMATION-STOP
-- ASN1STOP
```

SCGFailureInformation field descriptions

measResultFreqList

The field contains available results of measurements on NR frequencies the UE is configured to measure by measConfig.

measResultSCG-Failure

The field contains the MeasResultSCG-Failure IE which includes available results of measurements on NR frequencies the UE is configured to measure by the NR SCG RRCReconfiguration message.

SCGFailureInformationEUTRA

The SCGFailureInformationEUTRA message is used to provide information regarding E-UTRA SCG failures detected by the UE.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

SCGFailureInformationEUTRA message

```
-- ASN1START
-- TAG-SCGFAILUREINFORMATIONEUTRA-START
SCGFailureInformationEUTRA ::=
                                              SEQUENCE {
                                                     CHOICE {
    criticalExtensions
                                                        SCGFailureInformationEUTRA-IEs,
       scgFailureInformationEUTRA
       criticalExtensionsFuture
                                                         SEQUENCE {}
SCGFailureInformationEUTRA-IEs ::=
                                             SEOUENCE {
    failureReportSCG-EUTRA
                                                    FailureReportSCG-EUTRA
                                                                                                OPTIONAL,
    nonCriticalExtension
                                                     SCGFailureInformationEUTRA-v1590-IEs
SCGFailureInformationEUTRA-v1590-IEs ::= SEQUENCE {
   lateNonCriticalExtension
                                             OCTET STRING
                                                                     OPTIONAL,
    nonCriticalExtension
                                             SEQUENCE {}
                                                                     OPTIONAL
FailureReportSCG-EUTRA ::=
                                              SEQUENCE {
    failureType
                                                        ENUMERATED {
                                                               t313-Expiry, randomAccessProblem,
                                                               rlc-MaxNumRetx, scg-ChangeFailure, spare4,
                                                               spare3, spare2, spare1},
    measResultFreqListMRDC
                                                     MeasResultFreqListFailMRDC
                                                                                               OPTIONAL,
    measResultSCG-FailureMRDC
                                                    OCTET STRING
                                                                                          OPTIONAL,
```

```
}
MeasResultFreqListFailMRDC ::= SEQUENCE (SIZE (1.. maxFreq)) OF MeasResult2EUTRA
-- TAG-SCGFAILUREINFORMATIONEUTRA-STOP
-- ASN1STOP
```

SCGFailureInformationEUTRA field descriptions

measResultFreqListMRDC

The field contains available results of measurements on E-UTRA frequencies the UE is configured to measure by measConfig.

measResultSCG-FailureMRDC

Includes the E-UTRA MeasResultSCG-FailureMRDC IE as specified in TS 36.331 [10]. The field contains available results of measurements on E-UTRA frequencies the UE is configured to measure by the E-UTRA RRCConnectionReconfiguration message.

SecurityModeCommand

The SecurityModeCommand message is used to command the activation of AS security.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

SecurityModeCommand message

```
-- ASN1START
-- TAG-SECURITYMODECOMMAND-START
                                    SEQUENCE {
SecurityModeCommand ::=
    rrc-TransactionIdentifier
                                        RRC-TransactionIdentifier,
    criticalExtensions
       securityModeCommand
                                            SecurityModeCommand-IEs,
        criticalExtensionsFuture
                                            SEQUENCE {}
SecurityModeCommand-IEs ::=
                                    SEQUENCE
    securityConfigSMC
                                        SecurityConfigSMC,
    lateNonCriticalExtension
                                        OCTET STRING
                                                                                                                 OPTIONAL,
                                        SEQUENCE { }
    nonCriticalExtension
                                                                                                                 OPTIONAL
SecurityConfigSMC ::=
                                    SEQUENCE {
    securityAlgorithmConfig
                                        SecurityAlgorithmConfig,
```

```
}
-- TAG-SECURITYMODECOMMAND-STOP
-- ASN1STOP
```

SecurityModeComplete

The SecurityModeComplete message is used to confirm the successful completion of a security mode command.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

SecurityModeComplete message

OPTIONAL,

SecurityModeFailure

The SecurityModeFailure message is used to indicate an unsuccessful completion of a security mode command.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

SecurityModeFailure message

```
-- ASN1START
-- TAG-SECURITYMODEFAILURE-START
SecurityModeFailure ::=
                                             SEOUENCE {
    rrc-TransactionIdentifier RRC-TransactionIdentifier,
criticalExtensions CHOICE {
    securityModeFailure SecurityModeFailure-IE:
    criticalExtensionsFuture SEQUENCE {}
                                                        SecurityModeFailure-IEs,
SecurityModeFailure-IEs ::=
                                             SEQUENCE {
     lateNonCriticalExtension
                                                  OCTET STRING
                                                                                                                                                OPTIONAL,
     nonCriticalExtension
                                                   SEQUENCE { }
                                                                                                                                                OPTIONAL
-- TAG-SECURITYMODEFAILURE-STOP
-- ASN1STOP
```

- SIB1

SIB1 contains information relevant when evaluating if a UE is allowed to access a cell and defines the scheduling of other system information. It also contains radio resource configuration information that is common for all UEs and barring information applied to the unified access control.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channels: BCCH

Direction: Network to UE

SIB1 message

```
-- ASN1START
-- TAG-SIB1-START
SIB1 ::=
               SEQUENCE {
   cellSelectionInfo
                                       SEQUENCE {
       q-RxLevMin
                                          Q-RxLevMin,
       q-RxLevMinOffset
                                          INTEGER (1..8)
                                                                                                     OPTIONAL, -- Need S
                                                                                                     OPTIONAL, -- Need R
       q-RxLevMinSUL
                                          O-RxLevMin
       q-QualMin
                                          Q-QualMin
                                                                                                     OPTIONAL, -- Need S
```

```
q-OualMinOffset
                                           INTEGER (1..8)
                                                                                                       OPTIONAL
                                                                                                                   -- Need S
                                                                                                       OPTIONAL,
                                                                                                                   -- Cond Standalone
    cellAccessRelatedInfo
                                       CellAccessRelatedInfo.
                                       ConnEstFailureControl
    connEstFailureControl
                                                                                                       OPTIONAL,
                                                                                                                  -- Need R
    si-SchedulingInfo
                                       SI-SchedulingInfo
                                                                                                       OPTIONAL, -- Need R
    servingCellConfigCommon
                                       ServingCellConfigCommonSIB
                                                                                                       OPTIONAL, -- Need R
    ims-EmergencySupport
                                       ENUMERATED {true}
                                                                                                       OPTIONAL,
                                                                                                                  -- Need R
                                       ENUMERATED {true}
    eCallOverIMS-Support
                                                                                                       OPTIONAL, -- Cond Absent
    ue-TimersAndConstants
                                       UE-TimersAndConstants
                                                                                                       OPTIONAL,
                                                                                                                  -- Need R
    uac-BarringInfo
                                       SEQUENCE {
                                           UAC-BarringPerCatList
                                                                                                       OPTIONAL, -- Need S
       uac-BarringForCommon
       uac-BarringPerPLMN-List
                                           UAC-BarringPerPLMN-List
                                                                                                       OPTIONAL, -- Need S
       uac-BarringInfoSetList
                                           UAC-BarringInfoSetList,
       uac-AccessCategoryl-SelectionAssistanceInfo CHOICE {
           plmnCommon
                                                UAC-AccessCategoryl-SelectionAssistanceInfo,
                                                SEQUENCE (SIZE (2..maxPLMN)) OF UAC-AccessCategory1-SelectionAssistanceInfo
           individualPLMNList
                                                                                                       OPTIONAL
                                                                                                                   -- Need S
                                                                                                       OPTIONAL, -- Need R
    useFullResumeID
                                       ENUMERATED {true}
                                                                                                       OPTIONAL,
                                                                                                                  -- Need R
    lateNonCriticalExtension
                                       OCTET STRING
                                                                                                       OPTIONAL,
    nonCriticalExtension
                                       SEQUENCE { }
                                                                                                       OPTIONAL
UAC-AccessCategory1-SelectionAssistanceInfo ::=
                                                  ENUMERATED {a, b, c}
-- TAG-SIB1-STOP
-- ASN1STOP
```

SIB1 field descriptions

cellSelectionInfo

Parameters for cell selection related to the serving cell.

ims-EmergencySupport

Indicates whether the cell supports IMS emergency bearer services for UEs in limited service mode. If absent, IMS emergency call is not supported by the network in the cell for UEs in limited service mode.

g-QualMin

Parameter "Qqualmin" in TS 38.304 [20], applicable for serving cell. If the field is absent, the UE applies the (default) value of negative infinity for Qqualmin.

g-QualMinOffset

Parameter "Q_{qualminoffset}" in TS 38.304 [20]. Actual value Q_{qualminoffset} = field value [dB]. If the field is absent, the UE applies the (default) value of 0 dB for Q_{qualminoffset}. Affects the minimum required quality level in the cell.

q-RxLevMin

Parameter "Q_{rxlevmin}" in TS 38.304 [20], applicable for serving cell.

q-RxLevMinOffset

Parameter "Q_{rxlevminoffset}" in TS 38.304 [20]. Actual value Q_{rxlevminoffset} = field value * 2 [dB]. If absent, the UE applies the (default) value of 0 dB for Q_{rxlevminoffset}. Affects the minimum required Rx level in the cell.

g-RxLevMinSUL

Parameter "Q_{rxlevmin}" in TS 38.304 [20], applicable for serving cell.

servingCellConfigCommon

Configuration of the serving cell.

uac-AccessCategory1-SelectionAssistanceInfo

Information used to determine whether Access Category 1 applies to the UE, as defined in TS 22.261 [25].

uac-BarringForCommon

Common access control parameters for each access category. Common values are used for all PLMNs, unless overwritten by the PLMN specific configuration provided in *uac-BarringPerPLMN-List*. The parameters are specified by providing an index to the set of configurations (*uac-BarringInfoSetList*). UE behaviour upon absence of this field is specified in clause 5.3.14.2.

ue-TimersAndConstants

Timer and constant values to be used by the UE. The cell operating as PCell always provides this field.

useFullResumeID

Indicates which resume identifier and Resume request message should be used. UE uses *fullI-RNTI* and *RRCResumeRequest1* if the field is present, or *shortI-RNTI* and *RRCResumeRequest* if the field is absent.

Conditional Presence	Explanation
Absent	The field is not used in this version of the specification, if received the UE shall ignore.
Standalone	The field is mandatory present in a cell that supports standalone operation, otherwise it is absent.

SystemInformation

The SystemInformation message is used to convey one or more System Information Blocks. All the SIBs included are transmitted with the same periodicity.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channels: BCCH

Direction: Network to UE

SystemInformation message

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```
-- ASN1START
-- TAG-SYSTEMINFORMATION-START
SystemInformation ::=
                                    SEQUENCE {
                                        CHOICE {
    criticalExtensions
                                            SystemInformation-IEs,
        systemInformation
                                            SEQUENCE {}
        criticalExtensionsFuture
SystemInformation-IEs ::=
                                    SEQUENCE {
    sib-TypeAndInfo
                                        SEQUENCE (SIZE (1..maxSIB)) OF CHOICE {
        sib2
                                            SIB2,
        sib3
                                            SIB3,
        sib4
                                            SIB4,
        sib5
                                            SIB5,
        sib6
                                            SIB6,
        sib7
                                            SIB7,
        sib8
                                            SIB8,
        sib9
                                            SIB9,
    lateNonCriticalExtension
                                        OCTET STRING
                                                                             OPTIONAL,
    nonCriticalExtension
                                        SEQUENCE {}
                                                                             OPTIONAL
-- TAG-SYSTEMINFORMATION-STOP
-- ASN1STOP
```

UEAssistanceInformation

The UEAssistanceInformation message is used for the indication of UE assistance information to the network.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

UEAssistanceInformation message

```
-- ASN1START
-- TAG-UEASSISTANCEINFORMATION-START
UEAssistanceInformation ::=
                                    SEOUENCE {
    criticalExtensions
                                        CHOICE {
       ueAssistanceInformation
                                            UEAssistanceInformation-IEs,
        criticalExtensionsFuture
                                            SEQUENCE {}
UEAssistanceInformation-IEs ::=
                                    SEOUENCE {
    delayBudgetReport
                                        DelayBudgetReport
                                                                             OPTIONAL,
    lateNonCriticalExtension
                                        OCTET STRING
                                                                             OPTIONAL,
    nonCriticalExtension
                                        UEAssistanceInformation-v1540-IEs
                                                                            OPTIONAL
DelayBudgetReport::=
                                    CHOICE {
    type1
                                        ENUMERATED {
                                            msMinus1280, msMinus640, msMinus320, msMinus160, msMinus80, msMinus60, msMinus40,
                                            msMinus20, ms0, ms20, ms40, ms60, ms80, ms160, ms320, ms640, ms1280},
UEAssistanceInformation-v1540-IEs ::= SEQUENCE {
    overheatingAssistance
                                        OverheatingAssistance
                                                                             OPTIONAL,
    nonCriticalExtension
                                        SEQUENCE {}
                                                                             OPTIONAL
OverheatingAssistance ::=
                                    SEQUENCE {
    reducedMaxCCs
                                        SEOUENCE {
       reducedCCsDL
                                            INTEGER (0..31),
       reducedCCsUL
                                            INTEGER (0..31)
    } OPTIONAL,
    reducedMaxBW-FR1
                                        SEOUENCE {
                                            ReducedAggregatedBandwidth,
       reducedBW-FR1-DL
        reducedBW-FR1-UL
                                            ReducedAggregatedBandwidth
    } OPTIONAL,
    reducedMaxBW-FR2
                                        SEQUENCE {
                                            ReducedAggregatedBandwidth,
       reducedBW-FR2-DL
       reducedBW-FR2-UL
                                            ReducedAggregatedBandwidth
    } OPTIONAL,
    reducedMaxMIMO-LayersFR1
                                        SEQUENCE {
       reducedMIMO-LayersFR1-DL
                                            MIMO-LayersDL,
       reducedMIMO-LayersFR1-UL
                                            MIMO-LayersUL
    } OPTIONAL,
    reducedMaxMIMO-LayersFR2
                                        SEQUENCE {
        reducedMIMO-LayersFR2-DL
                                            MIMO-LayersDL,
                                            MIMO-LayersUL
        reducedMIMO-LayersFR2-UL
    } OPTIONAL
ReducedAggregatedBandwidth ::= ENUMERATED {mhz0, mhz10, mhz20, mhz40, mhz50, mhz60, mhz80, mhz100, mhz200, mhz300, mhz400}
```

- -- TAG-UEASSISTANCEINFORMATION-STOP
- -- ASN1STOP

UEAssistanceInformation field descriptions

delayBudgetReport

Indicates the UE-preferred adjustment to connected mode DRX.

reducedBW-FR1-DL

Indicates the UE's preference on reduced configuration corresponding to the maximum aggregated bandwidth across all downlink carrier(s) of FR1 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cell(s) operating on FR1. This maximum aggregated bandwidth includes downlink carrier(s) of FR1 of both the MCG and the SCG. Value *mhz0* is not used. The aggregated bandwidth across all downlink carrier(s) of FR1 is the sum of bandwidth of active downlink BWP(s) across all activated downlink carrier(s) of FR1.

reducedBW-FR1-UL

Indicates the UE's preference on reduced configuration corresponding to the maximum aggregated bandwidth across all uplink carrier(s) of FR1 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cell(s) operating on FR1. This maximum aggregated bandwidth includes uplink carrier(s) of FR1 of both the MCG and the SCG. Value *mhz0* is not used. The aggregated bandwidth across all uplink carrier(s) of FR1 is the sum of bandwidth of active uplink BWP(s) across all activated uplink carrier(s) of FR1.

reducedBW-FR2-DL

Indicates the UE's preference on reduced configuration corresponding to the maximum aggregated bandwidth across all downlink carrier(s) of FR2 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cell(s) operating on FR2. This maximum aggregated bandwidth includes downlink carrier(s) of FR2 of both the MCG and the NR SCG. The aggregated bandwidth across all downlink carrier(s) of FR2 is the sum of bandwidth of active downlink BWP(s) across all activated downlink carrier(s) of FR2.

reducedBW-FR2-UL

Indicates the UE's preference on reduced configuration corresponding to the maximum aggregated bandwidth across all uplink carrier(s) of FR2 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cell(s) operating on FR2. This maximum aggregated bandwidth includes uplink carrier(s) of FR2 of both the MCG and the NR SCG. The aggregated bandwidth across all uplink carrier(s) of FR2 is the sum of bandwidth of active uplink BWP(s) across all activated uplink carrier(s) of FR2.

reducedCCsDL

Indicates the UE's preference on reduced configuration corresponding to the maximum number of downlink SCells indicated by the field, to address overheating. This maximum number includes both SCells of the MCG and PSCell/SCells of the SCG.

reducedCCsUL

Indicates the UE's preference on reduced configuration corresponding to the maximum number of uplink SCells indicated by the field, to address overheating. This maximum number includes both SCells of the MCG and PSCell/SCells of the SCG.

reducedMIMO-LayersFR1-DL

Indicates the UE's preference on reduced configuration corresponding to the maximum number of downlink MIMO layers of each serving cell operating on FR1 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cells operating on FR1.

reducedMIMO-LaversFR1-UL

Indicates the UE's preference on reduced configuration corresponding to the maximum number of uplink MIMO layers of each serving cell operating on FR1 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cells operating on FR1.

reducedMIMO-LayersFR2-DL

Indicates the UE's preference on reduced configuration corresponding to the maximum number of downlink MIMO layers of each serving cell operating on FR2 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cells operating on FR2.

reducedMIMO-LayersFR2-UL

Indicates the UE's preference on reduced configuration corresponding to the maximum number of uplink MIMO layers of each serving cell operating on FR2 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cells operating on FR2.

type1

Indicates the preferred amount of increment/decrement to the long DRX cycle length with respect to the current configuration. Value in number of milliseconds. Value ms40 corresponds to 40 milliseconds, msMinus40 corresponds to -40 milliseconds and so on.

UECapabilityEnquiry

The UECapabilityEnquiry message is used to request UE radio access capabilities for NR as well as for other RATs.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

UECapabilityEnquiry message

```
-- ASN1START
-- TAG-UECAPABILITYENQUIRY-START
UECapabilityEnquiry ::=
                               SEQUENCE {
   rrc-TransactionIdentifier
                                        RRC-TransactionIdentifier,
   criticalExtensions
ueCapabilityEnquiry
                                        CHOICE {
       ueCapabilityEnquiry
criticalExtensionsFuture
                                            UECapabilityEnquiry-IEs,
                                            SEQUENCE {}
UECapabilityEnquiry-IEs ::=
                               SEQUENCE {
    ue-CapabilityRAT-RequestList
                                       UE-CapabilityRAT-RequestList,
   lateNonCriticalExtension
ue-CapabilityEnquiryExt
                                       OCTET STRING
                                       OCTET STRING (CONTAINING UECapabilityEnquiry-v1560-IEs)
UECapabilityEnquiry-v1560-IEs ::= SEQUENCE {
                                        UE-CapabilityRequestFilterCommon
    capabilityRequestFilterCommon
    nonCriticalExtension
                                        SEOUENCE { }
-- TAG-UECAPABILITYENQUIRY-STOP
```

OPTIONAL,
OPTIONAL -- Need N

OPTIONAL, -- Need N OPTIONAL

- UECapabilityInformation

The IE UECapabilityInformation message is used to transfer UE radio access capabilities requested by the network.

Signalling radio bearer: SRB1

RLC-SAP: AM

-- ASN1STOP

Logical channel: DCCH

Direction: UE to Network

UECapabilityInformation message

```
-- ASN1START
-- TAG-UECAPABILITYINFORMATION-START
                                    SEQUENCE {
UECapabilityInformation ::=
   rrc-TransactionIdentifier
                                        RRC-TransactionIdentifier,
    criticalExtensions
                                        CHOICE {
                                            UECapabilityInformation-IEs,
       ueCapabilityInformation
                                            SEQUENCE {}
        criticalExtensionsFuture
UECapabilityInformation-IEs ::=
                                    SEQUENCE {
    ue-CapabilityRAT-ContainerList
                                        UE-CapabilityRAT-ContainerList
                                                                                                                 OPTIONAL,
    lateNonCriticalExtension
                                        OCTET STRING
                                                                                                                 OPTIONAL,
    nonCriticalExtension
                                        SEQUENCE { }
                                                                                                                 OPTIONAL
-- TAG-UECAPABILITYINFORMATION-STOP
-- ASN1STOP
```

ULInformationTransfer

The ULInformationTransfer message is used for the uplink transfer of NAS or non-3GPP dedicated information.

Signalling radio bearer: SRB2 or SRB1 (only if SRB2 not established yet). If SRB2 is suspended, the UE does not send this message until SRB2 is resumed

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to network

ULInformationTransfer message

```
-- ASN1START
-- TAG-ULINFORMATIONTRANSFER-START

ULInformationTransfer ::= SEQUENCE {
    criticalExtensions CHOICE {
        ulInformationTransfer ULInformationTransfer-IEs,
        criticalExtensionsFuture SEQUENCE {}
}
```

```
ULInformationTransfer-IEs ::= SEQUENCE {
    dedicatedNAS-Message DedicatedNAS-Message OPTIONAL,
    lateNonCriticalExtension OCTET STRING OPTIONAL,
    nonCriticalExtension SEQUENCE {}

- TAG-ULINFORMATIONTRANSFER-STOP
- ASN1STOP
```

ULInformationTransferMRDC

The *ULInformationTransferMRDC* message is used for the uplink transfer of MR-DC dedicated information (e.g. for transferring the NR or E-UTRA RRC *MeasurementReport* message or the *FailureInformation* message).

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

ULInformationTransferMRDC message

```
-- ASN1START
-- TAG-ULINFORMATIONTRANSFERMRDC-START
ULInformationTransferMRDC ::=
                                            SEQUENCE {
    criticalExtensions
                                                CHOICE {
       c1
                                                    CHOICE
           ulInformationTransferMRDC
                                                        ULInformationTransferMRDC-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        criticalExtensionsFuture
                                            SEQUENCE {}
                                           SEQUENCE {
ULInformationTransferMRDC-IEs::=
    ul-DCCH-MessageNR
                                                OCTET STRING
                                                                                 OPTIONAL,
   ul-DCCH-MessageEUTRA
                                                OCTET STRING
                                                                                 OPTIONAL,
    lateNonCriticalExtension
                                                OCTET STRING
                                                                                OPTIONAL,
    nonCriticalExtension
                                                SEQUENCE {}
                                                                                 OPTIONAL
-- TAG-ULINFORMATIONTRANSFERMRDC-STOP
-- ASN1STOP
```

ULInformationTransferMRDC field descriptions

ul-DCCH-MessageNR

Includes the UL-DCCH-Message. In this version of the specification, the field is only used to transfer the NR RRC MeasurementReport and FailureInformation messages.

ul-DCCH-MessageEUTRA

Includes the UL-DCCH-Message. In this version of the specification, the field is only used to transfer the E-UTRA RRC MeasurementReport message.

6.3 RRC information elements

6.3.0 Parameterized types

SetupRelease

SetupRelease allows the ElementTypeParam to be used as the referenced data type for the setup and release entries. See A.3.8 for guidelines.

```
-- ASN1START
-- TAG-SETUPRELEASE-START

SetupRelease { ElementTypeParam } ::= CHOICE { release NULL, setup ElementTypeParam }

-- TAG-SETUPRELEASE-STOP
-- ASN1STOP
```

6.3.1 System information blocks

– SIB2

SIB2 contains cell re-selection information common for intra-frequency, inter-frequency and/or inter-RAT cell re-selection (i.e. applicable for more than one type of cell re-selection but not necessarily all) as well as intra-frequency cell re-selection information other than neighbouring cell related.

SIB2 information element

```
-- ASN1START
-- TAG-SIB2-START
SIB2 ::=
                                    SEQUENCE {
    cellReselectionInfoCommon
                                        SEQUENCE {
                                            INTEGER (2..maxNrofSS-BlocksToAverage)
                                                                                            OPTIONAL,
       nrofSS-BlocksToAverage
                                                                                                             -- Need S
       absThreshSS-BlocksConsolidation
                                            ThresholdNR
                                                                                            OPTIONAL,
                                                                                                            -- Need S
       rangeToBestCell
                                            RangeToBestCell
                                                                                            OPTIONAL,
                                                                                                             -- Need R
```

```
ENUMERATED {
        q-Hyst
                                                 dB0, dB1, dB2, dB3, dB4, dB5, dB6, dB8, dB10,
                                                 dB12, dB14, dB16, dB18, dB20, dB22, dB24},
        speedStateReselectionPars
                                             SEOUENCE
            mobilityStateParameters
                                                 MobilityStateParameters,
                                             SEQUENCE {
            q-HystSF
                sf-Medium
                                                 ENUMERATED {dB-6, dB-4, dB-2, dB0},
                                                 ENUMERATED {dB-6, dB-4, dB-2, dB0}
                sf-High
                                                                                              OPTIONAL,
                                                                                                               -- Need R
                                        SEOUENCE {
    cellReselectionServingFreqInfo
        s-NonIntraSearchP
                                             ReselectionThreshold
                                                                                              OPTIONAL,
                                                                                                               -- Need S
        s-NonIntraSearchO
                                             ReselectionThresholdO
                                                                                                               -- Need S
                                                                                              OPTIONAL,
        threshServingLowP
                                             ReselectionThreshold,
                                             ReselectionThresholdO
        threshServingLow0
                                                                                              OPTIONAL,
                                                                                                               -- Need R
        cellReselectionPriority
                                             CellReselectionPriority,
        cellReselectionSubPriority
                                             CellReselectionSubPriority
                                                                                              OPTIONAL,
                                                                                                               -- Need R
    intraFreqCellReselectionInfo
                                        SEQUENCE {
        q-RxLevMin
                                             Q-RxLevMin,
        q-RxLevMinSUL
                                             O-RxLevMin
                                                                                              OPTIONAL,
                                                                                                               -- Need R
        q-QualMin
                                             O-OualMin
                                                                                              OPTIONAL,
                                                                                                               -- Need S
        s-IntraSearchP
                                             ReselectionThreshold,
                                             ReselectionThresholdO
                                                                                                               -- Need S
        s-IntraSearchO
                                                                                              OPTIONAL,
        t-ReselectionNR
                                             T-Reselection,
                                             MultiFrequencyBandListNR-SIB
        frequencyBandList
                                                                                              OPTIONAL,
                                                                                                               -- Need S
                                             MultiFrequencyBandListNR-SIB
                                                                                                               -- Need R
        frequencyBandListSUL
                                                                                              OPTIONAL,
        p-Max
                                             P-Max
                                                                                              OPTIONAL,
                                                                                                               -- Need S
                                             SSB-MTC
                                                                                              OPTIONAL,
                                                                                                               -- Need S
        smtc
        ss-RSSI-Measurement
                                             SS-RSSI-Measurement
                                                                                              OPTIONAL,
                                                                                                               -- Need R
                                                                                                               -- Need S
        ssb-ToMeasure
                                             SSB-ToMeasure
                                                                                              OPTIONAL,
        deriveSSB-IndexFromCell
                                             BOOLEAN,
        . . . ,
        ] ]
        t-ReselectionNR-SF
                                             SpeedStateScaleFactors
                                                                                              OPTIONAL
                                                                                                               -- Need N
        ]]
RangeToBestCell
                   ::= Q-OffsetRange
-- TAG-SIB2-STOP
-- ASN1STOP
```

SIB2 field descriptions

absThreshSS-BlocksConsolidation

Threshold for consolidation of L1 measurements per RS index. If the field is absent, the UE uses the measurement quantity as specified in TS 38.304 [20].

cellReselectionInfoCommon

Cell re-selection information common for intra-frequency, inter-frequency and/ or inter-RAT cell re-selection.

cellReselectionServingFreqInfo

Information common for non-intra-frequency cell re-selection i.e. cell re-selection to inter-frequency and inter-RAT cells.

deriveSSB-IndexFromCell

This field indicates whether the UE can utilize serving cell timing to derive the index of SS block transmitted by neighbour cell. If this field is set to *true*, the UE assumes SFN and frame boundary alignment across cells on the serving frequency as specified in TS 38.133 [14].

frequencyBandList

Indicates the list of frequency bands for which the NR cell reselection parameters apply. The UE behaviour in case the field is absent is described in clause 5.2.2.4.3.

intraFreqCellReselectionInfo

Cell re-selection information common for intra-frequency cells.

nrof\$\$-BlocksToAverage

Number of SS blocks to average for cell measurement derivation. If the field is absent the UE uses the measurement quantity as specified in TS 38.304 [20].

p-Max

Value in dBm applicable for the intra-frequency neighbouring NR cells. If absent the UE applies the maximum power according to TS 38.101-1 [15] in case of an FR1 cell or TS 38.101-2 [39] in case of an FR2 cell. In this release of the specification, if *p-Max* is present on a carrier frequency in FR2, the UE shall ignore the field and applies the maximum power according to TS 38.101-2 [39].

q-Hyst

Parameter "Q_{hyst}" in TS 38.304 [20], Value in dB. Value dB1 corresponds to 1 dB, dB2 corresponds to 2 dB and so on.

q-HystSF

Parameter "Speed dependent ScalingFactor for Qhyst" in TS 38.304 [20]. The *sf-Medium* and *sf-High* concern the additional hysteresis to be applied, in Medium and High Mobility state respectively, to Qhyst as defined in TS 38.304 [20]. In dB. Value *dB-6* corresponds to -6dB, *dB-4* corresponds to -4dB and so on.

a-QualMin

Parameter "Q_{aualmin}" in TS 38.304 [20], applicable for intra-frequency neighbour cells. If the field is absent, the UE applies the (default) value of negative infinity for Q_{aualmin}.

q-RxLevMin

Parameter "Q_{rxlevmin}" in TS 38.304 [20], applicable for intra-frequency neighbour cells.

q-RxLevMinSUL

Parameter "Q_{rxlevmin}" in TS 38.304 [20], applicable for intra-frequency neighbour cells.

rangeToBestCell

Parameter "rangeToBestCell" in TS 38.304 [20]. The network configures only non-negative (in dB) values.

s-IntraSearchP

Parameter "S_{IntraSearchP}" in TS 38.304 [20].

s-IntraSearchQ

Parameter "SIntraSearchQ" in TS 38.304 [20]. If the field is absent, the UE applies the (default) value of 0 dB for SIntraSearchQ.

s-NonIntraSearchP

Parameter "SnonlntraSearchP" in TS 38.304 [20]. If this field is absent, the UE applies the (default) value of infinity for SnonlntraSearchP.

s-NonIntraSearchQ

Parameter "SnonIntraSearchQ" in TS 38.304 [20]. If the field is absent, the UE applies the (default) value of 0 dB for SnonIntraSearchQ.

smtc

Measurement timing configuration for intra-frequency measurement. If this field is absent, the UE assumes that SSB periodicity is 5 ms for the intra-frequency cells.

ssb-ToMeasure

The set of SS blocks to be measured within the SMTC measurement duration (see TS 38.215 [9]). When the field is absent the UE measures on all SS-blocks.

- SIB3

SIB3 contains neighbouring cell related information relevant only for intra-frequency cell re-selection. The IE includes cells with specific re-selection parameters as well as blacklisted cells.

SIB3 information element

```
-- ASN1START
-- TAG-SIB3-START
SIB3 ::=
                                   SEOUENCE {
    intraFreqNeighCellList
                                       IntraFreqNeighCellList
                                                                   OPTIONAL,
                                                                             -- Need R
   intraFreqBlackCellList
                                       IntraFreqBlackCellList
                                                                   OPTIONAL, -- Need R
                                       OCTET STRING
                                                                   OPTIONAL,
   lateNonCriticalExtension
                                   SEQUENCE (SIZE (1..maxCellIntra)) OF IntraFreqNeighCellInfo
IntraFreqNeighCellList ::=
IntraFreqNeighCellInfo ::=
                                   SEOUENCE {
   physCellId
                                       PhysCellId,
    q-OffsetCell
                                       Q-OffsetRange,
    q-RxLevMinOffsetCell
                                       INTEGER (1..8)
                                                                   OPTIONAL, -- Need R
   q-RxLevMinOffsetCellSUL
                                       INTEGER (1..8)
                                                                   OPTIONAL, -- Need R
                                                                   OPTIONAL, -- Need R
                                       INTEGER (1..8)
   q-QualMinOffsetCell
IntraFreqBlackCellList ::=
                                   SEQUENCE (SIZE (1..maxCellBlack)) OF PCI-Range
-- TAG-SIB3-STOP
-- ASN1STOP
```

IntraFreqBlackCellList List of blacklisted intra-frequency neighbouring cells. IntraFreqNeighCellList List of intra-frequency neighbouring cells with specific cell re-selection parameters. q-OffsetCell Parameter "Qoffsets,n" in TS 38.304 [20]. q-QualMinOffsetCell Parameter "Qqualminoffsetcell" in TS 38.304 [20]. Actual value Qqualminoffsetcell = field value [dB]. q-RxLevMinOffsetCell Parameter "Qrxlevminoffsetcell" in TS 38.304 [20]. Actual value Qrxlevminoffsetcell = field value * 2 [dB]. q-RxLevMinOffsetCellSUL Parameter "QrxlevminoffsetcellSUL" in TS 38.304 [20]. Actual value Qrxlevminoffsetcells = field value * 2 [dB].

– SIB4

SIB4 contains information relevant only for inter-frequency cell re-selection i.e. information about other NR frequencies and inter-frequency neighbouring cells relevant for cell re-selection. The IE includes cell re-selection parameters common for a frequency as well as cell specific re-selection parameters.

SIB4 information element

```
-- ASN1START
-- TAG-SIB4-START
    interFreqCarrierFreqList
                                       InterFreqCarrierFreqList,
   lateNonCriticalExtension
                                       OCTET STRING
                                                                                    OPTIONAL,
InterFreqCarrierFreqList ::=
                                   SEQUENCE (SIZE (1..maxFreq)) OF InterFreqCarrierFreqInfo
InterFreqCarrierFreqInfo ::=
                                   SEOUENCE {
    dl-CarrierFreq
                                       ARFCN-ValueNR,
    frequencyBandList
                                       MultiFrequencyBandListNR-SIB
                                                                                   OPTIONAL,
                                                                                               -- Cond Mandatory
    frequencyBandListSUL
                                       MultiFrequencyBandListNR-SIB
                                                                                   OPTIONAL,
                                                                                               -- Need R
    nrofSS-BlocksToAverage
                                       INTEGER (2..maxNrofSS-BlocksToAverage)
                                                                                               -- Need S
                                                                                   OPTIONAL,
    absThreshSS-BlocksConsolidation
                                       ThresholdNR
                                                                                   OPTIONAL, -- Need S
                                       SSB-MTC
                                                                                   OPTIONAL, -- Need S
    ssbSubcarrierSpacing
                                       SubcarrierSpacing,
    ssb-ToMeasure
                                       SSB-ToMeasure
                                                                                   OPTIONAL,
                                                                                               -- Need S
    deriveSSB-IndexFromCell
                                       BOOLEAN,
    ss-RSSI-Measurement
                                       SS-RSSI-Measurement
                                                                                   OPTIONAL,
                                                                                               -- Need R
    q-RxLevMin
                                       O-RxLevMin,
                                                                                              -- Need R
    q-RxLevMinSUL
                                       O-RxLevMin
                                                                                   OPTIONAL,
    q-QualMin
                                       O-OualMin
                                                                                   OPTIONAL, -- Need S
                                       P-Max
                                                                                   OPTIONAL, -- Need S
    p-Max
    t-ReselectionNR
                                       T-Reselection,
```

```
t-ReselectionNR-SF
                                       SpeedStateScaleFactors
                                                                                   OPTIONAL, -- Need S
    threshX-HighP
                                       ReselectionThreshold,
                                       ReselectionThreshold,
    threshX-LowP
    threshX-0
                                       SEOUENCE {
       threshX-HighO
                                           ReselectionThresholdO,
       threshX-LowO
                                           ReselectionThresholdO
                                                                                   OPTIONAL,
                                                                                              -- Cond RSRO
                                                                                   OPTIONAL, -- Need R
    cellReselectionPriority
                                       CellReselectionPriority
    cellReselectionSubPriority
                                       CellReselectionSubPriority
                                                                                   OPTIONAL, -- Need R
    q-OffsetFreq
                                       Q-OffsetRange
                                                                                   DEFAULT dB0,
    interFreqNeighCellList
                                       InterFreqNeighCellList
                                                                                   OPTIONAL, -- Need R
    interFreqBlackCellList
                                       InterFreqBlackCellList
                                                                                   OPTIONAL, -- Need R
InterFreqNeighCellList ::=
                                   SEQUENCE (SIZE (1..maxCellInter)) OF InterFreqNeighCellInfo
InterFreqNeighCellInfo ::=
                                   SEQUENCE {
    physCellId
                                       PhysCellId,
    q-OffsetCell
                                       Q-OffsetRange,
    q-RxLevMinOffsetCell
                                       INTEGER (1..8)
                                                                                   OPTIONAL,
                                                                                              -- Need R
                                                                                   OPTIONAL, -- Need R
    q-RxLevMinOffsetCellSUL
                                       INTEGER (1..8)
    q-QualMinOffsetCell
                                       INTEGER (1..8)
                                                                                   OPTIONAL, -- Need R
    . . .
InterFreqBlackCellList ::=
                                   SEQUENCE (SIZE (1..maxCellBlack)) OF PCI-Range
-- TAG-SIB4-STOP
-- ASN1STOP
```

SIB4 field descriptions

absThreshSS-BlocksConsolidation

Threshold for consolidation of L1 measurements per RS index. If the field is absent, the UE uses the measurement quantity as specified in TS 38.304 [20].

deriveSSB-IndexFromCell

This field indicates whether the UE may use the timing of any detected cell on that frequency to derive the SSB index of all neighbour cells on that frequency. If this field is set to *true*, the UE assumes SFN and frame boundary alignment across cells on the neighbor frequency as specified in TS 38.133 [14].

dl-CarrierFreq

This field indicates center frequency of the SS block of the neighbour cells, where the frequency corresponds to a GSCN value as specified in TS 38.101-1 [15].

frequencyBandList

Indicates the list of frequency bands for which the NR cell reselection parameters apply.

interFreqBlackCellList

List of blacklisted inter-frequency neighbouring cells.

interFreqCarrierFreqList

List of neighbouring carrier frequencies and frequency specific cell re-selection information.

interFreqNeighCellList

List of inter-frequency neighbouring cells with specific cell re-selection parameters.

nrofSS-BlocksToAverage

Number of SS blocks to average for cell measurement derivation. If the field is absent, the UE uses the measurement quantity as specified in TS 38.304 [20].

p-Max

Value in dBm applicable for the neighbouring NR cells on this carrier frequency. If absent the UE applies the maximum power according to TS 38.101-1 [15] in case of an FR1 cell or TS 38.101-2 [39] in case of an FR2 cell. In this release of the specification, if *p-Max* is present on a carrier frequency in FR2, the UE shall ignore the field and applies the maximum power according to TS 38.101-2 [39].

q-OffsetCell

Parameter "Qoffsets,n" in TS 38.304 [20].

a-OffsetFrea

Parameter "Qoffsetfrequency" in TS 38.304 [20].

g-QualMin

Parameter "Qqualmin" in TS 38.304 [20]. If the field is absent, the UE applies the (default) value of negative infinity for Qqualmin.

a-QualMinOffsetCell

Parameter "Qualminoffsetcell" in TS 38.304 [20]. Actual value Qqualminoffsetcell = field value [dB].

a-RxLevMin

Parameter "Q_{rxlevmin}" in TS 38.304 [20].

a-RxLevMinOffsetCell

Parameter "Qrxlevminoffsetcell" in TS 38.304 [20]. Actual value Qrxlevminoffsetcell = field value * 2 [dB].

g-RxLevMinOffsetCellSUL

Parameter "QrxleyminoffsetcellSUL" in TS 38.304 [20]. Actual value QrxleyminoffsetcellSUL = field value * 2 [dB].

q-RxLevMinSUL

Parameter "Qrxlevmin" in TS 38.304 [20].

smtc

Measurement timing configuration for inter-frequency measurement. If this field is absent, the UE assumes that SSB periodicity is 5 ms in this frequency.

ssb-ToMeasure

The set of SS blocks to be measured within the SMTC measurement duration (see TS 38.215 [9]). When the field is absent the UE measures on all SS-blocks.

ssbSubcarrierSpacing

Subcarrier spacing of SSB. Only the values 15 kHz or 30 kHz (FR1), and 120 kHz or 240 kHz (FR2) are applicable.

threshX-HighP

Parameter "Threshx, HighP" in TS 38.304 [20].

SIB4 field descriptions
threshX-HighQ
Parameter "Thresh _{X, HighQ} " in TS 38.304 [20].
threshX-LowP
Parameter "Threshx, Lowp" in TS 38.304 [20].
threshX-LowQ
Parameter "Threshx, LowQ" in TS 38.304 [20].
t-ReselectionNR
Parameter "Treselection _{NR} " in TS 38.304 [20].
t-ReselectionNR-SF
Parameter "Speed dependent ScalingFactor for Treselection _{NR} " in TS 38.304 [20]. If the field is absent, the UE behaviour is specified in TS 38.304 [20].

Conditional Presence	Explanation
Mandatory	The field is mandatory present in SIB4.
RSRQ	The field is mandatory present if threshServingLowQ is present in SIB2; otherwise it is absent.

- SIB5

SIB5 contains information relevant only for inter-RAT cell re-selection i.e. information about E-UTRA frequencies and E-UTRAs neighbouring cells relevant for cell re-selection. The IE includes cell re-selection parameters common for a frequency.

SIB5 information element

```
-- ASN1START
-- TAG-SIB5-START
SIB5 ::=
                                    SEQUENCE {
    carrierFreqListEUTRA
                                        CarrierFreqListEUTRA
                                                                                     OPTIONAL,
                                                                                                     -- Need R
    t-ReselectionEUTRA
                                        T-Reselection,
    t-ReselectionEUTRA-SF
                                        SpeedStateScaleFactors
                                                                                     OPTIONAL,
                                                                                                     -- Need S
    lateNonCriticalExtension
                                        OCTET STRING
                                                                                     OPTIONAL,
CarrierFreqListEUTRA ::=
                                    SEQUENCE (SIZE (1..maxEUTRA-Carrier)) OF CarrierFreqEUTRA
                                    SEQUENCE {
CarrierFreqEUTRA ::=
    carrierFreq
                                        ARFCN-ValueEUTRA,
    eutra-multiBandInfoList
                                        EUTRA-MultiBandInfoList
                                                                                     OPTIONAL,
                                                                                                     -- Need R
    eutra-FreqNeighCellList
                                        EUTRA-FreqNeighCellList
                                                                                     OPTIONAL,
                                                                                                     -- Need R
    eutra-BlackCellList
                                        EUTRA-FreqBlackCellList
                                                                                                     -- Need R
                                                                                     OPTIONAL,
    allowedMeasBandwidth
                                        EUTRA-AllowedMeasBandwidth,
    presenceAntennaPort1
                                        EUTRA-PresenceAntennaPort1,
    cellReselectionPriority
                                        CellReselectionPriority
                                                                                     OPTIONAL,
                                                                                                     -- Need R
    cellReselectionSubPriority
                                        CellReselectionSubPriority
                                                                                     OPTIONAL,
                                                                                                     -- Need R
                                        ReselectionThreshold,
    threshX-High
    threshX-Low
                                        ReselectionThreshold,
```

-- ASN1STOP

```
q-RxLevMin
                                        INTEGER (-70..-22),
    q-QualMin
                                        INTEGER (-34..-3),
    p-MaxEUTRA
                                        INTEGER (-30..33),
    threshX-Q
                                        SEQUENCE {
        threshX-HighO
                                            ReselectionThresholdO,
        threshX-LowO
                                            ReselectionThresholdO
                                                                                    OPTIONAL
                                                                                                    -- Cond RSRO
EUTRA-FreqBlackCellList ::=
                                    SEQUENCE (SIZE (1..maxEUTRA-CellBlack)) OF EUTRA-PhysCellIdRange
EUTRA-FreqNeighCellList ::=
                                    SEQUENCE (SIZE (1..maxCellEUTRA)) OF EUTRA-FreqNeighCellInfo
EUTRA-FreqNeighCellInfo ::=
                                    SEQUENCE {
                                        EUTRA-PhysCellId,
    physCellId
    dummy
                                        EUTRA-Q-OffsetRange,
    q-RxLevMinOffsetCell
                                        INTEGER (1..8)
                                                                                    OPTIONAL,
                                                                                                    -- Need R
    q-QualMinOffsetCell
                                        INTEGER (1..8)
                                                                                    OPTIONAL
                                                                                                    -- Need R
-- TAG-SIB5-STOP
```

SIB5 field descriptions

carrierFreqListEUTRA

List of carrier frequencies of E-UTRA.

dummy

This field is not used in the specification. If received it shall be ignored by the UE.

eutra-BlackCellList

List of blacklisted E-UTRA neighbouring cells.

eutra-multiBandInfoList

Indicates the list of frequency bands in addition to the band represented by *carrierFreq* for which cell reselection parameters are common, and a list of *additionalPmax* and *additionalSpectrumEmission* values, as defined in TS 36.101 [22], table 6.2.4-1, for the frequency bands in *eutra-multiBandInfoList*

p-MaxEUTRA

The maximum allowed transmission power in dBm on the (uplink) carrier frequency, see TS 36.304 [27].

q-QualMin

Parameter "Q_{qualmin}" in TS 36.304 [27]. Actual value Q_{qualmin} = field value [dB].

q-QualMinOffsetCell

Parameter "Qualminoffsetcell" in TS 36.304 [27]. Actual value Qqualminoffsetcell = field value [dB].

q-RxLevMin

Parameter "Q_{rxlevmin}" in TS 36.304 [27]. Actual value Q_{rxlevmin} = field value * 2 [dBm].

q-RxLevMinOffsetCell

Parameter "Qrxlevminoffsetcell" in TS 36.304 [27]. Actual value Qrxlevminoffsetcell = field value * 2 [dB].

t-ReselectionEUTRA

Parameter "Treselection_{EUTRA}" in TS 38.304 [20].

threshX-High

Parameter "Thresh_{X, HighP}" in TS 38.304 [20].

threshX-HighQ

Parameter "Threshx, HighQ" in TS 38.304 [20].

threshX-Low

Parameter "Thresh_{X, LowP}" in TS 38.304 [20].

threshX-LowQ

Parameter "Thresh_{X, LowQ}" in TS 38.304 [20].

t-ReselectionEUTRA-SF

Parameter "Speed dependent ScalingFactor for Treselection_{EUTRA}" in TS 38.304 [20]. If the field is absent, the UE behaviour is specified in TS 38.304 [20].

Conditional Presence	Explanation
RSRQ	The field is mandatory present if the threshServingLowQ is present in SIB2; otherwise it is absent.

- SIB6

SIB6 contains an ETWS primary notification.

SIB6 information element

⁻⁻ ASN1START

⁻⁻ TAG-SIB6-START

SIB6 field descriptions

messageldentifier

Identifies the source and type of ETWS notification.

serialNumber

Identifies variations of an ETWS notification.

warningType

Identifies the warning type of the ETWS primary notification and provides information on emergency user alert and UE popup.

- SIB7

SIB7 contains an ETWS secondary notification.

SIB7 information element

```
-- ASN1START
-- TAG-SIB7-START
SIB7 ::=
                                    SEQUENCE {
    messageIdentifier
                                        BIT STRING (SIZE (16)),
    serialNumber
                                        BIT STRING (SIZE (16)),
    warningMessageSegmentType
                                        ENUMERATED {notLastSegment, lastSegment},
    warningMessageSegmentNumber
                                        INTEGER (0..63),
    warningMessageSegment
                                        OCTET STRING,
    dataCodingScheme
                                        OCTET STRING (SIZE (1))
                                                                                                -- Cond Segment1
                                                                                    OPTIONAL,
    lateNonCriticalExtension
                                        OCTET STRING
                                                                                    OPTIONAL,
-- TAG-SIB7-STOP
-- ASN1STOP
```

SIB7 field descriptions

dataCodingScheme

Identifies the alphabet/coding and the language applied variations of an ETWS notification.

messageldentifier

Identifies the source and type of ETWS notification.

serialNumber

Identifies variations of an ETWS notification.

warningMessageSegment

Carries a segment of the Warning Message Contents IE.

warningMessageSegmentNumber

Segment number of the ETWS warning message segment contained in the SIB. A segment number of zero corresponds to the first segment, A segment number of one corresponds to the second segment, and so on.

warningMessageSegmentType

Indicates whether the included ETWS warning message segment is the last segment or not.

Conditional Presence	Explanation	
Segment1	The field is mandatory present in the first segment of SIB7, otherwise it is absent.	

– SIB8

SIB8 contains a CMAS notification.

SIB8 information element

```
-- ASN1START
-- TAG-SIB8-START

SIB8 ::= SEQUENCE {
    messageIdentifier BIT STRING (SIZE (16)),
    serialNumber BIT STRING (SIZE (16)),
    warningMessageSegmentType ENUMERATED {notLastSegment, lastSegment},
    warningMessageSegment Unumber INTEGER (0..63),
    warningMessageSegment OCTET STRING,
    dataCodingScheme OCTET STRING (SIZE (1)) OPTIONAL, -- Cond Segment1
    warningAreaCoordinatesSegment OCTET STRING OPTIONAL, -- Need R
    lateNonCriticalExtension OCTET STRING OPTIONAL,
}

-- TAG-SIB8-STOP
-- ASN1STOP
```

SIB8 field descriptions

dataCodingScheme

Identifies the alphabet/coding and the language applied variations of a CMAS notification.

messageldentifier

Identifies the source and type of CMAS notification.

serialNumber

Identifies variations of a CMAS notification.

warningAreaCoordinatesSegment

If present, carries a segment, with one or more octets, of the geographical area where the CMAS warning message is valid as defined in [28]. The first octet of the first warningAreaCoordinatesSegment is equivalent to the first octet of Warning Area Coordinates IE defined in and encoded according to TS 23.041 [29] and so on.

warningMessageSegment

Carries a segment, with one or more octets, of the Warning Message Contents IE defined in TS 38.413 [42]. The first octet of the Warning Message Contents IE is equivalent to the first octet of the CB data IE defined in and encoded according to TS 23.041 [29], clause 9.4.2.2.5, and so on.

warningMessageSegmentNumber

Segment number of the CMAS warning message segment contained in the SIB. A segment number of zero corresponds to the first segment, one corresponds to the second segment, and so on. If warning area coordinates are provided for the warning message, then this field applies to both warning message segment and warning area coordinates segment.

warningMessageSegmentType

Indicates whether the included CMAS warning message segment is the last segment or not. If warning area coordinates are provided for the warning message, then this field applies to both warning message segment and warning area coordinates segment.

Conditional Presence	Ex	planation
Segment1	The field is mandatory present in the first segment of SIB8,	otherwise it is absent.

- SIB9

SIB9 contains information related to GPS time and Coordinated Universal Time (UTC). The UE may use the parameters provided in this system information block to obtain the UTC, the GPS and the local time.

NOTE: The UE may use the time information for numerous purposes, possibly involving upper layers e.g. to assist GPS initialisation, to synchronise the UE clock.

SIB9 information element

```
-- ASN1START
-- TAG-SIB9-START
SIB9 ::=
                                   SEOUENCE {
       -
eInfo
timeInfoUTC
dayLightSavingTime
    timeInfo
                                       SEQUENCE {
                                           INTEGER (0..549755813887),
                                          BIT STRING (SIZE (2))
                                                                                  OPTIONAL, -- Need R
       leapSeconds
                                          INTEGER (-127..128)
                                                                                  OPTIONAL, -- Need R
       localTimeOffset
                                          INTEGER (-63..64)
                                                                                  OPTIONAL -- Need R
                                                                                  OPTIONAL, -- Need R
    lateNonCriticalExtension
                                      OCTET STRING
                                                                                  OPTIONAL,
```

-- TAG-SIB9-STOP
-- ASN1STOP

SIB9 field descriptions

dayLightSavingTime

Indicates if and how daylight-saving time (DST) is applied to obtain the local time. The semantics are the same as the semantics of the *Daylight Saving Time* IE in TS 24.501 [23] and TS 24.008 [38]. The first/leftmost bit of the bit string contains the b2 of octet 3 and the second bit of the bit string contains b1 of octet 3 in the value part of the *Daylight Saving Time* IE in TS 24.008 [38].

leapSeconds

Number of leap seconds offset between GPS Time and UTC. UTC and GPS time are related i.e. GPS time -leapSeconds = UTC time.

localTimeOffset

Offset between UTC and local time in units of 15 minutes. Actual value = field value * 15 minutes. Local time of the day is calculated as UTC time + localTimeOffset.

timeInfoUTC

Coordinated Universal Time corresponding to the SFN boundary at or immediately after the ending boundary of the SI-window in which SIB9 is transmitted. The field counts the number of UTC seconds in 10 ms units since 00:00:00 on Gregorian calendar date 1 January, 1900 (midnight between Sunday, December 31, 1899 and Monday, January 1, 1900). See NOTE 1. This field is excluded when determining changes in system information, i.e. changes of *timeInfoUTC* should neither result in system information change notifications nor in a modification of *valueTag* in *SIB1*.

NOTE 1: The UE may use this field together with the *leapSeconds* field to obtain GPS time as follows: GPS Time (in seconds) = timeInfoUTC (in seconds) - 2,524,953,600 (seconds) + leapSeconds, where 2,524,953,600 is the number of seconds between 00:00:00 on Gregorian calendar date 1 January, 1900 and 00:00:00 on Gregorian calendar date 6 January, 1980 (start of GPS time).

6.3.2 Radio resource control information elements

AdditionalSpectrumEmission

The IE Additional Spectrum Emission is used to indicate emission requirements to be fulfilled by the UE (see TS 38.101-1 [15], clause 6.2.3, and TS 38.101-2 [39], clause 6.2.3).

AdditionalSpectrumEmission information element

```
-- ASN1START
-- TAG-ADDITIONALSPECTRUMEMISSION-START

AdditionalSpectrumEmission ::= INTEGER (0..7)

-- TAG-ADDITIONALSPECTRUMEMISSION-STOP
-- ASN1STOP
```

– Alpha

The IE *Alpha* defines possible values of a the pathloss compensation coefficient for uplink power control. Value *alpha0* corresponds to the value 0, Value *alpha04* corresponds to the value 0.4, Value *alpha05* corresponds to the value 0.5 and so on. Value *alpha1* corresponds to value 1. See also clause 7.1 of TS 38.213 [13].

```
-- ASN1START
-- TAG-ALPHA-START

Alpha ::= ENUMERATED {alpha04, alpha05, alpha06, alpha07, alpha08, alpha09, alpha1}

-- TAG-ALPHA-STOP
-- ASN1STOP
```

– AMF-Identifier

The IE AMF-Identifier (AMFI) comprises of an AMF Region ID, an AMF Set ID and an AMF Pointer as specified in TS 23.003 [21], clause 2.10.1.

AMF-Identifier information element

```
-- ASN1START
-- TAG-AMF-IDENTIFIER-START

AMF-Identifier ::= BIT STRING (SIZE (24))

-- TAG-AMF-IDENTIFIER-STOP
-- ASN1STOP
```

ARFCN-ValueEUTRA

The IE ARFCN-ValueEUTRA is used to indicate the ARFCN applicable for a downlink, uplink or bi-directional (TDD) E-UTRA carrier frequency, as defined in TS 36.101 [22].

ARFCN-ValueEUTRA information element

```
-- ASN1START
-- TAG-ARFCN-VALUEEUTRA-START

ARFCN-ValueEUTRA ::= INTEGER (0..maxEARFCN)

-- TAG-ARFCN-VALUEEUTRA-STOP
-- ASN1STOP
```

- ARFCN-ValueNR

The IE *ARFCN-ValueNR* is used to indicate the ARFCN applicable for a downlink, uplink or bi-directional (TDD) NR global frequency raster, as defined in TS 38.101-1 [15] and TS 38.101-2 [39], clause 5.4.2.

```
-- ASN1START
-- TAG-ARFCN-VALUENR-START

ARFCN-ValueNR ::= INTEGER (0..maxNARFCN)
-- TAG-ARFCN-VALUENR-STOP
-- ASN1STOP
```

BeamFailureRecoveryConfig

The IE *BeamFailureRecoveryConfig* is used to configure the UE with RACH resources and candidate beams for beam failure recovery in case of beam failure detection. See also TS 38.321 [3], clause 5.1.1.

BeamFailureRecoveryConfig information element

```
-- ASN1START
-- TAG-BEAMFAILURERECOVERYCONFIG-START
BeamFailureRecoveryConfig ::=
    rootSequenceIndex-BFR
                                        INTEGER (0..137)
                                                                                                                   OPTIONAL, -- Need M
    rach-ConfigBFR
                                        RACH-ConfigGeneric
                                                                                                                   OPTIONAL, -- Need M
    rsrp-ThresholdSSB
                                        RSRP-Range
                                                                                                                   OPTIONAL, -- Need M
    candidateBeamRSList
                                        SEQUENCE (SIZE(1..maxNrofCandidateBeams)) OF PRACH-ResourceDedicatedBFR
                                                                                                                   OPTIONAL, -- Need M
                                        ENUMERATED {oneEighth, oneFourth, oneHalf, one, two,
    ssb-perRACH-Occasion
                                                       four, eight, sixteen}
                                                                                                                   OPTIONAL, -- Need M
    ra-ssb-OccasionMaskIndex
                                        INTEGER (0..15)
                                                                                                                   OPTIONAL, -- Need M
    recoverySearchSpaceId
                                        SearchSpaceId
                                                                                                                   OPTIONAL, -- Need R
    ra-Prioritization
                                        RA-Prioritization
                                                                                                                   OPTIONAL, -- Need R
    beamFailureRecoveryTimer
                                        ENUMERATED {ms10, ms20, ms40, ms60, ms80, ms100, ms150, ms200}
                                                                                                                   OPTIONAL, -- Need M
    ] ]
   msg1-SubcarrierSpacing
                                        SubcarrierSpacing
                                                                                                                   OPTIONAL -- Need M
PRACH-ResourceDedicatedBFR ::=
                                    CHOICE {
    ssb
                                        BFR-SSB-Resource,
    csi-RS
                                        BFR-CSIRS-Resource
BFR-SSB-Resource ::=
                                    SEQUENCE {
                                        SSB-Index,
                                        INTEGER (0..63),
    ra-PreambleIndex
```

BeamFailureRecoveryConfig field descriptions

beamFailureRecoveryTimer

Timer for beam failure recovery timer. Upon expiration of the timer the UE does not use CFRA for BFR. Value in ms. Value *ms10* corresponds to 10 ms, value *ms20* corresponds to 20 ms, and so on.

candidateBeamRSList

A list of reference signals (CSI-RS and/or SSB) identifying the candidate beams for recovery and the associated RA parameters. The network configures these reference signals to be within the linked DL BWP (i.e., within the DL BWP with the same bwp-ld) of the UL BWP in which the BeamFailureRecoveryConfig is provided.

msg1-SubcarrierSpacing

Subcarrier spacing for contention free beam failure recovery. Only the values 15 kHz or 30 kHz (FR1), and 60 kHz or 120 kHz (FR2) are applicable. See TS 38.211 [16], clause 5.3.2.

rsrp-ThresholdSSB

L1-RSRP threshold used for determining whether a candidate beam may be used by the UE to attempt contention free random access to recover from beam failure (see TS 38.213 [13], clause 6).

ra-prioritization

Parameters which apply for prioritized random access procedure for BFR (see TS 38.321 [3], clause 5.1.1).

ra-ssb-OccasionMaskIndex

Explicitly signalled PRACH Mask Index for RA Resource selection in TS 38.321 [3]. The mask is valid for all SSB resources.

rach-ConfigBFR

Configuration of random access parameters for BFR.

recoverySearchSpaceId

Search space to use for BFR RAR. The network configures this search space to be within the linked DL BWP (i.e., within the DL BWP with the same *bwp-ld*) of the UL BWP in which the *BeamFailureRecoveryConfig* is provided. The CORESET associated with the recovery search space cannot be associated with another search space. Network always configures the UE with a value for this field when contention free random access resources for BFR are configured.

rootSequenceIndex-BFR

PRACH root sequence index (see TS 38.211 [16], clause 6.3.3.1) for beam failure recovery.

ssb-perRACH-Occasion

Number of SSBs per RACH occasion for CF-BFR, see TS 38.213 [13], clause 8.1.

BFR-CSIRS-Resource field descriptions

csi-RS

The ID of a NZP-CSI-RS-Resource configured in the CSI-MeasConfig of this serving cell. This reference signal determines a candidate beam for beam failure recovery (BFR).

ra-OccasionList

RA occasions that the UE shall use when performing BFR upon selecting the candidate beam identified by this CSI-RS. The network ensures that the RA occasion indexes provided herein are also configured by *prach-ConfigurationIndex* and *msg1-FDM*. Each RACH occasion is sequentially numbered, first, in increasing order of frequency resource indexes for frequency multiplexed PRACH occasions; second, in increasing order of time resource indexes for time multiplexed PRACH occasions within a PRACH slot and Third, in increasing order of indexes for PRACH slots.

If the field is absent the UE uses the RA occasion associated with the SSB that is QCLed with this CSI-RS.

ra-PreambleIndex

The RA preamble index to use in the RA occasions associated with this CSI-RS. If the field is absent, the UE uses the preamble index associated with the SSB that is QCLed with this CSI-RS.

BFR-SSB-Resource field descriptions

ra-PreambleIndex

The preamble index that the UE shall use when performing BFR upon selecting the candidate beams identified by this SSB.

ssb

The ID of an SSB transmitted by this serving cell. It determines a candidate beam for beam failure recovery (BFR).

BetaOffsets

-- TAG-BETAOFFSETS-STOP

-- ASN1STOP

The IE *BetaOffsets* is used to configure beta-offset values, see TS 38.213 [13], clause 9.3.

BetaOffsets information element

```
-- ASN1START
-- TAG-BETAOFFSETS-START
BetaOffsets ::=
                                     SEOUENCE {
    betaOffsetACK-Index1
                                        INTEGER (0..31)
                                                                                                                  OPTIONAL, -- Need S
                                                                                                                  OPTIONAL, -- Need S
   betaOffsetACK-Index2
                                         INTEGER (0..31)
                                                                                                                  OPTIONAL, -- Need S
    betaOffsetACK-Index3
                                        INTEGER (0..31)
    betaOffsetCSI-Part1-Index1
                                                                                                                  OPTIONAL, -- Need S
                                        INTEGER (0..31)
                                                                                                                  OPTIONAL, -- Need S
    betaOffsetCSI-Part1-Index2
                                        INTEGER (0..31)
    betaOffsetCSI-Part2-Index1
                                        INTEGER(0..31)
                                                                                                                  OPTIONAL, -- Need S
    betaOffsetCSI-Part2-Index2
                                                                                                                  OPTIONAL -- Need S
                                        INTEGER (0..31)
```

BetaOffsets field descriptions

betaOffsetACK-Index1

Up to 2 bits HARQ-ACK (see TS 38.213 [13], clause 9.3). When the field is absent the UE applies the value 11.

betaOffsetACK-Index2

Up to 11 bits HARQ-ACK (see TS 38.213 [13], clause 9.3). When the field is absent the UE applies the value 11.

betaOffsetACK-Index3

Above 11 bits HARQ-ACK (see TS 38.213 [13], clause 9.3). When the field is absent the UE applies the value 11.

betaOffsetCSI-Part1-Index1

Up to 11 bits of CSI part 1 bits (see TS 38.213 [13], clause 9.3), When the field is absent the UE applies the value 13.

betaOffsetCSI-Part1-Index2

Above 11 bits of CSI part 1 bits (see TS 38.213 [13], clause 9.3). When the field is absent the UE applies the value 13.

betaOffsetCSI-Part2-Index1

Up to 11 bits of CSI part 2 bits (see TS 38.213 [13], clause 9.3). When the field is absent the UE applies the value 13.

betaOffsetCSI-Part2-Index2

Above 11 bits of CSI part 2 bits (see TS 38.213 [13], clause 9.3). When the field is absent the UE applies the value 13.

BSR-Config

The IE BSR-Config is used to configure buffer status reporting.

BSR-Config information element

BSR-Config field descriptions

logicalChannelSR-DelayTimer

Value in number of subframes. Value sf20 corresponds to 20 subframes, sf40 corresponds to 40 subframes, and so on.

periodicBSR-Timer

Value in number of subframes. Value sf1 corresponds to 1 subframe, value sf5 corresponds to 5 subframes and so on.

retxBSR-Timer

Value in number of subframes. Value sf10 corresponds to 10 subframes, value sf20 corresponds to 20 subframes and so on.

- BWP

The IE BWP is used to configure generic parameters of a bandwidth part as defined in TS 38.211 [16], clause 4.5, and TS 38.213 [13], clause 12.

For each serving cell the network configures at least an initial downlink bandwidth part and one (if the serving cell is configured with an uplink) or two (if using supplementary uplink (SUL)) initial uplink bandwidth parts. Furthermore, the network may configure additional uplink and downlink bandwidth parts for a serving cell.

The uplink and downlink bandwidth part configurations are divided into common and dedicated parameters.

BWP information element

```
-- ASN1START
-- TAG-BWP-START

BWP ::= SEQUENCE {
    locationAndBandwidth INTEGER (0..37949),
    subcarrierSpacing SubcarrierSpacing,
    cyclicPrefix ENUMERATED { extended }

-- TAG-BWP-STOP
```

BWP field descriptions

cyclicPrefix

-- ASN1STOP

Indicates whether to use the extended cyclic prefix for this bandwidth part. If not set, the UE uses the normal cyclic prefix. Normal CP is supported for all subcarrier spacings and slot formats. Extended CP is supported only for 60 kHz subcarrier spacing. (see TS 38.211 [16], clause 4.2). Except for SUL, the network ensures the same cyclic prefix length is used in active DL BWP and active UL BWP within a serving cell.

IocationAndBandwidth

Frequency domain location and bandwidth of this bandwidth part. The value of the field shall be interpreted as resource indicator value (RIV) as defined TS 38.214 [19] with

assumptions as described in TS 38.213 [13], clause 12, i.e. setting N_{BWP}^{size} =275. The first PRB is a PRB determined by subcarrierSpacing of this BWP and offsetToCarrier (configured in SCS-SpecificCarrier contained within FrequencyInfoDL / FrequencyInfoUL / FrequencyInfoUL - SIB / FrequencyInfoDL - SIB within ServingCellConfigCommon / ServingCellConfigCommonSIB) corresponding to this subcarrier spacing. In case of TDD, a BWP-pair (UL BWP and DL BWP with the same bwp-Id) must have the same center frequency (see TS 38.213 [13], clause 12)

subcarrierSpacing

Subcarrier spacing to be used in this BWP for all channels and reference signals unless explicitly configured elsewhere. Corresponds to subcarrier spacing according to TS 38.211 [16], table 4.2-1. The value kHz15 corresponds to μ =0, value kHz30 corresponds to μ =1, and so on. Only the values 15 kHz, 30 kHz, or 60 kHz (FR1), and 60 kHz or 120 kHz (FR2) are applicable. For the initial DL BWP this field has the same value as the field subCarrierSpacingCommon in subcar

BWP-Downlink

The IE BWP-Downlink is used to configure an additional downlink bandwidth part (not for the initial BWP).

BWP-Downlink information element

```
-- ASN1START
-- TAG-BWP-DOWNLINK-START

BWP-Downlink ::= SEQUENCE {
    bwp-Id BWP-Id,
    bwp-Common BWP-DownlinkCommon OPTIONAL, -- Cond SetupOtherBWP bwp-Dedicated OPTIONAL, -- Cond SetupOtherBWP ...
}

-- TAG-BWP-DOWNLINK-STOP -- ASN1STOP
```

BWP-Downlink field descriptions

bwp-ld

An identifier for this bandwidth part. Other parts of the RRC configuration use the *BWP-Id* to associate themselves with a particular bandwidth part. The network configures the BWPs with consecutive IDs from 1. The Network does not include the value 0, since value 0 is reserved for the initial BWP.

Conditional Presence	Explanation
SetupOtherBWP	The field is mandatory present upon configuration of a new DL BWP. The field is optionally present, Need M, otherwise.

BWP-DownlinkCommon

The IE *BWP-DownlinkCommon* is used to configure the common parameters of a downlink BWP. They are "cell specific" and the network ensures the necessary alignment with corresponding parameters of other UEs. The common parameters of the initial bandwidth part of the PCell are also provided via system information. For all other serving cells, the network provides the common parameters via dedicated signalling.

BWP-DownlinkCommon information element

```
-- ASN1START
-- TAG-BWP-DOWNLINKCOMMON-START

BWP-DownlinkCommon ::= SEQUENCE {
    genericParameters BWP,
    pdcch-ConfigCommon SetupRelease { PDCCH-ConfigCommon } OPTIONAL, -- Need M
    pdsch-ConfigCommon SetupRelease { PDSCH-ConfigCommon } OPTIONAL, -- Need M
    ...
}

-- TAG-BWP-DOWNLINKCOMMON-STOP
-- ASN1STOP
```

DownlinkCommon field descriptions ### pdcch-ConfigCommon Cell specific parameters for the PDCCH of this BWP. ### pdsch-ConfigCommon Cell specific parameters for the PDSCH of this BWP.

BWP-DownlinkDedicated

The IE BWP-DownlinkDedicated is used to configure the dedicated (UE specific) parameters of a downlink BWP.

BWP-DownlinkDedicated information element

```
-- ASN1START
-- TAG-BWP-DOWNLINKDEDICATED-START
BWP-DownlinkDedicated ::=
                                   SEOUENCE {
   pdcch-Config
                                       SetupRelease { PDCCH-Config }
                                                                                                              OPTIONAL, -- Need M
   pdsch-Config
                                       SetupRelease { PDSCH-Config }
                                                                                                              OPTIONAL, -- Need M
                                       SetupRelease { SPS-Config }
                                                                                                              OPTIONAL, -- Need M
    sps-Config
   radioLinkMonitoringConfig
                                       SetupRelease { RadioLinkMonitoringConfig }
                                                                                                              OPTIONAL, -- Need M
-- TAG-BWP-DOWNLINKDEDICATED-STOP
-- ASN1STOP
```

BWP-DownlinkDedicated field descriptions

pdcch-Confia

UE specific PDCCH configuration for one BWP.

pdsch-Config

UE specific PDSCH configuration for one BWP.

sps-Config

UE specific SPS (Semi-Persistent Scheduling) configuration for one BWP. Except for reconfiguration with sync, the NW does not reconfigure sps-Config when there is an active configured downlink assignment (see TS 38.321 [3]). However, the NW may release the sps-Config at any time.

radioLinkMonitoringConfig

UE specific configuration of radio link monitoring for detecting cell- and beam radio link failure occasions. The maximum number of failure detection resources should be limited up to 8 for both cell and beam radio link failure detection in Rel-15.

– BWP-Id

The IE BWP-Id is used to refer to Bandwidth Parts (BWP). The initial BWP is referred to by BWP-Id 0. The other BWPs are referred to by BWP-Id 1 to maxNrofBWPs.

BWP-Id information element

```
-- ASN1START
-- TAG-BWP-ID-START

BWP-Id ::= INTEGER (0..maxNrofBWPs)

-- TAG-BWP-ID-STOP
-- ASN1STOP
```

- BWP-Uplink

The IE BWP-Uplink is used to configure an additional uplink bandwidth part (not for the initial BWP).

BWP-Uplink information element

```
-- ASN1START
-- TAG-BWP-UPLINK-START

BWP-Uplink ::= SEQUENCE {
   bwp-Id BWP-UplinkCommon OPTIONAL, -- Cond SetupOtherBWP bwp-Dedicated BWP-UplinkDedicated OPTIONAL, -- Cond SetupOtherBWP ...
}

-- TAG-BWP-UPLINK-STOP -- ASN1STOP
```

BWP-Uplink field descriptions

bwp-ld

An identifier for this bandwidth part. Other parts of the RRC configuration use the *BWP-Id* to associate themselves with a particular bandwidth part. The network configures the BWPs with consecutive IDs from 1. The Network does not include the value 0, since value 0 is reserved for the initial BWP.

Conditional Presence	Explanation
SetupOtherBWP	The field is mandatory present upon configuration of a new UL BWP. The field is optionally present, Need M, otherwise.

BWP-UplinkCommon

The IE *BWP-UplinkCommon* is used to configure the common parameters of an uplink BWP. They are "cell specific" and the network ensures the necessary alignment with corresponding parameters of other UEs. The common parameters of the initial bandwidth part of the PCell are also provided via system information. For all other serving cells, the network provides the common parameters via dedicated signalling.

BWP-UplinkCommon information element

```
-- ASN1START
-- TAG-BWP-UPLINKCOMMON-START
                                   SEOUENCE {
BWP-UplinkCommon ::=
    genericParameters
                                       BWP,
                                       SetupRelease { RACH-ConfigCommon }
    rach-ConfigCommon
                                                                                                               OPTIONAL, -- Need M
                                       SetupRelease { PUSCH-ConfigCommon }
                                                                                                               OPTIONAL, -- Need M
   pusch-ConfigCommon
   pucch-ConfigCommon
                                       SetupRelease { PUCCH-ConfigCommon }
                                                                                                               OPTIONAL, -- Need M
-- TAG-BWP-UPLINKCOMMON-STOP
-- ASN1STOP
```

BWP-UplinkCommon field descriptions

pucch-ConfigCommon

Cell specific parameters for the PUCCH of this BWP.

pusch-ConfigCommon

Cell specific parameters for the PUSCH of this BWP.

rach-ConfigCommon

Configuration of cell specific random access parameters which the UE uses for contention based and contention free random access as well as for contention based beam failure recovery in this BWP. The NW configures SSB-based RA (and hence *RACH-ConfigCommon*) only for UL BWPs if the linked DL BWPs (same *bwp-Id* as UL-BWP) are the initial DL BWPs or DL BWPs containing the SSB associated to the initial DL BWP. The network configures *rach-ConfigCommon*, whenever it configures contention free random access (for reconfiguration with sync or for beam failure recovery).

BWP-UplinkDedicated

The IE BWP-UplinkDedicated is used to configure the dedicated (UE specific) parameters of an uplink BWP.

BWP-UplinkDedicated information element

```
-- ASN1START
-- TAG-BWP-UPLINKDEDICATED-START
BWP-UplinkDedicated ::=
                                   SEQUENCE {
   pucch-Config
                                       SetupRelease { PUCCH-Config }
                                                                                                       OPTIONAL, -- Need M
   pusch-Config
                                       SetupRelease { PUSCH-Config }
                                                                                                       OPTIONAL, -- Need M
    configuredGrantConfig
                                       SetupRelease { ConfiguredGrantConfig }
                                                                                                       OPTIONAL, -- Need M
    srs-Config
                                       SetupRelease { SRS-Config }
                                                                                                       OPTIONAL, -- Need M
   beamFailureRecoveryConfig
                                       SetupRelease { BeamFailureRecoveryConfig }
                                                                                                       OPTIONAL, -- Cond SpCellOnly
-- TAG-BWP-UPLINKDEDICATED-STOP
-- ASN1STOP
```

BWP-UplinkDedicated field descriptions

beamFailureRecoveryConfig

Configuration of beam failure recovery. If supplementary Uplink is present, the field is present only in one of the uplink carriers, either UL or SUL.

configuredGrantConfig

A Configured-Grant of type1 or type2. It may be configured for UL or SUL but in case of type1 not for both at a time. Except for reconfiguration with sync, the NW does not reconfigure configuredGrantConfig when there is an active configured uplink grant Type 2 (see TS 38.321 [3]). However, the NW may release the configuredGrantConfig at any time.

pucch-Config

PUCCH configuration for one BWP of the normal UL or SUL of a serving cell. If the UE is configured with SUL, the network configures PUCCH only on the BWPs of one of the uplinks (normal UL or SUL). The network configures *PUCCH-Config* at least on non-initial BWP(s) for SpCell and PUCCH SCell. If supported by the UE, the network may configure at most one additional SCell of a cell group with *PUCCH-Config* (i.e. PUCCH SCell).

In (NG)EN-DC and NE-DC, the NW configures at most one serving cell per frequency range with PUCCH. In (NG)EN-DC and NE-DC, if two PUCCH groups are configured, the serving cells of the NR PUCCH group in FR2 use the same numerology. For NR-DC, the maximum number of PUCCH groups in each cell group is one, and only the same numerology is supported for the cell group with carriers only in FR2.

The NW may configure PUCCH for a BWP when setting up the BWP. The network may also add/remove the *pucch-Config* in an *RRCReconfiguration* with *reconfigurationWithSync* (for SpCell or PUCCH SCell) or with SCell release and add (for PUCCH SCell) to move the PUCCH between the UL and SUL carrier of one serving cell. In other cases, only modifications of a previously configured *pucch-Config* are allowed.

If one (S)UL BWP of a serving cell is configured with PUCCH, all other (S)UL BWPs must be configured with PUCCH, too.

pusch-Config

PUSCH configuration for one BWP of the normal UL or SUL of a serving cell. If the UE is configured with SUL and if it has a *PUSCH-Config* for both UL and SUL, an UL/SUL indicator field in DCI indicates which of the two to use. See TS 38.212 [17], clause 7.3.1.

srs-Config

Uplink sounding reference signal configuration.

Conditional Presence	Explanation
SpCellOnly	The field is optionally present, Need M, in the BWP-UplinkDedicated of an SpCell. It is absent otherwise.

NOTE 1: In case of *RRCReconfiguration* with *reconfigurationWithSync*, the UE performs a MAC reset, which involves releasing the PUCCH-CSI/SRS/SR configuration in accordance with clause 5.3.12 and TS 38.321 [6], clauses 5.12 and 5.2. Hence, for these parts of the dedicated radio resource configuration, delta signalling is not supported in the message when *reconfigurationWithSync* is included.

CellAccessRelatedInfo

The IE CellAccessRelatedInfo indicates cell access related information for this cell.

CellAccessRelatedInfo information element

- -- ASN1START
- -- TAG-CELLACCESSRELATEDINFO-START

```
CellAccessRelatedInfo ::= SEQUENCE {
   plmn-IdentityInfoList PLMN-IdentityInfoList,
   cellReservedForOtherUse ENUMERATED {true} OPTIONAL, -- Need R
   ...
}
-- TAG-CELLACCESSRELATEDINFO-STOP
-- ASN1STOP
```

CellAccessRelatedInfo field descriptions

cellReservedForOtherUse

Indicates whether the cell is reserved, as defined in 38.304 [20]. The field is applicable to all PLMNs.

plmn-IdentityInfoList

The *plmn-IdentityInfoList* is used to configure a set of *PLMN-IdentityInfo* elements. Each of those elements contains a list of one or more PLMN Identities and additional information associated with those PLMNs. The total number of PLMNs in the *PLMN-IdentityInfoList* does not exceed 12. A PLMN-identity can be included only once, and in only one entry of the *PLMN-IdentityInfoList*. The PLMN index is defined as *b1+b2+...+b(n-1)+i* for the PLMN included at the *n*-th entry of *PLMN-IdentityInfoList* and the *i*-th entry of its corresponding *PLMN-IdentityInfo*, where *b(j)* is the number of *PLMN-Identity entries* in each *PLMN-IdentityInfo*, respectively.

CellAccessRelatedInfo-EUTRA-5GC

The IE CellAccessRelatedInfo-EUTRA-5GC indicates cell access related information for an LTE cell connected to 5GC.

CellAccessRelatedInfo-EUTRA-5GC information element

```
-- ASN1START
-- TAG-CELLACCESSRELATEDINFOEUTRA-5GC-START
CellAccessRelatedInfo-EUTRA-5GC ::=
                                       SEOUENCE {
   plmn-IdentityList-eutra-5gc
                                           PLMN-IdentityList-EUTRA-5GC,
    trackingAreaCode-eutra-5gc
                                           TrackingAreaCode,
    ranac-5qc
                                           RAN-AreaCode
                                                                                        OPTIONAL,
    cellIdentity-eutra-5gc
                                           CellIdentity-EUTRA-5GC
PLMN-IdentityList-EUTRA-5GC::=
                                        SEQUENCE (SIZE (1..maxPLMN)) OF PLMN-Identity-EUTRA-5GC
PLMN-Identity-EUTRA-5GC ::=
                                        CHOICE {
    plmn-Identity-EUTRA-5GC
                                            PLMN-Identity,
    plmn-index
                                            INTEGER (1..maxPLMN)
CellIdentity-EUTRA-5GC ::=
    cellIdentity-EUTRA
                                           BIT STRING (SIZE (28)),
cellId-index
                                        INTEGER (1..maxPLMN)
-- TAG-CELLACCESSRELATEDINFOEUTRA-5GC-STOP
-- ASN1STOP
```

CellAccessRelatedInfo-EUTRA-EPC

The IE CellAccessRelatedInfo-EUTRA-EPC indicates cell access related information for an LTE cell connected to EPC.

CellAccessRelatedInfo-EUTRA-EPC information element

CellGroupConfig

]]

The *CellGroupConfig* IE is used to configure a master cell group (MCG) or secondary cell group (SCG). A cell group comprises of one MAC entity, a set of logical channels with associated RLC entities and of a primary cell (SpCell) and one or more secondary cells (SCells).

CellGroupConfig information element

```
-- ASN1START
-- TAG-CELLGROUPCONFIG-START
-- Configuration of one Cell-Group:
CellGroupConfig ::=
                                            SEQUENCE {
    cellGroupId
                                                CellGroupId,
    rlc-BearerToAddModList
                                                SEQUENCE (SIZE(1..maxLC-ID)) OF RLC-BearerConfig
                                                                                                            OPTIONAL,
                                                                                                                        -- Need N
    rlc-BearerToReleaseList
                                                SEQUENCE (SIZE(1..maxLC-ID)) OF LogicalChannelIdentity
                                                                                                            OPTIONAL,
                                                                                                                       -- Need N
    mac-CellGroupConfig
                                                MAC-CellGroupConfig
                                                                                                            OPTIONAL,
                                                                                                                        -- Need M
    physicalCellGroupConfig
                                                PhysicalCellGroupConfig
                                                                                                            OPTIONAL,
                                                                                                                        -- Need M
    spCellConfig
                                                SpCellConfig
                                                                                                            OPTIONAL,
                                                                                                                        -- Need M
    sCellToAddModList
                                                SEQUENCE (SIZE (1..maxNrofSCells)) OF SCellConfig
                                                                                                            OPTIONAL,
                                                                                                                       -- Need N
    sCellToReleaseList
                                                SEQUENCE (SIZE (1..maxNrofSCells)) OF SCellIndex
                                                                                                            OPTIONAL, -- Need N
    . . . .
```

```
ENUMERATED {true}
    reportUplinkTxDirectCurrent
                                                                                                                         -- Cond BWP-Reconfig
                                                                                                            OPTIONAL
    ]]
-- Serving cell specific MAC and PHY parameters for a SpCell:
SpCellConfig ::=
                                        SEOUENCE {
    servCellIndex
                                        ServCellIndex
                                                                                                    OPTIONAL,
                                                                                                                -- Cond SCG
    reconfigurationWithSync
                                                                                                    OPTIONAL, -- Cond ReconfWithSync
                                        ReconfigurationWithSync
                                                                                                    OPTIONAL, -- Need M
    rlf-TimersAndConstants
                                        SetupRelease { RLF-TimersAndConstants }
                                                                                                    OPTIONAL, -- Need S
    rlmInSyncOutOfSyncThreshold
                                        ENUMERATED {n1}
    spCellConfigDedicated
                                        ServingCellConfig
                                                                                                    OPTIONAL, -- Need M
    . . .
ReconfigurationWithSync ::=
                                    SEOUENCE {
    spCellConfigCommon
                                        ServingCellConfigCommon
                                                                                                         OPTIONAL, -- Need M
    newUE-Identity
                                        RNTI-Value,
                                        ENUMERATED {ms50, ms100, ms150, ms200, ms500, ms1000, ms2000, ms10000},
    t304
    rach-ConfigDedicated
                                        CHOICE {
                                            RACH-ConfigDedicated,
        uplink
        supplementaryUplink
                                            RACH-ConfigDedicated
                                                                                                    OPTIONAL,
                                                                                                               -- Need N
    . . . ,
    Π
    smtc
                                        SSB-MTC
                                                                                                    OPTIONAL
                                                                                                                -- Need S
    ]]
SCellConfig ::=
                                    SEQUENCE {
    sCellIndex
                                        SCellIndex,
                                        ServingCellConfigCommon
    sCellConfigCommon
                                                                                                     OPTIONAL,
                                                                                                                -- Cond SCellAdd
    sCellConfigDedicated
                                        ServingCellConfig
                                                                                                    OPTIONAL,
                                                                                                                -- Cond SCellAddMod
    . . . ,
    ] ]
    smtc
                                        SSB-MTC
                                                                                                     OPTIONAL
                                                                                                                -- Need S
    ]]
-- TAG-CELLGROUPCONFIG-STOP
-- ASN1STOP
```

CellGroupConfig field descriptions

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mac-CellGroupConfig

MAC parameters applicable for the entire cell group.

rlc-BearerToAddModList

Configuration of the MAC Logical Channel, the corresponding RLC entities and association with radio bearers.

reportUplinkTxDirectCurrent

Enables reporting of uplink and supplementary uplink Direct Current location information upon BWP configuration and reconfiguration. This field is only present when the BWP configuration is modified or any serving cell is added or removed. This field is absent in the IE *CellGroupConfig* when provided as part of *RRCSetup* message. If UE is configured with SUL carrier, UE reports both UL and SUL Direct Current locations.

rlmInSyncOutOfSyncThreshold

BLER threshold pair index for IS/OOS indication generation, see TS 38.133 [14], table 8.1.1-1. *n1* corresponds to the value 1. When the field is absent, the UE applies the value 0. Whenever this is reconfigured, UE resets N310 and N311, and stops T310, if running. Network does not include this field.

sCellToAddModList

List of seconary serving cells (SCells) to be added or modified.

sCellToReleaseList

List of secondary serving cells (SCells) to be released.

spCellConfig

Parameters for the SpCell of this cell group (PCell of MCG or PSCell of SCG).

ReconfigurationWithSync field descriptions

rach-ConfigDedicated

Random access configuration to be used for the reconfiguration with sync (e.g. handover). The UE performs the RA according to these parameters in the firstActiveUplinkBWP (see UplinkConfig).

smtc

The SSB periodicity/offset/duration configuration of target cell for NR PSCell change, NR PCell change and (for NR-DC) NR PSCell addition. The network sets the periodicityAndOffset to indicate the same periodicity as ssb-periodicityServingCell in spCellConfigCommon. For case of NR PCell change and NR PSCell addition, the smtc is based on the timing reference of (source) PCell. For case of NR PSCell change, it is based on the timing reference of source PSCell. If the field is absent, the UE uses the SMTC in the measObjectNR having the same SSB frequency and subcarrier spacing, as configured before the reception of the RRC message.

SCellConfig field descriptions

smtc

The SSB periodicity/offset/duration configuration of target cell for NR SCell addition. The network sets the *periodicityAndOffset* to indicate the same periodicity as *ssb-periodicityServingCell* in *sCellConfigCommon*. The *smtc* is based on the timing of the SpCell of associated cell group. In case of inter-RAT handover to NR, the timing reference is the NR PCell. In case of intra-NR PCell change (standalone NR) or NR PSCell change (EN-DC), the timing reference is the target SpCell. If the field is absent, the UE uses the SMTC in the *measObjectNR* having the same SSB frequency and subcarrier spacing, as configured before the reception of the RRC message.

SpCellConfig field descriptions

reconfigurationWithSync

Parameters for the synchronous reconfiguration to the target SpCell.

rlf-TimersAndConstants

Timers and constants for detecting and triggering cell-level radio link failure. For the SCG, rlf-TimersAndConstants can only be set to setup and is always included at SCG addition.

servCellIndex

Serving cell ID of a PSCell. The PCell of the Master Cell Group uses ID = 0.

Conditional Presence	Explanation
BWP-Reconfig	The field is optionally present, Need N, if the BWPs are reconfigured or if serving cells are added or removed. Otherwise it is
	absent.
ReconfWithSync	The field is mandatory present in the RRCReconfiguration message:
	- in each configured <i>CellGroupConfig</i> for which the SpCell changes,
	 in the masterCellGroup at change of AS security key derived from K_{gNB},
	- in the secondaryCellGroup at:
	- PSCell addition,
	- update of required SI for PSCell,
	- change of AS security key derived from S-K _{gNB} in NR-DC while the UE is configured with at least one radio bearer
	with keyToUse set to secondary and that is not released by this RRCReconfiguration message.
	- MN handover in (NG)EN-DC.
	Otherwise it is optionally present, need M. The field is absent in RRCResume or RRCSetup messages.
SCellAdd	The field is mandatory present upon SCell addition; otherwise it is absent, Need M.
SCellAddMod	The field is mandatory present upon SCell addition; otherwise it is optionally present, need M.
SCG	The field is mandatory present in an SpCellConfig for the PSCell. It is absent otherwise.

NOTE: In case of change of AS security key derived from S-K_{gNB}/S-K_{eNB}, if *reconfigurationWithSync* is not included in the *masterCellGroup*, the network releases all existing MCG RLC bearers associated with a radio bearer with *keyToUse* set to *secondary*. In case of change of AS security key derived from K_{gNB}/K_{eNB}, if *reconfigurationWithSync* is not included in the *secondaryCellGroup*, the network releases all existing SCG RLC bearers associated with a radio bearer with *keyToUse* set to *primary*.

CellGroupId

The IE *CellGroupId* is used to identify a cell group. Value 0 identifies the master cell group. Other values identify secondary cell groups. In this version of the specification only values 0 and 1 are supported.

CellGroupId information element

-- ASN1START

-- TAG-CELLGROUPID-START

CellGroupId ::=

INTEGER (0.. maxSecondaryCellGroups)

-- TAG-CELLGROUPID-STOP

-- ASN1STOP

CellIdentity

The IE CellIdentity is used to unambiguously identify a cell within a PLMN.

CellIdentity information element

```
-- ASN1START
-- TAG-CELLIDENTITY-START

Cellidentity ::= BIT STRING (SIZE (36))
-- TAG-CELLIDENTITY-STOP
-- ASN1STOP
```

CellReselectionPriority

The IE *CellReselectionPriority* concerns the absolute priority of the concerned carrier frequency, as used by the cell reselection procedure. Corresponds to parameter "priority" in TS 38.304 [20]. Value 0 means lowest priority. The UE behaviour for the case the field is absent, if applicable, is specified in TS 38.304 [20].

CellReselectionPriority information element

```
-- ASN1START
-- TAG-CELLRESELECTIONPRIORITY-START

CellReselectionPriority ::= INTEGER (0..7)

-- TAG-CELLRESELECTIONPRIORITY-STOP
-- ASN1STOP
```

CellReselectionSubPriority

The IE *CellReselectionSubPriority* indicates a fractional value to be added to the value of *cellReselectionPriority* to obtain the absolute priority of the concerned carrier frequency for E-UTRA and NR. Value *oDot2* corresponds to 0.2, value *oDot4* corresponds to 0.4 and so on.

CellReselectionSubPriority information element

```
-- ASN1START
-- TAG-CELLRESELECTIONSUBPRIORITY-START

CellReselectionSubPriority ::= ENUMERATED {oDot2, oDot4, oDot6, oDot8}

-- TAG-CELLRESELECTIONSUBPRIORITY-STOP
```

-- ASN1STOP

CGI-InfoEUTRA

The IE CGI-InfoEUTRA indicates EUTRA cell access related information, which is reported by the UE as part of E-UTRA report CGI procedure.

CGI-InfoEUTRA information element

```
-- ASN1START
-- TAG-CGI-INFOEUTRA-START
                                     SEQUENCE {
CGI-InfoEUTRA ::=
    cgi-info-EPC
                                            SEQUENCE {
            cgi-info-EPC-legacy
                                                    CellAccessRelatedInfo-EUTRA-EPC,
           cgi-info-EPC-list
                                                    SEQUENCE (SIZE (1..maxPLMN)) OF CellAccessRelatedInfo-EUTRA-EPC
                                                                                                                          OPTIONAL
                                                                                                                          OPTIONAL,
                                            SEQUENCE (SIZE (1..maxPLMN)) OF CellAccessRelatedInfo-EUTRA-5GC
    cgi-info-5GC
                                                                                                                          OPTIONAL,
    freqBandIndicator
                                            FreqBandIndicatorEUTRA,
    multiBandInfoList
                                            MultiBandInfoListEUTRA
                                                                                                                          OPTIONAL,
    fregBandIndicatorPriority
                                            ENUMERATED {true}
                                                                                                                          OPTIONAL
-- TAG-CGI-INFOEUTRA-STOP
```

- CGI-InfoNR

-- ASN1STOP

The IE CGI-InfoNR indicates cell access related information, which is reported by the UE as part of report CGI procedure.

CGI-InfoNR information element

```
-- ASN1START
-- TAG-CGI-INFO-NR-START
CGI-InfoNR ::=
                                  SEQUENCE {
   plmn-IdentityInfoList
                                        PLMN-IdentityInfoList
                                                                             OPTIONAL.
                                        MultiFrequencyBandListNR
   frequencyBandList
                                                                             OPTIONAL,
   noSIB1
                                        SEQUENCE {
       ssb-SubcarrierOffset
                                            INTEGER (0..15),
                                            PDCCH-ConfigSIB1
       pdcch-ConfigSIB1
                                                                             OPTIONAL,
-- TAG-CGI-INFO-NR-STOP
-- ASN1STOP
```

CGI-InfoNR field descriptions

noSIB1

Contains ssb-SubcarrierOffset and pdcch-ConfigSIB1 fields acquired by the UE from MIB of the cell for which report CGI procedure was requested by the network in case SIB1 was not broadcast by the cell.

CodebookConfig

The IE CodebookConfig is used to configure codebooks of Type-I and Type-II (see TS 38.214 [19], clause 5.2.2.2)

CodebookConfig information element

```
-- ASN1START
-- TAG-CODEBOOKCONFIG-START
CodebookConfig ::=
                                                    SEOUENCE {
    codebookType
                                                        CHOICE {
        type1
                                                            SEOUENCE {
            subType
                typeI-SinglePanel
                                                                     SEOUENCE
                    nrOfAntennaPorts
                                                                         CHOICE
                        two
                                                                             SEOUENCE
                            twoTX-CodebookSubsetRestriction
                                                                                 BIT STRING (SIZE (6))
                        moreThanTwo
                                                                             SEOUENCE {
                            n1-n2
                                                                                 CHOICE {
                                two-one-TypeI-SinglePanel-Restriction
                                                                                     BIT STRING (SIZE (8)),
                                two-two-TypeI-SinglePanel-Restriction
                                                                                     BIT STRING (SIZE (64)),
                                four-one-TypeI-SinglePanel-Restriction
                                                                                     BIT STRING (SIZE (16)),
                                three-two-TypeI-SinglePanel-Restriction
                                                                                     BIT STRING (SIZE (96)),
                                six-one-TypeI-SinglePanel-Restriction
                                                                                     BIT STRING (SIZE (24)),
                                four-two-TypeI-SinglePanel-Restriction
                                                                                     BIT STRING (SIZE (128)),
                                eight-one-TypeI-SinglePanel-Restriction
                                four-three-TypeI-SinglePanel-Restriction
                                                                                     BIT STRING (SIZE (192)),
                                six-two-TypeI-SinglePanel-Restriction
                                                                                     BIT STRING (SIZE (192)),
                                twelve-one-TypeI-SinglePanel-Restriction
                                                                                     BIT STRING (SIZE (48)),
                                four-four-TypeI-SinglePanel-Restriction
                                                                                     BIT STRING (SIZE (256)),
                                eight-two-TypeI-SinglePanel-Restriction
                                                                                     BIT STRING (SIZE (256)),
                                sixteen-one-TypeI-SinglePanel-Restriction
                                                                                     BIT STRING (SIZE (64))
                            typeI-SinglePanel-codebookSubsetRestriction-i2
                                                                                 BIT STRING (SIZE (16))
                                                                                                               OPTIONAL
                                                                                                                           -- Need R
                    typeI-SinglePanel-ri-Restriction
                                                                         BIT STRING (SIZE (8))
                typeI-MultiPanel
                                                                     SEOUENCE {
                                                                             CHOICE {
                    nq-n1-n2
                        two-two-one-TypeI-MultiPanel-Restriction
                                                                                 BIT STRING (SIZE (8)),
                        two-four-one-TypeI-MultiPanel-Restriction
                                                                                 BIT STRING (SIZE (16)),
                        four-two-one-TypeI-MultiPanel-Restriction
                                                                                BIT STRING (SIZE (8)),
                        two-two-two-TypeI-MultiPanel-Restriction
                                                                                BIT STRING (SIZE (64)),
```

```
two-eight-one-TypeI-MultiPanel-Restriction
                                                                                 BIT STRING (SIZE (32)),
                        four-four-one-TypeI-MultiPanel-Restriction
                                                                                 BIT STRING (SIZE (16)),
                        two-four-two-TypeI-MultiPanel-Restriction
                                                                                 BIT STRING (SIZE (128)),
                        four-two-two-TypeI-MultiPanel-Restriction
                                                                                 BIT STRING (SIZE (64))
                    ri-Restriction
                                                             BIT STRING (SIZE (4))
           codebookMode
                                                                 INTEGER (1..2)
                                                 SEQUENCE {
        type2
                                                     CHOICE {
            subType
                typeII
                                                         SEQUENCE
                    n1-n2-codebookSubsetRestriction
                                                             CHOICE {
                        t.wo-one
                                                                 BIT STRING (SIZE (16)),
                        two-two
                                                                 BIT STRING (SIZE (43)),
                        four-one
                                                                 BIT STRING (SIZE (32)),
                        three-two
                                                                 BIT STRING (SIZE (59)),
                        six-one
                                                                 BIT STRING (SIZE (48)),
                        four-two
                                                                 BIT STRING (SIZE (75)),
                        eight-one
                                                                 BIT STRING (SIZE (64)),
                        four-three
                                                                 BIT STRING (SIZE (107)),
                        six-two
                                                                 BIT STRING (SIZE (107)),
                        twelve-one
                                                                 BIT STRING (SIZE (96)),
                        four-four
                                                                 BIT STRING (SIZE (139)),
                        eight-two
                                                                 BIT STRING (SIZE (139)),
                        sixteen-one
                                                                 BIT STRING (SIZE (128))
                    typeII-RI-Restriction
                                                             BIT STRING (SIZE (2))
                typeII-PortSelection
                                                         SEQUENCE {
                    \verb"portSelectionSamplingSize"
                                                             ENUMERATED {n1, n2, n3, n4}
                                                                                                            OPTIONAL,
                                                                                                                             -- Need R
                    typeII-PortSelectionRI-Restriction
                                                             BIT STRING (SIZE (2))
            phaseAlphabetSize
                                                     ENUMERATED {n4, n8},
            subbandAmplitude
                                                     BOOLEAN,
           numberOfBeams
                                                     ENUMERATED {two, three, four}
-- TAG-CODEBOOKCONFIG-STOP
-- ASN1STOP
```

CodebookConfig field descriptions

codebookMode

CodebookMode as specified in TS 38.214 [19], clause 5.2.2.2.2.

codebookType

CodebookType including possibly sub-types and the corresponding parameters for each (see TS 38.214 [19], clause 5.2.2.2).

n1-n2-codebookSubsetRestriction

Number of antenna ports in first (n1) and second (n2) dimension and codebook subset restriction (see TS 38.214 [19] clause 5.2.2.2.3).

Number of bits for codebook subset restriction is CEIL(log2(nchoosek(O1*O2.4)))+8*n1*n2 where nchoosek(a,b) = a!/(b!(a-b)!).

n1-n2

Number of antenna ports in first (n1) and second (n2) dimension and codebook subset restriction (see TS 38.214 [19] clause 5.2.2.2.1).

ng-n1-n2

Codebook subset restriction for Type I Multi-panel codebook (see TS 38.214 [19], clause 5.2.2.2.2).

numberOfBeams

Number of beams, L, used for linear combination.

phaseAlphabetSize

The size of the PSK alphabet, QPSK or 8-PSK.

portSelectionSamplingSize

The size of the port selection codebook (parameter d).

ri-Restriction

Restriction for RI for *TypeI-MultiPanel-RI-Restriction* (see TS 38.214 [19], clause 5.2.2.2.2).

subbandAmplitude

If subband amplitude reporting is activated (true).

twoTX-CodebookSubsetRestriction

Codebook subset restriction for 2TX codebook (see TS 38.214 [19] clause 5.2.2.2.1).

typel-SinglePanel-codebookSubsetRestriction-i2

i2 codebook subset restriction for Type I Single-panel codebook used when reportQuantity is CRI/Ri/i1/CQI (see TS 38.214 [19] clause 5.2.2.2.1).

typel-SinglePanel-ri-Restriction

Restriction for RI for TypeI-SinglePanel-RI-Restriction (see TS 38.214 [19], clause 5.2.2.2.1).

typeII-PortSelectionRI-Restriction

Restriction for RI for TypeII-PortSelection-RI-Restriction (see TS 38.214 [19], clause 5.2.2.4).

typell-RI-Restriction

Restriction for RI for *TypeII-RI-Restriction* (see TS 38.214 [19], clause 5.2.2.2.3).

ConfiguredGrantConfig

The IE *ConfiguredGrantConfig* is used to configure uplink transmission without dynamic grant according to two possible schemes. The actual uplink grant may either be configured via RRC (*type1*) or provided via the PDCCH (addressed to CS-RNTI) (*type2*).

ConfiguredGrantConfig information element

```
-- ASN1START
-- TAG-CONFIGUREDGRANTCONFIG-START

ConfiguredGrantConfig ::= SEQUENCE {
   frequencyHopping ENUMERATED {intraSlot, interSlot}
```

```
cq-DMRS-Configuration
                                        DMRS-UplinkConfig,
    mcs-Table
                                        ENUMERATED {gam256, gam64LowSE}
                                                                                                                OPTIONAL. -- Need S
                                        ENUMERATED {gam256, gam64LowSE}
   mcs-TableTransformPrecoder
                                                                                                                OPTIONAL.
                                                                                                                           -- Need S
                                        SetupRelease { CG-UCI-OnPUSCH }
                                                                                                                           -- Need M
    uci-OnPUSCH
                                                                                                                OPTIONAL.
    resourceAllocation
                                        ENUMERATED { resourceAllocationType0, resourceAllocationType1, dynamicSwitch },
                                        ENUMERATED {config2}
    rbq-Size
                                                                                                                OPTIONAL, -- Need S
    powerControlLoopToUse
                                        ENUMERATED {n0, n1},
    p0-PUSCH-Alpha
                                       PO-PUSCH-AlphaSetId,
    transformPrecoder
                                       ENUMERATED {enabled, disabled}
                                                                                                                OPTIONAL, -- Need S
    nrofHARO-Processes
                                        INTEGER(1..16),
    repK
                                       ENUMERATED {n1, n2, n4, n8},
                                        ENUMERATED {s1-0231, s2-0303, s3-0000}
    repK-RV
                                                                                                                OPTIONAL, -- Need R
    periodicity
                                        ENUMERATED
                                                sym2, sym7, sym1x14, sym2x14, sym4x14, sym5x14, sym8x14, sym10x14, sym16x14, sym20x14,
                                                sym32x14, sym40x14, sym64x14, sym80x14, sym128x14, sym160x14, sym256x14, sym320x14, sym512x14,
                                                sym640x14, sym1024x14, sym1280x14, sym2560x14, sym5120x14,
                                                sym6, sym1x12, sym2x12, sym4x12, sym5x12, sym8x12, sym10x12, sym16x12, sym20x12, sym32x12,
                                                sym40x12, sym64x12, sym80x12, sym128x12, sym160x12, sym256x12, sym320x12, sym512x12, sym640x12,
                                                sym1280x12, sym2560x12
    configuredGrantTimer
                                            INTEGER (1..64)
                                                                                                                OPTIONAL, -- Need R
    rrc-ConfiguredUplinkGrant
                                            SEQUENCE {
       timeDomainOffset
                                               INTEGER (0..5119),
        timeDomainAllocation
                                                INTEGER (0..15),
        frequencyDomainAllocation
                                               BIT STRING (SIZE(18)),
        ant.ennaPort
                                               INTEGER (0..31),
       dmrs-SegInitialization
                                               INTEGER (0..1)
                                                                                                                OPTIONAL, -- Need R
       precodingAndNumberOfLayers
                                               INTEGER (0..63),
       srs-ResourceIndicator
                                               INTEGER (0..15)
                                                                                                                OPTIONAL,
                                                                                                                           -- Need R
       mcsAndTBS
                                               INTEGER (0..31),
        frequencyHoppingOffset
                                                INTEGER (1.. maxNrofPhysicalResourceBlocks-1)
                                                                                                                OPTIONAL,
                                                                                                                           -- Need R
       pathlossReferenceIndex
                                               INTEGER (0..maxNrofPUSCH-PathlossReferenceRSs-1),
       . . .
                                                                                                                OPTIONAL, -- Need R
CG-UCI-OnPUSCH ::= CHOICE {
    dynamic
                                            SEQUENCE (SIZE (1..4)) OF BetaOffsets,
    semiStatic
                                            BetaOffsets
-- TAG-CONFIGUREDGRANTCONFIG-STOP
-- ASN1STOP
```

ConfiguredGrantConfig field descriptions

antennaPort

Indicates the antenna port(s) to be used for this configuration, and the maximum bitwidth is 5. See TS 38.214 [19], clause 6.1.2, and TS 38.212 [17], clause 7.3.1.

cg-DMRS-Configuration

DMRS configuration (see TS 38.214 [19], clause 6.1.2.3).

configuredGrantTimer

Indicates the initial value of the configured grant timer (see TS 38.321 [3]) in multiples of periodicity.

dmrs-SegInitialization

The network configures this field if transformPrecoder is disabled. Otherwise the field is absent.

frequencyDomainAllocation

Indicates the frequency domain resource allocation, see TS 38.214 [19], clause 6.1.2, and TS 38.212 [17], clause 7.3.1).

frequencyHopping

The value intraSlot enables 'Intra-slot frequency hopping' and the value interSlot enables 'Inter-slot frequency hopping'. If the field is absent, frequency hopping is not configured.

frequencyHoppingOffset

Frequency hopping offset used when frequency hopping is enabled (see TS 38.214 [19], clause 6.1.2 and clause 6.3).

mcs-Table

Indicates the MCS table the UE shall use for PUSCH without transform precoding. If the field is absent the UE applies the value qam64.

mcs-TableTransformPrecoder

Indicates the MCS table the UE shall use for PUSCH with transform precoding. If the field is absent the UE applies the value gam64.

mcsAndTBS

The modulation order, target code rate and TB size (see TS 38.214 [19], clause 6.1.2). The NW does not configure the values 28~31 in this version of the specification.

nrofHARQ-Processes

The number of HARQ processes configured. It applies for both Type 1 and Type 2. See TS 38.321 [3], clause 5.4.1.

p0-PUSCH-Alpha

Index of the P0-PUSCH-AlphaSet to be used for this configuration.

pathlossReferenceIndex

Indicates the reference signal index used as PUSCH pathloss reference (see TS 38.213 [13], clause 7.1.1).

periodicity

Periodicity for UL transmission without UL grant for type 1 and type 2 (see TS 38.321 [3], clause 5.8.2).

The following periodicities are supported depending on the configured subcarrier spacing [symbols]:

15 kHz: 2, 7, n*14, where n={1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 320, 640}

30 kHz: 2, 7, n*14, where n={1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 256, 320, 640, 1280}

60 kHz with normal CP 2, 7, n*14, where n={1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 256, 320, 512, 640, 1280, 2560}

60 kHz with ECP: 2, 6, n*12, where n={1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 256, 320, 512, 640, 1280, 2560}

120 kHz: 2, 7, n*14, where n={1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 256, 320, 512, 640, 1024, 1280, 2560, 5120}

powerControlLoopToUse

Closed control loop to apply (see TS 38.213 [13], clause 7.1.1).

precodingAndNumberOfLayers

Indicates the precoding and number of layers (see TS 38.212 [17], clause 7.3.1.1.2, and TS 38.214 [19], clause 6.1.2.3).

rba-Size

Selection between configuration 1 and configuration 2 for RBG size for PUSCH. The UE does not apply this field if *resourceAllocation* is set to *resourceAllocationType1*. Otherwise, the UE applies the value *config1* when the field is absent. Note: *rbg-Size* is used when the *transformPrecoder* parameter is disabled.

repK-RV

The redundancy version (RV) sequence to use. See TS 38.214 [19], clause 6.1.2. The network configures this field if repetitions are used, i.e., if *repK* is set to *n*2, *n*4 or *n*8. Otherwise, the field is absent.

repK

Number of repetitions K, see TS 38.214 [19].

resourceAllocation

Configuration of resource allocation type 0 and resource allocation type 1. For Type 1 UL data transmission without grant, resourceAllocation should be resourceAllocationType0 or resourceAllocationType1.

rrc-ConfiguredUplinkGrant

Configuration for "configured grant" transmission with fully RRC-configured UL grant (Type1). If this field is absent the UE uses UL grant configured by DCI addressed to CS-RNTI (Type2). Type 1 configured grant may be configured for UL or SUL, but not for both simultaneously.

srs-ResourceIndicator

Indicates the SRS resource to be used.

timeDomainAllocation

Indicates a combination of start symbol and length and PUSCH mapping type, see TS 38.214 [19], clause 6.1.2 and TS 38.212 [17], clause 7.3.1.

timeDomainOffset

Offset related to SFN=0, see TS 38.321 [3], clause 5.8.2.

transformPrecoder

Enables or disables transform precoding for *type1* and *type2*. If the field is absent, the UE enables or disables transform precoding in accordance with the field *msg3-transformPrecoder* in *RACH-ConfigCommon*, see TS 38.214 [19], clause 6.1.3.

uci-OnPUSCH

-- ASN1STOP

Selection between and configuration of dynamic and semi-static beta-offset. For Type 1 UL data transmission without grant, uci-OnPUSCH should be set to semiStatic.

ConnEstFailureControl

The IE ConnEstFailureControl is used to configure parameters for connection establishment failure control.

ConnEstFailureControl information element

ConnEstFailureControl field descriptions

connEstFailCount

Number of times that the UE detects T300 expiry on the same cell before applying connEstFailOffset.

connEstFailOffset

Parameter "Qoffset_{temp}" in TS 38.304 [20]. If the field is absent, the value of infinity shall be used for "Qoffset_{temp}".

connEstFailOffsetValidity

Amount of time that the UE applies *connEstFailOffset* before removing the offset from evaluation of the cell. Value *s30* corresponds to 30 seconds, value *s60* corresponds to 60 seconds, and so on.

ControlResourceSet

The IE *ControlResourceSet* is used to configure a time/frequency control resource set (CORESET) in which to search for downlink control information (see TS 38.213 [13], clause 10.1).

ControlResourceSet information element

```
-- ASN1START
-- TAG-CONTROLRESOURCESET-START
ControlResourceSet ::=
                                    SEQUENCE {
    controlResourceSetId
                                        ControlResourceSetId,
    frequencyDomainResources
                                        BIT STRING (SIZE (45)),
    duration
                                        INTEGER (1..maxCoReSetDuration),
                                        CHOICE {
    cce-REG-MappingType
                                            SEOUENCE {
       interleaved
           reg-BundleSize
                                                ENUMERATED {n2, n3, n6},
                                                ENUMERATED {n2, n3, n6},
            interleaverSize
            shiftIndex
                                                INTEGER(0..maxNrofPhysicalResourceBlocks-1)
                                                                                                  OPTIONAL -- Need S
       nonInterleaved
                                            NULL
    precoderGranularity
                                        ENUMERATED {sameAsREG-bundle, allContiguousRBs},
    tci-StatesPDCCH-ToAddList
                                        SEQUENCE(SIZE (1..maxNrofTCI-StatesPDCCH)) OF TCI-StateId OPTIONAL, -- Cond NotSIB1-initialBWP
                                        SEQUENCE(SIZE (1..maxNrofTCI-StatesPDCCH)) OF TCI-StateId OPTIONAL, -- Cond NotSIB1-initialBWP
    tci-StatesPDCCH-ToReleaseList
                                            ENUMERATED {enabled}
                                                                                                  OPTIONAL, -- Need S
    tci-PresentInDCI
                                            INTEGER (0..65535)
    pdcch-DMRS-ScramblingID
                                                                                                  OPTIONAL, -- Need S
-- TAG-CONTROLRESOURCESET-STOP
-- ASN1STOP
```

ControlResourceSet field descriptions

cce-REG-MappingType

Mapping of Control Channel Elements (CCE) to Resource Element Groups (REG) (see TS 38.211 [16], clauses 7.3.2.2 and 7.4.1.3.2).

controlResourceSetId

Value 0 identifies the common CORESET configured in MIB and in ServingCellConfigCommon (controlResourceSetZero) and is hence not used here in the ControlResourceSet IE. Values 1..maxNrofControlResourceSets-1 identify CORESETs configured by dedicated signalling or in SIB1. The controlResourceSetId is unique among the BWPs of a serving cell.

duration

Contiguous time duration of the CORESET in number of symbols (see TS 38.211 [16], clause 7.3.2.2).

frequencyDomainResources

Frequency domain resources for the CORESET. Each bit corresponds a group of 6 RBs, with grouping starting from the first RB group (see TS 38.213 [13], clause 10.1) in the BWP. The first (left-most / most significant) bit corresponds to the first RB group in the BWP, and so on. A bit that is set to 1 indicates that this RB group belongs to the frequency domain resource of this CORESET. Bits corresponding to a group of RBs not fully contained in the bandwidth part within which the CORESET is configured are set to zero (see TS 38.211 [16], clause 7.3.2.2).

interleaverSize

Interleaver-size (see TS 38.211 [16], clause 7.3.2.2).

pdcch-DMRS-ScramblingID

PDCCH DMRS scrambling initialization (see TS 38.211 [16], clause 7.4.1.3.1). When the field is absent the UE applies the value of the *physCellId* configured for this serving cell.

precoderGranularity

Precoder granularity in frequency domain (see TS 38.211 [16], clauses 7.3.2.2 and 7.4.1.3.2).

reg-BundleSize

Resource Element Groups (REGs) can be bundled to create REG bundles. This parameter defines the size of such bundles (see TS 38.211 [16], clause 7.3.2.2).

shiftIndex

When the field is absent the UE applies the value of the physCellIdconfigured for this serving cell (see TS 38.211 [16], clause 7.3.2.2).

tci-PresentInDCI

This field indicates if TCI field is present or absent in DL-related DCI. When the field is absent the UE considers the TCI to be absent/disabled. In case of cross carrier scheduling, the network sets this field to enabled for the *ControlResourceSet* used for cross carrier scheduling in the scheduling cell (see TS 38.214 [19], clause 5.1.5).

tci-StatesPDCCH-ToAddList

A subset of the TCI states defined in pdsch-Config included in the *BWP-DownlinkDedicated* corresponding to the serving cell and to the DL BWP to which the *ControlResourceSet* belong to. They are used for providing QCL relationships between the DL RS(s) in one RS Set (TCI-State) and the PDCCH DMRS ports (see TS 38.213 [13], clause 6.). The network configures at most *maxNrofTCI-StatesPDCCH* entries.

Conditional Presence	Explanation
NotSIB1-initialBWP	The field is absent in SIB1 and in the PDCCH-ConfigCommon of the initial BWP in ServingCellConfigCommon, if SIB1 is
	broadcasted. Otherwise, it is optionally present, Need N.

ControlResourceSetId

The *ControlResourceSetId* IE concerns a short identity, used to identify a control resource set within a serving cell. The *ControlResourceSetId* = 0 identifies the ControlResourceSet#0 configured via PBCH (*MIB*) and in *controlResourceSetZero* (*ServingCellConfigCommon*). The ID space is used across the BWPs of a Serving Cell.

ControlResourceSetId information element

```
-- ASN1START
-- TAG-CONTROLRESOURCESETID-START

ControlResourceSetId ::= INTEGER (0..maxNrofControlResourceSets-1)
-- TAG-CONTROLRESOURCESETID-STOP
-- ASN1STOP
```

ControlResourceSetZero

The IE ControlResourceSetZero is used to configure CORESET#0 of the initial BWP (see TS 38.213 [13], clause 13).

ControlResourceSetZero information element

```
-- ASN1START
-- TAG-CONTROLRESOURCESETZERO-START

ControlResourceSetZero ::= INTEGER (0..15)

-- TAG-CONTROLRESOURCESETZERO-STOP
-- ASN1STOP
```

CrossCarrierSchedulingConfig

The IE CrossCarrierSchedulingConfig is used to specify the configuration when the cross-carrier scheduling is used in a cell.

CrossCarrierSchedulingConfig information element

```
-- ASN1START
-- TAG-CrossCarrierSchedulingConfig-START
CrossCarrierSchedulingConfig ::=
    schedulingCellInfo
                                            CHOICE {
                                                                            -- Cross carrier scheduling: scheduling cell
       own
                                                SEQUENCE {
                                                    BOOLEAN
           cif-Presence
       other
                                                SEQUENCE {
                                                                            -- Cross carrier scheduling: scheduled cell
           schedulingCellId
                                                    ServCellIndex,
           cif-InSchedulingCell
                                                    INTEGER (1..7)
-- TAG-CrossCarrierSchedulingConfig-STOP
```

-- ASN1STOP

CrossCarrierSchedulingConfig field descriptions

cif-Presence

The field is used to indicate whether carrier indicator field is present (value *true*) or not (value *false*) in PDCCH DCI formats, see TS 38.213 [13]. If *cif-Presence* is set to *true*, the CIF value indicating a grant or assignment for this cell is 0.

cif-InSchedulingCell

The field indicates the CIF value used in the scheduling cell to indicate a grant or assignment applicable for this cell, see TS 38.213 [13].

other

Parameters for cross-carrier scheduling, i.e., a serving cell is scheduled by a PDCCH on another (scheduling) cell. The network configures this field only for SCells.

own

Parameters for self-scheduling, i.e., a serving cell is scheduled by its own PDCCH.

schedulingCellId

Indicates which cell signals the downlink allocations and uplink grants, if applicable, for the concerned SCell. In case the UE is configured with DC, the scheduling cell is part of the same cell group (i.e. MCG or SCG) as the scheduled cell. In case the UE is configured with two PUCCH groups, the scheduling cell and the scheduled cell are within the same PUCCH group.

CSI-AperiodicTriggerStateList

The CSI-AperiodicTriggerStateList IE is used to configure the UE with a list of aperiodic trigger states. Each codepoint of the DCI field "CSI request" is associated with one trigger state (see TS 38.321 [3], clause 6.1.3.13). Upon reception of the value associated with a trigger state, the UE will perform measurement of CSI-RS, CSI-IM and/or SSB (reference signals) and aperiodic reporting on L1 according to all entries in the associatedReportConfigInfoList for that trigger state.

CSI-AperiodicTriggerStateList information element

```
-- ASN1START
-- TAG-CSI-APERIODICTRIGGERSTATELIST-START
CSI-AperiodicTriggerStateList ::= SEQUENCE (SIZE (1..maxNrOfCSI-AperiodicTriggerS)) OF CSI-AperiodicTriggerState
CSI-AperiodicTriggerState ::=
                                    SEOUENCE
    associatedReportConfigInfoList
                                       SEQUENCE (SIZE(1..maxNrofReportConfigPerAperiodicTrigger)) OF CSI-AssociatedReportConfigInfo,
CSI-AssociatedReportConfigInfo ::= SEQUENCE {
                                       CSI-ReportConfigId,
    reportConfigId
                                       CHOICE {
    resourcesForChannel
       nzp-CSI-RS
                                            SEOUENCE {
           resourceSet
                                                INTEGER (1..maxNrofNZP-CSI-RS-ResourceSetsPerConfig),
           qcl-info
                                                SEQUENCE (SIZE(1..maxNrofAP-CSI-RS-ResourcesPerSet)) OF TCI-StateId
                                                                                        OPTIONAL -- Cond Aperiodic
       csi-SSB-ResourceSet
                                            INTEGER (1..maxNrofCSI-SSB-ResourceSetsPerConfig)
    csi-IM-ResourcesForInterference
                                        INTEGER(1..maxNrofCSI-IM-ResourceSetsPerConfig)
                                                                                        OPTIONAL, -- Cond CSI-IM-ForInterference
```

```
nzp-CSI-RS-ResourcesForInterference INTEGER (1..maxNrofNZP-CSI-RS-ResourceSetsPerConfig)

OPTIONAL, -- Cond NZP-CSI-RS-ForInterference

...
}

-- TAG-CSI-APERIODICTRIGGERSTATELIST-STOP

-- ASN1STOP
```

CSI-AssociatedReportConfigInfo field descriptions

csi-IM-ResourcesForInterference

CSI-IM-ResourceSet for interference measurement. Entry number in csi-IM-ResourceSetList in the CSI-ResourceConfig indicated by csi-IM-ResourceSetInterference in the CSI-ReportConfig indicated by reportConfigId above (value 1 corresponds to the first entry, value 2 to the second entry, and so on). The indicated CSI-IM-ResourceSet should have exactly the same number of resourceSet like the NZP-CSI-RS-ResourceSet indicated in resourceSet within nzp-CSI-RS.

csi-SSB-ResourceSet

CSI-SSB-ResourceSet for channel measurements. Entry number in *csi-SSB-ResourceSetList* in the *CSI-ResourceConfig* indicated by *resourcesForChannelMeasurement* in the *CSI-ReportConfig* indicated by *reportConfigld* above (value 1 corresponds to the first entry, value 2 to the second entry, and so on).

nzp-CSI-RS-ResourcesForInterference

NZP-CSI-RS-ResourceSet for interference measurement. Entry number in nzp-CSI-RS-ResourceSetList in the CSI-ResourceConfig indicated by nzp-CSI-RS-ResourceSForInterference in the CSI-ReportConfig indicated by reportConfigld above (value 1 corresponds to the first entry, value 2 to the second entry, and so on).

qcl-info

List of references to TCI-States for providing the QCL source and QCL type for each NZP-CSI-RS-Resource listed in nzp-CSI-RS-Resources of the NZP-CSI-RS-ResourceSet indicated by resourceSet within nzp-CSI-RS. Each TCI-StateId refers to the TCI-State which has this value for tci-StateId and is defined in tci-StatesToAddModList in the PDSCH-Config included in the BWP-Downlink corresponding to the serving cell and to the DL BWP to which the resourcesForChannelMeasurement (in the CSI-ReportConfig indicated by reportConfigId above) belong to. First entry in qcl-info corresponds to first entry in nzp-CSI-RS-ResourceSet, second entry in qcl-info corresponds to second entry in nzp-CSI-RS-Resources, and so on (see TS 38.214 [19], clause 5.2.1.5.1)

reportConfigld

The reportConfigId of one of the CSI-ReportConfigToAddMod configured in CSI-MeasConfig

resourceSet

NZP-CSI-RS-ResourceSet for channel measurements. Entry number in nzp-CSI-RS-ResourceSetList in the CSI-ResourceConfig indicated by resourcesForChannelMeasurement in the CSI-ReportConfig indicated by reportConfigld above (value 1 corresponds to the first entry, value 2 to thesecond entry, and so on).

Conditional Presence	Explanation
Aperiodic	The field is mandatory present if the NZP-CSI-RS-Resources in the associated resourceSet have the resourceType
	aperiodic. The field is absent otherwise.
CSI-IM-ForInterference	This field is mandatory present if the CSI-ReportConfig identified by reportConfigId is configured with csi-IM-
	ResourcesForInterference; otherwise it is absent.
NZP-CSI-RS-ForInterference	This field is mandatory present if the CSI-ReportConfig identified by reportConfigId is configured with nzp-CSI-RS-
	ResourcesForInterference; otherwise it is absent.

CSI-FrequencyOccupation

The IE CSI-FrequencyOccupation is used to configure the frequency domain occupation of a channel state information measurement resource (e.g. NZP-CSI-RS-Resource, CSI-IM-Resource).

CSI-FrequencyOccupation information element

CSI-FrequencyOccupation field descriptions

nrofRBs

Number of PRBs across which this CSI resource spans. Only multiples of 4 are allowed. The smallest configurable number is the minimum of 24 and the width of the associated BWP. If the configured value is larger than the width of the corresponding BWP, the UE shall assume that the actual CSI-RS bandwidth is equal to the width of the BWP.

startingRB

PRB where this CSI resource starts in relation to common resource block #0 (CRB#0) on the common resource block grid. Only multiples of 4 are allowed (0, 4, ...)

CSI-IM-Resource

The IE CSI-IM-Resource is used to configure one CSI Interference Management (IM) resource.

CSI-IM-Resource information element

```
-- ASN1START
-- TAG-CSI-IM-RESOURCE-START
CSI-IM-Resource ::=
                                   SEOUENCE {
    csi-IM-ResourceId
                                       CSI-IM-ResourceId,
    csi-IM-ResourceElementPattern
                                           CHOICE {
                                               SEQUENCE {
       pattern0
           subcarrierLocation-p0
                                                   ENUMERATED { s0, s2, s4, s6, s8, s10 },
                                                   INTEGER (0..12)
           symbolLocation-p0
       pattern1
                                               SEOUENCE {
           subcarrierLocation-p1
                                                   ENUMERATED { s0, s4, s8 },
           symbolLocation-p1
                                                   INTEGER (0..13)
                                                                                       OPTIONAL, -- Need M
    fregBand
                                       CSI-FrequencyOccupation
                                                                                       OPTIONAL, -- Need M
    periodicityAndOffset
                                       CSI-ResourcePeriodicityAndOffset
                                                                                       OPTIONAL, -- Cond PeriodicOrSemiPersistent
```

- -- TAG-CSI-IM-RESOURCE-STOP
- -- ASN1STOP

CSI-IM-Resource field descriptions

csi-IM-ResourceElementPattern

The resource element pattern (Pattern0 (2,2) or Pattern1 (4,1)) with corresponding parameters (see TS 38.214 [19], clause 5.2.2.4)

freqBand

Frequency-occupancy of CSI-IM (see TS 38.214 [19], clause 5.2.2.4)

periodicityAndOffset

Periodicity and slot offset for periodic/semi-persistent CSI-IM. Network always configures the UE with a value for this field for periodic and semi-persistent CSI-IM-Resources (as indicated in CSI-ResourceConfig). A change of configuration between periodic or semi-persistent and aperiodic for a CSI-IM-Resource is not supported without a release and add.

subcarrierLocation-p0

OFDM subcarrier occupancy of the CSI-IM resource for Pattern0 (see TS 38.214 [19], clause 5.2.2.4)

subcarrierLocation-p1

OFDM subcarrier occupancy of the CSI-IM resource for Pattern1 (see TS 38.214 [19], clause 5.2.2.4)

symbolLocation-p0

OFDM symbol location of the CSI-IM resource for Pattern0 (see TS 38.214 [19], clause 5.2.2.4)

symbolLocation-p1

OFDM symbol location of the CSI-IM resource for Pattern1 (see TS 38.214 [19], clause 5.2.2.4)

Conditional Presence	Explanation
PeriodicOrSemiPersistent	The field is optionally present, Need M, for periodic and semi-persistent CSI-IM-Resources (as indicated in CSI-
	ResourceConfig). The field is absent otherwise.

CSI-IM-ResourceId

The IE CSI-IM-ResourceId is used to identify one CSI-IM-Resource.

CSI-IM-Resourceld information element

- -- ASN1START
- -- TAG-CSI-IM-RESOURCEID-START

CSI-IM-ResourceId ::=

INTEGER (0..maxNrofCSI-IM-Resources-1)

- -- TAG-CSI-IM-RESOURCEID-STOP
- -- ASN1STOP

CSI-IM-ResourceSet

The IE CSI-IM-ResourceSet is used to configure a set of one or more CSI Interference Management (IM) resources (their IDs) and set-specific parameters.

CSI-IM-ResourceSet information element

```
-- ASN1START
-- TAG-CSI-IM-RESOURCESET-START

CSI-IM-ResourceSet ::= SEQUENCE {
    csi-IM-ResourceSetId CSI-IM-ResourceSetId,
    csi-IM-Resources SEQUENCE (SIZE(1..maxNrofCSI-IM-ResourcesPerSet)) OF CSI-IM-ResourceId,
    ...
}
-- TAG-CSI-IM-RESOURCESET-STOP
-- ASN1STOP
```

CSI-IM-ResourceSet field descriptions

csi-IM-Resources

CSI-IM-Resources associated with this CSI-IM-ResourceSet (see TS 38.214 [19], clause 5.2).

CSI-IM-ResourceSetId

The IE CSI-IM-ResourceSetId is used to identify CSI-IM-ResourceSets.

CSI-IM-ResourceSetId information element

```
-- ASN1START
-- TAG-CSI-IM-RESOURCESETID-START

CSI-IM-ResourceSetId ::= INTEGER (0..maxNrofCSI-IM-ResourceSets-1)

-- TAG-CSI-IM-RESOURCESETID-STOP
-- ASN1STOP
```

CSI-MeasConfig

The IE *CSI-MeasConfig* is used to configure CSI-RS (reference signals) belonging to the serving cell in which *CSI-MeasConfig* is included, channel state information reports to be transmitted on PUCCH on the serving cell in which *CSI-MeasConfig* is included and channel state information reports on PUSCH triggered by DCI received on the serving cell in which *CSI-MeasConfig* is included. See also TS 38.214 [19], clause 5.2.

CSI-MeasConfig information element

```
nzp-CSI-RS-ResourceSetToAddModList SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourceSets)) OF NZP-CSI-RS-ResourceSet
                                                                                                            OPTIONAL, -- Need N
    nzp-CSI-RS-ResourceSetToReleaseList SEQUENCE (SIZE (1...maxNrofNZP-CSI-RS-ResourceSets)) OF NZP-CSI-RS-ResourceSetId
                                                                                                            OPTIONAL, -- Need N
    csi-IM-ResourceToAddModList
                                     SEQUENCE (SIZE (1..maxNrofCSI-IM-Resources)) OF CSI-IM-Resource
                                                                                                            OPTIONAL. -- Need N
    csi-IM-ResourceToReleaseList
                                                                                                            OPTIONAL, -- Need N
                                     SEQUENCE (SIZE (1..maxNrofCSI-IM-Resources)) OF CSI-IM-ResourceId
                                     SEQUENCE (SIZE (1..maxNrofCSI-IM-ResourceSets)) OF CSI-IM-ResourceSet
                                                                                                            OPTIONAL, -- Need N
    csi-IM-ResourceSetToAddModList
    csi-IM-ResourceSetToReleaseList
                                     SEOUENCE (SIZE (1..maxNrofCSI-IM-ResourceSets)) OF CSI-IM-ResourceSetId
                                                                                                            OPTIONAL, -- Need N
    csi-SSB-ResourceSetToAddModList
                                     SEQUENCE (SIZE (1..maxNrofCSI-SSB-ResourceSets)) OF CSI-SSB-ResourceSet
                                                                                                            OPTIONAL, -- Need N
                                     SEQUENCE (SIZE (1..maxNrofCSI-SSB-ResourceSets)) OF CSI-SSB-ResourceSetId OPTIONAL, -- Need N
    csi-SSB-ResourceSetToReleaseList
    csi-ResourceConfigToAddModList
                                     SEQUENCE (SIZE (1..maxNrofCSI-ResourceConfigurations)) OF CSI-ResourceConfig
                                                                                                            OPTIONAL, -- Need N
    csi-ResourceConfigToReleaseList
                                     SEQUENCE (SIZE (1..maxNrofCSI-ResourceConfigurations)) OF CSI-ResourceConfigId
                                                                                                            OPTIONAL, -- Need N
    csi-ReportConfigToAddModList
                                     SEQUENCE (SIZE (1..maxNrofCSI-ReportConfigurations)) OF CSI-ReportConfig OPTIONAL, -- Need N
    csi-ReportConfigToReleaseList
                                     SEQUENCE (SIZE (1..maxNrofCSI-ReportConfigurations)) OF CSI-ReportConfigId
                                                                                                            OPTIONAL, -- Need N
    reportTriggerSize
                                     INTEGER (0..6)
                                                                                                            OPTIONAL, -- Need M
    aperiodicTriggerStateList
                                     SetupRelease { CSI-AperiodicTriggerStateList }
                                                                                                            OPTIONAL, -- Need M
    OPTIONAL, -- Need M
-- TAG-CSI-MEASCONFIG-STOP
-- ASN1STOP
```

CSI-MeasConfig field descriptions

aperiodicTriggerStateList

Contains trigger states for dynamically selecting one or more aperiodic and semi-persistent reporting configurations and/or triggering one or more aperiodic CSI-RS resource sets for channel and/or interference measurement.

csi-IM-ResourceSetToAddModList

Pool of CSI-IM-ResourceSet which can be referred to from CSI-ResourceConfig or from MAC CEs.

csi-IM-ResourceToAddModList

Pool of CSI-IM-Resource which can be referred to from CSI-IM-ResourceSet.

csi-ReportConfigToAddModList

Configured CSI report settings as specified in TS 38.214 [19] clause 5.2.1.1.

csi-ResourceConfigToAddModList

Configured CSI resource settings as specified in TS 38.214 [19] clause 5.2.1.2.

csi-SSB-ResourceSetToAddModList

Pool of CSI-SSB-ResourceSet which can be referred to from CSI-ResourceConfig.

nzp-CSI-RS-ResourceSetToAddModList

Pool of NZP-CSI-RS-ResourceSet which can be referred to from CSI-ResourceConfig or from MAC CEs.

nzp-CSI-RS-ResourceToAddModList

Pool of NZP-CSI-RS-Resource which can be referred to from NZP-CSI-RS-ResourceSet.

reportTriggerSize

Size of CSI request field in DCI (bits) (see TS 38.214 [19], clause 5.2.1.5.1).

CSI-ReportConfig

The IE *CSI-ReportConfig* is used to configure a periodic or semi-persistent report sent on PUCCH on the cell in which the *CSI-ReportConfig* is included, or to configure a semi-persistent or aperiodic report sent on PUSCH triggered by DCI received on the cell in which the *CSI-ReportConfig* is included (in this case, the cell on which the report is sent is determined by the received DCI). See TS 38.214 [19], clause 5.2.1.

CSI-ReportConfig information element

```
-- ASN1START
-- TAG-CSI-REPORTCONFIG-START
CSI-ReportConfig ::=
                                    SEOUENCE {
                                            CSI-ReportConfigId,
    reportConfiqId
    carrier
                                            ServCellIndex
                                                                             OPTIONAL.
                                                                                        -- Need S
    resourcesForChannelMeasurement
                                            CSI-ResourceConfigId,
    csi-IM-ResourcesForInterference
                                            CSI-ResourceConfiqId
                                                                             OPTIONAL,
                                                                                        -- Need R
    nzp-CSI-RS-ResourcesForInterference
                                            CSI-ResourceConfigId
                                                                            OPTIONAL, -- Need R
                                            CHOICE {
    reportConfigType
       periodic
                                                SEQUENCE {
           reportSlotConfig
                                                    CSI-ReportPeriodicityAndOffset,
           pucch-CSI-ResourceList
                                                    SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
       semiPersistentOnPUCCH
                                                SEQUENCE {
           reportSlotConfig
                                                    CSI-ReportPeriodicityAndOffset,
           pucch-CSI-ResourceList
                                                    SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
        semiPersistentOnPUSCH
                                                SEOUENCE {
                                                    ENUMERATED {s15, s110, s120, s140, s180, s1160, s1320},
            reportSlotConfig
           reportSlotOffsetList
                                                SEQUENCE (SIZE (1.. maxNrofUL-Allocations)) OF INTEGER(0..32),
           p0alpha
                                                    P0-PUSCH-AlphaSetId
        aperiodic
                                                SEOUENCE {
            reportSlotOffsetList
                                                SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32)
    reportQuantity
                                            CHOICE {
       none
                                                NULL,
       cri-RI-PMI-CQI
                                                NULL,
       cri-RI-i1
                                                NULL,
        cri-RI-i1-COI
                                                SEQUENCE {
            pdsch-BundleSizeForCSI
                                                    ENUMERATED {n2, n4}
                                                                                                                 OPTIONAL
                                                                                                                             -- Need S
       cri-RI-CQI
                                                NULL,
       cri-RSRP
                                                NULL,
       ssb-Index-RSRP
                                                NULL,
        cri-RI-LI-PMI-CQI
                                                NULL
    reportFreqConfiguration
                                            SEQUENCE {
        cqi-FormatIndicator
                                                ENUMERATED {
                                                             widebandCQI, subbandCQI
                                                                                                                 OPTIONAL,
                                                                                                                             -- Need R
       pmi-FormatIndicator
                                                ENUMERATED { widebandPMI, subbandPMI }
                                                                                                                 OPTIONAL, -- Need R
        csi-ReportingBand
                                                CHOICE {
            subbands3
                                                    BIT STRING(SIZE(3)),
```

```
subbands4
                                                     BIT STRING(SIZE(4)),
            subbands5
                                                     BIT STRING(SIZE(5)),
            subbands6
                                                     BIT STRING(SIZE(6)),
            subbands7
                                                     BIT STRING(SIZE(7)),
                                                     BIT STRING(SIZE(8)),
            subbands8
            subbands9
                                                     BIT STRING(SIZE(9)),
            subbands10
                                                     BIT STRING(SIZE(10)),
            subbands11
                                                     BIT STRING(SIZE(11)).
            subbands12
                                                     BIT STRING(SIZE(12)),
            subbands13
                                                     BIT STRING(SIZE(13)),
            subbands14
                                                     BIT STRING(SIZE(14)),
            subbands15
                                                     BIT STRING(SIZE(15)),
            subbands16
                                                     BIT STRING(SIZE(16)),
            subbands17
                                                     BIT STRING(SIZE(17)),
            subbands18
                                                     BIT STRING(SIZE(18)),
                                                     BIT STRING(SIZE(19))
            subbands19-v1530
           OPTIONAL -- Need S
                                                                                                                  OPTIONAL, -- Need R
    timeRestrictionForChannelMeasurements
                                                     ENUMERATED {configured, notConfigured},
                                                     ENUMERATED {configured, notConfigured},
    timeRestrictionForInterferenceMeasurements
    codebookConfig
                                                     CodebookConfig
                                                                                                                  OPTIONAL,
                                                                                                                             -- Need R
                                                     ENUMERATED {n1, n2}
                                                                                                                             -- Need R
    dummy
                                                                                                                  OPTIONAL,
    groupBasedBeamReporting
                                                CHOICE {
        enabled
                                                     NULL,
        disabled
                                                     SEQUENCE {
                                                     ENUMERATED {n1, n2, n3, n4}
            nrofReportedRS
                                                                                                                  OPTIONAL
                                                                                                                              -- Need S
    cgi-Table
                                ENUMERATED {table1, table2, table3, spare1}
                                                                                                                  OPTIONAL,
                                                                                                                              -- Need R
    subbandSize
                                ENUMERATED {value1, value2},
    non-PMI-PortIndication
                                SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourcesPerConfig)) OF PortIndexFor8Ranks OPTIONAL,
    11
    semiPersistentOnPUSCH-v1530
                                        SEOUENCE {
        reportSlotConfig-v1530
                                            ENUMERATED {s14, s18, s116}
                                                                                                                  OPTIONAL
                                                                                                                              -- Need R
    ]]
CSI-ReportPeriodicityAndOffset ::= CHOICE {
    slots4
                                        INTEGER(0...3),
    slots5
                                        INTEGER(0..4),
    slots8
                                        INTEGER(0..7),
    slots10
                                        INTEGER(0..9),
    slots16
                                        INTEGER(0..15),
    slots20
                                        INTEGER(0..19),
    slots40
                                        INTEGER(0..39),
    slots80
                                        INTEGER(0..79),
    slots160
                                        INTEGER(0..159),
    slots320
                                        INTEGER(0..319)
```

```
PUCCH-CSI-Resource ::=
                                    SEOUENCE {
    uplinkBandwidthPartId
                                        BWP-Id,
    pucch-Resource
                                        PUCCH-ResourceId
PortIndexFor8Ranks ::=
                                    CHOICE {
    portIndex8
                                        SEQUENCE {
        rank1-8
                                            PortIndex8
        rank2-8
                                            SEQUENCE(SIZE(2)) OF PortIndex8
        rank3-8
                                            SEQUENCE(SIZE(3)) OF PortIndex8
        rank4-8
                                            SEQUENCE(SIZE(4)) OF PortIndex8
        rank5-8
                                            SEQUENCE(SIZE(5)) OF PortIndex8
       rank6-8
                                            SEQUENCE(SIZE(6)) OF PortIndex8
        rank7-8
                                            SEQUENCE(SIZE(7)) OF PortIndex8
        rank8-8
                                            SEQUENCE(SIZE(8)) OF PortIndex8
                                        SEQUENCE {
    portIndex4
        rank1-4
                                            PortIndex4
        rank2-4
                                            SEQUENCE(SIZE(2)) OF PortIndex4
       rank3-4
                                            SEQUENCE(SIZE(3)) OF PortIndex4
        rank4-4
                                            SEQUENCE(SIZE(4)) OF PortIndex4
   portIndex2
                                        SEQUENCE {
        rank1-2
                                            PortIndex2
        rank2-2
                                            SEQUENCE(SIZE(2)) OF PortIndex2
    portIndex1
                                        NULL
PortIndex8::=
                                    INTEGER (0..7)
PortIndex4::=
                                    INTEGER (0..3)
PortIndex2::=
                                    INTEGER (0..1)
-- TAG-CSI-REPORTCONFIG-STOP
-- ASN1STOP
```

```
OPTIONAL,
          -- Need R
          -- Need R
OPTIONAL,
OPTIONAL,
          -- Need R
OPTIONAL
          -- Need R
OPTIONAL,
          -- Need R
OPTIONAL,
          -- Need R
           -- Need R
OPTIONAL,
OPTIONAL
           -- Need R
OPTIONAL,
          -- Need R
OPTIONAL
           -- Need R
```

CSI-ReportConfig field descriptions

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carrier

Indicates in which serving cell the CSI-ResourceConfig indicated below are to be found. If the field is absent, the resources are on the same serving cell as this report configuration.

codebookConfig

Codebook configuration for Type-1 or Type-2 including codebook subset restriction.

cgi-FormatIndicator

Indicates whether the UE shall report a single (wideband) or multiple (subband) CQI (see TS 38.214 [19], clause 5.2.1.4).

cqi-Table

Which CQI table to use for CQI calculation (see TS 38.214 [19], clause 5.2.2.1).

csi-IM-ResourcesForInterference

CSI IM resources for interference measurement. csi-ResourceConfigld of a CSI-ResourceConfig included in the configuration of the serving cell indicated with the field "carrier" above. The CSI-ResourceConfig indicated here contains only CSI-IM resources. The bwp-Id in that CSI-ResourceConfig is the same value as the bwp-Id in the CSI-ResourceConfig indicated by resourcesForChannelMeasurement.

csi-ReportingBand

Indicates a contiguous or non-contiguous subset of subbands in the bandwidth part which CSI shall be reported for. Each bit in the bit-string represents one subband. The right-most bit in the bit string represents the lowest subband in the BWP. The choice determines the number of subbands (subbands3 for 3 subbands, subbands4 for 4 subbands, and so on) (see TS 38.214 [19], clause 5.2.1.4). This field is absent if there are less than 24 PRBs (no sub band) and present otherwise (see TS 38.214 [19], clause 5.2.1.4).

dummy

This field is not used in the specification. If received it shall be ignored by the UE.

groupBasedBeamReporting

Turning on/off group beam based reporting (see TS 38.214 [19], clause 5.2.1.4).

non-PMI-PortIndication

Port indication for RI/CQI calculation. For each CSI-RS resource in the linked ResourceConfig for channel measurement, a port indication for each rank R, indicating which R ports to use. Applicable only for non-PMI feedback (see TS 38.214 [19], clause 5.2.1.4.2).

The first entry in non-PMI-PortIndication corresponds to the NZP-CSI-RS-Resource indicated by the first entry in nzp-CSI-RS-Resources in the NZP-CSI-RS-ResourceSet indicated in the first entry of nzp-CSI-RS-ResourceSetList of the CSI-ResourceConfig whose CSI-ResourceConfigld is indicated in a CSI-Measld together with the above CSI-ReportConfigld; the second entry in non-PMI-PortIndication corresponds to the NZP-CSI-RS-Resource indicated by the second entry in nzp-CSI-RS-Resources in the NZP-CSI-RS-ResourceSet indicated in the first entry of nzp-CSI-RS-ResourceSetList of the same CSI-ResourceConfig, and so on until the NZP-CSI-RS-Resource indicated by the last entry in nzp-CSI-RS-ResourceSetList of the same CSI-ResourceSetList of the same CSI-ResourceSetList of the same CSI-ResourceSetList of the same CSI-ResourceSetList of the same CSI-ResourceSet indicated in the first entry in nzp-CSI-RS-ResourceSet indicated in the second entry of nzp-CSI-RS-ResourceSetList of the same CSI-ResourceSetList of the same CSI-ResourceSetList of the same CSI-ResourceSetList of the same CSI-ResourceSetList of the same CSI-ResourceConfig and so on.

nrofReportedRS

The number (N) of measured RS resources to be reported per report setting in a non-group-based report. N <= N_max, where N_max is either 2 or 4 depending on UE capability.

(see TS 38.214 [19], clause 5.2.1.4) When the field is absent the UE applies the value 1.

nzp-CSI-RS-ResourcesForInterference

NZP CSI RS resources for interference measurement. csi-ResourceConfigld of a CSI-ResourceConfig included in the configuration of the serving cell indicated with the field "carrier" above. The CSI-ResourceConfig indicated here contains only NZP-CSI-RS resources. The bwp-Id in that CSI-ResourceConfig is the same value as the bwp-Id in the CSI-ResourceConfig indicated by resourcesForChannelMeasurement.

p0alpha

Index of the p0-alpha set determining the power control for this CSI report transmission (see TS 38.214 [19], clause 6.2.1.2).

pdsch-BundleSizeForCSI

PRB bundling size to assume for CQI calculation when *reportQuantity* is CRI/RI/i1/CQI. If the field is absent, the UE assumes that no PRB bundling is applied (see TS 38.214 [19], clause 5.2.1.4.2).

pmi-FormatIndicator

Indicates whether the UE shall report a single (wideband) or multiple (subband) PMI. (see TS 38.214 [19], clause 5.2.1.4).

pucch-CSI-ResourceList

Indicates which PUCCH resource to use for reporting on PUCCH.

reportConfigType

Time domain behavior of reporting configuration.

reportFreqConfiguration

Reporting configuration in the frequency domain. (see TS 38.214 [19], clause 5.2.1.4).

reportQuantity

The CSI related quantities to report, see TS 38.214 [19], clause 5.2.1.

reportSlotConfig

Periodicity and slot offset (see TS 38.214 [19], clause 5.2.1.4). If the field reportSlotConfig-v1530 is present, the UE shall ignore the value provided in reportSlotConfig (without suffix).

reportSlotOffsetList

Timing offset Y for semi persistent reporting using PUSCH. This field lists the allowed offset values. This list must have the same number of entries as the *pusch-TimeDomainAllocationList* in *PUSCH-Config.* A particular value is indicated in DCI. The network indicates in the DCI field of the UL grant, which of the configured report slot offsets the UE shall apply. The DCI value 0 corresponds to the first report slot offset in this list, the DCI value 1 corresponds to the second report slot offset in this list, and so on. The first report is transmitted in slot n+Y, second report in n+Y+P, where P is the configured periodicity.

Timing offset Y for aperiodic reporting using PUSCH. This field lists the allowed offset values. This list must have the same number of entries as the *pusch-TimeDomainAllocationList* in *PUSCH-Config*. A particular value is indicated in DCI. The network indicates in the DCI field of the UL grant, which of the configured report slot offsets the UE shall apply. The DCI value 0 corresponds to the first report slot offset in this list, the DCI value 1 corresponds to the second report slot offset in this list, and so on (see TS 38.214 [19], clause 6.1.2.1).

resourcesForChannelMeasurement

Resources for channel measurement. csi-ResourceConfigld of a CSI-ResourceConfig included in the configuration of the serving cell indicated with the field "carrier" above. The CSI-ResourceConfig indicated here contains only NZP-CSI-RS resources and/or SSB resources. This CSI-ReportConfig is associated with the DL BWP indicated by bwp-Id in that CSI-ResourceConfig.

subbandSize

Indicates one out of two possible BWP-dependent values for the subband size as indicated in TS 38.214 [19], table 5.2.1.4-2 . If csi-ReportingBand is absent, the UE shall ignore this field.

timeRestrictionForChannelMeasurements

Time domain measurement restriction for the channel (signal) measurements (see TS 38.214 [19], clause 5.2.1.1).

timeRestrictionForInterferenceMeasurements

Time domain measurement restriction for interference measurements (see TS 38.214 [19], clause 5.2.1.1).

PortIndexFor8Ranks field descriptions

portIndex8

Port-Index configuration for up to rank 8. If present, the network configures port indexes for at least one of the ranks.

portIndex4

Port-Index configuration for up to rank 4. If present, the network configures port indexes for at least one of the ranks.

portIndex2

Port-Index configuration for up to rank 2. If present, the network configures port indexes for at least one of the ranks.

portIndex1

Port-Index configuration for rank 1.

PUCCH-CSI-Resource field descriptions

pucch-Resource

PUCCH resource for the associated uplink BWP. Only PUCCH-Resource of format 2, 3 and 4 is supported. The actual PUCCH-Resource is configured in *PUCCH-Config* and referred to by its ID.

CSI-ReportConfigld

The IE CSI-ReportConfigId is used to identify one CSI-ReportConfig.

CSI-ReportConfigId information element

```
-- ASN1START
-- TAG-CSI-REPORTCONFIGID-START

CSI-ReportConfigId ::= INTEGER (0..maxNrofCSI-ReportConfigurations-1)
-- TAG-CSI-REPORTCONFIGID-STOP
-- ASN1STOP
```

CSI-ResourceConfig

The IE CSI-ResourceConfig defines a group of one or more NZP-CSI-RS-ResourceSet, CSI-IM-ResourceSet and/or CSI-SSB-ResourceSet.

CSI-ResourceConfig information element

```
-- ASN1START
-- TAG-CSI-RESOURCECONFIG-START
CSI-ResourceConfig ::=
                           SEQUENCE {
    csi-ResourceConfigId
                               CSI-ResourceConfigId,
    csi-RS-ResourceSetList
                               CHOICE {
       nzp-CSI-RS-SSB
                                    SEOUENCE {
           nzp-CSI-RS-ResourceSetList SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourceSetsPerConfig)) OF NZP-CSI-RS-ResourceSetId
                                                                                                                 OPTIONAL, -- Need R
           csi-SSB-ResourceSetList
                                       SEQUENCE (SIZE (1..maxNrofCSI-SSB-ResourceSetsPerConfig)) OF CSI-SSB-ResourceSetId
                                                                                                                 OPTIONAL -- Need R
                                    SEQUENCE (SIZE (1..maxNrofCSI-IM-ResourceSetsPerConfig)) OF CSI-IM-ResourceSetId
       csi-IM-ResourceSetList
    bwp-Id
                               ENUMERATED { aperiodic, semiPersistent, periodic },
    resourceType
-- TAG-CSI-RESOURCECONFIG-STOP
-- ASN1STOP
```

CSI-ResourceConfig field descriptions

bwp-ld

The DL BWP which the CSI-RS associated with this CSI-ResourceConfig are located in (see TS 38.214 [19], clause 5.2.1.2.

csi-IM-ResourceSetList

List of references to CSI-IM resources used for CSI measurement and reporting in a CSI-RS resource set. Contains up to maxNrofCSI-IM-ResourceSetsPerConfig resource sets if resourceType is 'aperiodic' and 1 otherwise (see TS 38.214 [19], clause 5.2.1.2).

csi-ResourceConfigId

Used in CSI-ReportConfig to refer to an instance of CSI-ResourceConfig.

csi-SSB-ResourceSetList

List of references to SSB resources used for beam measurement and reporting in a CSI-RS resource set (see TS 38.214 [19], clause 5.2.1.2).

nzp-CSI-RS-ResourceSetList

List of references to NZP CSI-RS resources used for CSI measurement and reporting in a CSI-RS resource set. Contains up to maxNrofNZP-CSI-RS-ResourceSetsPerConfig resource sets if resourceType is 'aperiodic' and 1 otherwise (see TS 38.214 [19], clause 5.2.1.2).

resourceType

Time domain behavior of resource configuration (see TS 38.214 [19], clause 5.2.1.2). It does not apply to resources provided in the csi-SSB-ResourceSetList.

CSI-ResourceConfigld

The IE CSI-ResourceConfigId is used to identify a CSI-ResourceConfig.

CSI-ResourceConfigId information element

```
-- ASN1START
-- TAG-CSI-RESOURCECONFIGID-START

CSI-ResourceConfigId ::= INTEGER (0..maxNrofCSI-ResourceConfigurations-1)

-- TAG-CSI-RESOURCECONFIGID-STOP
-- ASN1STOP
```

CSI-ResourcePeriodicityAndOffset

The IE CSI-ResourcePeriodicityAndOffset is used to configure a periodicity and a corresponding offset for periodic and semi-persistent CSI resources, and for periodic and semi-persistent reporting on PUCCH. both, the periodicity and the offset are given in number of slots. The periodicity value slots4 corresponds to 4 slots, value slots5 corresponds to 5 slots, and so on.

CSI-ResourcePeriodicityAndOffset information element

```
-- ASN1START
-- TAG-CSI-RESOURCEPERIODICITYANDOFFSET-START

CSI-ResourcePeriodicityAndOffset ::= CHOICE {
```

```
slots4
                                         INTEGER (0..3),
    slots5
                                         INTEGER (0..4),
    slots8
                                         INTEGER (0..7),
    slots10
                                         INTEGER (0..9),
    slots16
                                        INTEGER (0..15),
    slots20
                                        INTEGER (0..19),
    slots32
                                        INTEGER (0..31),
    slots40
                                        INTEGER (0..39),
    slots64
                                        INTEGER (0..63),
    slots80
                                         INTEGER (0..79),
    slots160
                                         INTEGER (0..159),
    slots320
                                         INTEGER (0..319),
    slots640
                                         INTEGER (0..639)
-- TAG-CSI-RESOURCEPERIODICITYANDOFFSET-STOP
-- ASN1STOP
```

CSI-RS-ResourceConfigMobility

The IE CSI-RS-ResourceConfigMobility is used to configure CSI-RS based RRM measurements.

CSI-RS-ResourceConfigMobility information element

```
-- ASN1START
-- TAG-CSI-RS-RESOURCECONFIGMOBILITY-START
CSI-RS-ResourceConfigMobility ::= SEQUENCE {
    subcarrierSpacing
    csi-RS-CellList-Mobility
                                        SEQUENCE (SIZE (1..maxNrofCSI-RS-CellsRRM)) OF CSI-RS-CellMobility,
    ] ]
    refServCellIndex
                                        ServCellIndex
                                                                                                                 OPTIONAL
                                                                                                                            -- Need S
    11
CSI-RS-CellMobility ::=
                                    SEQUENCE {
    cellId
                                        PhysCellId,
    csi-rs-MeasurementBW
                                        SEQUENCE {
       nrofPRBs
                                            ENUMERATED { size24, size48, size96, size192, size264},
                                            INTEGER(0..2169)
        startPRB
                                        ENUMERATED {d1,d3}
                                                                                                                            -- Need R
    csi-rs-ResourceList-Mobility
                                        SEQUENCE (SIZE (1...maxNrofCSI-RS-ResourcesRRM)) OF CSI-RS-Resource-Mobility
CSI-RS-Resource-Mobility ::=
                                    SEQUENCE {
    csi-RS-Index
                                        CSI-RS-Index,
    slotConfig
                                        CHOICE {
```

```
ms4
                                            INTEGER (0..31),
       ms5
                                            INTEGER (0..39),
        ms10
                                            INTEGER (0..79),
       ms20
                                            INTEGER (0..159),
        ms40
                                            INTEGER (0..319)
    associatedSSB
                                        SEOUENCE {
       ssb-Index
                                            SSB-Index,
       isOuasiColocated
                                            BOOLEAN
    frequencyDomainAllocation
                                        CHOICE {
       row1
                                            BIT STRING (SIZE (4)),
       row2
                                           BIT STRING (SIZE (12))
    firstOFDMSymbolInTimeDomain
                                       INTEGER (0..13),
    sequenceGenerationConfig
                                        INTEGER (0..1023),
CSI-RS-Index ::=
                                    INTEGER (0..maxNrofCSI-RS-ResourcesRRM-1)
-- TAG-CSI-RS-RESOURCECONFIGMOBILITY-STOP
-- ASN1STOP
```

OPTIONAL, -- Need R

CSI-RS-CellMobility field descriptions

csi-rs-ResourceList-Mobility

List of CSI-RS resources for mobility. The maximum number of CSI-RS resources that can be configured per *measObjectNR* depends on the configuration of *associatedSSB* (see TS 38.214 [19], clause 5.1.6.1.3).

density

Frequency domain density for the 1-port CSI-RS for L3 mobility. See TS 38.211 [16], clause 7.4.1.

nrofPRBs

Allowed size of the measurement BW in PRBs. See TS 38.211 [16], clause 7.4.1.

startPRB

Starting PRB index of the measurement bandwidth. See TS 38.211 [16], clause 7.4.1.

CSI-RS-ResourceConfigMobility field descriptions

csi-RS-CellList-Mobility

List of cells for CSI-RS based RRM measurements.

refServCellIndex

Indicates the serving cell providing the timing reference for CSI-RS resources without associatedSSB. The field may be present only if there is at least one CSI-RS resource configured without associatedSSB. If this field is absent, the UE shall use the timing of the PCell for measurements on the CSI-RS resources without associatedSSB. The CSI-RS resources and the serving cell indicated by refServCellIndex for timing reference should be located in the same band.

subcarrierSpacing

Subcarrier spacing of CSI-RS. Only the values 15, 30 kHz or 60 kHz (FR1), and 60 or 120 kHz (FR2) are applicable.

CSI-RS-Resource-Mobility field descriptions

associatedSSB

If this field is present, the UE may base the timing of the CSI-RS resource indicated in CSI-RS-Resource-Mobility on the timing of the cell indicated by the cellId in the CSI-RS-CellMobility. In this case, the UE is not required to monitor that CSI-RS resource if the UE cannot detect the SS/PBCH block indicated by this associatedSSB and cellId. If this field is absent, the UE shall base the timing of the CSI-RS resource indicated in CSI-RS-Resource-Mobility on the timing of the serving cell indicated by refServCellIndex. In this case, the UE is required to measure the CSI-RS resource even if SS/PBCH block(s) with cellId in the CSI-RS-CellMobility are not detected.

CSI-RS resources with and without associatedSSB may be configured in accordance with the rules in TS 38.214 [19], clause 5.1.6.1.3.

csi-RS-Index

CSI-RS resource index associated to the CSI-RS resource to be measured (and used for reporting).

firstOFDMSymbolInTimeDomain

Time domain allocation within a physical resource block. The field indicates the first OFDM symbol in the PRB used for CSI-RS, see TS 38.211 [16], clause 7.4.1.5.3. Value 2 is supported only when *dmrs-TypeA-Position* equals *pos3*.

frequency Domain Allocation

Frequency domain allocation within a physical resource block in accordance with TS 38.211 [16], clause 7.4.1.5.3 including table 7.4.1.5.2-1. The number of bits that may be set to one depend on the chosen row in that table.

isQuasiColocated

Indicates that the CSI-RS resource is quasi co-located with the associated SS/PBCH block, see TS 38.214 [19], clause 5.1.6.1.3.

sequenceGenerationConfig

Scrambling ID for CSI-RS (see TS 38.211 [16], clause 7.4.1.5.2).

slotConfig

Indicates the CSI-RS periodicity (in milliseconds) and for each periodicity the offset (in number of slots). When *subcarrierSpacing* is set to *kHz15*, the maximum offset values for periodicities *ms4/ms5/ms10/ms20/ms40* are 3/4/9/19/39 slots. When *subcarrierSpacing* is set to *kHz30*, the maximum offset values for periodicities *ms4/ms5/ms10/ms20/ms40* are 7/9/19/39/79 slots. When *subcarrierSpacing* is set to *kHz60*, the maximum offset values for periodicities *ms4/ms5/ms10/ms20/ms40* are 15/19/39/79/159 slots. When *subcarrierSpacing* is set *kHz120*, the maximum offset values for periodicities *ms4/ms5/ms10/ms20/ms40* are 31/39/79/159/319 slots.

CSI-RS-ResourceMapping

The IE CSI-RS-ResourceMapping is used to configure the resource element mapping of a CSI-RS resource in time- and frequency domain.

CSI-RS-ResourceMapping information element

```
-- ASN1START
-- TAG-CSI-RS-RESOURCEMAPPING-START
CSI-RS-ResourceMapping ::=
                                   SEOUENCE {
                                       CHOICE {
    frequencyDomainAllocation
       row1
                                            BIT STRING (SIZE (4)),
       row2
                                            BIT STRING (SIZE (12)),
       row4
                                            BIT STRING (SIZE (3)),
                                            BIT STRING (SIZE (6))
        other
                                        ENUMERATED {p1,p2,p4,p8,p12,p16,p24,p32},
    nrofPorts
    firstOFDMSymbolInTimeDomain
                                       INTEGER (0..13),
    firstOFDMSvmbolInTimeDomain2
                                       INTEGER (2..12)
                                                                                                                OPTIONAL, -- Need R
    cdm-Type
                                       ENUMERATED {noCDM, fd-CDM2, cdm4-FD2-TD2, cdm8-FD2-TD4},
    density
                                        CHOICE {
                                            ENUMERATED {evenPRBs, oddPRBs},
        dot5
```

```
one three NULL,
spare NULL,
spare NULL
},
freqBand CSI-FrequencyOccupation,
...
}
-- TAG-CSI-RS-RESOURCEMAPPING-STOP
-- ASN1STOP
```

CSI-RS-ResourceMapping field descriptions

cdm-Type

CDM type (see TS 38.214 [19], clause 5.2.2.3.1).

density

Density of CSI-RS resource measured in RE/port/PRB (see TS 38.211 [16], clause 7.4.1.5.3).

Values 0.5 (*dot5*), 1 (*one*) and 3 (*three*) are allowed for X=1, values 0.5 (*dot5*) and 1 (*one*) are allowed for X=2, 16, 24 and 32, value 1 (*one*) is allowed for X=4, 8, 12. For density = 1/2, includes 1-bit indication for RB level comb offset indicating whether odd or even RBs are occupied by CSI-RS.

firstOFDMSymbolInTimeDomain2

Time domain allocation within a physical resource block. See TS 38.211 [16], clause 7.4.1.5.3.

firstOFDMSymbolInTimeDomain

Time domain allocation within a physical resource block. The field indicates the first OFDM symbol in the PRB used for CSI-RS. See TS 38.211 [16], clause 7.4.1.5.3. Value 2 is supported only when *dmrs-TypeA-Position* equals *pos3*.

freqBand

Wideband or partial band CSI-RS, (see TS 38.214 [19], clause 5.2.2.3.1).

frequencyDomainAllocation

Frequency domain allocation within a physical resource block in accordance with TS 38.211 [16], clause 7.4.1.5.3. The applicable row number in table 7.4.1.5.3-1 is determined by the *frequencyDomainAllocation* for rows 1, 2 and 4, and for other rows by matching the values in the column Ports, Density and CDMtype in table 7.4.1.5.3-1 with the values of *nrofPorts*, *cdm-Type* and density below and, when more than one row has the 3 values matching, by selecting the row where the column (k bar, I bar) in table 7.4.1.5.3-1 has indexes for k ranging from 0 to 2*n-1 where n is the number of bits set to 1 in *frequencyDomainAllocation*.

nrofPorts

Number of ports (see TS 38.214 [19], clause 5.2.2.3.1).

CSI-SemiPersistentOnPUSCH-TriggerStateList

The CSI-SemiPersistentOnPUSCH-TriggerStateList IE is used to configure the UE with list of trigger states for semi-persistent reporting of channel state information on L1. See also TS 38.214 [19], clause 5.2.

CSI-SemiPersistentOnPUSCH-TriggerStateList information element

```
-- ASN1START
-- TAG-CSI-SEMIPERSISTENTONPUSCHTRIGGERSTATELIST-START

CSI-SemiPersistentOnPUSCH-TriggerStateList ::=

SEQUENCE(SIZE (1..maxNrOfSemiPersistentPUSCH-Triggers)) OF CSI-SemiPersistentOnPUSCH-TriggerState
```

CSI-SSB-ResourceSet

The IE CSI-SSB-ResourceSet is used to configure one SS/PBCH block resource set which refers to SS/PBCH as indicated in ServingCellConfigCommon.

CSI-SSB-ResourceSet information element

```
-- ASN1START
-- TAG-CSI-SSB-RESOURCESET-START

CSI-SSB-ResourceSet ::= SEQUENCE {
    csi-SSB-ResourceSetId CSI-SSB-ResourceSetId,
    csi-SSB-ResourceList SEQUENCE (SIZE(1..maxNrofCSI-SSB-ResourcePerSet)) OF SSB-Index,
    ...
}

-- TAG-CSI-SSB-RESOURCESET-STOP
-- ASN1STOP
```

CSI-SSB-ResourceSetId

The IE CSI-SSB-ResourceSetId is used to identify one SS/PBCH block resource set.

CSI-SSB-Resourceld information element

```
-- ASN1START
-- TAG-CSI-SSB-RESOURCESETID-START

CSI-SSB-ResourceSetId ::= INTEGER (0..maxNrofCSI-SSB-ResourceSets-1)

-- TAG-CSI-SSB-RESOURCESETID-STOP
-- ASN1STOP
```

- DedicatedNAS-Message

The IE DedicatedNAS-Message is used to transfer UE specific NAS layer information between the 5GC CN and the UE. The RRC layer is transparent for this information.

DedicatedNAS-Message information element

```
-- ASN1START
-- TAG-DEDICATED-NAS-MESSAGE-START

DedicatedNAS-Message ::= OCTET STRING
-- TAG-DEDICATED-NAS-MESSAGE-STOP
-- ASN1STOP
```

DMRS-DownlinkConfig

-- TAG-DMRS-DOWNLINKCONFIG-STOP

-- ASN1STOP

The IE DMRS-DownlinkConfig is used to configure downlink demodulation reference signals for PDSCH.

DMRS-DownlinkConfig information element

DMRS-DownlinkConfig field descriptions

dmrs-AdditionalPosition

Position for additional DM-RS in DL, see Tables 7.4.1.1.2-3 and 7.4.1.1.2-4 in TS 38.211 [16]. If the field is absent, the UE applies the value pos2. See also clause 7.4.1.1.2 for additional constraints on how the network may set this field depending on the setting of other fields.

dmrs-Type

Selection of the DMRS type to be used for DL (see TS 38.211 [16], clause 7.4.1.1.1). If the field is absent, the UE uses DMRS type 1.

maxLength

The maximum number of OFDM symbols for DL front loaded DMRS. *len1* corresponds to value 1. *len2* corresponds to value 2. If the field is absent, the UE applies value *len1*. If set to *len2*, the UE determines the actual number of DM-RS symbols by the associated DCI. (see TS 38.211 [16], clause 7.4.1.1.2).

phaseTrackingRS

Configures downlink PTRS. If the field is not configured, the UE assumes that downlink PTRS are absent. See TS 38.214 [19] clause 5.1.6.3.

scramblingID0

DL DMRS scrambling initialization (see TS 38.211 [16], clause 7.4.1.1.1). When the field is absent the UE applies the value physCellId configured for this serving cell.

scramblingID1

DL DMRS scrambling initialization (see TS 38.211 [16], clause 7.4.1.1.1). When the field is absent the UE applies the value physCellId configured for this serving cell.

DMRS-UplinkConfig

The IE DMRS-UplinkConfig is used to configure uplink demodulation reference signals for PUSCH.

DMRS-UplinkConfig information element

```
-- ASN1START
-- TAG-DMRS-UPLINKCONFIG-START
DMRS-UplinkConfig ::=
                                   SEOUENCE {
                                       ENUMERATED {type2}
   dmrs-Type
                                                                                                         OPTIONAL,
                                                                                                                    -- Need S
                                       ENUMERATED {pos0, pos1, pos3}
    dmrs-AdditionalPosition
                                                                                                         OPTIONAL, -- Need S
   phaseTrackingRS
                                       SetupRelease { PTRS-UplinkConfig }
                                                                                                         OPTIONAL,
                                                                                                                    -- Need M
   maxLength
                                      ENUMERATED {len2}
                                                                                                         OPTIONAL.
                                                                                                                    -- Need S
    transformPrecodingDisabled
                                       SEQUENCE {
       scramblingID0
                                          INTEGER (0..65535)
                                                                                                         OPTIONAL,
                                                                                                                    -- Need S
                                                                                                                    -- Need S
       scramblingID1
                                          INTEGER (0..65535)
                                                                                                         OPTIONAL,
                                                                                                         OPTIONAL,
                                                                                                                    -- Need R
    transformPrecodingEnabled
                                       SEQUENCE {
       nPUSCH-Identity
                                           INTEGER(0..1007)
                                                                                                         OPTIONAL,
                                                                                                                    -- Need S
                                          ENUMERATED {disabled}
       sequenceGroupHopping
                                                                                                         OPTIONAL, -- Need S
                                          ENUMERATED {enabled}
       sequenceHopping
                                                                                                         OPTIONAL, -- Need S
                                                                                                         OPTIONAL, -- Need R
-- TAG-DMRS-UPLINKCONFIG-STOP
-- ASN1STOP
```

DMRS-UplinkConfig field descriptions

dmrs-AdditionalPosition

Position for additional DM-RS in UL (see TS 38.211 [16], clause 6.4.1.1.3). If the field is absent, the UE applies the value pos2. See also clause 6.4.1.1.3 for additional constraints on how the network may set this field depending on the setting of other fields.

dmrs-Type

Selection of the DMRS type to be used for UL (see TS 38.211 [16], clause 6.4.1.1.3) If the field is absent, the UE uses DMRS type 1.

maxLength

The maximum number of OFDM symbols for UL front loaded DMRS. *len1* corresponds to value 1. *len2* corresponds to value 2. If the field is absent, the UE applies value *len1*. If set to *len2*, the UE determines the actual number of DM-RS symbols by the associated DCI, (see TS 38,211 [16], clause 6,4,1,1,3).

nPUSCH-Identity

Parameter: N ID^(PUSCH) for DFT-s-OFDM DMRS. If the value is absent or released, the UE uses the value Physical cell ID (physCellId). See TS 38.211 [16].

phaseTrackingRS

Configures uplink PTRS (see TS 38.211 [16]).

scramblingID0

UL DMRS scrambling initialization for CP-OFDM (see TS 38.211 [16], clause 6.4.1.1.1.1). When the field is absent the UE applies the value Physical cell ID (physCellId).

scramblingID1

UL DMRS scrambling initialization for CP-OFDM. (see TS 38.211 [16], clause 6.4.1.1.1.1). When the field is absent the UE applies the value Physical cell ID (physCelld).

sequenceGroupHopping

For DMRS transmission with transform precoder the NW may configure group hopping by the cell-specific parameter *groupHoppingEnabledTransformPrecoding* in *PUSCH-ConfigCommon*. In this case, the NW may include this UE specific field to disable group hopping for PUSCH transmission except for Msg3, i.e., to override the configuration in *PUSCH-ConfigCommon* (see TS 38.211 [16]). If the field is absent, the UE uses the same hopping mode as for Msg3.

sequenceHopping

Determines if sequence hopping is enabled for DMRS transmission with transform precoder for PUSCH transmission other than Msg3 (sequence hopping is always disabled for Msg3). If the field is absent, the UE uses the same hopping mode as for msg3. The network does not configure simultaneous group hopping and sequence hopping. See TS 38.211 [16], clause 6.4.1.1.1.2.

transformPrecodingDisabled

DMRS related parameters for Cyclic Prefix OFDM.

transformPrecodingEnabled

DMRS related parameters for DFT-s-OFDM (Transform Precoding).

DownlinkConfigCommon

The IE *DownlinkConfigCommon* provides common downlink parameters of a cell.

DownlinkConfigCommon information element

-- ASN1STOP

DownlinkConfigCommon field descriptions

frequencyInfoDL

Basic parameters of a downlink carrier and transmission thereon.

initialDownlinkBWP

The initial downlink BWP configuration for a serving cell. The network configures the *locationAndBandwidth* so that the initial downlink BWP contains the entire CORESET#0 of this serving cell in the frequency domain.

Conditional Presence	Explanation
InterFreqHOAndServCellAdd	This field is mandatory present for inter-frequency handover, and upon serving cell (PSCell/SCell) addition. Otherwise, the field is
	optionally present, Need M.
ServCellAdd	This field is mandatory present upon serving cell addition (for PSCell and SCell) and upon handover from E-UTRA to NR. It is
	optionally present, Need M otherwise.

DownlinkConfigCommonSIB

The IE *DownlinkConfigCommonSIB* provides common downlink parameters of a cell.

DownlinkConfigCommonSIB information element

```
-- ASN1START
-- TAG-DOWNLINKCONFIGCOMMONSIB-START
DownlinkConfigCommonSIB ::= SEQUENCE {
   frequencyInfoDL FrequencyInfoDL-SIB, initialDownlinkBWP BWP-DownlinkCommon,
   bcch-Config
                                      BCCH-Config,
                                         PCCH-Config,
   pcch-Config
BCCH-Config ::=
                                SEQUENCE {
    modificationPeriodCoeff
                                    ENUMERATED {n2, n4, n8, n16},
PCCH-Config ::=
                            SEQUENCE {
    defaultPagingCycle
                                         PagingCycle,
    nAndPagingFrameOffset
                                         CHOICE {
        oneT
                                             NULL,
       halfT
                                             INTEGER (0..1),
        quarterT
                                             INTEGER (0..3),
        oneEighthT
                                             INTEGER (0..7),
```

```
oneSixteenthT
                                           INTEGER (0..15)
                                       ENUMERATED {four, two, one},
    ns
    firstPDCCH-MonitoringOccasionOfPO
                                       CHOICE {
       sCS15KHZoneT
                                                                               SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..139),
       sCS30KHZoneT-SCS15KHZhalfT
                                                                               SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..279),
       sCS60KHZoneT-SCS30KHZhalfT-SCS15KHZquarterT
                                                                               SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..559),
       sCS120KHZoneT-SCS60KHZhalfT-SCS30KHZquarterT-SCS15KHZoneEighthT
                                                                               SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..1119),
       sCS120KHZhalfT-SCS60KHZquarterT-SCS30KHZoneEighthT-SCS15KHZoneSixteenthT
                                                                               SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..2239),
       sCS120KHZquarterT-SCS60KHZoneEighthT-SCS30KHZoneSixteenthT
                                                                               SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..4479),
       sCS120KHZoneEighthT-SCS60KHZoneSixteenthT
                                                                               SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..8959),
                                                                               SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..17919)
       sCS120KHZoneSixteenthT
      OPTIONAL. -- Need R
-- TAG-DOWNLINKCONFIGCOMMONSIB-STOP
-- ASN1STOP
```

DownlinkConfigCommonSIB field descriptions

frequencyInfoDL-SIB

Basic parameters of a downlink carrier and transmission thereon.

initialDownlinkBWP

The initial downlink BWP configuration for a PCell. The network configures the *locationAndBandwidth* so that the initial downlink BWP contains the entire CORESET#0 of this serving cell in the frequency domain. The UE applies the *locationAndBandwidth* upon reception of this field (e.g. to determine the frequency position of signals described in relation to this *locationAndBandwidth*) but it keeps CORESET#0 until after reception of *RRCSetup/RRCResume*

bcch-Config

The modification period related configuration.

pcch-Config

The paging related configuration.

BCCH-Config field descriptions

modificationPeriodCoeff

Actual modification period, expressed in number of radio frames m = modificationPeriodCoeff * defaultPagingCycle, see clause 5.2.2.2.2. n2 corresponds to value 2, n4 corresponds to value 4, and so on.

PCCH-Config field descriptions

defaultPagingCycle

Default paging cycle, used to derive 'T' in TS 38.304 [20]. Value rf32 corresponds to 32 radio frames, value rf64 corresponds to 64 radio frames and so on.

firstPDCCH-MonitoringOccasionOfPO

Points out the first PDCCH monitoring occasion for paging of each PO of the PF, see TS 38.304 [20].

nAndPagingFrameOffset

Used to derive the number of total paging frames in T (corresponding to parameter N in TS 38.304 [20]) and paging frame offset (corresponding to parameter PF_offset in TS 38.304 [20]). A value of oneSixteenthT corresponds to T / 16, a value of oneEighthT corresponds to T / 8, and so on.

If pagingSearchSpace is set to zero and if SS/PBCH block and CORESET multiplexing pattern is 2 or 3 (as specified in TS 38.213 [13]):

- for ssb-periodicityServingCell of 5 or 10 ms, N can be set to one of {oneT, halfT, quarterT, oneEighthT, oneSixteenthT}
- for ssb-periodicityServingCell of 20 ms, N can be set to one of {halfT, quarterT, oneEighthT, oneSixteenthT}
- for ssb-periodicityServingCell of 40 ms, N can be set to one of {quarterT, oneEighthT, oneSixteenthT}
- for ssb-periodicityServingCell of 80 ms, N can be set to one of {oneEighthT, oneSixteenthT}
- for ssb-periodicityServingCell of 160 ms, N can be set to oneSixteenthT

If pagingSearchSpace is set to zero and if SS/PBCH block and CORESET multiplexing pattern is 1 (as specified in TS 38.213 [13]), N can be set to one of {halfT, quarterT, oneEighthT, oneSixteenthT}

If pagingSearchSpace is not set to zero, N can be configured to one of {oneT, halfT, quarterT, oneEighthT, oneSixteenthT}

ns

Number of paging occasions per paging frame.

DownlinkPreemption

The IE *DownlinkPreemption* is used to configure the UE to monitor PDCCH for the INT-RNTI (interruption).

DownlinkPreemption information element

```
-- ASN1START
-- TAG-DOWNLINKPREEMPTION-START
DownlinkPreemption ::=
                                   SEOUENCE {
   int-RNTI
                                       RNTI-Value,
    timeFrequencySet
                                        ENUMERATED {set0, set1},
                                        INTEGER (0..maxINT-DCI-PayloadSize),
   dci-PayloadSize
    int-ConfigurationPerServingCell
                                       SEQUENCE (SIZE (1...maxNrofServingCells)) OF INT-ConfigurationPerServingCell,
INT-ConfigurationPerServingCell ::= SEQUENCE {
    servingCellId
                                       ServCellIndex,
    positionInDCI
                                       INTEGER (0..maxINT-DCI-PayloadSize-1)
-- TAG-DOWNLINKPREEMPTION-STOP
-- ASN1STOP
```

DownlinkPreemption field descriptions

dci-PayloadSize

Total length of the DCI payload scrambled with INT-RNTI (see TS 38.213 [13], clause 11.2).

int-ConfigurationPerServingCell

Indicates (per serving cell) the position of the 14 bit INT values inside the DCI payload (see TS 38.213 [13], clause 11.2).

int-RNTI

RNTI used for indication pre-emption in DL (see TS 38.213 [13], clause 10).

timeFrequencySet

Set selection for DL-preemption indication (see TS 38.213 [13], clause 11.2) The set determines how the UE interprets the DL preemption DCI payload.

INT-ConfigurationPerServingCell field descriptions

positionInDCI

Starting position (in number of bit) of the 14 bit INT value applicable for this serving cell (servingCellId) within the DCI payload (see TS 38.213 [13], clause 11.2). Must be multiples of 14 (bit).

DRB-Identity

The IE *DRB-Identity* is used to identify a DRB used by a UE.

DRB-Identity information element

```
-- ASN1START
-- TAG-DRB-IDENTITY-START

DRB-Identity ::= INTEGER (1..32)

-- TAG-DRB-IDENTITY-STOP
-- ASN1STOP
```

– DRX-Config

The IE *DRX-Config* is used to configure DRX related parameters.

DRX-Config information element

-- TAG-DRX-CONFIG-STOP

-- ASN1STOP

```
ms1600, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 }
                                        },
drx-InactivityTimer
                                    ENUMERATED
                                        ms0, ms1, ms2, ms3, ms4, ms5, ms6, ms8, ms10, ms20, ms30, ms40, ms50, ms60, ms80,
                                        ms100, ms200, ms300, ms500, ms750, ms1280, ms1920, ms2560, spare9, spare8,
                                        spare7, spare6, spare5, spare4, spare3, spare2, spare1},
drx-HARO-RTT-TimerDL
                                    INTEGER (0..56),
                                    INTEGER (0..56),
drx-HARO-RTT-TimerUL
drx-RetransmissionTimerDL
                                    ENUMERATED {
                                        sl0, sl1, sl2, sl4, sl6, sl8, sl16, sl24, sl33, sl40, sl64, sl80, sl96, sl112, sl128,
                                        sl160, sl320, spare15, spare14, spare13, spare12, spare11, spare10, spare9,
                                        spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1},
drx-RetransmissionTimerUL
                                    ENUMERATED {
                                        s10, s11, s12, s14, s16, s18, s116, s124, s133, s140, s164, s180, s196, s1112, s1128,
                                        s1160, s1320, spare15, spare14, spare13, spare12, spare11, spare10, spare9,
                                        spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 },
drx-LongCycleStartOffset
                                    CHOICE {
   ms10
                                        INTEGER(0..9),
   ms20
                                        INTEGER(0..19),
   ms32
                                        INTEGER(0..31),
   ms40
                                        INTEGER(0..39),
   ms60
                                        INTEGER(0..59),
   ms64
                                        INTEGER(0..63),
   ms70
                                        INTEGER(0..69),
   ms80
                                        INTEGER(0..79),
   ms128
                                        INTEGER(0..127),
   ms160
                                        INTEGER(0..159),
   ms256
                                        INTEGER(0..255),
   ms320
                                        INTEGER(0..319),
   ms512
                                        INTEGER(0..511),
   ms640
                                        INTEGER(0..639),
   ms1024
                                        INTEGER(0..1023),
   ms1280
                                        INTEGER(0..1279),
   ms2048
                                        INTEGER(0..2047),
   ms2560
                                        INTEGER(0..2559),
   ms5120
                                        INTEGER(0..5119),
   ms10240
                                        INTEGER(0..10239)
shortDRX
                                    SEOUENCE {
   drx-ShortCycle
                                        ENUMERATED {
                                            ms2, ms3, ms4, ms5, ms6, ms7, ms8, ms10, ms14, ms16, ms20, ms30, ms32,
                                            ms35, ms40, ms64, ms80, ms128, ms160, ms256, ms320, ms512, ms640, spare9,
                                            spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 },
                                        INTEGER (1..16)
   drx-ShortCvcleTimer
                                                                                                             OPTIONAL, -- Need R
drx-SlotOffset
                                    INTEGER (0..31)
```

DRX-Config field descriptions

drx-HARQ-RTT-TimerDL

Value in number of symbols of the BWP where the transport block was received.

drx-HARQ-RTT-TimerUL

Value in number of symbols of the BWP where the transport block was transmitted.

drx-InactivityTimer

Value in multiple integers of 1 ms. ms0 corresponds to 0, ms1 corresponds to 1 ms, ms2 corresponds to 2 ms, and so on.

drx-LongCycleStartOffset

drx-LongCycle in ms and drx-StartOffset in multiples of 1 ms. If drx-ShortCycle is configured, the value of drx-LongCycle shall be a multiple of the drx-ShortCycle value.

drx-onDurationTimer

Value in multiples of 1/32 ms (subMilliSeconds) or in ms (milliSecond). For the latter, value ms1 corresponds to 1 ms, value ms2 corresponds to 2 ms, and so on.

drx-RetransmissionTimerDL

Value in number of slot lengths of the BWP where the transport block was received. value sl0 corresponds to 0 slots, sl1 corresponds to 1 slot, sl2 corresponds to 2 slots, and so on.

drx-RetransmissionTimerUL

Value in number of slot lengths of the BWP where the transport block was transmitted. sl0 corresponds to 0 slots, sl1 corresponds to 1 slot, sl2 corresponds to 2 slots, and so on.

drx-ShortCycleTimer

Value in multiples of drx-ShortCycle. A value of 1 corresponds to drx-ShortCycle, a value of 2 corresponds to 2 * drx-ShortCycle and so on.

drx-ShortCycle

Value in ms. ms1 corresponds to 1 ms, ms2 corresponds to 2 ms, and so on.

drx-SlotOffset

Value in 1/32 ms. Value 0 corresponds to 0 ms, value 1 corresponds to 1/32 ms, value 2 corresponds to 2/32 ms, and so on.

FilterCoefficient

The IE *FilterCoefficient* specifies the measurement filtering coefficient. Value $fc\theta$ corresponds to k = 0, $fc\theta$ corresponds to k = 1, and so on.

FilterCoefficient information element

```
-- ASN1START
-- TAG-FILTERCOEFFICIENT-START

FilterCoefficient ::= ENUMERATED { fc0, fc1, fc2, fc3, fc4, fc5, fc6, fc7, fc8, fc9, fc11, fc13, fc15, fc17, fc19, spare1, ...}

-- TAG-FILTERCOEFFICIENT-STOP
-- ASN1STOP
```

FreqBandIndicatorNR

The IE FreqBandIndicatorNR is used to convey an NR frequency band number as defined in TS 38.101-1 [15] and TS 38.101-2 [39].

FreqBandIndicatorNR information element

```
-- ASN1START
-- TAG-FREQBANDINDICATORNR-START

FreqBandIndicatorNR ::= INTEGER (1..1024)
-- TAG-FREQBANDINDICATORNR-STOP
-- ASN1STOP
```

FrequencyInfoDL

The IE FrequencyInfoDL provides basic parameters of a downlink carrier and transmission thereon.

FrequencyInfoDL information element

```
-- ASN1START
-- TAG-FREQUENCYINFODL-START

FrequencyInfoDL ::= SEQUENCE {
   absoluteFrequencySSB ARFCN-ValueNR MultiFrequencyBandListNR,
   absoluteFrequencyPointA Scs-SpecificCarrierList SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier,
   ...
}

-- TAG-FREQUENCYINFODL-STOP
-- ASN1STOP
```

FrequencyInfoDL field descriptions

absoluteFrequencyPointA

Absolute frequency position of the reference resource block (Common RB 0). Its lowest subcarrier is also known as Point A (see TS 38.211 [16], clause 4.4.4.2). Note that the lower edge of the actual carrier is not defined by this field but rather in the scs-SpecificCarrierList.

absoluteFrequencySSB

Frequency of the SSB to be used for this serving cell. SSB related parameters (e.g. SSB index) provided for a serving cell refer to this SSB frequency unless mentioned otherwise. The cell-defining SSB of the PCell is always on the sync raster. Frequencies are considered to be on the sync raster if they are also identifiable with a GSCN value (see TS 38.101-1 [15]). If the field is absent, the SSB related parameters should be absent, e.g. ssb-PositionsInBurst, ssb-periodicityServingCell and subcarrierSpacing in ServingCellConfigCommon IE. If the field is absent, the UE obtains timing reference from the SpCell. This is only supported in case the SCell is in the same frequency band as the SpCell.

frequencyBandList

List containing only one frequency band to which this carrier(s) belongs. Multiple values are not supported.

scs-SpecificCarrierList

A set of carriers for different subcarrier spacings (numerologies). Defined in relation to Point A. The network configures a scs-SpecificCarrier at least for each numerology (SCS) that is used e.g. in a BWP (see TS 38.211 [16], clause 5.3).

Conditional Presence	Explanation
SpCellAdd	The field is mandatory present if this <i>FrequencyInfoDL</i> is for SpCell. Otherwise the field is optionally present, Need S.

FrequencyInfoDL-SIB

The IE FrequencyInfoDL-SIB provides basic parameters of a downlink carrier and transmission thereon.

FrequencyInfoDL-SIB information element

```
-- ASN1START
-- TAG-FREQUENCYINFODL-SIB-START

FrequencyInfoDL-SIB ::= SEQUENCE {
    frequencyBandList MultiFrequencyBandListNR-SIB,
    offsetToPointA INTEGER (0..2199),
    scs-SpecificCarrierList SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier
}

-- TAG-FREQUENCYINFODL-SIB-STOP
-- ASN1STOP
```

FrequencyInfoDL-SIB field descriptions

offsetToPointA

Represents the offset to Point A as defined in TS 38.211 [16], clause 4.4.4.2.

frequencyBandList

List of one or multiple frequency bands to which this carrier(s) belongs.

scs-SpecificCarrierList

A set of carriers for different subcarrier spacings (numerologies). Defined in relation to Point A (see TS 38.211 [16], clause 5.3). The network configures this for all SCSs that are used in DL BWPs in this serving cell.

FrequencyInfoUL

The IE FrequencyInfoUL provides basic parameters of an uplink carrier and transmission thereon.

FrequencyInfoUL information element

```
-- ASN1START
-- TAG-FREQUENCYINFOUL-START
FrequencyInfoUL ::=
                                   SEQUENCE {
    frequencyBandList
                                       MultiFrequencyBandListNR
                                                                                               OPTIONAL.
                                                                                                           -- Cond FDD-OrSUL
    absoluteFrequencyPointA
                                       ARFCN-ValueNR
                                                                                               OPTIONAL,
                                                                                                          -- Cond FDD-OrSUL
                                       SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier,
    scs-SpecificCarrierList
    additionalSpectrumEmission
                                       AdditionalSpectrumEmission
                                                                                               OPTIONAL,
                                                                                                          -- Need S
                                                                                               OPTIONAL,
    p-Max
                                       P-Max
                                                                                                          -- Need S
```

```
frequencyShift7p5khz ENUMERATED {true}
...
}
-- TAG-FREQUENCYINFOUL-STOP
-- ASN1STOP
```

OPTIONAL, -- Cond FDD-TDD-OrSUL-Optional

FrequencyInfoUL field descriptions

absoluteFrequencyPointA

Absolute frequency of the reference resource block (Common RB 0). Its lowest subcarrier is also known as Point A. Note that the lower edge of the actual carrier is not defined by this field but rather in the scs-SpecificCarrierList (see TS 38.211 [16], clause 4.4.4.2).

additionalSpectrumEmission

The additional spectrum emission requirements to be applied by the UE on this uplink. If the field is absent, the UE uses value 0 for the *additionalSpectrumEmission* (see TS 38.101-1 [15], table 6.2.3.1-1A, and TS 38.101-2 [39], table 6.2.3.1-2).

frequencyBandList

List containing only one frequency band to which this carrier(s) belongs. Multiple values are not supported.

frequencyShift7p5khz

Enable the NR UL transmission with a 7.5 kHz shift to the LTE raster. If the field is absent, the frequency shift is disabled.

p-Max

Maximum transmit power allowed in this serving cell. The maximum transmit power that the UE may use on this serving cell may be additionally limited by *p-NR-FR1* (configured for the cell group) and by *p-UE-FR1* (configured total for all serving cells operating on FR1). If absent, the UE applies the maximum power according to TS 38.101-1 [15] in case of an FR1 cell or TS 38.101-2 [39] in case of an FR2 cell. In this release of the specification, if p-Max is present on a carrier frequency in FR2, the UE shall ignore the field and applies the maximum power according to TS 38.101-2 [39]. Value in dBm.

scs-SpecificCarrierList

A set of carriers for different subcarrier spacings (numerologies). Defined in relation to Point A. The network configures a scs-SpecificCarrier at least for each numerology (SCS) that is used e.g. in a BWP (see TS 38.211 [16], clause 5.3).

Conditional Presence	Explanation
FDD-OrSUL	The field is mandatory present if this <i>FrequencyInfoUL</i> is for the paired UL for a DL (defined in a <i>FrequencyInfoDL</i>) or if this <i>FrequencyInfoUL</i> is for a supplementary uplink (SUL). It is absent, Need R, otherwise (if this <i>FrequencyInfoUL</i> is for an unpaired UL (TDD).
FDD-TDD-OrSUL-Optional	The field is optionally present, Need R, if this <i>FrequencyInfoUL</i> is for the paired UL for a DL (defined in a <i>FrequencyInfoDL</i>), or if this <i>FrequencyInfoUL</i> is for an unpaired UL (TDD) in certain bands (as defined in clause 5.4.2.1 of TS 38.101-1 and in clause 5.4.2.1 of TS 38.104 [12]), or if this <i>FrequencyInfoUL</i> is for a supplementary uplink (SUL). It is absent, Need R, otherwise.

FrequencyInfoUL-SIB

The IE FrequencyInfoUL-SIB provides basic parameters of an uplink carrier and transmission thereon.

FrequencyInfoUL-SIB information element

⁻⁻ ASN1START

⁻⁻ TAG-FREQUENCYINFOUL-SIB-START

```
FrequencyInfoUL-SIB ::=
frequencyBandList
absoluteFrequencyPointA
scs-SpecificCarrierList
p-Max
frequencyShift7p5khz
...
}

-- TAG-FREQUENCYINFOUL-SIB-STOP
-- ASNISTOP
```

```
SEQUENCE {
MultiFrequencyBandListNR-SIB OPTIONAL, -- Cond FDD-OrSUL
ARFCN-ValueNR OPTIONAL, -- Cond FDD-OrSUL
SEQUENCE (SIZE (1.maxSCSs)) OF SCS-SpecificCarrier,
P-Max OPTIONAL, -- Need S
ENUMERATED {true} OPTIONAL, -- Cond FDD-TDD-OrSUL-Optional
```

FrequencyInfoUL-SIB field descriptions

absoluteFrequencyPointA

Absolute frequency of the reference resource block (Common RB 0). Its lowest subcarrier is also known as Point A. Note that the lower edge of the actual carrier is not defined by this field but rather in the scs-SpecificCarrierList (see TS 38.211 [16], clause 4.4.4.2).

frequencyBandList

Provides the frequency band indicator and a list of *additionalPmax* and *additionalSpectrumEmission* values as defined in TS 38.101-1 [15], table 6.2.3.1-1, and TS 38.101-2 [39], table 6.2.3.1-2. The UE shall apply the first listed band which it supports in the *frequencyBandList* field.

frequencyShift7p5khz

Enable the NR UL transmission with a 7.5 kHz shift to the LTE raster. If the field is absent, the frequency shift is disabled.

p-Max

Value in dBm applicable for the cell. If absent the UE applies the maximum power according to TS 38.101-1 [15] in case of an FR1 cell or TS 38.101-2 [39] in case of an FR2 cell. In this release of the specification, if p-Max is present on a carrier frequency in FR2, the UE shall ignore the field and applies the maximum power according to TS 38.101-2 [39].

scs-SpecificCarrierList

A set of carriers for different subcarrier spacings (numerologies). Defined in relation to Point A (see TS 38.211 [16], clause 5.3). The network configures this for all SCSs that are used in UL BWPs configured in this serving cell.

Conditional Presence	Explanation
FDD-OrSUL	The field is mandatory present if this <i>FrequencyInfoUL-SIB</i> is for the paired UL for a DL (defined in a <i>FrequencyInfoDL-SIB</i>) or if this <i>FrequencyInfoUL-SIB</i> is for a supplementary uplink (SUL). It is absent otherwise (if this <i>FrequencyInfoUL-SIB</i> is for an unpaired UL (TDD).
FDD-TDD-OrSUL-Optional	The field is optionally present, Need R, if this <i>FrequencyInfoUL-SIB</i> is for the paired UL for a DL (defined in a <i>FrequencyInfoDL-SIB</i>), or if this <i>FrequencyInfoUL-SIB</i> is for an unpaired UL (TDD) in certain bands (as defined in clause 5.4.2.1 of TS 38.101-1 and in clause 5.4.2.1 of TS 38.104 [12]), or if this <i>FrequencyInfoUL-SIB</i> is for a supplementary uplink (SUL). It is absent otherwise.

- Hvsteresis

The IE *Hysteresis* is a parameter used within the entry and leave condition of an event triggered reporting condition. The actual value is field value * 0.5 dB.

Hysteresis information element

```
-- ASN1START
-- TAG-HYSTERESIS-START

Hysteresis ::= INTEGER (0..30)

-- TAG-HYSTERESIS-STOP
-- ASN1STOP
```

· I-RNTI-Value

The IE *I-RNTI-Value* is used to identify the suspended UE context of a UE in RRC_INACTIVE.

I-RNTI-Value information element

```
-- ASN1START
-- TAG-I-RNTI-VALUE-START

I-RNTI-Value ::= BIT STRING (SIZE(40))

-- TAG-I-RNTI-VALUE-STOP
-- ASN1STOP
```

LocationMeasurementInfo

The IE LocationMeasurementInfo defines the information sent by the UE to the network to assist with the configuration of measurement gaps for location related measurements.

LocationMeasurementInfo information element

```
}
-- TAG-LOCATIONMEASUREMENTINFO-STOP
-- ASN1STOP
```

LocationMeasurementInfo field descriptions

carrierFreq

The EARFCN value of the carrier received from upper layers for which the UE needs to perform the inter-RAT RSTD measurements.

measPRS-Offset

Indicates the requested gap offset for performing RSTD measurements towards E-UTRA. It is the smallest subframe offset from the beginning of subframe 0 of SFN=0 of the serving cell of the requested gap for measuring PRS positioning occasions in the carrier frequency *carrierFreq* for which the UE needs to perform the inter-RAT RSTD measurements. The PRS positioning occasion information is received from upper layers. The value of *measPRS-Offset* is obtained by mapping the starting subframe of the PRS positioning occasion in the measured cell onto the corresponding subframe in the serving cell and is calculated as the serving cell's number of subframes from SFN=0 mod 40.

The UE shall take into account any additional time required by the UE to start PRS measurements on the other carrier when it does this mapping for determining the measPRS-Offset.

NOTE: Figure 6.2.2-1 in TS 36.331[10] illustrates the measPRS-Offset field.

LogicalChannelConfig

The IE LogicalChannelConfig is used to configure the logical channel parameters.

LogicalChannelConfig information element

```
-- ASN1START
-- TAG-LOGICALCHANNELCONFIG-START
LogicalChannelConfig ::=
                                   SEOUENCE {
    ul-SpecificParameters
                                       SEOUENCE {
       priority
                                           INTEGER (1..16),
       prioritisedBitRate
                                           ENUMERATED {kBps0, kBps8, kBps16, kBps32, kBps64, kBps128, kBps256, kBps512,
                                           kBps1024, kBps2048, kBps4096, kBps8192, kBps16384, kBps32768, kBps65536, infinity},
                                           ENUMERATED {ms5, ms10, ms20, ms50, ms100, ms150, ms300, ms500, ms1000,
       bucketSizeDuration
                                                           spare7, spare6, spare5, spare4, spare3, spare2, spare1},
        allowedServingCells
                                           SEQUENCE (SIZE (1..maxNrofServingCells-1)) OF ServCellIndex
                                                                                                   OPTIONAL, -- PDCP-CADuplication
        allowedSCS-List
                                            SEQUENCE (SIZE (1..maxSCSs)) OF SubcarrierSpacing
                                                                                                   OPTIONAL, -- Need R
       maxPUSCH-Duration
                                           ENUMERATED {ms0p02, ms0p04, ms0p0625, ms0p125, ms0p25, ms0p5, spare2, spare1}
                                                                                                    OPTIONAL, -- Need R
       configuredGrantType1Allowed
                                           ENUMERATED {true}
                                                                                                   OPTIONAL, -- Need R
       logicalChannelGroup
                                           INTEGER (0..maxLCG-ID)
                                                                                                    OPTIONAL, -- Need R
                                                                                                    OPTIONAL, -- Need R
       schedulingRequestID
                                           SchedulingRequestId
       logicalChannelSR-Mask
                                           BOOLEAN,
       logicalChannelSR-DelayTimerApplied BOOLEAN,
       bitRateOueryProhibitTimer
                                       ENUMERATED { s0, s0dot4, s0dot8, s1dot6, s3, s6, s12,s30}
                                                                                                   OPTIONAL
                                                                                                               -- Need R
                                                                                                    OPTIONAL, -- Cond UL
```

-- TAG-LOGICALCHANNELCONFIG-STOP

LogicalChannelConfig field descriptions

allowedSCS-List

If present, UL MAC SDUs from this logical channel can only be mapped to the indicated numerology. Otherwise, UL MAC SDUs from this logical channel can be mapped to any configured numerology. Only the values 15/30/60 kHz (for FR1) and 60/120 kHz (for FR2) are applicable. Corresponds to 'allowedSCS-List' as specified in TS 38.321 [3].

allowedServingCells

If present, UL MAC SDUs from this logical channel can only be mapped to the serving cells indicated in this list. Otherwise, UL MAC SDUs from this logical channel can be mapped to any configured serving cell of this cell group. Corresponds to 'allowedServingCells' in TS 38.321 [3].

bitRateQueryProhibitTimer

The timer is used for bit rate recommendation query in TS 38.321 [3], in seconds. Value s0 means 0 s, s0dot4 means 0.4 s and so on.

bucketSizeDuration

Value in ms. ms5 corresponds to 5 ms, value ms10 corresponds to 10 ms, and so on.

configuredGrantType1Allowed

If present, or if the capability *lcp-Restriction* as specified in TS 38.306 [26] is not supported, UL MAC SDUs from this logical channel can be transmitted on a configured grant type 1. Otherwise, UL MAC SDUs from this logical channel cannot be transmitted on a configured grant type 1. Corresponds to 'configuredGrantType1Allowed' in TS 38.321 [3].

logicalChannelGroup

ID of the logical channel group, as specified in TS 38.321 [3], which the logical channel belongs to.

logicalChannelSR-Mask

Controls SR triggering when a configured uplink grant of *type1* or *type2* is configured. *true* indicates that SR masking is configured for this logical channel as specified in TS 38.321 [3].

logicalChannelSR-DelayTimerApplied

Indicates whether to apply the delay timer for SR transmission for this logical channel. Set to false if logicalChannelSR-DelayTimer is not included in BSR-Config.

maxPUSCH-Duration

If present, UL MAC SDUs from this logical channel can only be transmitted using uplink grants that result in a PUSCH duration shorter than or equal to the duration indicated by this field. Otherwise, UL MAC SDUs from this logical channel can be transmitted using an uplink grant resulting in any PUSCH duration. Corresponds to "maxPUSCH-Duration" in TS 38.321 [3]. The PUSCH duration is calculated based on the same length of all symbols, and the shortest length applies if the symbol lengths are different.

priority

Logical channel priority, as specified in TS 38.321 [3].

prioritisedBitRate

Value in kiloBytes/s. Value *kBps0* corresponds to 0 kiloBytes/s, value *kBps8* corresponds to 8 kiloBytes/s, value *kBps16* corresponds to 16 kiloBytes/s, and so on. For SRBs, the value can only be set to *infinity*.

schedulingRequestId

If present, it indicates the scheduling request configuration applicable for this logical channel, as specified in TS 38.321 [3].

Conditional Presence	Explanation
PDCP-CADuplication	The field is mandatory present if the DRB/SRB associated with this logical channel is configured with PDCP CA duplication in UL (i.e. the PDCP entity is associated with multiple RLC entities belonging to the same cell group). Otherwise the field is optionally present, need R.
UL	The field is mandatory present for a logical channel with uplink if it serves DRB. It is optionally present, Need R, for a logical channel with uplink if it serves an SRB. Otherwise it is absent.

LogicalChannelIdentity

The IE LogicalChannelIdentity is used to identify one logical channel (LogicalChannelConfig) and the corresponding RLC bearer (RLC-BearerConfig).

LogicalChannelIdentity information element

```
-- ASN1START
-- TAG-LOGICALCHANNELIDENTITY-START

LogicalChannelIdentity ::= INTEGER (1..maxLC-ID)
-- TAG-LOGICALCHANNELIDENTITY-STOP
-- ASN1STOP
```

MAC-CellGroupConfig

The IE MAC-CellGroupConfig is used to configure MAC parameters for a cell group, including DRX.

MAC-CellGroupConfig information element

```
-- ASN1START
-- TAG-MAC-CELLGROUPCONFIG-START
MAC-CellGroupConfig ::=
                                   SEOUENCE {
                                       SetupRelease { DRX-Config }
    drx-Config
                                                                                                      OPTIONAL, -- Need M
    schedulingRequestConfig
                                       SchedulingRequestConfig
                                                                                                      OPTIONAL, -- Need M
    bsr-Config
                                       BSR-Config
                                                                                                      OPTIONAL, -- Need M
    tag-Config
                                       TAG-Config
                                                                                                      OPTIONAL, -- Need M
                                       SetupRelease { PHR-Config }
    phr-Config
                                                                                                      OPTIONAL, -- Need M
    skipUplinkTxDynamic
                                       BOOLEAN,
    ] ]
    csi-Mask
                                           BOOLEAN
                                                                                                      OPTIONAL, -- Need M
    dataInactivityTimer
                                           SetupRelease { DataInactivityTimer }
                                                                                                      OPTIONAL -- Cond MCG-Only
    ]]
DataInactivityTimer ::=
                               ENUMERATED {s1, s2, s3, s5, s7, s10, s15, s20, s40, s50, s60, s80, s100, s120, s150, s180}
-- TAG-MAC-CELLGROUPCONFIG-STOP
```

-- ASN1STOP

MAC-CellGroupConfig field descriptions	
csi-Mask	
If set to true, the UE limits CSI reports to the on-duration period of the DRX cycle, see TS 38.321 [3].	
datalnactivityTimer	
Releases the RRC connection upon data inactivity as specified in clause 5.3.8.5 and in TS 38.321 [3]. Value s1 corresponds to 1 second, value s2 corresponds to 2 seconds,	
and so on.	
drx-Config	
Used to configure DRX as specified in TS 38.321 [3].	
skipUplinkTxDynamic	
If set to true, the UE skips UL transmissions as described in TS 38.321 [3].	

Conditional Presence	Explanation
MCG-Only	This field is optionally present, Need M, for the MAC-CellGroupConfig of the MCG. It is absent otherwise.

MeasConfig

The IE *MeasConfig* specifies measurements to be performed by the UE, and covers intra-frequency, inter-frequency and inter-RAT mobility as well as configuration of measurement gaps.

MeasConfig information element

```
-- ASN1START
-- TAG-MEASCONFIG-START
                                   SEQUENCE {
MeasConfig ::=
   measObjectToRemoveList
                                       MeasObjectToRemoveList
                                                                                                          OPTIONAL, -- Need N
   measObjectToAddModList
                                       MeasObjectToAddModList
                                                                                                          OPTIONAL, -- Need N
    reportConfigToRemoveList
                                       ReportConfigToRemoveList
                                                                                                          OPTIONAL, -- Need N
    reportConfigToAddModList
                                       ReportConfigToAddModList
                                                                                                          OPTIONAL, -- Need N
    measIdToRemoveList
                                       MeasIdToRemoveList
                                                                                                          OPTIONAL, -- Need N
    measIdToAddModList
                                       MeasIdToAddModList
                                                                                                          OPTIONAL, -- Need N
    s-MeasureConfig
                                       CHOICE {
       ssb-RSRP
                                           RSRP-Range,
       csi-RSRP
                                           RSRP-Range
                                                                                                          OPTIONAL, -- Need M
                                       QuantityConfig
                                                                                                          OPTIONAL, -- Need M
    quantityConfig
    measGapConfig
                                       MeasGapConfig
                                                                                                          OPTIONAL, -- Need M
    measGapSharingConfig
                                       MeasGapSharingConfig
                                                                                                          OPTIONAL, -- Need M
MeasObjectToRemoveList ::=
                                       SEQUENCE (SIZE (1..maxNrofObjectId)) OF MeasObjectId
MeasIdToRemoveList ::=
                                       SEQUENCE (SIZE (1..maxNrofMeasId)) OF MeasId
```

```
ReportConfigToRemoveList ::= SEQUENCE (SIZE (1..maxReportConfigId)) OF ReportConfigId

-- TAG-MEASCONFIG-STOP

-- ASN1STOP
```

MeasConfig field descriptions

measGapConfig

Used to setup and release measurement gaps in NR.

measIdToAddModList

List of measurement identities to add and/or modify.

measIdToRemoveList

List of measurement identities to remove.

measObjectToAddModList

List of measurement objects to add and/or modify.

measObjectToRemoveList

List of measurement objects to remove.

reportConfigToAddModList

List of measurement reporting configurations to add and/or modify.

reportConfigToRemoveList

List of measurement reporting configurations to remove.

s-MeasureConfig

Threshold for NR SpCell RSRP measurement controlling when the UE is required to perform measurements on non-serving cells. Choice of *ssb-RSRP* corresponds to cell RSRP based on SS/PBCH block and choice of *csi-RSRP* corresponds to cell RSRP of CSI-RS.

measGapSharingConfig

Specifies the measurement gap sharing scheme and controls setup/ release of measurement gap sharing.

MeasGapConfig

The IE *MeasGapConfig* specifies the measurement gap configuration and controls setup/release of measurement gaps.

MeasGapConfig information element

```
-- ASN1START
-- TAG-MEASGAPCONFIG-START
MeasGapConfig ::=
                                   SEOUENCE {
                                       SetupRelease { GapConfig }
   gapFR2
                                                                                                                OPTIONAL, -- Need M
    . . . ,
    ] ]
                                       SetupRelease { GapConfig }
   gapFR1
                                                                                                                OPTIONAL, -- Need M
                                       SetupRelease { GapConfig }
                                                                                                                OPTIONAL -- Need M
    qapUE
    ]]
```

```
GapConfig ::=
                                    SEOUENCE {
    qapOffset
                                        INTEGER (0..159).
   mal
                                        ENUMERATED {ms1dot5, ms3, ms3dot5, ms4, ms5dot5, ms6}.
   mgrp
                                        ENUMERATED {ms20, ms40, ms80, ms160},
                                        ENUMERATED {ms0, ms0dot25, ms0dot5},
    mqta
    refServCellIndicator
                                        ENUMERATED {pCell, pSCell, mcg-FR2}
                                                                                                                     OPTIONAL -- Cond NEDCorNRDC
    11
-- TAG-MEASGAPCONFIG-STOP
-- ASN1STOP
```

MeasGapConfig field descriptions

gapFR1

Indicates measurement gap configuration that applies to FR1 only. In (NG)EN-DC, *gapFR1* cannot be set up by NR RRC (i.e. only LTE RRC can configure FR1 measurement gap). In NE-DC, *gapFR1* can only be set up by NR RRC (i.e. LTE RRC cannot configure FR1 gap). In NR-DC, *gapFR1* can only be set up in the *measConfig* associated with MCG. *gapFR1* can not be configured together with *gapUE*. The applicability of the FR1 measurement gap is according to Table 9.1.2-2 and Table 9.1.2-3 in TS 38.133 [14].

gapFR2

Indicates measurement gap configuration applies to FR2 only. In (NG)EN-DC or NE-DC, *gapFR2* can only be set up by NR RRC (i.e. LTE RRC cannot configure FR2 gap). In NR-DC, *gapFR2* can only be set up in the *measConfig* associated with MCG. *gapFR2* cannot be configured together with *gapUE*. The applicability of the FR2 measurement gap is according to Table 9.1.2-2 and Table 9.1.2-3 in TS 38.133 [14].

gapUE

Indicates measurement gap configuration that applies to all frequencies (FR1 and FR2). In (NG)EN-DC, *gapUE* cannot be set up by NR RRC (i.e. only LTE RRC can configure per UE measurement gap). In NE-DC, *gapUE* can only be set up by NR RRC (i.e. LTE RRC cannot configure per UE gap). In NR-DC, *gapUE* can only be set up in the *measConfig* associated with MCG. If *gapUE* is configured, then neither *gapFR1* nor *gapFR2* can be configured. The applicability of the per UE measurement gap is according to Table 9.1.2-3 and Table 9.1.2-3 in TS 38.133 [14].

gapOffset

Value gap Offset is the gap offset of the gap pattern with MGRP indicated in the field mgrp. The value range is from 0 to mgrp-1.

mgi

Value *mgl* is the measurement gap length in ms of the measurement gap. The measurement gap length is according to in Table 9.1.2-1 in TS 38.133 [14]. Value *ms1dot5* corresponds to 1.5 ms, *ms3* corresponds to 3 ms and so on.

mgrp

Value mgrp is measurement gap repetition period in (ms) of the measurement gap. The measurement gap repetition period is according to Table 9.1.2-1 in TS 38.133 [14].

mgta

Value *mgta* is the measurement gap timing advance in ms. The applicability of the measurement gap timing advance is according to clause 9.1.2 of TS 38.133 [14]. Value *ms0* corresponds to 0 ms, *ms0dot25* corresponds to 0.25 ms and *ms0dot5* corresponds to 0.5 ms. For FR2, the network only configures 0 ms and 0.25 ms.

refServCellIndicator

Indicates the serving cell whose SFN and subframe are used for gap calculation for this gap pattern. Value pCell corresponds to the PCell, pSCell corresponds to the PSCell, and mcg-FR2 corresponds to a serving cell on FR2 frequency in MCG.

Conditional Presence	Explanation
NEDCorNRDC	This field is mandatory present when configuring gap pattern to UE in NE-DC or NR-DC. In case the gap pattern to UE in
	NE-DC and NR-DC is already configured, then the field is absent, need M. Otherwise, it is absent.

MeasGapSharingConfig

The IE MeasGapSharingConfig specifies the measurement gap sharing scheme and controls setup/ release of measurement gap sharing.

MeasGapSharingConfig information element

```
-- ASN1START
-- TAG-MEASGAPSHARINGCONFIG-START
MeasGapSharingConfig ::=
                               SEQUENCE {
    gapSharingFR2
                                   SetupRelease { MeasGapSharingScheme }
                                                                               OPTIONAL, -- Need M
    . . . ,
    ] ]
    gapSharingFR1
                                   SetupRelease { MeasGapSharingScheme }
                                                                                         --Need M
                                                                               OPTIONAL,
    gapSharingUE
                                   SetupRelease { MeasGapSharingScheme }
                                                                               OPTIONAL --Need M
    11
MeasGapSharingScheme::=
                               ENUMERATED {scheme00, scheme01, scheme10, scheme11}
-- TAG-MEASGAPSHARINGCONFIG-STOP
-- ASN1STOP
```

MeasGapSharingConfig field descriptions

gapSharingFR1

Indicates the measurement gap sharing scheme that applies to the gap set for FR1 only. In (NG)EN-DC, *gapSharingFR1* cannot be set up by NR RRC (i.e. only LTE RRC can configure FR1 gap sharing). In NE-DC, *gapSharingFR1* can only be set up by NR RRC (i.e. LTE RRC cannot configure FR1 gap sharing). In NR-DC, *gapSharingFR1* can only be set up in the *measConfig* associated with MCG. *gapSharingFR1* can not be configured together with *gapSharingUE*. For the applicability of the different gap sharing schemes, see TS 38.133 [14]. Value *scheme00* corresponds to scheme "00", value *scheme01* corresponds to scheme "01", and so on.

gapSharingFR2

Indicates the measurement gap sharing scheme that applies to the gap set for FR2 only. In (NG)EN-DC or NE-DC, *gapSharingFR2* can only be set up by NR RRC (i.e. LTE RRC cannot configure FR2 gap sharing). In NR-DC, *gapSharingFR2* can only be set up by MCG in the *measConfig* associated with MCG. *gapSharingFR2* cannot be configured together with *gapSharingUE*. For applicability of the different gap sharing schemes, see TS 38.133 [14]. Value *scheme00* corresponds to scheme "00", value *scheme01* corresponds to scheme "01", and so on.

gapSharingUE

Indicates the measurement gap sharing scheme that applies to the gap set per UE. In (NG)EN-DC, *gapSharingUE* cannot be set up by NR RRC (i.e. only LTE RRC can configure per UE gap sharing). In NE-DC, *gapSharingUE* can only be set up by NR RRC (i.e. LTE RRC cannot configure per UE gap sharing). In NR-DC, *gapSharingUE* can only be set up in the *measConfig* associated with MCG. If *gapSharingUE* is configured, then neither *gapSharingFR1* nor *gapSharingFR2* can be configured. For the applicability of the different gap sharing schemes, see TS 38.133 [14]. Value *scheme00* corresponds to scheme "00", value *scheme01* corresponds to scheme "01", and so on.

– Measid

The IE MeasId is used to identify a measurement configuration, i.e., linking of a measurement object and a reporting configuration.

MeasId information element

```
-- ASN1START
-- TAG-MEASID-START

MeasId ::= INTEGER (1..maxNrofMeasId)
-- TAG-MEASID-STOP
-- ASN1STOP
```

MeasIdToAddModList

The IE MeasIdToAddModList concerns a list of measurement identities to add or modify, with for each entry the measId, the associated measObjectId and the associated reportConfigId.

MeasIdToAddModList information element

```
-- ASN1START
-- TAG-MEASIDTOADDMODLIST-START

MeasIdToAddModList ::= SEQUENCE (SIZE (1..maxNrofMeasId)) OF MeasIdToAddMod

MeasIdToAddMod ::= SEQUENCE {
    measId MeasId,
    measObjectId MeasObjectId,
    reportConfigId ReportConfigId
}

-- TAG-MEASIDTOADDMODLIST-STOP
-- ASN1STOP
```

- MeasObjectEUTRA

The IE MeasObjectEUTRA specifies information applicable for E-UTRA cells.

MeasObjectEUTRA information element

```
-- ASN1START
-- TAG-MEASOBJECTEUTRA-START

MeasObjectEUTRA::= SEQUENCE {
    carrierFreq ARFCN-ValueEUTRA,
```

-- Need N

-- Need N

-- Need N

```
allowedMeasBandwidth
                                                EUTRA-AllowedMeasBandwidth,
    cellsToRemoveListEUTRAN
                                                EUTRA-CellIndexList
                                                                                                             OPTIONAL,
    cellsToAddModListEUTRAN
                                                SEQUENCE (SIZE (1..maxCellMeasEUTRA)) OF EUTRA-Cell
                                                                                                             OPTIONAL,
    blackCellsToRemoveListEUTRAN
                                                EUTRA-CellIndexList
                                                                                                             OPTIONAL,
   blackCellsToAddModListEUTRAN
                                                SEQUENCE (SIZE (1..maxCellMeasEUTRA)) OF EUTRA-BlackCell
                                                                                                             OPTIONAL,
                                                                                                                          -- Need N
                                                EUTRA-PresenceAntennaPort1,
    eutra-PresenceAntennaPort1
    eutra-Q-OffsetRange
                                                EUTRA-O-OffsetRange
                                                                                                             OPTIONAL.
                                                                                                                          -- Need R
    widebandRSRO-Meas
                                                BOOLEAN,
EUTRA-CellIndexList ::=
                                            SEQUENCE (SIZE (1..maxCellMeasEUTRA)) OF EUTRA-CellIndex
EUTRA-CellIndex ::=
                                            INTEGER (1..maxCellMeasEUTRA)
EUTRA-Cell ::=
                                            SEOUENCE {
                                                EUTRA-CellIndex,
    cellIndexEUTRA
                                                EUTRA-PhysCellId,
    physCellId
                                                EUTRA-Q-OffsetRange
    cellIndividualOffset
EUTRA-BlackCell ::=
                                            SEOUENCE {
    cellIndexEUTRA
                                                EUTRA-CellIndex,
    physCellIdRange
                                                EUTRA-PhysCellIdRange
-- TAG-MEASOBJECTEUTRA-STOP
-- ASN1STOP
```

EUTRAN-BlackCell field descriptions

cellIndexEUTRA

Entry index in the cell list.

physicalCellIdRange

Physical cell identity or a range of physical cell identities.

EUTRAN-Cell field descriptions

physicalCellId

Physical cell identity of a cell in the cell list.

cellIndividualOffset

Cell individual offset applicable to a specific cell. Value dB-24 corresponds to -24 dB, dB-22 corresponds to -22 dB and so on.

MeasObjectEUTRA field descriptions

allowedMeasBandwidth

The maximum allowed measurement bandwidth on a carrier frequency as defined by the parameter Transmission Bandwidth Configuration "N_{RB}" TS 36.104 [33].

blackCellsToAddModListEUTRAN

List of cells to add/ modify in the black list of cells.

blackCellsToRemoveListEUTRAN

List of cells to remove from the black list of cells.

carrierFreq

Identifies E-UTRA carrier frequency for which this configuration is valid. Network does not configure more than one *MeasObjectEUTRA* for the same physical frequency, regardless of the E-ARFCN used to indicate this.

cellsToAddModListEUTRAN

List of cells to add/ modify in the cell list.

cellsToRemoveListEUTRAN

List of cells to remove from the cell list.

eutra-PresenceAntennaPort1

When set to true, the UE may assume that at least two cell-specific antenna ports are used in all neighbouring cells.

eutra-Q-OffsetRange

Used to indicate a cell, or frequency specific offset to be applied when evaluating triggering conditions for measurement reporting. The value is in dB. Value dB-24 corresponds to -24 dB, value dB-22 corresponds to -22 dB and so on.

widebandRSRQ-Meas

If set to *true*, the UE shall, when performing RSRQ measurements, use a wider bandwidth in accordance with TS 36.133 [40]. The network may set the field to *true* if the measurement bandwidth indicated by *allowedMeasBandwidth* is 50 resource blocks or larger; otherwise the network sets this field to *false*.

– MeasObjectId

The IE MeasObjectId used to identify a measurement object configuration.

MeasObjectId information element

- -- ASN1START
- -- TAG-MEASOBJECTID-START

MeasObjectId ::=

INTEGER (1..maxNrofObjectId)

- -- TAG-MEASOBJECTID-STOP
- -- ASN1STOP

- MeasObjectNR

The IE MeasObjectNR specifies information applicable for SS/PBCH block(s) intra/inter-frequency measurements and/or CSI-RS intra/inter-frequency measurements.

MeasObjectNR information element

```
-- TAG-MEASOBJECTNR-START
MeasObjectNR ::=
                                    SECUENCE {
    ssbFrequency
                                        ARFCN-ValueNR
                                                                                                 OPTIONAL.
                                                                                                              -- Cond SSBorAssociatedSSB
    ssbSubcarrierSpacing
                                        SubcarrierSpacing
                                                                                                 OPTIONAL.
                                                                                                              -- Cond SSBorAssociatedSSB
                                                                                                              -- Cond SSBorAssociatedSSB
    smt.c1
                                        SSB-MTC
                                                                                                 OPTIONAL,
    smt.c2
                                        SSB-MTC2
                                                                                                 OPTIONAL,
                                                                                                              -- Cond IntraFregConnected
    refFreqCSI-RS
                                        ARFCN-ValueNR
                                                                                                 OPTIONAL,
                                                                                                             -- Cond CSI-RS
    referenceSignalConfig
                                        ReferenceSignalConfig,
    absThreshSS-BlocksConsolidation
                                        ThresholdNR
                                                                                                                      -- Need R
                                                                                                          OPTIONAL,
    absThreshCSI-RS-Consolidation
                                        ThresholdNR
                                                                                                          OPTIONAL,
                                                                                                                      -- Need R
    nrofSS-BlocksToAverage
                                        INTEGER (2..maxNrofSS-BlocksToAverage)
                                                                                                          OPTIONAL,
                                                                                                                    -- Need R
    nrofCSI-RS-ResourcesToAverage
                                        INTEGER (2..maxNrofCSI-RS-ResourcesToAverage)
                                                                                                          OPTIONAL,
                                                                                                                     -- Need R
    quantityConfiqIndex
                                        INTEGER (1..maxNrofOuantityConfig),
    offsetMO
                                        O-OffsetRangeList,
    cellsToRemoveList
                                        PCI-List
                                                                                                          OPTIONAL,
                                                                                                                      -- Need N
    cellsToAddModList
                                                                                                                      -- Need N
                                        CellsToAddModList
                                                                                                          OPTIONAL,
    blackCellsToRemoveList.
                                        PCI-RangeIndexList
                                                                                                          OPTIONAL,
                                                                                                                     -- Need N
    blackCellsToAddModList
                                        SEQUENCE (SIZE (1..maxNrofPCI-Ranges)) OF PCI-RangeElement
                                                                                                          OPTIONAL, -- Need N
    whiteCellsToRemoveList
                                                                                                                      -- Need N
                                        PCI-RangeIndexList
                                                                                                          OPTIONAL,
    whiteCellsToAddModList
                                        SEQUENCE (SIZE (1..maxNrofPCI-Ranges)) OF PCI-RangeElement
                                                                                                          OPTIONAL.
                                                                                                                     -- Need N
    11
    fregBandIndicatorNR
                                        FregBandIndicatorNR
                                                                                                          OPTIONAL.
                                                                                                                      -- Need R
                                        ENUMERATED {sf160, sf256, sf320, sf512, sf640, sf1024, sf1280}
    measCycleSCell
                                                                                                         OPTIONAL
                                                                                                                      -- Need R
    11
ReferenceSignalConfig::=
                                    SEOUENCE {
    ssb-ConfiqMobility
                                        SSB-ConfigMobility
                                                                                                          OPTIONAL,
                                                                                                                      -- Need M
    csi-rs-ResourceConfigMobility
                                        SetupRelease { CSI-RS-ResourceConfigMobility }
                                                                                                          OPTIONAL
                                                                                                                      -- Need M
SSB-ConfigMobility::=
                                    SEQUENCE {
    ssb-ToMeasure
                                            SetupRelease { SSB-ToMeasure }
                                                                                                          OPTIONAL,
                                                                                                                      -- Need M
    deriveSSB-IndexFromCell
                                        BOOLEAN,
    ss-RSSI-Measurement
                                                SS-RSSI-Measurement
                                                                                                          OPTIONAL,
                                                                                                                      -- Need M
Q-OffsetRangeList ::=
                                    SEOUENCE {
    rsrpOffsetSSB
                                        O-OffsetRange
                                                                     DEFAULT dB0,
    rsrqOffsetSSB
                                        O-OffsetRange
                                                                     DEFAULT dB0.
    sinrOffsetSSB
                                        Q-OffsetRange
                                                                     DEFAULT dB0.
    rsrpOffsetCSI-RS
                                        O-OffsetRange
                                                                     DEFAULT dB0.
    rsrqOffsetCSI-RS
                                        Q-OffsetRange
                                                                     DEFAULT dB0,
    sinrOffsetCSI-RS
                                        Q-OffsetRange
                                                                     DEFAULT dB0
ThresholdNR ::=
                                    SEQUENCE {
    thresholdRSRP
                                        RSRP-Range
                                                                                                          OPTIONAL,
                                                                                                                     -- Need R
```

OPTIONAL,

OPTIONAL

-- Need R

-- Need R

CellsToAddMod field descriptions

cellIndividualOffset

Cell individual offsets applicable to a specific cell.

physCellId

Physical cell identity of a cell in the cell list.

MeasObjectNR field descriptions

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absThreshCSI-RS-Consolidation

Absolute threshold for the consolidation of measurement results per CSI-RS resource(s) from L1 filter(s). The field is used for the derivation of cell measurement results as described in 5.5.3.3 and the reporting of beam measurement information per CSI-RS resource as described in 5.5.5.2.

absThreshSS-BlocksConsolidation

Absolute threshold for the consolidation of measurement results per SS/PBCH block(s) from L1 filter(s). The field is used for the derivation of cell measurement results as described in 5.5.3.3 and the reporting of beam measurement information per SS/PBCH block index as described in 5.5.5.2.

blackCellsToAddModList

List of cells to add/modify in the black list of cells. It applies only to SSB resources.

blackCellsToRemoveList

List of cells to remove from the black list of cells.

cellsToAddModList

List of cells to add/modify in the cell list.

cellsToRemoveList

List of cells to remove from the cell list.

freqBandIndicatorNR

The frequency band in which the SSB and/or CSI-RS indicated in this *MeasObjectNR* are located and according to which the UE shall perform the RRM measurements. This field is always provided when the network configures measurements with this *MeasObjectNR*.

measCycleSCell

The parameter is used only when an SCell is configured on the frequency indicated by the measObjectNR and is in deactivated state, see TS 38.133 [14]. gNB configures the parameter whenever an SCell is configured on the frequency indicated by the *measObjectNR*, but the field may also be signalled when an SCell is not configured. Value *sf160* corresponds to 160 sub-frames, value *sf256* corresponds to 256 sub-frames and so on.

nrofCSInrofCSI-RS-ResourcesToAverage

Indicates the maximum number of measurement results per beam based on CSI-RS resources to be averaged. The same value applies for each detected cell associated with this MeasObjectNR.

nrofSS-BlocksToAverage

Indicates the maximum number of measurement results per beam based on SS/PBCH blocks to be averaged. The same value applies for each detected cell associated with this *MeasObject*.

offsetMO

Offset values applicable to all measured cells with reference signal(s) indicated in this MeasObjectNR.

*quantity*ConfigIndex

Indicates the n-th element of quantityConfigNR-List provided in MeasConfig.

referenceSignalConfig

RS configuration for SS/PBCH block and CSI-RS.

refFreqCSI-RS

Point A which is used for mapping of CSI-RS to physical resources according to TS 38,211 [16] clause 7.4.1.5.3.

smtc1

Primary measurement timing configuration. (see clause 5.5.2.10).

smtc2

Secondary measurement timing configuration for SS corresponding to this *MeasObjectNR* with PCI listed in *pci-List*. For these SS, the periodicity is indicated by *periodicity* in *smtc2* and the timing offset is equal to the offset indicated in *periodicityAndOffset* modulo *periodicity*. *periodicity* in smtc2 can only be set to a value strictly shorter than the periodicity indicated by *periodicityAndOffset* in *smtc1* (e.g. if *periodicityAndOffset* indicates *sf10*, *periodicity* can only be set of *sf5*, if *periodicityAndOffset* indicates *sf5*, *smtc2* cannot be configured).

ssbFrequency

Indicates the frequency of the SS associated to this MeasObjectNR.

ssbSubcarrierSpacing

Subcarrier spacing of SSB. Only the values 15 kHz or 30 kHz (FR1), and 120 kHz or 240 kHz (FR2) are applicable.

whiteCellsToAddModList

List of cells to add/modify in the white list of cells. It applies only to SSB resources.

whiteCellsToRemoveList

List of cells to remove from the white list of cells.

ReferenceSignalConfig field descriptions

csi-rs-ResourceConfigMobility

CSI-RS resources to be used for CSI-RS based RRM measurements.

ssb-ConfigMobility

SSB configuration for mobility (nominal SSBs, timing configuration).

SSB-ConfigMobility field descriptions

deriveSSB-IndexFromCell

If this field is set to *true*, UE assumes SFN and frame boundary alignment across cells on the same frequency carrier as specified in TS 38.133 [14]. Hence, if the UE is configured with a serving cell for which (*absoluteFrequencySSB*, *subcarrierSpacing*) in *ServingCellConfigCommon* is equal to (*ssbFrequency*, *ssbSubcarrierSpacing*) in this *MeasObjectNR*, this field indicates whether the UE can utilize the timing of this serving cell to derive the index of SS block transmitted by neighbour cell. Otherwise, this field indicates whether the UE may use the timing of any detected cell on that target frequency to derive the SSB index of all neighbour cells on that frequency.

ssb-ToMeasure

The set of SS blocks to be measured within the SMTC measurement duration. The first/leftmost bit corresponds to SS/PBCH block index 0, the second bit corresponds to SS/PBCH block index 1, and so on. Value 0 in the bitmap indicates that the corresponding SS/PBCH block is not to be measured while value 1 indicates that the corresponding SS/PBCH block is to be measured (see TS 38.215 [9]). When the field is not configured the UE measures on all SS blocks. Regardless of the value of this field, SS/PBCH blocks outside of the applicable *smtc* are not to be measured. See TS 38.215 [9] clause 5.1.1.

Conditional Presence	Explanation
CSI-RS	This field is mandatory present if csi-rs-ResourceConfigMobility is configured, otherwise, it is absent.
SSBorAssociatedSSB	This field is mandatory present if ssb-ConfigMobility is configured or associatedSSB is configured in at least one cell.
	Otherwise, it is absent, Need R.
IntraFreqConnected	This field is optionally present, Need R if the UE is configured with a serving cell for which (absoluteFrequencySSB, subcarrierSpacing) in ServingCellConfigCommon is equal to (ssbFrequency, ssbSubcarrierSpacing) in this MeasObjectNR,
	otherwise, it is absent.

– MeasObjectToAddModList

The IE MeasObjectToAddModList concerns a list of measurement objects to add or modify.

MeasObjectToAddModList information element

- -- ASN1START
- -- TAG-MEASOBJECTTOADDMODLIST-START

MeasResultCellListSFTD-NR

The IE MeasResultCellListSFTD-NR consists of SFN and radio frame boundary difference between the PCell and an NR cell as specified in TS 38.215 [9] and TS 38.133 [14].

MeasResultCellListSFTD-NR information element

```
-- ASN1START
-- TAG-MEASRESULTCELLLISTSFTD-NR-START
MeasResultCellListSFTD-NR ::=
                                       SEQUENCE (SIZE (1..maxCellSFTD)) OF MeasResultCellSFTD-NR
MeasResultCellSFTD-NR ::=
                                       SEQUENCE {
                                         PhysCellId,
   physCellId
    sfn-OffsetResult
                                          INTEGER (0..1023),
    frameBoundaryOffsetResult
                                         INTEGER (-30720..30719),
    rsrp-Result
                                         RSRP-Range
                                                                          OPTIONAL
-- TAG-MEASRESULTCELLLISTSFTD-NR-STOP
-- ASN1STOP
```

MeasResultCellSFTD-NR field descriptions

sfn-OffsetResult

Indicates the SFN difference between the PCell and the NR cell as an integer value according to TS 38.215 [9].

frameBoundaryOffsetResult

Indicates the frame boundary difference between the PCell and the NR cell as an integer value according to TS 38.215 [9].

MeasResultCellListSFTD-EUTRA

The IE MeasResultCellListSFTD-EUTRA consists of SFN and radio frame boundary difference between the PCell and an E-UTRA PSCell.

MeasResultCellListSFTD-EUTRA information element

```
-- ASN1START
-- TAG-MEASRESULTCELLLISTSFTD-EUTRA-START
MeasResultCellListSFTD-EUTRA ::=
                                         SEOUENCE (SIZE (1..maxCellSFTD)) OF MeasResultSFTD-EUTRA
                                  SEQUENCE {
MeasResultSFTD-EUTRA ::=
    eutra-PhysCellId
                                       EUTRA-PhysCellId,
    sfn-OffsetResult
                                       INTEGER (0..1023),
    frameBoundaryOffsetResult
                                       INTEGER (-30720..30719),
    rsrp-Result
                                       RSRP-Range
                                                                       OPTIONAL
-- TAG-MEASRESULTCELLLISTSFTD-EUTRA-STOP
-- ASN1STOP
```

MeasResultSFTD-EUTRA field descriptions

eutra-PhysCellId

Identifies the physical cell identity of the E-UTRA cell for which the reporting is being performed.

sfn-OffsetResult

Indicates the SFN difference between the PCell and the E-UTRA cell as an integer value according to TS 38.215 [9].

frameBoundaryOffsetResult

Indicates the frame boundary difference between the PCell and the E-UTRA cell as an integer value according to TS 38.215 [9].

MeasResults

The IE MeasResults covers measured results for intra-frequency, inter-frequency, and inter-RAT mobility.

MeasResults information element

```
-- ASN1START
-- TAG-MEASRESULTS-START
MeasResults ::=
                                        SEQUENCE {
   measId
                                            MeasId,
   measResultServingMOList
                                            MeasResultServMOList,
   measResultNeighCells
                                            CHOICE {
       measResultListNR
                                                MeasResultListNR,
                                                MeasResultListEUTRA
       measResultListEUTRA
                                                                                                                          OPTIONAL,
    ] ]
    measResultServFreqListEUTRA-SCG
                                            MeasResultServFreqListEUTRA-SCG
                                                                                                                          OPTIONAL,
    measResultServFreqListNR-SCG
                                            MeasResultServFreqListNR-SCG
                                                                                                                          OPTIONAL,
    measResultSFTD-EUTRA
                                            MeasResultSFTD-EUTRA
                                                                                                                          OPTIONAL,
    measResultSFTD-NR
                                            MeasResultCellSFTD-NR
                                                                                                                          OPTIONAL
```

```
]],
    ] ]
    measResultCellListSFTD-NR
                                                     MeasResultCellListSFTD-NR
                                                                                                                                        OPTIONAL
    ]]
MeasResultServMOList ::=
                                         SEQUENCE (SIZE (1..maxNrofServingCells)) OF MeasResultServMO
MeasResultServMO ::=
                                         SEQUENCE {
    servCellId
                                             ServCellIndex,
    measResultServingCell
                                             MeasResultNR,
    measResultBestNeighCell
                                             MeasResultNR
                                                                                                                           OPTIONAL,
MeasResultListNR ::=
                                         SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultNR
MeasResultNR ::=
                                         SEOUENCE {
                                             PhysCellId
    physCellId
                                                                                                                           OPTIONAL,
    measResult
                                             SEQUENCE {
        cellResults
                                                 SEQUENCE {
            resultsSSB-Cell
                                                     MeasQuantityResults
                                                                                                                           OPTIONAL,
            resultsCSI-RS-Cell
                                                     MeasQuantityResults
                                                                                                                           OPTIONAL
        rsIndexResults
                                                 SEQUENCE {
            resultsSSB-Indexes
                                                     ResultsPerSSB-IndexList
                                                                                                                           OPTIONAL,
            resultsCSI-RS-Indexes
                                                     ResultsPerCSI-RS-IndexList
                                                                                                                           OPTIONAL
                                                                                                                           OPTIONAL
    },
    . . . ,
    ] ]
    cgi-Info
                                             CGI-InfoNR
                                                                                                                           OPTIONAL
    ]]
MeasResultListEUTRA ::=
                                         SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultEUTRA
MeasResultEUTRA ::=
                                         SEQUENCE {
    eutra-PhysCellId
                                             PhysCellId,
    measResult
                                             MeasQuantityResultsEUTRA,
    cgi-Info
                                             CGI-InfoEUTRA
                                                                                                                           OPTIONAL,
MultiBandInfoListEUTRA ::=
                                         SEQUENCE (SIZE (1..maxMultiBands)) OF FreqBandIndicatorEUTRA
MeasQuantityResults ::=
                                         SEQUENCE {
    rsrp
                                             RSRP-Range
                                                                                                                           OPTIONAL,
                                             RSRQ-Range
                                                                                                                           OPTIONAL,
    rsrq
    sinr
                                             SINR-Range
                                                                                                                           OPTIONAL
```

```
MeasQuantityResultsEUTRA ::=
                                        SEOUENCE {
    rsrp
                                            RSRP-RangeEUTRA
                                                                                                                          OPTIONAL.
    rsrq
                                            RSRO-RangeEUTRA
                                                                                                                          OPTIONAL,
    sinr
                                            SINR-RangeEUTRA
                                                                                                                          OPTIONAL
ResultsPerSSB-IndexList::=
                                        SEQUENCE (SIZE (1..maxNrofIndexesToReport2)) OF ResultsPerSSB-Index
ResultsPerSSB-Index ::=
                                        SEQUENCE {
    ssb-Index
                                            SSB-Index,
    ssb-Results
                                            MeasQuantityResults
                                                                                                                          OPTIONAL
ResultsPerCSI-RS-IndexList::=
                                        SEQUENCE (SIZE (1..maxNrofIndexesToReport2)) OF ResultsPerCSI-RS-Index
ResultsPerCSI-RS-Index ::=
                                        SEOUENCE {
                                            CSI-RS-Index,
    csi-RS-Index
    csi-RS-Results
                                            MeasQuantityResults
                                                                                                                          OPTIONAL
MeasResultServFreqListEUTRA-SCG ::= SEQUENCE (SIZE (1..maxNrofServingCellsEUTRA)) OF MeasResult2EUTRA
MeasResultServFreqListNR-SCG ::= SEOUENCE (SIZE (1..maxNrofServingCells)) OF MeasResult2NR
-- TAG-MEASRESULTS-STOP
-- ASN1STOP
```

MeasResultEUTRA field descriptions

eutra-PhysCellId

Identifies the physical cell identity of the E-UTRA cell for which the reporting is being performed. The UE reports a value in the range 0..503, other values are reserved.

MeasResultNR field descriptions

cellResults

Cell level measurement results.

physCellId

The physical cell identity of the NR cell for which the reporting is being performed.

resultsSSB-Cell

Cell level measurement results based on SS/PBCH related measurements.

resultsSSB-Indexes

Beam level measurement results based on SS/PBCH related measurements.

resultsCSI-RS-Cell

Cell level measurement results based on CSI-RS related measurements.

resultsCSI-RS-Indexes

Beam level measurement results based on CSI-RS related measurements.

rsIndexResults

Beam level measurement results.

MeasResults field descriptions

measId

Identifies the measurement identity for which the reporting is being performed.

measResultCellListSFTD-NR

SFTD measurement results between the PCell and the NR neighbour cell(s) in NR standalone.

measResultEUTRA

Measured results of an E-UTRA cell.

measResultListEUTRA

List of measured results for the maximum number of reported best cells for an E-UTRA measurement identity.

measResultListNR

List of measured results for the maximum number of reported best cells for an NR measurement identity.

measResultNR

Measured results of an NR cell.

measResultServFreqListEUTRA-SCG

Measured results of the E-UTRA SCG serving frequencies: the measurement result of PSCell and each SCell, if any, and of the best neighbouring cell on each E-UTRA SCG serving frequency.

measResultServFreqListNR-SCG

Measured results of the NR SCG serving frequencies: the measurement result of PSCell and each SCell, if any, and of the best neighbouring cell on each NR SCG serving frequency.

measResultServingMOList

Measured results of measured cells with reference signals indicated in the serving cell measurement objects including measurement results of SpCell, configured SCell(s) and best neighbouring cell within measured cells with reference signals indicated in on each serving cell measurement object.

measResultSFTD-EUTRA

SFTD measurement results between the PCell and the E-UTRA PScell in NE-DC.

measResultSFTD-NR

SFTD measurement results between the PCell and the NR PScell in NR-DC.

MeasResult2EUTRA

The IE MeasResult2EUTRA contains measurements on E-UTRA frequencies.

MeasResult2EUTRA information element

MeasResult2NR

The IE MeasResult2NR contains measurements on NR frequencies.

MeasResult2NR information element

```
-- ASN1START
-- TAG-MEASRESULT2NR-START
MeasResult2NR ::=
                                SEQUENCE {
                                  ARFCN-ValueNR
    ssbFrequency
                                                                                OPTIONAL,
   refFreqCSI-RS
                                       ARFCN-ValueNR
                                                                                OPTIONAL,
   measResultServingCell
measResultNeighCellListNR
                                       MeasResultNR
                                                                                OPTIONAL,
                                       MeasResultListNR
                                                                                OPTIONAL,
-- TAG-MEASRESULT2NR-STOP
-- ASN1STOP
```

MeasResultSCG-Failure

The IE MeasResultSCG-Failure is used to provide information regarding failures detected by the UE in (NG)EN-DC and NR-DC.

MeasResultSCG-Failure information element

```
-- ASN1START
-- TAG-MEASRESULTSCG-FAILURE-START

MeasResultSCG-Failure ::= SEQUENCE {
    measResultPerMOList MeasResultList2NR,
    ...
}

MeasResultList2NR ::= SEQUENCE (SIZE (1..maxFreq)) OF MeasResult2NR
-- TAG-MEASRESULTSCG-FAILURE-STOP
-- ASN1STOP
```

MeasTriggerQuantityEUTRA

The IE *MeasTriggerQuantityEUTRA* is used to configure the trigger quantity and reporting range for E-UTRA measurements. The RSRP, RSRQ and SINR ranges correspond to *RSRP-Range*, *RSRQ-Range* and *RS-SINR-Range* in TS 36.331 [10], respectively.

MeasTriggerQuantityEUTRA information element

```
-- ASN1START
-- TAG-MEASTRIGGERQUANTITYEUTRA-START

MeasTriggerQuantityEUTRA::= CHOICE {
    rsrp RSRP-RangeEUTRA, rsrq RSRQ-RangeEUTRA, sinr SINR-RangeEUTRA}
}

RSRP-RangeEUTRA ::= INTEGER (0..97)
RSRQ-RangeEUTRA ::= INTEGER (0..34)
SINR-RangeEUTRA ::= INTEGER (0..127)

-- TAG-MEASTRIGGERQUANTITYEUTRA-STOP
-- ASN1STOP
```

MobilityStateParameters 4 6 1

The IE MobilityStateParameters contains parameters to determine UE mobility state.

MobilityStateParameters information element

```
-- ASN1START
-- TAG-MOBILITYSTATEPARAMETERS-START
                                   SEQUENCE {
MobilityStateParameters ::=
    t-Evaluation
                                       ENUMERATED {
                                           s30, s60, s120, s180, s240, spare3, spare2, spare1},
                                       ENUMERATED {
    t-HystNormal
                                       s30, s60, s120, s180, s240, spare3, spare2, spare1},
                             s30, s60, s1:
INTEGER (1..16),
   n-CellChangeMedium
   n-CellChangeHigh
                                       INTEGER (1..16)
-- TAG-MOBILITYSTATEPARAMETERS-STOP
-- ASN1STOP
```

MobilityStateParameters field descriptions

n-CellChangeHigh

The number of cell changes to enter high mobility state. Corresponds to N_{CR_H} in TS 38.304 [20].

n-CellChangeMedium

The number of cell changes to enter medium mobility state. Corresponds to Ncr_M in TS 38.304 [20].

t-Evaluation

The duration for evaluating criteria to enter mobility states. Corresponds to TCRmax in TS 38.304 [20]. Value in seconds, s30 corresponds to 30 s and so on.

t-HystNormal

The additional duration for evaluating criteria to enter normal mobility state. Corresponds to T_{CRmaxHyst} in TS 38.304 [20]. Value in seconds, value *s30* corresponds to 30 seconds and so on.

MultiFrequencyBandListNR

The IE MultiFrequencyBandListNR is used to configure a list of one or multiple NR frequency bands.

MultiFrequencyBandListNR information element

```
-- ASN1START
-- TAG-MULTIFREQUENCYBANDLISTNR-START

MultiFrequencyBandListNR ::= SEQUENCE (SIZE (1..maxNrofMultiBands)) OF FreqBandIndicatorNR
-- TAG-MULTIFREQUENCYBANDLISTNR-STOP
-- ASN1STOP
```

MultiFrequencyBandListNR-SIB

The IE MultiFrequencyBandListNR-SIB indicates the list of frequency bands, for which cell (re-)selection parameters are common, and a list of additionalPmax and additionalSpectrumEmission.

MultiFrequencyBandListNR-SIB information element

NR-MultiBandInfo field descriptions freqBandIndicatorNR Provides an NR frequency band number as defined in TS 38.101-1 [15] and TS 38.101-2 [39], table 5.2-1. nr-NS-PmaxList

Provides a list of additionalPmax and additionalSpectrumEmission values. If the field is absent the UE uses value 0 for the additionalSpectrumEmission (see TS 38.101-1 [15] table 6.2.3.1-1A, and TS 38.101-2 [39], table 6.2.3.1-2).

Conditional Presence	Explanation
OptULNotSIB2	The field is absent for SIB2 and is mandatory present in SIB4 and frequencyInfoDL-SIB. Otherwise, if the field is absent in frequencyInfoUL-
	SIB in UplinkConfigCommonSIB, the UE will use the frequency band indicated in frequencyInfoDL-SIB in DownlinkConfigCommonSIB.

NextHopChainingCount

The IE NextHopChainingCount is used to update the K_{gNB} key and corresponds to parameter NCC: See TS 33.501 [11].

NextHopChainingCount information element

```
-- ASN1START
-- TAG-NEXTHOPCHAININGCOUNT-START

NextHopChainingCount ::= INTEGER (0..7)

-- TAG-NEXTHOPCHAININGCOUNT-STOP
-- ASN1STOP
```

– NG-5G-S-TMSI

The IE *NG-5G-S-TMSI* contains a 5G S-Temporary Mobile Subscription Identifier (5G-S-TMSI), a temporary UE identity provided by the 5GC which uniquely identifies the UE within the tracking area, see TS 23.003 [21].

NG-5G-S-TMSI information element

```
-- ASN1START
-- TAG-NG-5G-S-TMSI-START

NG-5G-S-TMSI ::= BIT STRING (SIZE (48))

-- TAG-NG-5G-S-TMSI-STOP
-- ASN1STOP
```

NR-NS-PmaxList

The IE NR-NS-PmaxList is used to configure a list of additionalPmax and additionalSpectrumEmission, as defined in TS 38.101-1 [15], table 6.2.3.1-1A, and TS 38.101-2 [39], table 6.2.3.1-2, for a given frequency band.

NR-NS-PmaxList information element

```
-- ASN1START
-- TAG-NR-NS-PMAXLIST-START

NR-NS-PmaxList ::= SEQUENCE (SIZE (1..maxNR-NS-Pmax)) OF NR-NS-PmaxValue

NR-NS-PmaxValue ::= SEQUENCE {
   additionalPmax P-Max OPTIONAL, -- Need N AdditionalSpectrumEmission
}

-- TAG-NR-NS-PMAXLIST-STOP
-- ASN1STOP
```

NZP-CSI-RS-Resource

The IE NZP-CSI-RS-Resource is used to configure Non-Zero-Power (NZP) CSI-RS transmitted in the cell where the IE is included, which the UE may be configured to measure on (see TS 38.214 [19], clause 5.2.2.3.1). A change of configuration between periodic, semi-persistent or aperiodic for an NZP-CSI-RS-Resource is not supported without a release and add.

NZP-CSI-RS-Resource information element

```
-- ASN1START
-- TAG-NZP-CSI-RS-RESOURCE-START
NZP-CSI-RS-Resource ::=
                                   SEQUENCE {
    nzp-CSI-RS-ResourceId
                                       NZP-CSI-RS-ResourceId,
    resourceMapping
                                       CSI-RS-ResourceMapping,
                                       INTEGER (-8..15),
   powerControlOffset
                                       ENUMERATED{db-3, db0, db3, db6}
    powerControlOffsetSS
                                                                                       OPTIONAL, -- Need R
    scramblingID
                                       ScramblingId,
    periodicityAndOffset
                                       CSI-ResourcePeriodicityAndOffset
                                                                                       OPTIONAL, -- Cond PeriodicOrSemiPersistent
                                                                                       OPTIONAL, -- Cond Periodic
    qcl-InfoPeriodicCSI-RS
                                       TCI-StateId
-- TAG-NZP-CSI-RS-RESOURCE-STOP
-- ASN1STOP
```

NZP-CSI-RS-Resource field descriptions

periodicityAndOffset

Periodicity and slot offset *sl1* corresponds to a periodicity of 1 slot, *sl2* to a periodicity of two slots, and so on. The corresponding offset is also given in number of slots (see TS 38.214 [19], clause 5.2.2.3.1). Network always configures the UE with a value for this field for periodic and semi-persistent NZP-CSI-RS-Resource (as indicated in *CSI-ResourceConfig*).

powerControlOffset

Power offset of PDSCH RE to NZP CSI-RS RE. Value in dB (see TS 38.214 [19], clauses 5.2.2.3.1 and 4.1).

powerControlOffsetSS

Power offset of NZP CSI-RS RE to SSS RE. Value in dB (see TS 38.214 [19], clause 5.2.2.3.1).

qcl-InfoPeriodicCSI-RS

For a target periodic CSI-RS, contains a reference to one *TCI-State* in TCI-States for providing the QCL source and QCL type. For periodic CSI-RS, the source can be SSB or another periodic-CSI-RS. Refers to the *TCI-State* which has this value for *tci-StateId* and is defined in *tci-StatesToAddModList* in the *PDSCH-Config* included in the *BWP-Downlink* corresponding to the serving cell and to the DL BWP to which the resource belongs to (see TS 38.214 [19], clause 5.2.2.3.1).

resourceMapping

OFDM symbol location(s) in a slot and subcarrier occupancy in a PRB of the CSI-RS resource.

scramblingID

Scrambling ID (see TS 38.214 [19], clause 5.2.2.3.1).

Conditional Presence	Explanation
Periodic	The field is optionally present, Need M, for periodic NZP-CSI-RS-Resources (as indicated in CSI-ResourceConfig). The field
	is absent otherwise.
PeriodicOrSemiPersistent	The field is optionally present, Need M, for periodic and semi-persistent NZP-CSI-RS-Resources (as indicated in CSI-
	ResourceConfig). The field is absent otherwise.

NZP-CSI-RS-ResourceId

The IE NZP-CSI-RS-ResourceId is used to identify one NZP-CSI-RS-Resource.

NZP-CSI-RS-Resourceld information element

```
-- ASN1START
-- TAG-NZP-CSI-RS-RESOURCEID-START

NZP-CSI-RS-ResourceId ::= INTEGER (0..maxNrofNZP-CSI-RS-Resources-1)

-- TAG-NZP-CSI-RS-RESOURCEID-STOP
-- ASN1STOP
```

NZP-CSI-RS-ResourceSet

The IE NZP-CSI-RS-ResourceSet is a set of Non-Zero-Power (NZP) CSI-RS resources (their IDs) and set-specific parameters.

NZP-CSI-RS-ResourceSet information element

```
-- ASN1START
-- TAG-NZP-CSI-RS-RESOURCESET-START
NZP-CSI-RS-ResourceSet ::= SEQUENCE {
    nzp-CSI-ResourceSetId
                                      NZP-CSI-RS-ResourceSetId,
   nzp-CSI-RS-Resources
                                      SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourcesPerSet)) OF NZP-CSI-RS-ResourceId,
                                      ENUMERATED { on, off }
   repetition
                                                                                                                    OPTIONAL, -- Need S
    aperiodicTriggeringOffset
                                      INTEGER(0..6)
                                                                                                                    OPTIONAL, -- Need S
    trs-Info
                                      ENUMERATED {true}
                                                                                                                    OPTIONAL, -- Need R
-- TAG-NZP-CSI-RS-RESOURCESET-STOP
-- ASN1STOP
```

NZP-CSI-RS-ResourceSet field descriptions

aperiodicTriggeringOffset

Offset X between the slot containing the DCI that triggers a set of aperiodic NZP CSI-RS resources and the slot in which the CSI-RS resource set is transmitted. The value 0 corresponds to 0 slots, value 1 corresponds to 1 slot, value 2 corresponds to 2 slots, value 3 corresponds to 3 slots, value 4 corresponds to 4 slots, value 5 corresponds to 16 slots, value 6 corresponds to 24 slots. When the field is absent the UE applies the value 0.

nzp-CSI-RS-Resources

NZP-CSI-RS-Resources associated with this NZP-CSI-RS resource set (see TS 38.214 [19], clause 5.2). For CSI, there are at most 8 NZP CSI RS resources per resource set.

repetition

Indicates whether repetition is on/off. If the field is set to *off* or if the field is absent, the UE may not assume that the NZP-CSI-RS resources within the resource set are transmitted with the same downlink spatial domain transmission filter (see TS 38.214 [19], clauses 5.2.2.3.1 and 5.1.6.1.2). It can only be configured for CSI-RS resource sets which are associated with *CSI-ReportConfig* with report of L1 RSRP or "no report".

trs-Info

Indicates that the antenna port for all NZP-CSI-RS resources in the CSI-RS resource set is same. If the field is absent or released the UE applies the value *false* (see TS 38.214 [19], clause 5.2.2.3.1).

NZP-CSI-RS-ResourceSetId

The IE NZP-CSI-RS-ResourceSetId is used to identify one NZP-CSI-RS-ResourceSet.

NZP-CSI-RS-ResourceSetId information element

```
-- ASN1START
-- TAG-NZP-CSI-RS-RESOURCESETID-START

NZP-CSI-RS-ResourceSetId ::= INTEGER (0..maxNrofNZP-CSI-RS-ResourceSets-1)

-- TAG-NZP-CSI-RS-RESOURCESETID-STOP
-- ASN1STOP
```

– P-Max

The IE *P-Max* is used to limit the UE's uplink transmission power on a carrier frequency, in TS 38.101-1 [15] and is used to calculate the parameter *Pcompensation* defined in TS 38.304 [20].

P-Max information element

```
-- ASN1START
-- TAG-P-MAX-START

P-Max ::= INTEGER (-30..33)

-- TAG-P-MAX-STOP
-- ASN1STOP
```

– PCI-List

The IE *PCI-List* concerns a list of physical cell identities, which may be used for different purposes.

PCI-List information element

```
-- ASN1START
-- TAG-PCI-LIST-START

PCI-List ::= SEQUENCE (SIZE (1..maxNrofCellMeas)) OF PhysCellId
-- TAG-PCI-LIST-STOP
-- ASN1STOP
```

PCI-Range

The IE *PCI-Range* is used to encode either a single or a range of physical cell identities. The range is encoded by using a *start* value and by indicating the number of consecutive physical cell identities (including *start*) in the range. For fields comprising multiple occurrences of *PCI-Range*, the Network may configure overlapping ranges of physical cell identities.

PCI-Range information element

```
-- TAG-PCI-RANGE-STOP
-- ASN1STOP
```

PCI-Range field descriptions

range

Indicates the number of physical cell identities in the range (including *start*). Value *n4* corresponds with 4, value *n8* corresponds with 8 and so on. The UE shall apply value 1 in case the field is absent, in which case only the physical cell identity value indicated by *start* applies.

start

Indicates the lowest physical cell identity in the range.

PCI-RangeElement

The IE PCI-RangeElement is used to define a PCI-Range as part of a list (e.g. AddMod list).

PCI-RangeElement information element

```
-- ASN1START
-- TAG-PCI-RANGEELEMENT-START

PCI-RangeElement ::= SEQUENCE {
    pci-RangeIndex PCI-RangeIndex,
    pci-Range PCI-Range
}

-- TAG-PCI-RANGEELEMENT-STOP
-- ASN1STOP
```

PCI-RangeElement field descriptions

pci-Range

Physical cell identity or a range of physical cell identities.

PCI-RangeIndex

The IE PCI-RangeIndex identifies a physical cell id range, which may be used for different purposes.

PCI-RangeIndex information element

```
-- ASN1START
-- TAG-PCI-RANGEINDEX-START

PCI-RangeIndex ::= INTEGER (1..maxNrofPCI-Ranges)
```

```
-- TAG-PCI-RANGEINDEX-STOP
-- ASN1STOP
```

PCI-RangeIndexList

The IE PCI-RangeIndexList concerns a list of indexes of physical cell id ranges, which may be used for different purposes.

PCI-RangeIndexList information element

```
-- ASN1START
-- TAG-PCI-RANGEINDEXLIST-START

PCI-RangeIndexList ::= SEQUENCE (SIZE (1..maxNrofPCI-Ranges)) OF PCI-RangeIndex
-- TAG-PCI-RANGEINDEXLIST-STOP
-- ASN1STOP
```

PDCCH-Config

The IE *PDCCH-Config* is used to configure UE specific PDCCH parameters such as control resource sets (CORESET), search spaces and additional parameters for acquiring the PDCCH. If this IE is used for the scheduled cell in case of cross carrier scheduling, the fields other than *searchSpacesToAddModList* and *searchSpacesToReleaseList* are absent.

PDCCH-Config information element

```
-- ASN1START
-- TAG-PDCCH-CONFIG-START
PDCCH-Config ::=
                                   SEQUENCE {
   controlResourceSetToAddModList
                                       SEQUENCE(SIZE (1..3)) OF ControlResourceSet
                                                                                                  OPTIONAL, -- Need N
   controlResourceSetToReleaseList
                                       SEQUENCE(SIZE (1..3)) OF ControlResourceSetId
                                                                                                  OPTIONAL, -- Need N
                                                                                                  OPTIONAL, -- Need N
    searchSpacesToAddModList
                                       SEQUENCE(SIZE (1..10)) OF SearchSpace
   searchSpacesToReleaseList
                                       SEQUENCE(SIZE (1..10)) OF SearchSpaceId
                                                                                                  OPTIONAL, -- Need N
                                                                                                  OPTIONAL, -- Need M
   downlinkPreemption
                                       SetupRelease { DownlinkPreemption }
    tpc-PUSCH
                                       SetupRelease { PUSCH-TPC-CommandConfig }
                                                                                                  OPTIONAL, -- Need M
                                                                                                  OPTIONAL, -- Need M
    tpc-PUCCH
                                       SetupRelease { PUCCH-TPC-CommandConfig }
                                                                                                  OPTIONAL, -- Need M
    tpc-SRS
                                       SetupRelease { SRS-TPC-CommandConfig}
-- TAG-PDCCH-CONFIG-STOP
-- ASN1STOP
```

PDCCH-Config field descriptions

controlResourceSetToAddModList

List of UE specifically configured Control Resource Sets (CORESETs) to be used by the UE. The network configures at most as many CORESETs per DL BWP as specified in TS 38.213 [13], clause 10.1. In case network reconfigures control resource set with the same *ControlResourceSetId* as used for *commonControlResourceSet* configured via *PDCCH-ConfigCommon*, the configuration from *PDCCH-Config* always takes precedence and should not be updated by the UE based on *servingCellConfigCommon*.

controlResourceSetToReleaseList

List of UE specifically configured Control Resource Sets (CORESETs) to be released by the UE. This field only applies to CORESETs configured by controlResourceSetToAddModList and does not release the field commonControlResourceSet configured by PDCCH-ConfigCommon.

downlinkPreemption

Configuration of downlink preemption indications to be monitored in this cell (see TS 38.213 [13], clause 11.2).

searchSpacesToAddModList

List of UE specifically configured Search Spaces. The network configures at most 10 Search Spaces per BWP per cell (including UE-specific and common Search Spaces).

tpc-PUCCH

Enable and configure reception of group TPC commands for PUCCH.

tpc-PUSCH

Enable and configure reception of group TPC commands for PUSCH.

tpc-SRS

Enable and configure reception of group TPC commands for SRS.

– PDCCH-ConfigCommon

The IE PDCCH-Config Common is used to configure cell specific PDCCH parameters provided in SIB as well as in dedicated signalling.

PDCCH-ConfigCommon information element

```
-- ASN1START
-- TAG-PDCCH-CONFIGCOMMON-START
PDCCH-ConfigCommon ::=
                                    SEOUENCE {
    controlResourceSetZero
                                        ControlResourceSetZero
                                                                                                OPTIONAL,
                                                                                                            -- Cond InitialBWP-Only
                                        ControlResourceSet
    commonControlResourceSet
                                                                                                OPTIONAL,
                                                                                                            -- Need R
    searchSpaceZero
                                        SearchSpaceZero
                                                                                                OPTIONAL,
                                                                                                            -- Cond InitialBWP-Only
    commonSearchSpaceList
                                        SEQUENCE (SIZE(1..4)) OF SearchSpace
                                                                                                            -- Need R
                                                                                                OPTIONAL,
    searchSpaceSIB1
                                        SearchSpaceId
                                                                                                OPTIONAL,
                                                                                                           -- Need S
    searchSpaceOtherSystemInformation
                                       SearchSpaceId
                                                                                                OPTIONAL,
                                                                                                           -- Need S
    pagingSearchSpace
                                        SearchSpaceId
                                                                                                OPTIONAL,
                                                                                                           -- Need S
    ra-SearchSpace
                                        SearchSpaceId
                                                                                                OPTIONAL.
                                                                                                            -- Need S
    11
    firstPDCCH-MonitoringOccasionOfPO
                                       CHOICE {
        sCS15KHZoneT
                                                                                 SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..139),
        sCS30KHZoneT-SCS15KHZhalfT
                                                                                 SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..279),
        sCS60KHZoneT-SCS30KHZhalfT-SCS15KHZquarterT
                                                                                 SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..559),
        sCS120KHZoneT-SCS60KHZhalfT-SCS30KHZquarterT-SCS15KHZoneEighthT
                                                                                 SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..1119),
        scS120KHzhalfT-ScS60KHzquarterT-ScS30KHzoneEighthT-ScS15KHzoneSixteenthT SEOUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..2239),
        sCS120KHZquarterT-SCS60KHZoneEighthT-SCS30KHZoneSixteenthT
                                                                                 SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..4479),
        sCS120KHZoneEighthT-SCS60KHZoneSixteenthT
                                                                                 SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..8959),
        sCS120KHZoneSixteenthT
                                                                                 SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..17919)
```

OPTIONAL -- Cond

```
}
OtherBWP
]]
}
-- TAG-PDCCH-CONFIGCOMMON-STOP
-- ASN1STOP
```

PDCCH-ConfigCommon field descriptions

commonControlResourceSet

An additional common control resource set which may be configured and used for any common or UE-specific search space. If the network configures this field, it uses a *ControlResourceSetId* other than 0 for this *ControlResourceSet*. The network configures the *commonControlResourceSet* in *SIB1* so that it is contained in the bandwidth of CORESET#0.

commonSearchSpaceList

A list of additional common search spaces. If the network configures this field, it uses the SearchSpaceIds other than 0. If the field is included, it replaces any previous list, i.e. all the entries of the list are replaced and each of the SearchSpace entries is considered to be newly created and the conditions and Need codes for setup of the entry apply.

controlResourceSetZero

Parameters of the common CORESET#0 which can be used in any common or UE-specific search spaces. The values are interpreted like the corresponding bits in MIB pdcch-ConfigSIB1. Even though this field is only configured in the initial BWP (BWP#0) controlResourceSetZero can be used in search spaces configured in other DL BWP(s) than the initial DL BWP if the conditions defined in TS 38.213 [13], clause 10 are satisfied.

firstPDCCH-MonitoringOccasionOfPO

Indicates the first PDCCH monitoring occasion of each PO of the PF on this BWP, see TS 38.304 [20].

pagingSearchSpace

ID of the Search space for paging (see TS 38.213 [13], clause 10.1). If the field is absent, the UE does not receive paging in this BWP (see TS 38.213 [13], clause 10.1).

ra-SearchSpace

ID of the Search space for random access procedure (see TS 38.213 [13], clause 10.1). If the field is absent, the UE does not receive RAR in this BWP. This field is mandatory present in the DL BWP(s) if the conditions described in TS 38.321 [3], clause 5.15 are met.

searchSpaceOtherSystemInformation

ID of the Search space for other system information, i.e., SIB2 and beyond (see TS 38.213 [13], clause 10.1) If the field is absent, the UE does not receive other system information in this BWP.

searchSpaceSIB1

ID of the search space for *SIB1* message. In the initial DL BWP of the UE's PCell, the network sets this field to 0. If the field is absent, the UE does not receive *SIB1* in this BWP. (see TS 38.213 [13], clause 10)

searchSpaceZero

Parameters of the common SearchSpace#0. The values are interpreted like the corresponding bits in *MIB pdcch-ConfigSIB1*. Even though this field is only configured in the initial BWP (BWP#0), searchSpaceZero can be used in search spaces configured in other DL BWP(s) than the initial DL BWP if the conditions described in TS 38.213 [13], clause 10, are satisfied.

Conditional Presence	Explanation
InitialBWP-Only	If SIB1 is broadcast the field is mandatory present in the PDCCH-ConfigCommon of the initial BWP (BWP#0) in
	ServingCellConfigCommon; it is absent in other BWPs and when sent in system information. If SIB1 is not broadcast and there is
	an SSB associated to the cell, the field is optionally present, Need M, in the PDCCH-ConfigCommon of the initial BWP (BWP#0)
	in ServingCellConfigCommon (still with the same setting for all UEs). In other cases, the field is absent.
OtherBWP	This field is optionally present, Need R, if this BWP is not the initial DL BWP and pagingSearchSpace is configured in this BWP.
	Otherwise this field is absent.

– PDCCH-ConfigSIB1

The IE *PDCCH-ConfigSIB1* is used to configure CORESET#0 and search space#0.

PDCCH-ConfigSIB1 information element

```
-- ASN1START
-- TAG-PDCCH-CONFIGSIB1-START

PDCCH-ConfigSIB1 ::= SEQUENCE {
    controlResourceSetZero ControlResourceSetZero, searchSpaceZero SearchSpaceZero}
}

-- TAG-PDCCH-CONFIGSIB1-STOP
-- ASN1STOP
```

PDCCH-ConfigSIB1 field descriptions

controlResourceSetZero

Determines a common ControlResourceSet (CORESET) with ID #0, see TS 38.213 [13], clause 13.

searchSpaceZero

Determines a common search space with ID #0, see TS 38.213 [13], clause 13.

PDCCH-ServingCellConfig

The IE PDCCH-Serving CellConfig is used to configure UE specific PDCCH parameters applicable across all bandwidth parts of a serving cell.

PDCCH-ServingCellConfig information element

PDCCH-ServingCellConfig field descriptions

slotFormatIndicator

Configuration of Slot-Format-Indicators to be monitored in the correspondingly configured PDCCHs of this serving cell.

PDCP-Config

The IE *PDCP-Config* is used to set the configurable PDCP parameters for signalling and data radio bearers.

PDCP-Config information element

```
-- ASN1START
-- TAG-PDCP-CONFIG-START
PDCP-Config ::=
                        SEOUENCE {
    drb
                            SEQUENCE
        discardTimer
                                ENUMERATED {ms10, ms20, ms30, ms40, ms50, ms60, ms75, ms100, ms150, ms200,
                                            ms250, ms300, ms500, ms750, ms1500, infinity}
                                                                                                  OPTIONAL, -- Cond Setup
        pdcp-SN-SizeUL
                                ENUMERATED {len12bits, len18bits}
                                                                                                  OPTIONAL, -- Cond Setup2
                                ENUMERATED {len12bits, len18bits}
                                                                                                  OPTIONAL, -- Cond Setup2
        pdcp-SN-SizeDL
       headerCompression
                                CHOICE {
            notUsed
                                    NULL,
           rohc
                                    SEQUENCE {
                maxCID
                                        INTEGER (1..16383)
                                                                                                  DEFAULT 15,
                profiles
                                        SEQUENCE {
                    profile0x0001
                                            BOOLEAN,
                    profile0x0002
                                            BOOLEAN,
                    profile0x0003
                                            BOOLEAN,
                    profile0x0004
                                            BOOLEAN,
                    profile0x0006
                                            BOOLEAN,
                    profile0x0101
                                            BOOLEAN,
                    profile0x0102
                                            BOOLEAN,
                    profile0x0103
                                            BOOLEAN,
                    profile0x0104
                                            BOOLEAN
                drb-ContinueROHC
                                             ENUMERATED { true }
                                                                                                  OPTIONAL
                                                                                                              -- Need N
            uplinkOnlyROHC
                                     SEQUENCE {
                maxCID
                                        INTEGER (1..16383)
                                                                                                  DEFAULT 15,
                profiles
                                        SEQUENCE {
                    profile0x0006
                                            BOOLEAN
                drb-ContinueROHC
                                            ENUMERATED { true }
                                                                                                  OPTIONAL
                                                                                                              -- Need N
        integrityProtection
                                ENUMERATED
                                             enabled }
                                                                                                  OPTIONAL,
                                                                                                              -- Cond ConnectedTo5GC1
        statusReportRequired
                                ENUMERATED
                                                                                                  OPTIONAL,
                                                                                                              -- Cond Rlc-AM
                                              true
        outOfOrderDelivery
                                ENUMERATED { true
                                                                                                  OPTIONAL
                                                                                                              -- Need R
                                                                                                  OPTIONAL,
                                                                                                              -- Cond DRB
    moreThanOneRLC
                            SEQUENCE {
        primaryPath
                                SEQUENCE {
                                    CellGroupId
            cellGroup
                                                                                                  OPTIONAL,
                                                                                                              -- Need R
            logicalChannel
                                    LogicalChannelIdentity
                                                                                                  OPTIONAL
                                                                                                              -- Need R
       ul-DataSplitThreshold
                                UL-DataSplitThreshold
                                                                                                  OPTIONAL, -- Cond SplitBearer
        pdcp-Duplication
                                                                                                              -- Need R
                                    BOOLEAN
                                                                                                  OPTIONAL
                                                                                                  OPTIONAL, -- Cond MoreThanOneRLC
```

-- ASN1STOP

```
t-Reordering
                                ENUMERATED {
                                    ms0, ms1, ms2, ms4, ms5, ms8, ms10, ms15, ms20, ms30, ms40,
                                    ms50, ms60, ms80, ms100, ms120, ms140, ms160, ms180, ms200, ms220,
                                    ms240, ms260, ms280, ms300, ms500, ms750, ms1000, ms1250,
                                    ms1500, ms1750, ms2000, ms2250, ms2500, ms2750,
                                    ms3000, spare28, spare27, spare26, spare25, spare24,
                                    spare23, spare22, spare21, spare20,
                                    spare19, spare18, spare17, spare16, spare15, spare14,
                                    spare13, spare12, spare11, spare10, spare09,
                                    spare08, spare07, spare06, spare05, spare04, spare03,
                                    spare02, spare01 }
                                                                                                 OPTIONAL, -- Need S
    . . . ,
    ] ]
                            ENUMERATED {true}
    cipheringDisabled
                                                                                                 OPTIONAL
                                                                                                            -- Cond ConnectedTo5GC
    ]]
UL-DataSplitThreshold ::= ENUMERATED {
                                            b0, b100, b200, b400, b800, b1600, b3200, b6400, b12800, b25600, b51200, b102400, b204800,
                                            b409600, b819200, b1228800, b1638400, b2457600, b3276800, b4096000, b4915200, b5734400,
                                            b6553600, infinity, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1}
-- TAG-PDCP-CONFIG-STOP
```

PDCP-Config field descriptions

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cipheringDisabled

If included, ciphering is disabled for this DRB regardless of which ciphering algorithm is configured for the SRB/DRBs. The field may only be included if the UE is connected to 5GC. Otherwise the field is absent. The network configures all DRBs with the same PDU-session ID with same value for this field. The value for this field cannot be changed after the DRB is set up.

discardTimer

Value in ms of discardTimer specified in TS 38.323 [5]. Value ms10 corresponds to 10 ms, value ms20 corresponds to 20 ms and so on.

drb-ContinueROHC

Indicates whether the PDCP entity continues or resets the ROHC header compression protocol during PDCP re-establishment, as specified in TS 38.323 [5]. This field is configured only in case of resuming an RRC connection or reconfiguration with sync, where the PDCP termination point is not changed and the *fullConfig* is not indicated.

headerCompression

If rohc is configured, the UE shall apply the configured ROHC profile(s) in both uplink and downlink. If *uplinkOnlyROHC* is configured, the UE shall apply the configured ROHC profile(s) in uplink (there is no header compression in downlink). ROHC can be configured for any bearer type. The network reconfigures *headerCompression* only upon reconfiguration involving PDCP re-establishment, and without any drb-ContinueROHC. Network configures *headerCompression* to *notUsed* when *outOfOrderDelivery* is configured.

integrityProtection

Indicates whether or not integrity protection is configured for this radio bearer. The network configures all DRBs with the same PDU-session ID with same value for this field. The value for this field cannot be changed after the DRB is set up.

maxCID

Indicates the value of the MAX_CID parameter as specified in TS 38.323 [5].

The total value of MAX_CIDs across all bearers for the UE should be less than or equal to the value of maxNumberROHC-ContextSessions parameter as indicated by the UE.

moreThanOneRLC

This field configures UL data transmission when more than one RLC entity is associated with the PDCP entity.

outOfOrderDelivery

Indicates whether or not *outOfOrderDelivery* specified in TS 38.323 [5] is configured. This field should be either always present or always absent, after the radio bearer is established.

pdcp-Duplication

Indicates whether or not uplink duplication status at the time of receiving this IE is configured and activated as specified in TS 38.323 [5]. The presence of this field indicates that duplication is configured. PDCP duplication is not configured for CA packet duplication of LTE RLC bearer. The value of this field, when the field is present, indicates the state of the duplication at the time of receiving this IE. If set to *true*, duplication is activated. The value of this field is always *true*, when configured for a SRB.

pdcp-SN-SizeDL

PDCP sequence number size for downlink, 12 or 18 bits, as specified in TS 38.323 [5]. For SRBs only the value *len12bits* is applicable.

pdcp-SN-SizeUL

PDCP sequence number size for uplink, 12 or 18 bits, as specified in TS 38.323 [5]. For SRBs only the value *len12bits* is applicable.

primaryPath

Indicates the cell group ID and LCID of the primary RLC entity as specified in TS 38.323 [5], clause 5.2.1 for UL data transmission when more than one RLC entity is associated with the PDCP entity. In this version of the specification, only cell group ID corresponding to MCG is supported for SRBs. The NW indicates *cellGroup* for split bearers using logical channels in different cell groups. The NW indicates *logicalChannel* for CA based PDCP duplication, i.e., if both logical channels terminate in the same cell group.

statusReportRequired

For AM DRBs, indicates whether the DRB is configured to send a PDCP status report in the uplink, as specified in TS 38.323 [5].

t-Reordering

Value in ms of t-Reordering specified in TS 38.323 [5]. Value *ms0* corresponds to 0 ms, value *ms20* corresponds to 20 ms, value *ms40* corresponds to 40 ms, and so on. When the field is absent the UE applies the value *infinity*.

PDCP-Config field descriptions

ul-DataSplitThreshold

Parameter specified in TS 38.323 [5]. Value *b0* corresponds to 0 bytes, value *b100* corresponds to 100 bytes, value *b200* corresponds to 200 bytes, and so on. The network sets this field to *infinity* for UEs not supporting *splitDRB-withUL-Both-MCG-SCG*. If the field is absent when the split bearer is configured for the radio bearer first time, then the default value *infinity* is applied.

Conditional presence	Explanation
DRB	This field is mandatory present when the corresponding DRB is being set up, absent for SRBs. Otherwise this field is optionally present, need M.
MoreThanOneRLC	This field is mandatory present upon RRC reconfiguration with setup of a PDCP entity for a radio bearer with more than one associated logical channel and upon RRC reconfiguration with the association of an additional logical channel to the PDCP entity. Upon RRC reconfiguration when a PDCP entity is associated with multiple logical channels, this field is optionally present need M. Otherwise, this field is absent. Need R.
RIc-AM	For RLC AM, the field is optionally present, need R. Otherwise, the field is absent.
Setup	The field is mandatory present in case of radio bearer setup. Otherwise the field is optionally present, need M.
SplitBearer	The field is absent for SRBs. Otherwise, the field is optional present, need M, in case of radio bearer with more than one associated RLC mapped to different cell groups.
ConnectedTo5GC	The field is optionally present, need R, if the UE is connected to 5GC. Otherwise the field is absent.
ConnectedTo5GC1	The field is optionally present, need R, if the UE is connected to NR/5GC. Otherwise the field is absent.
Setup2	This field is mandatory present in case for radio bearer setup for RLC-AM and RLC-UM. Otherwise, this field is absent, Need M.

PDSCH-Config

The PDSCH-Config IE is used to configure the UE specific PDSCH parameters.

PDSCH-Config information element

```
-- ASN1START
-- TAG-PDSCH-CONFIG-START
PDSCH-Config ::=
                                       SEQUENCE {
    dataScramblingIdentityPDSCH
                                           INTEGER (0..1023)
                                                                                                               OPTIONAL,
                                                                                                                          -- Need S
                                                                                                                           -- Need M
    dmrs-DownlinkForPDSCH-MappingTypeA
                                           SetupRelease { DMRS-DownlinkConfig
                                                                                                               OPTIONAL,
                                                                                                                           -- Need M
    dmrs-DownlinkForPDSCH-MappingTypeB
                                           SetupRelease { DMRS-DownlinkConfig
                                                                                                               OPTIONAL,
    tci-StatesToAddModList
                                           SEQUENCE (SIZE(1..maxNrofTCI-States)) OF TCI-State
                                                                                                               OPTIONAL,
                                                                                                                           -- Need N
    tci-StatesToReleaseList
                                           SEQUENCE (SIZE(1..maxNrofTCI-States)) OF TCI-StateId
                                                                                                               OPTIONAL,
                                                                                                                           -- Need N
                                                                                                                           -- Need S
    vrb-ToPRB-Interleaver
                                           ENUMERATED {n2, n4}
                                                                                                               OPTIONAL,
    resourceAllocation
                                           ENUMERATED { resourceAllocationType0, resourceAllocationType1, dynamicSwitch},
                                           SetupRelease { PDSCH-TimeDomainResourceAllocationList }
    pdsch-TimeDomainAllocationList
                                                                                                               OPTIONAL,
                                                                                                                           -- Need M
                                           ENUMERATED { n2, n4, n8 }
    pdsch-AggregationFactor
                                                                                                               OPTIONAL,
                                                                                                                           -- Need S
    rateMatchPatternToAddModList
                                           SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPattern
                                                                                                               OPTIONAL,
                                                                                                                           -- Need N
    rateMatchPatternToReleaseList
                                           SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPatternId OPTIONAL,
                                                                                                                          -- Need N
    rateMatchPatternGroup1
                                           RateMatchPatternGroup
                                                                                                               OPTIONAL,
                                                                                                                          -- Need R
    rateMatchPatternGroup2
                                           RateMatchPatternGroup
                                                                                                               OPTIONAL,
                                                                                                                          -- Need R
```

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```
ENUMERATED {config1, config2},
    rbq-Size
    mcs-Table
                                           ENUMERATED {gam256, gam64LowSE}
                                                                                                               OPTIONAL, -- Need S
    maxNrofCodeWordsScheduledByDCI
                                           ENUMERATED {n1, n2}
                                                                                                               OPTIONAL. -- Need R
    prb-BundlingType
                                           CHOICE {
        staticBundling
                                               SEOUENCE {
           bundleSize
                                                    ENUMERATED { n4, wideband }
                                                                                                               OPTIONAL
                                                                                                                           -- Need S
                                           SEQUENCE {
       dynamicBundling
           bundleSizeSet1
                                               ENUMERATED { n4, wideband, n2-wideband, n4-wideband }
                                                                                                               OPTIONAL,
                                                                                                                           -- Need S
           bundleSizeSet2
                                               ENUMERATED { n4, wideband }
                                                                                                               OPTIONAL
                                                                                                                           -- Need S
    zp-CSI-RS-ResourceToAddModList
                                                    SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-Resources)) OF ZP-CSI-RS-Resource
    zp-CSI-RS-ResourceToReleaseList
                                                   SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-Resources)) OF ZP-CSI-RS-ResourceId
                                                                                                               OPTIONAL,
                                                   SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-ResourceSets)) OF ZP-CSI-RS-ResourceSet
    aperiodic-ZP-CSI-RS-ResourceSetsToAddModList
                                                                                                                OPTIONAL,
    aperiodic-ZP-CSI-RS-ResourceSetsToReleaseList SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-ResourceSets)) OF ZP-CSI-RS-ResourceSetId
                                                                                                               OPTIONAL,
                                                                                                                           -- Need N
    sp-ZP-CSI-RS-ResourceSetsToAddModList SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-ResourceSets)) OF ZP-CSI-RS-ResourceSet
                                                                                                               OPTIONAL,
                                                                                                                           -- Need N
    sp-ZP-CSI-RS-ResourceSetsToReleaseList SEOUENCE (SIZE (1..maxNrofZP-CSI-RS-ResourceSets)) OF ZP-CSI-RS-ResourceSetId
                                                                                                               OPTIONAL,
                                                                                                                           -- Need N
                                           SetupRelease { ZP-CSI-RS-ResourceSet }
    p-ZP-CSI-RS-ResourceSet
                                                                                                               OPTIONAL, -- Need M
                                       SEQUENCE (SIZE (1...maxNrofRateMatchPatternsPerGroup)) OF CHOICE {
RateMatchPatternGroup ::=
    cellLevel
                                           RateMatchPatternId,
    bwpLevel
                                           RateMatchPatternId
-- TAG-PDSCH-CONFIG-STOP
-- ASN1STOP
```

PDSCH-Config field descriptions

aperiodic-ZP-CSI-RS-ResourceSetsToAddModList

AddMod/Release lists for configuring aperiodically triggered zero-power CSI-RS resource sets. Each set contains a ZP-CSI-RS-ResourceSetId and the IDs of one or more ZP-CSI-RS-Resources (the actual resources are defined in the zp-CSI-RS-ResourceToAddModList). The network configures the UE with at most 3 aperiodic ZP-CSI-RS-ResourceSets and it uses only the ZP-CSI-RS-ResourceSetId 1 to 3. The network triggers a set by indicating its ZP-CSI-RS-ResourceSetId in the DCI payload. The DCI codepoint '01' triggers the resource set with ZP-CSI-RS-ResourceSetId 2, and the DCI codepoint '11' triggers the resource set with ZP-CSI-RS-ResourceSetId 3 (see TS 38.214 [19], clause 5.1.4.2)

dataScramblingIdentityPDSCH

Identifier used to initialize data scrambling (c_init) for PDSCH. If the field is absent, the UE applies the physical cell ID. (see TS 38.211 [16], clause 7.3.1.1).

dmrs-DownlinkForPDSCH-MappingTypeA

DMRS configuration for PDSCH transmissions using PDSCH mapping type A (chosen dynamically via PDSCH-TimeDomainResourceAllocation). Only the fields dmrs-Type, dmrs-AdditionalPosition and maxLength may be set differently for mapping type A and B.

dmrs-DownlinkForPDSCH-MappingTypeB

DMRS configuration for PDSCH transmissions using PDSCH mapping type B (chosen dynamically via PDSCH-TimeDomainResourceAllocation). Only the fields dmrs-Type, dmrs-AdditionalPosition and maxLength may be set differently for mapping type A and B.

maxNrofCodeWordsScheduledByDCI

Maximum number of code words that a single DCI may schedule. This changes the number of MCS/RV/NDI bits in the DCI message from 1 to 2.

mcs-Table

Indicates which MCS table the UE shall use for PDSCH. (see TS 38.214 [19], clause 5.1.3.1). If the field is absent the UE applies the value 64QAM.

pdsch-AggregationFactor

Number of repetitions for data (see TS 38.214 [19], clause 5.1.2.1). When the field is absent the UE applies the value 1.

pdsch-TimeDomainAllocationList

List of time-domain configurations for timing of DL assignment to DL data (see table 5.1.2.1.1-1 in TS 38.214 [19]).

prb-BundlingType

Indicates the PRB bundle type and bundle size(s) (see TS 38.214 [19], clause 5.1.2.3). If *dynamic* is chosen, the actual *bundleSizeSet1* or *bundleSizeSet2* to use is indicated via DCI. Constraints on *bundleSize(Set)* setting depending on *vrb-ToPRB-Interleaver* and *rbg-Size* settings are described in TS 38.214 [19], clause 5.1.2.3. If a *bundleSize(Set)* value is absent, the UE applies the value *n2*.

p-ZP-CSI-RS-ResourceSet

A set of periodically occurring ZP-CSI-RS-Resources (the actual resources are defined in the zp-CSI-RS-ResourceToAddModList). The network uses the ZP-CSI-RS-ResourceSetId=0 for this set.

rateMatchPatternGroup1

The IDs of a first group of RateMatchPatterns defined in PDSCH-Config->rateMatchPatternToAddModList (BWP level) or in ServingCellConfig->rateMatchPatternToAddModList (cell level). These patterns can be activated dynamically by DCI (see TS 38.214 [19], clause 5.1.4.1).

rateMatchPatternGroup2

The IDs of a second group of *RateMatchPatterns* defined in *PDSCH-Config->rateMatchPatternToAddModList* (BWP level) or in *ServingCellConfig->rateMatchPatternToAddModList* (cell level). These patterns can be activated dynamically by DCI (see TS 38.214 [19], clause 5.1.4.1).

rateMatchPatternToAddModList

Resources patterns which the UE should rate match PDSCH around. The UE rate matches around the union of all resources indicated in the rate match patterns (see TS 38.214 [19], clause 5.1.4.1).

rbg-Size

Selection between config 1 and config 2 for RBG size for PDSCH. The UE ignores this field if resourceAllocation is set to resourceAllocationType1 (see TS 38.214 [19], clause 5.1.2.2.1).

resourceAllocation

Configuration of resource allocation type 0 and resource allocation type 1 for non-fallback DCI (see TS 38.214 [19], clause 5.1.2.2).

sp-ZP-CSI-RS-ResourceSetsToAddModList

AddMod/Release lists for configuring semi-persistent zero-power CSI-RS resource sets. Each set contains a *ZP-CSI-RS-ResourceSetId* and the IDs of one or more *ZP-CSI-RS-ResourceSetId* and th

tci-StatesToAddModList

A list of Transmission Configuration Indicator (TCI) states indicating a transmission configuration which includes QCL-relationships between the DL RSs in one RS set and the PDSCH DMRS ports (see TS 38.214 [19], clause 5.1.5).

vrb-ToPRB-Interleaver

Interleaving unit configurable between 2 and 4 PRBs (see TS 38.211 [16], clause 7.3.1.6). When the field is absent, the UE performs non-interleaved VRB-to-PRB mapping.

zp-CSI-RS-ResourceToAddModList

A list of Zero-Power (ZP) CSI-RS resources used for PDSCH rate-matching. Each resource in this list may be referred to from only one type of resource set, i.e., aperiodic, semi-persistent or periodic (see TS 38.214 [19]).

PDSCH-ConfigCommon

The IE *PDSCH-ConfigCommon* is used to configure cell specific PDSCH parameters.

PDSCH-ConfigCommon information element

PDSCH-ConfigCommon field descriptions

pdsch-TimeDomainAllocationList

List of time-domain configurations for timing of DL assignment to DL data (see table 5.1.2.1.1-1 in TS 38.214 [19]).

PDSCH-ServingCellConfig

The IE PDSCH-Serving CellConfig is used to configure UE specific PDSCH parameters that are common across the UE's BWPs of one serving cell.

PDSCH-ServingCellConfig information element

```
-- ASN1START
-- TAG-PDSCH-SERVINGCELLCONFIG-START
PDSCH-ServingCellConfig ::=
                                       SEQUENCE {
    codeBlockGroupTransmission
                                           SetupRelease { PDSCH-CodeBlockGroupTransmission }
                                                                                                   OPTIONAL, -- Need M
                                           ENUMERATED { x0h6, x0h12, x0h18 }
                                                                                                   OPTIONAL, -- Need S
    x0verhead
    nrofHARQ-ProcessesForPDSCH
                                           ENUMERATED {n2, n4, n6, n10, n12, n16}
                                                                                                   OPTIONAL, -- Need S
                                           ServCellIndex
                                                                                                   OPTIONAL, -- Cond SCellAddOnly
    pucch-Cell
```

PDSCH-CodeBlockGroupTransmission field descriptions

codeBlockGroupFlushIndicator

Indicates whether CBGFI for CBG based (re)transmission in DL is enabled (true). (see TS 38.212 [17], clause 7.3.1.2.2).

maxCodeBlockGroupsPerTransportBlock

Maximum number of code-block-groups (CBGs) per TB. In case of multiple CW, the maximum CBG is 4 (see TS 38.213 [13], clause 9.1.1).

PDSCH-ServingCellConfig field descriptions

codeBlockGroupTransmission

Enables and configures code-block-group (CBG) based transmission (see TS 38.213 [13], clause 9.1.1). Network does not configure for a UE both spatial bundling of HARQ ACKs and codeBlockGroupTransmission within the same cell group.

maxMIMO-Layers

Indicates the maximum number of MIMO layers to be used for PDSCH in all BWPs of this serving cell. (see TS 38.212 [17], clause 5.4.2.1).

nrofHARQ-ProcessesForPDSCH

The number of HARQ processes to be used on the PDSCH of a serving cell. Value *n2* corresponds to 2 HARQ processes, value *n4* to 4 HARQ processes, and so on. If the field is absent, the UE uses 8 HARQ processes (see TS 38.214 [19], clause 5.1).

processingType2Enabled

Enables configuration of advanced processing time capability 2 for PDSCH (see 38.214 [19], clause 5.3).

pucch-Cell

The ID of the serving cell (of the same cell group) to use for PUCCH. If the field is absent, the UE sends the HARQ feedback on the PUCCH of the SpCell of this cell group, or on this serving cell if it is a PUCCH SCell.

xOverhead

Accounts for overhead from CSI-RS, CORESET, etc. If the field is absent, the UE applies value xOh0 (see TS 38.214 [19], clause 5.1.3.2).

Conditional Presence	Explanation
SCellAddOnly	It is optionally present, Need S, for (non-PUCCH) SCells when adding a new SCell. The field is absent, Need M, when
	reconfiguring SCells. The field is also absent for the SpCells as well as for a PUCCH SCell.

PDSCH-TimeDomainResourceAllocationList

The IE *PDSCH-TimeDomainResourceAllocation* is used to configure a time domain relation between PDCCH and PDSCH. The *PDSCH-TimeDomainResourceAllocationList* contains one or more of such *PDSCH-TimeDomainResourceAllocations*. The network indicates in the DL assignment which of the configured time domain allocations the UE shall apply for that DL assignment. The UE determines the bit width of the DCI field based on the number of entries in the *PDSCH-TimeDomainResourceAllocationList*. Value 0 in the DCI field refers to the first element in this list, value 1 in the DCI field refers to the second element in this list, and so on.

PDSCH-TimeDomainResourceAllocationList information element

PDSCH-TimeDomainResourceAllocation field descriptions

k0

Slot offset between DCI and its scheduled PDSCH (see TS 38.214 [19], clause 5.1.2.1) When the field is absent the UE applies the value 0.

mappingType

PDSCH mapping type. (see TS 38.214 [19], clause 5.3).

startSymbolAndLength

An index giving valid combinations of start symbol and length (jointly encoded) as start and length indicator (SLIV). The network configures the field so that the allocation does not cross the slot boundary (see TS 38.214 [19], clause 5.1.2.1).

PHR-Config

The IE *PHR-Config* is used to configure parameters for power headroom reporting.

PHR-Config information element

```
-- ASN1START
-- TAG-PHR-CONFIG-START

PHR-Config ::= SEQUENCE {
    phr-PeriodicTimer ENUMERATED {sf10, sf20, sf50, sf100, sf200, sf500, sf1000, infinity},
    phr-Tx-PowerFactorChange ENUMERATED {dB1, dB3, dB6, infinity},
```

```
multiplePHR BOOLEAN,
dummy BOOLEAN,
phr-Type2OtherCell BOOLEAN,
phr-ModeOtherCG ENUMERATED {real, virtual},
...
}

-- TAG-PHR-CONFIG-STOP
-- ASN1STOP
```

PHR-Config field descriptions

dummy

This field is not used in this version of the specification and the UE ignores the received value.

multiplePHR

Indicates if power headroom shall be reported using the Single Entry PHR MAC control element or Multiple Entry PHR MAC control element defined in TS 38.321 [3]. True means to use Multiple Entry PHR MAC control element and False means to use the Single Entry PHR MAC control element defined in TS 38.321 [3]. The network configures this field to *true* for MR-DC and UL CA for NR, and to *false* in all other cases.

phr-ModeOtherCG

Indicates the mode (i.e. real or virtual) used for the PHR of the activated cells that are part of the other Cell Group (i.e. MCG or SCG), when DC is configured. If the UE is configured with only one cell group (no DC), it ignores the field.

phr-PeriodicTimer

Value in number of subframes for PHR reporting as specified in TS 38.321 [3]. Value sf10 corresponds to 10 subframes, value sf20 corresponds to 20 subframes, and so on.

phr-ProhibitTimer

Value in number of subframes for PHR reporting as specified in TS 38.321 [3]. Value sf0 corresponds to 0 subframe, value sf10 corresponds to 10 subframes, value sf20 corresponds to 20 subframes, and so on.

phr-Tx-PowerFactorChange

Value in dB for PHR reporting as specified in TS 38.321 [3]. Value *dB1* corresponds to 1 dB, *dB3* corresponds to 3 dB and so on. The same value applies for each serving cell (although the associated functionality is performed independently for each cell).

phr-Type2OtherCell

If set to true, the UE shall report a PHR type 2 for the SpCell of the other MAC entity. See TS 38.321 [3], clause 5.4.6. Network sets this field to *false* if the UE is not configured with an E-UTRA MAC entity.

– PhysCellId

The *PhysCellId* identifies the physical cell identity (PCI).

PhysCellId information element

```
-- ASN1START
-- TAG-PHYSCELLID-START

PhysCellId ::= INTEGER (0..1007)

-- TAG-PHYSCELLID-STOP
-- ASN1STOP
```

OPTIONAL, -- Need S

OPTIONAL, -- Need S
OPTIONAL, -- Need R

OPTIONAL, -- Need M

OPTIONAL, -- Need R

-- Cond MCG-Only

-- Cond SCG-Only

-- Need M

OPTIONAL

OPTIONAL

OPTIONAL

PhysicalCellGroupConfig

The IE *PhysicalCellGroupConfig* is used to configure cell-group specific L1 parameters.

PhysicalCellGroupConfig information element

```
-- ASN1START
-- TAG-PHYSICALCELLGROUPCONFIG-START
PhysicalCellGroupConfig ::=
                                     SEOUENCE {
    harg-ACK-SpatialBundlingPUCCH
                                         ENUMERATED {true}
    harq-ACK-SpatialBundlingPUSCH
                                         ENUMERATED {true}
    p-NR-FR1
                                         P-Max
    pdsch-HARQ-ACK-Codebook
                                         ENUMERATED {semiStatic, dynamic},
                                         RNTI-Value
    tpc-SRS-RNTI
                                        RNTI-Value
    tpc-PUCCH-RNTI
    tpc-PUSCH-RNTI
                                         RNTI-Value
    sp-CSI-RNTI
                                        RNTI-Value
                                         SetupRelease { RNTI-Value }
    cs-RNTI
    . . . ,
    [ [
    mcs-C-RNTI
                                         RNTI-Value
    p-UE-FR1
                                         P-Max
    ]],
    ] ]
    xScale
                                         ENUMERATED {dB0, dB6, spare2, spare1}
    11,
    ] ]
                                         SetupRelease { PDCCH-BlindDetection }
    pdcch-BlindDetection
    ]]
PDCCH-BlindDetection ::=
                                         INTEGER (1..15)
-- TAG-PHYSICALCELLGROUPCONFIG-STOP
-- ASN1STOP
```

PhysicalCellGroupConfig field descriptions

cs-RNTI

RNTI value for downlink SPS (see SPS-Config) and uplink configured grant (see ConfiguredGrantConfig).

harg-ACK-SpatialBundlingPUCCH

Enables spatial bundling of HARQ ACKs. It is configured per cell group (i.e. for all the cells within the cell group) for PUCCH reporting of HARQ-ACK. It is only applicable when more than 4 layers are possible to schedule. When the field is absent, the spatial bundling is disabled (see TS 38.213 [13], clause 9.1.2.1). Network does not configure for a UE both spatial bundling of HARQ ACKs and *codeBlockGroupTransmission* within the same cell group.

harq-ACK-SpatialBundlingPUSCH

Enables spatial bundling of HARQ ACKs. It is configured per cell group (i.e. for all the cells within the cell group) for PUSCH reporting of HARQ-ACK. It is only applicable when more than 4 layers are possible to schedule. When the field is absent, the spatial bundling is disabled (see TS 38.213 [13], clauses 9.1.2.2 and 9.1.3.2). Network does not configure for a UE both spatial bundling of HARQ ACKs and *codeBlockGroupTransmission* within the same cell group.

mcs-C-RNTI

RNTI to indicate use of *qam64LowSE* for grant-based transmissions. When the *mcs-C-RNT*I is configured, RNTI scrambling of DCI CRC is used to choose the corresponding MCS table.

pdcch-BlindDetection

Indicates the reference number of cells for PDCCH blind detection for the CG. Network configures the field for each CG when the UE is in NR DC and sets the value in accordance with the constraints specified in TS 38.213 [13]. The network configures *pdcch-BlindDetection* only if the UE is in NR-DC.

p-NR-FR1

The maximum total transmit power to be used by the UE in this NR cell group across all serving cells in frequency range 1 (FR1). The maximum transmit power that the UE may use may be additionally limited by *p-Max* (configured in *FrequencyInfoUL*) and by *p-UE-FR1* (configured total for all serving cells operating on FR1).

p-UE-FR1

The maximum total transmit power to be used by the UE across all serving cells in frequency range 1 (FR1) across all cell groups. The maximum transmit power that the UE may use may be additionally limited by *p-Max* (configured in *FrequencyInfoUL*) and by *p-NR-FR1* (configured for the cell group).

pdsch-HARQ-ACK-Codebook

The PDSCH HARQ-ACK codebook is either semi-static or dynamic. This is applicable to both CA and none CA operation (see TS 38.213 [13], clauses 9.1.2 and 9.1.3).

sp-CSI-RNTI

RNTI for Semi-Persistent CSI reporting on PUSCH (see CSI-ReportConfig) (see TS 38.214 [19], clause 5.2.1.5.2). Network always configures the UE with a value for this field when at least one CSI-ReportConfig with reportConfigType set to semi-PersistentOnPUSCH is configured.

tpc-PUCCH-RNTI

RNTI used for PUCCH TPC commands on DCI (see TS 38.213 [13], clause 10.1).

tpc-PUSCH-RNTI

RNTI used for PUSCH TPC commands on DCI (see TS 38.213 [13], clause 10.1).

tpc-SRS-RNTI

RNTI used for SRS TPC commands on DCI (see TS 38.213 [13], clause 10.1).

xScale

The UE is allowed to drop NR only if the power scaling applied to NR results in a difference between scaled and unscaled NR UL of more than xScale dB (see TS 38.213 [13]). If the value is not configured for dynamic power sharing, the UE assumes default value of 6 dB.

Conditional Presence	Explanation
MCG-Only	This field is optionally present, Need R, in the <i>PhysicalCellGroupConfig</i> of the MCG. It is absent otherwise.
SCG-Only	This field is optionally present, Need S, in the <i>PhysicalCellGroupConfig</i> of the SCG in (NG)EN-DC as defined in TS 38.213
	[13]. It is absent otherwise.

- PLMN-Identity

The IE PLMN-Identity identifies a Public Land Mobile Network. Further information regarding how to set the IE is specified in TS 23.003 [21].

PLMN-Identity information element

```
-- ASN1START
-- TAG-PLMN-IDENTITY-START
PLMN-Identity ::=
                                    SEOUENCE {
    mcc
                                        MCC
                                                             OPTIONAL,
                                                                                         -- Cond MCC
    mnc
                                        MNC
MCC ::=
                                    SEQUENCE (SIZE (3)) OF MCC-MNC-Digit
MNC ::=
                                    SEQUENCE (SIZE (2..3)) OF MCC-MNC-Digit
MCC-MNC-Digit ::=
                                    INTEGER (0..9)
-- TAG-PLMN-IDENTITY-STOP
-- ASN1STOP
```

PLMN-Identity field descriptions

mcc

The first element contains the first MCC digit, the second element the second MCC digit and so on. If the field is absent, it takes the same value as the *mcc* of the immediately preceding IE PLMN-Identity. See TS 23.003 [21].

mno

The first element contains the first MNC digit, the second element the second MNC digit and so on. See TS 23.003 [21].

Conditional Presence	Explanation
MCC	This field is mandatory present when PLMN-Identity is not used in a list or if it is the first entry of PLMN-Identity in a list. Otherwise it is
	optionally present, Need S.

PLMN-IdentityInfoList

The IE PLMN-IdentityInfoList includes a list of PLMN identity information.

PLMN-IdentityInfoList information element

```
-- ASN1START
-- TAG-PLMN-IDENTITYINFOLIST-START

PLMN-IdentityInfoList ::= SEQUENCE (SIZE (1..maxPLMN)) OF PLMN-IdentityInfo
```

```
PLMN-IdentityInfo ::=
                                        SEOUENCE {
    plmn-IdentityList
                                            SEQUENCE (SIZE (1..maxPLMN)) OF PLMN-Identity,
    trackingAreaCode
                                            TrackingAreaCode
                                                                                                        OPTIONAL,
                                                                                                                        -- Need R
                                            RAN-AreaCode
                                                                                                        OPTIONAL.
                                                                                                                        -- Need R
    ranac
                                            CellIdentity,
    cellIdentity
    cellReservedForOperatorUse
                                            ENUMERATED {reserved, notReserved},
-- TAG-PLMN-IDENTITYINFOLIST-STOP
-- ASN1STOP
```

PLMN-IdentityInfo field descriptions

cellReservedForOperatorUse

Indicates whether the cell is reserved for operator use (per PLMN), as defined in TS 38.304 [20].

trackingAreaCode

Indicates Tracking Area Code to which the cell indicated by *cellIdentity* field belongs. The absence of the field indicates that the cell only supports PSCell/SCell functionality (per PLMN).

The IE PRB-Id identifies a Physical Resource Block (PRB) position within a carrier.

PRB-Id information element

```
-- ASN1START
-- TAG-PRB-ID-START

PRB-Id ::= INTEGER (0..maxNrofPhysicalResourceBlocks-1)

-- TAG-PRB-ID-STOP
-- ASN1STOP
```

PTRS-DownlinkConfig

The IE PTRS-DownlinkConfig is used to configure downlink phase tracking reference signals (PTRS) (see TS 38.214 [19] clause 5.1.6.3)

PTRS-DownlinkConfig information element

```
-- ASN1START
-- TAG-PTRS-DOWNLINKCONFIG-START

PTRS-DownlinkConfig ::= SEQUENCE {
    frequencyDensity SEQUENCE (SIZE (2)) OF INTEGER (1..276) OPTIONAL, -- Need S
    timeDensity SEQUENCE (SIZE (3)) OF INTEGER (0..29) OPTIONAL, -- Need S
```

```
epre-Ratio INTEGER (0..3)
resourceElementOffset ENUMERATED { offset10, offset11 }

OPTIONAL, -- Need S
OPTIONAL, -- Need S

-- TAG-PTRS-DOWNLINKCONFIG-STOP
-- ASN1STOP
```

PTRS-DownlinkConfig field descriptions

epre-Ratio

EPRE ratio between PTRS and PDSCH. Value 0 corresponds to the codepoint "00" in table 4.1-2. Value 1 corresponds to codepoint "01", and so on. If the field is not provided, the UE applies value 0 (see TS 38.214 [19], clause 4.1).

frequencyDensity

Presence and frequency density of DL PT-RS as a function of Scheduled BW. If the field is absent, the UE uses K_PT-RS = 2 (see TS 38.214 [19], clause 5.1.6.3, table 5.1.6.3-2).

resourceElementOffset

Indicates the subcarrier offset for DL PTRS. If the field is absent, the UE applies the value offset00 (see TS 38.211 [16], clause 7.4.1.2.2).

timeDensity

Presence and time density of DL PT-RS as a function of MCS. The value 29 is only applicable for MCS Table 5.1.3.1-1 (TS 38.214 [19]). If the field is absent, the UE uses L PT-RS = 1 (see TS 38.214 [19], clause 5.1.6.3, table 5.1.6.3-1).

PTRS-UplinkConfig

The IE PTRS-UplinkConfig is used to configure uplink Phase-Tracking-Reference-Signals (PTRS).

PTRS-UplinkConfig information element

```
-- ASN1START
-- TAG-PTRS-UPLINKCONFIG-START
PTRS-UplinkConfig ::=
                                        SEOUENCE {
    transformPrecoderDisabled
                                            SEOUENCE
        frequencyDensity
                                            SEQUENCE (SIZE (2)) OF INTEGER (1..276)
                                                                                                    OPTIONAL,
                                                                                                                -- Need S
                                                                                                                -- Need S
                                            SEQUENCE (SIZE (3)) OF INTEGER (0..29)
       timeDensity
                                                                                                    OPTIONAL,
                                            ENUMERATED {n1, n2},
       maxNrofPorts
                                            ENUMERATED {offset01, offset10, offset11 }
       resourceElementOffset
                                                                                                    OPTIONAL,
                                                                                                                -- Need S
                                            ENUMERATED {p00, p01, p10, p11}
       ptrs-Power
                                                                                                    OPTIONAL,
                                                                                                                -- Need R
    transformPrecoderEnabled
                                            SEQUENCE {
                                                SEQUENCE (SIZE (5)) OF INTEGER (1..276),
       sampleDensity
        timeDensityTransformPrecoding
                                                ENUMERATED {d2}
                                                                                                    OPTIONAL
                                                                                                                -- Need S
                                                                                                               -- Need R
                                                                                                    OPTIONAL,
-- TAG-PTRS-UPLINKCONFIG-STOP
-- ASN1STOP
```

PTRS-UplinkConfig field descriptions

frequencyDensity

Presence and frequency density of UL PT-RS for CP-OFDM waveform as a function of scheduled BW If the field is absent, the UE uses K_PT-RS = 2 (see TS 38.214 [19], clause 6.1).

maxNrofPorts

The maximum number of UL PTRS ports for CP-OFDM (see TS 38.214 [19], clause 6.2.3.1).

ptrs-Power

UL PTRS power boosting factor per PTRS port (see TS 38.214 [19], clause 6.1, table 6.2.3.1.3).

resourceElementOffset

Indicates the subcarrier offset for UL PTRS for CP-OFDM. If the field is absent, the UE applies the value offset00 (see TS 38.211 [16], clause 6.4.1.2.2).

sampleDensity

Sample density of PT-RS for DFT-s-OFDM, pre-DFT, indicating a set of thresholds T={NRBn, n=0,1,2,3,4}, that indicates dependency between presence of PT-RS and scheduled BW and the values of X and K the UE should use depending on the scheduled BW, see TS 38,214 [19], clause 6,1, table 6,2,3,2-1.

timeDensity

Presence and time density of UL PT-RS for CP-OFDM waveform as a function of MCS If the field is absent, the UE uses L PT-RS = 1 (see TS 38.214 [19], clause 6.1).

timeDensityTransformPrecoding

Time density (OFDM symbol level) of PT-RS for DFT-s-OFDM. If the field is absent, the UE applies value d1 (see TS 38.214 [19], clause 6.1).

transformPrecoderDisabled

Configuration of UL PTRS without transform precoder (with CP-OFDM).

transformPrecoderEnabled

Configuration of UL PTRS with transform precoder (DFT-S-OFDM).

PUCCH-Config

The IE *PUCCH-Config* is used to configure UE specific PUCCH parameters (per BWP).

PUCCH-Config information element

```
-- ASN1START
-- TAG-PUCCH-CONFIG-START
PUCCH-Config ::=
                                        SEOUENCE {
    resourceSetToAddModList
                                            SEQUENCE (SIZE (1..maxNrofPUCCH-ResourceSets)) OF PUCCH-ResourceSet
                                                                                                                  OPTIONAL, -- Need N
    resourceSetToReleaseList
                                            SEQUENCE (SIZE (1..maxNrofPUCCH-ResourceSets)) OF PUCCH-ResourceSetId OPTIONAL, -- Need N
    resourceToAddModList
                                            SEQUENCE (SIZE (1..maxNrofPUCCH-Resources)) OF PUCCH-Resource
                                                                                                                  OPTIONAL, -- Need N
                                            SEOUENCE (SIZE (1..maxNrofPUCCH-Resources)) OF PUCCH-ResourceId
                                                                                                                  OPTIONAL, -- Need N
    resourceToReleaseList
    format1
                                            SetupRelease { PUCCH-FormatConfig
                                                                                                                  OPTIONAL, -- Need M
                                                                                                                  OPTIONAL, -- Need M
    format2
                                            SetupRelease { PUCCH-FormatConfig
                                            SetupRelease { PUCCH-FormatConfig
    format3
                                                                                                                  OPTIONAL, -- Need M
    format4
                                            SetupRelease { PUCCH-FormatConfig }
                                                                                                                  OPTIONAL, -- Need M
    schedulingRequestResourceToAddModList
                                            SEQUENCE (SIZE (1..maxNrofSR-Resources)) OF SchedulingRequestResourceConfig
                                                                                                                  OPTIONAL, -- Need N
    schedulingRequestResourceToReleaseList SEOUENCE (SIZE (1..maxNrofSR-Resources)) OF SchedulingRequestResourceId
                                                                                                                  OPTIONAL, -- Need N
```

```
multi-CSI-PUCCH-ResourceList
                                            SEQUENCE (SIZE (1..2)) OF PUCCH-ResourceId
                                                                                                                    OPTIONAL, -- Need M
    dl-DataToUL-ACK
                                            SEQUENCE (SIZE (1..8)) OF INTEGER (0..15)
                                                                                                                    OPTIONAL, -- Need M
    spatialRelationInfoToAddModList
                                            SEQUENCE (SIZE (1..maxNrofSpatialRelationInfos)) OF PUCCH-SpatialRelationInfo
                                                                                                                    OPTIONAL, -- Need N
                                            SEQUENCE (SIZE (1..maxNrofSpatialRelationInfos)) OF PUCCH-SpatialRelationInfold
    spatialRelationInfoToReleaseList
                                                                                                                    OPTIONAL, -- Need N
    pucch-PowerControl
                                            PUCCH-PowerControl
                                                                                                                    OPTIONAL, -- Need M
PUCCH-FormatConfig ::=
                                        SEOUENCE {
                                            ENUMERATED {enabled}
    interslotFrequencyHopping
                                                                                                                    OPTIONAL, -- Need R
    additionalDMRS
                                            ENUMERATED {true}
                                                                                                                    OPTIONAL, -- Need R
    maxCodeRate
                                            PUCCH-MaxCodeRate
                                                                                                                    OPTIONAL, -- Need R
    nrofSlots
                                            ENUMERATED {n2,n4,n8}
                                                                                                                    OPTIONAL, -- Need S
                                                                                                                    OPTIONAL, -- Need R
                                            ENUMERATED {enabled}
    pi2BPSK
                                                                                                                    OPTIONAL -- Need R
    simultaneousHARO-ACK-CSI
                                            ENUMERATED {true}
PUCCH-MaxCodeRate ::=
                                        ENUMERATED {zeroDot18, zeroDot15, zeroDot25, zeroDot35, zeroDot45, zeroDot60, zeroDot80}
-- A set with one or more PUCCH resources
PUCCH-ResourceSet ::=
                                        SEOUENCE {
    pucch-ResourceSetId
                                            PUCCH-ResourceSetId,
    resourceList.
                                            SEQUENCE (SIZE (1..maxNrofPUCCH-ResourcesPerSet)) OF PUCCH-ResourceId,
    maxPayloadSize
                                            INTEGER (4..256)
                                                                                                                    OPTIONAL -- Need R
PUCCH-ResourceSetId ::=
                                        INTEGER (0..maxNrofPUCCH-ResourceSets-1)
PUCCH-Resource ::=
                                        SEQUENCE {
    pucch-ResourceId
                                            PUCCH-ResourceId,
    startingPRB
                                            PRB-Id,
                                            ENUMERATED { enabled }
    intraSlotFrequencyHopping
                                                                                                                    OPTIONAL, -- Need R
    secondHopPRB
                                            PRB-Id
                                                                                                                    OPTIONAL, -- Need R
    format.
                                            CHOICE {
        format0
                                                PUCCH-format0,
        format1
                                                PUCCH-format1,
        format2
                                                PUCCH-format2,
        format3
                                                PUCCH-format3,
        format.4
                                                PUCCH-format.4
PUCCH-ResourceId ::=
                                        INTEGER (0..maxNrofPUCCH-Resources-1)
PUCCH-format0 ::=
                                                SEQUENCE {
    initialCyclicShift
                                                     INTEGER(0..11),
    nrofSymbols
                                                     INTEGER (1..2),
    startingSymbolIndex
                                                     INTEGER(0..13)
```

```
PUCCH-format1 ::=
                                                SEOUENCE {
    initialCyclicShift
                                                    INTEGER(0..11),
    nrofSymbols
                                                    INTEGER (4..14),
    startingSymbolIndex
                                                    INTEGER(0..10),
    timeDomainOCC
                                                    INTEGER(0..6)
PUCCH-format2 ::=
                                                SEQUENCE {
   nrofPRBs
                                                    INTEGER (1..16),
                                                    INTEGER (1..2),
    nrofSymbols
    startingSymbolIndex
                                                    INTEGER(0..13)
PUCCH-format3 ::=
                                                SEQUENCE {
    nrofPRBs
                                                    INTEGER (1..16),
   nrofSymbols
                                                    INTEGER (4..14),
    startingSymbolIndex
                                                    INTEGER(0..10)
PUCCH-format4 ::=
                                                SEQUENCE {
    nrofSymbols
                                                    INTEGER (4..14),
    occ-Length
                                                    ENUMERATED {n2,n4},
    occ-Index
                                                    ENUMERATED \{n0, n1, n2, n3\},
    startingSymbolIndex
                                                    INTEGER(0..10)
-- TAG-PUCCH-CONFIG-STOP
-- ASN1STOP
```

PUCCH-Config field descriptions

dl-DataToUL-ACK

List of timing for given PDSCH to the DL ACK (see TS 38.213 [13], clause 9.1.2).

format1

Parameters that are common for all PUCCH resources of format 1.

format2

Parameters that are common for all PUCCH resources of format 2.

format3

Parameters that are common for all PUCCH resources of format 3.

format4.

Parameters that are common for all PUCCH resources of format 4

resourceSetToAddModList, resourceSetToReleaseList

Lists for adding and releasing PUCCH resource sets (see TS 38.213 [13], clause 9.2).

resourceToAddModList, resourceToReleaseList

Lists for adding and releasing PUCCH resources applicable for the UL BWP and serving cell in which the *PUCCH-Config* is defined. The resources defined herein are referred to from other parts of the configuration to determine which resource the UE shall use for which report.

spatialRelationInfoToAddModList

Configuration of the spatial relation between a reference RS and PUCCH. Reference RS can be SSB/CSI-RS/SRS. If the list has more than one element, MAC-CE selects a single element (see TS 38.321 [3], clause 5.18.8 and TS 38.213 [13], clause 9.2.2).

PUCCH-format3 field descriptions

nrofPRBs

The supported values are 1,2,3,4,5,6,8,9,10,12,15 and 16.

PUCCH-FormatConfig field descriptions

additionalDMRS

If the field is present, the UE enables 2 DMRS symbols per hop of a PUCCH Format 3 or 4 if both hops are more than X symbols when FH is enabled (X=4). And it enables 4 DMRS symbols for a PUCCH Format 3 or 4 with more than 2X+1 symbols when FH is disabled (X=4). The field is not applicable for format 1 and 2. See TS 38.213 [13], clause 9.2.2.

interslotFrequencyHopping

If the field is present, the UE enables inter-slot frequency hopping when PUCCH Format 1, 3 or 4 is repeated over multiple slots. For long PUCCH over multiple slots, the intra and inter slot frequency hopping cannot be enabled at the same time for a UE. The field is not applicable for format 2. See TS 38.213 [13], clause 9.2.6.

maxCodeRate

Max coding rate to determine how to feedback UCI on PUCCH for format 2, 3 or 4. The field is not applicable for format 1. See TS 38.213 [13], clause 9.2.5.

nrofSlots

Number of slots with the same PUCCH F1, F3 or F4. When the field is absent the UE applies the value n1. The field is not applicable for format 2. See TS 38.213 [13], clause 9.2.6.

pi2BPSK

If the field is present, the UE uses pi/2 BPSK for UCI symbols instead of QPSK for PUCCH. The field is not applicable for format 1 and 2. See TS 38.213 [13], clause 9.2.5.

simultaneousHARQ-ACK-CSI

If the field is present, the UE uses simultaneous transmission of CSI and HARQ-ACK feedback with or without SR with PUCCH Format 2, 3 or 4. See TS 38.213 [13], clause 9.2.5. When the field is absent the UE applies the value off. The field is not applicable for format 1.

PUCCH-Resource field descriptions

format

Selection of the PUCCH format (format 0 – 4) and format-specific parameters, see TS 38.213 [13], clause 9.2. *format0* and *format1* are only allowed for a resource in a first PUCCH resource set. *format2*, *format3* and *format4* are only allowed for a resource in non-first PUCCH resource set.

intraSlotFrequencyHopping

Enabling intra-slot frequency hopping, applicable for all types of PUCCH formats. For long PUCCH over multiple slots, the intra and inter slot frequency hopping cannot be enabled at the same time for a UE. See TS 38.213 [13], clause 9.2.1.

pucch-Resourceld

Identifier of the PUCCH resource.

secondHopPRB

Index of first PRB after frequency hopping of PUCCH. This value is applicable for intra-slot frequency hopping (see TS 38.213 [13], clause 9.2.1) or inter-slot frequency hopping (see TS 38.213 [13], clause 9.2.6).

PUCCH-ResourceSet field descriptions

maxPayloadSize

Maximum number of UCI information bits that the UE may transmit using this PUCCH resource set (see TS 38.213 [13], clause 9.2.1). In a PUCCH occurrence, the UE chooses the first of its *PUCCH-ResourceSet* which supports the number of bits that the UE wants to transmit. The field is absent in the first set (Set0) and in the last configured set since the UE derives the maximum number of UCI information bits as specified in TS 38.213 [13], clause 9.2.1. This field can take integer values that are multiples of 4.

resourceList

PUCCH resources of *format0* and *format1* are only allowed in the first PUCCH resource set, i.e., in a PUCCH-ResourceSet with *pucch-ResourceSetId* = 0. This set may contain between 1 and 32 resources. PUCCH resources of *format2*, *format3* and *format4* are only allowed in a *PUCCH-ResourceSet* with *pucch-ResourceSetId* > 0. If present, these sets contain between 1 and 8 resources each. The UE chooses a *PUCCH-Resource* from this list as specified in TS 38.213 [13], clause 9.2.3. Note that this list contains only a list of resource IDs. The actual resources are configured in *PUCCH-Config*.

PUCCH-ConfigCommon

The IE PUCCH-ConfigCommon is used to configure the cell specific PUCCH parameters.

PUCCH-ConfigCommon information element

```
-- ASN1START
-- TAG-PUCCH-CONFIGCOMMON-START
PUCCH-ConfigCommon ::=
                                   SEOUENCE {
                                       INTEGER (0..15)
    pucch-ResourceCommon
                                                                                            OPTIONAL, -- Cond InitialBWP-Only
                                       ENUMERATED { neither, enable, disable },
    pucch-GroupHopping
   hoppingId
                                       INTEGER (0..1023)
                                                                                            OPTIONAL, -- Need R
    p0-nominal
                                       INTEGER (-202..24)
                                                                                            OPTIONAL, -- Need R
-- TAG-PUCCH-CONFIGCOMMON-STOP
-- ASN1STOP
```

PUCCH-ConfigCommon field descriptions

hoppingld

Cell-specific scrambling ID for group hopping and sequence hopping if enabled, see TS 38.211 [16], clause 6.3.2.2.

p0-nominal

Power control parameter P0 for PUCCH transmissions. Value in dBm. Only even values (step size 2) allowed (see TS 38.213 [13], clause 7.2).

pucch-GroupHopping

Configuration of group- and sequence hopping for all the PUCCH formats 0, 1, 3 and 4. Value *neither* implies neither group or sequence hopping is enabled. Value *enable* enables group hopping and disables sequence hopping. Value *disable* disables group hopping and enables sequence hopping (see TS 38.211 [16], clause 6.3.2.2).

pucch-ResourceCommon

An entry into a 16-row table where each row configures a set of cell-specific PUCCH resources/parameters. The UE uses those PUCCH resources until it is provided with a dedicated *PUCCH-Config* (e.g. during initial access) on the initial uplink BWP. Once the network provides a dedicated *PUCCH-Config* for that bandwidth part the UE applies that one instead of the one provided in this field (see TS 38.213 [13], clause 9.2).

Conditional Presence	Explanation
InitialBWP-Only	The field is mandatory present in the <i>PUCCH-ConfigCommon</i> of the initial BWP (BWP#0) in SIB1. It is absent in other BWPs.

PUCCH-PathlossReferenceRS-Id

The IE *PUCCH-PathlossReferenceRS-Id* is an ID for a reference signal (RS) configured as PUCCH pathloss reference (see TS 38.213 [13], clause 7.2).

PUCCH-PathlossReferenceRS-Id information element

```
-- ASN1START
-- TAG-PUCCH-PATHLOSSREFERENCERS-ID-START

PUCCH-PathlossReferenceRS-Id ::= INTEGER (0..maxNrofPUCCH-PathlossReferenceRSs-1)

-- TAG-PUCCH-PATHLOSSREFERENCERS-ID-STOP
-- ASN1STOP
```

PUCCH-PowerControl

The IE *PUCCH-PowerControl* is used to configure UE-specific parameters for the power control of PUCCH.

PUCCH-PowerControl information element

```
-- ASN1START
-- TAG-PUCCH-POWERCONTROL-START
PUCCH-PowerControl ::=
                                    SEOUENCE {
   deltaF-PUCCH-f0
                                        INTEGER (-16..15)
                                                                                                                 OPTIONAL, -- Need R
                                                                                                                 OPTIONAL, -- Need R
    deltaF-PUCCH-f1
                                        INTEGER (-16..15)
                                                                                                                 OPTIONAL, -- Need R
    deltaF-PUCCH-f2
                                        INTEGER (-16..15)
    deltaF-PUCCH-f3
                                        INTEGER (-16..15)
                                                                                                                 OPTIONAL, -- Need R
    deltaF-PUCCH-f4
                                        INTEGER (-16..15)
                                                                                                                 OPTIONAL, -- Need R
```

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```
p0-Set
                                        SEQUENCE (SIZE (1..maxNrofPUCCH-P0-PerSet)) OF P0-PUCCH
                                                                                                                OPTIONAL, -- Need M
    pathlossReferenceRSs
                                        SEQUENCE (SIZE (1..maxNrofPUCCH-PathlossReferenceRSs)) OF PUCCH-PathlossReferenceRS
                                                                                                                OPTIONAL, -- Need M
                                        ENUMERATED {twoStates}
                                                                                                                OPTIONAL, -- Need S
    twoPUCCH-PC-AdjustmentStates
                                        SEQUENCE {
PO-PUCCH ::=
    p0-PUCCH-Id
                                            PO-PUCCH-Id,
    p0-PUCCH-Value
                                            INTEGER (-16..15)
P0-PUCCH-Id ::=
                                        INTEGER (1..8)
PUCCH-PathlossReferenceRS ::=
                                                SEOUENCE {
    pucch-PathlossReferenceRS-Id
                                                PUCCH-PathlossReferenceRS-Id,
    referenceSignal
                                                CHOICE {
       ssb-Index
                                                    SSB-Index,
        csi-RS-Index
                                                    NZP-CSI-RS-ResourceId
-- TAG-PUCCH-POWERCONTROL-STOP
-- ASN1STOP
```

P0-PUCCH field descriptions

p0-PUCCH-Value

P0 value for PUCCH with 1dB step size.

PUCCH-PowerControl field descriptions deltaF-PUCCH-f0 deltaF for PUCCH format 0 with 1dB step size (see TS 38.213 [13], clause 7.2). deltaF-PUCCH-f1 deltaF for PUCCH format 1 with 1dB step size (see TS 38.213 [13], clause 7.2). deltaF-PUCCH-f2 deltaF for PUCCH format 2 with 1dB step size (see TS 38.213 [13], clause 7.2). deltaF-PUCCH-f3 deltaF for PUCCH format 3 with 1dB step size (see TS 38.213 [13], clause 7.2). deltaF-PUCCH-f4 deltaF for PUCCH format 4 with 1dB step size (see TS 38.213 [13], clause 7.2). p0-Set A set with dedicated P0 values for PUCCH, i.e., {P01, P02,...} (see TS 38.213 [13], clause 7.2). pathlossReferenceRSs A set of Reference Signals (e.g. a CSI-RS config or a SS block) to be used for PUCCH pathloss estimation. Up to maxNrofPUCCH-PathlossReference-RSs may be configured. If the field is not configured, the UE uses the SSB as reference signal (see TS 38.213 [13], clause 7.2). twoPUCCH-PC-AdjustmentStates Number of PUCCH power control adjustment states maintained by the UE (i.e., g(i)). If the field is present (n2) the UE maintains two power control states (i.e., g(i,0) and g(i,1)).

PUCCH-SpatialRelationInfo

If the field is absent, it maintains one power control state (i.e., q(i,0)) (see TS 38.213 [13], clause 7.2).

The IE *PUCCH-SpatialRelationInfo* is used to configure the spatial setting for PUCCH transmission and the parameters for PUCCH power control, see TS 38.213, [13], clause 9.2.2.

PUCCH-SpatialRelationInfo information element

```
-- ASN1START
-- TAG-PUCCH-SPATIALRELATIONINFO-START
PUCCH-SpatialRelationInfo ::=
    pucch-SpatialRelationInfoId
                                        PUCCH-SpatialRelationInfoId,
    servingCellId
                                            ServCellIndex
                                                                                                              OPTIONAL, -- Need S
    referenceSignal
                                            CHOICE {
        ssb-Index
                                                SSB-Index,
       csi-RS-Index
                                                NZP-CSI-RS-ResourceId,
       srs
                                                SEQUENCE {
                                                                                         SRS-ResourceId,
                                                    resource
                                                    uplinkBWP
                                                                                         BWP-Id
   pucch-PathlossReferenceRS-Id
                                            PUCCH-PathlossReferenceRS-Id,
   p0-PUCCH-Id
                                            P0-PUCCH-Id,
    closedLoopIndex
                                            ENUMERATED { i0, i1 }
PUCCH-SpatialRelationInfoId ::=
                                        INTEGER (1..maxNrofSpatialRelationInfos)
```

```
-- TAG-PUCCH-SPATIALRELATIONINFO-STOP
-- ASN1STOP
```

PUCCH-SpatialRelationInfo field descriptions servingCellId If the field is absent, the UE applies the ServCellId of the serving cell in which this PUCCH-SpatialRelationInfo is configured

PUCCH-TPC-CommandConfig

The IE PUCCH-TPC-CommandConfig is used to configure the UE for extracting TPC commands for PUCCH from a group-TPC messages on DCI.

PUCCH-TPC-CommandConfig information element

PUCCH-TPC-CommandConfig field descriptions tpc-IndexPCell An index determining the position of the first bit of TPC command (applicable to the SpCell) inside the DCI format 2-2 payload. tpc-IndexPUCCH-SCell An index determining the position of the first bit of TPC command (applicable to the PUCCH SCell) inside the DCI format 2-2 payload.

Conditional Presence	Explanation
PDCCH-OfSpcell	The field is mandatory present if the PUCCH-TPC-CommandConfig is provided in the PDCCH-Config for the SpCell.
	Otherwise, the field is absent, Need R.
PDCCH-ofSpCellOrPUCCH-SCell	The field is mandatory present if the <i>PUCCH-TPC-CommandConfig</i> is provided in the <i>PDCCH-Config</i> for the PUCCH-SCell. The field is optionally present, need R, if the UE is configured with a PUCCH SCell in this cell group and if the <i>PUCCH-TPC-CommandConfig</i> is provided in the <i>PDCCH-Config</i> for the SpCell.
	Otherwise, the field is absent, Need R.

PUSCH-Config

The IE *PUSCH-Config* is used to configure the UE specific PUSCH parameters applicable to a particular BWP.

PUSCH-Config information element

```
-- ASN1START
-- TAG-PUSCH-CONFIG-START
PUSCH-Config ::=
                                        SEOUENCE {
    dataScramblingIdentityPUSCH
                                            INTEGER (0..1023)
                                                                                                                 OPTIONAL.
                                                                                                                             -- Need S
    txConfig
                                            ENUMERATED {codebook, nonCodebook}
                                                                                                                 OPTIONAL,
                                                                                                                            -- Need S
    dmrs-UplinkForPUSCH-MappingTypeA
                                            SetupRelease { DMRS-UplinkConfig
                                                                                                                 OPTIONAL,
                                                                                                                             -- Need M
    dmrs-UplinkForPUSCH-MappingTypeB
                                            SetupRelease { DMRS-UplinkConfig
                                                                                                                 OPTIONAL,
                                                                                                                             -- Need M
                                            PUSCH-PowerControl
    pusch-PowerControl
                                                                                                                 OPTIONAL,
                                                                                                                             -- Need M
                                            ENUMERATED {intraSlot, interSlot}
    frequencyHopping
                                                                                                                 OPTIONAL,
                                                                                                                             -- Need S
    frequencyHoppingOffsetLists
                                            SEQUENCE (SIZE (1..4)) OF INTEGER (1.. maxNrofPhysicalResourceBlocks-1)
                                                                                                                 OPTIONAL,
                                                                                                                             -- Need M
    resourceAllocation
                                            ENUMERATED { resourceAllocationType0, resourceAllocationType1, dynamicSwitch},
                                            SetupRelease { PUSCH-TimeDomainResourceAllocationList }
    pusch-TimeDomainAllocationList
                                                                                                                 OPTIONAL,
                                                                                                                             -- Need M
                                            ENUMERATED { n2, n4, n8 }
                                                                                                                 OPTIONAL.
                                                                                                                             -- Need S
    pusch-AggregationFactor
   mcs-Table
                                            ENUMERATED { qam256, qam64LowSE }
                                                                                                                 OPTIONAL,
                                                                                                                             -- Need S
    mcs-TableTransformPrecoder
                                            ENUMERATED {gam256, gam64LowSE}
                                                                                                                 OPTIONAL,
                                                                                                                             -- Need S
    transformPrecoder
                                            ENUMERATED {enabled, disabled}
                                                                                                                 OPTIONAL,
                                                                                                                             -- Need S
    codebookSubset
                                            ENUMERATED {fullyAndPartialAndNonCoherent, partialAndNonCoherent, nonCoherent}
                                                                                                       OPTIONAL, -- Cond codebookBased
    maxRank
                                            INTEGER (1..4)
                                                                                                       OPTIONAL, -- Cond codebookBased
    rbq-Size
                                            ENUMERATED { config2}
                                                                                                       OPTIONAL, -- Need S
    uci-OnPUSCH
                                            SetupRelease { UCI-OnPUSCH}
                                                                                                       OPTIONAL, -- Need M
                                            ENUMERATED {enabled}
                                                                                                       OPTIONAL, -- Need S
    tp-pi2BPSK
UCI-OnPUSCH ::=
                                        SEQUENCE {
    betaOffsets
            dvnamic
                                                SEQUENCE (SIZE (4)) OF BetaOffsets,
            semiStatic
                                                BetaOffsets
                                                                                                                   OPTIONAL, -- Need M
    scaling
                                            ENUMERATED { f0p5, f0p65, f0p8, f1 }
-- TAG-PUSCH-CONFIG-STOP
-- ASN1STOP
```

PUSCH-Config field descriptions

codebookSubset

Subset of PMIs addressed by TPMI, where PMIs are those supported by UEs with maximum coherence capabilities (see TS 38.214 [19], clause 6.1.1.1).

dataScramblingIdentityPUSCH

Identifier used to initalite data scrambling (c_init) for PUSCH. If the field is absent, the UE applies the physical cell ID. (see TS 38.211 [16], clause 6.3.1.1).

dmrs-UplinkForPUSCH-MappingTypeA

DMRS configuration for PUSCH transmissions using PUSCH mapping type A (chosen dynamically via *PUSCH-TimeDomainResourceAllocation*). Only the fields *dmrs-Type*, *dmrs-AdditionalPosition* and *maxLength* may be set differently for mapping type A and B.

dmrs-UplinkForPUSCH-MappingTypeB

DMRS configuration for PUSCH transmissions using PUSCH mapping type B (chosen dynamically via *PUSCH-TimeDomainResourceAllocation*). Only the fields *dmrs-Type*, *dmrs-AdditionalPosition* and *maxLength* may be set differently for mapping type A and B.

frequencyHopping

The value *intraSlot* enables 'Intra-slot frequency hopping' and the value *interSlot* enables 'Inter-slot frequency hopping'. If the field is absent, frequency hopping is not configured (see TS 38.214 [19], clause 6.3).

frequencyHoppingOffsetLists

Set of frequency hopping offsets used when frequency hopping is enabled for granted transmission (not msg3) and type 2 configured grant activation (see TS 38.214 [19], clause 6.3).

maxRank

Subset of PMIs addressed by TRIs from 1 to ULmaxRank (see TS 38.214 [19], clause 6.1.1.1).

mcs-Table

Indicates which MCS table the UE shall use for PUSCH without transform precoder (see TS 38.214 [19], clause 6.1.4.1). If the field is absent the UE applies the value 64QAM

mcs-TableTransformPrecoder

Indicates which MCS table the UE shall use for PUSCH with transform precoding (see TS 38.214 [19], clause 6.1.4.1) If the field is absent the UE applies the value 64QAM

pusch-AggregationFactor

Number of repetitions for data (see TS 38.214 [19], clause 6.1.2.1). If the field is absent the UE applies the value 1.

pusch-TimeDomainAllocationList

List of time domain allocations for timing of UL assignment to UL data (see TS 38.214 [19], table 6.1.2.1.1-1).

rbg-Size

Selection between configuration 1 and configuration 2 for RBG size for PUSCH. The UE does not apply this field if *resourceAllocation* is set to *resourceAllocationType1*. Otherwise, the UE applies the value *config1* when the field is absent (see TS 38.214 [19], clause 6.1.2.2.1).

resourceAllocation

Configuration of resource allocation type 0 and resource allocation type 1 for non-fallback DCI (see TS 38.214 [19], clause 6.1.2).

tp-pi2BPSK

Enables pi/2-BPSK modulation with transform precoding if the field is present and disables it otherwise.

transformPrecoder

The UE specific selection of transformer precoder for PUSCH (see TS 38.214 [19], clause 6.1.3). When the field is absent the UE applies the value of the field *msg3-transformPrecoder*.

txConfig

Whether UE uses codebook based or non-codebook based transmission (see TS 38.214 [19], clause 6.1.1). If the field is absent, the UE transmits PUSCH on one antenna port, see TS 38.214 [19], clause 6.1.1.

UCI-OnPUSCH field descriptions

betaOffsets

Selection between and configuration of dynamic and semi-static beta-offset. If the field is not configured, the UE applies the value 'semiStatic' (see TS 38.213 [13], clause 9.3).

scaling

Indicates a scaling factor to limit the number of resource elements assigned to UCI on PUSCH. Value *f0p5* corresponds to 0.5, value *f0p65* corresponds to 0.65, and so on. The value configured herein is applicable for PUSCH with configured grant (see TS 38.212 [17], clause 6.3).

Conditional Presence	Explanation
codebookBased	The field is mandatory present if txConfig is set to codebook and absent otherwise.

PUSCH-ConfigCommon

The IE *PUSCH-ConfigCommon* is used to configure the cell specific PUSCH parameters.

PUSCH-ConfigCommon information element

```
-- ASN1START
-- TAG-PUSCH-CONFIGCOMMON-START
PUSCH-ConfigCommon ::=
                                 SEOUENCE {
   OPTIONAL.
                                                                                                       -- Need R
   pusch-TimeDomainAllocationList
                                    PUSCH-TimeDomainResourceAllocationList
                                                                                              OPTIONAL, -- Need R
   msq3-DeltaPreamble
                                    INTEGER (-1..6)
                                                                                              OPTIONAL, -- Need R
   p0-NominalWithGrant
                                    INTEGER (-202..24)
                                                                                              OPTIONAL, -- Need R
-- TAG-PUSCH-CONFIGCOMMON-STOP
```

PUSCH-ConfigCommon field descriptions

groupHoppingEnabledTransformPrecoding

For DMRS transmission with transform precoder, the NW may configure group hopping by this cell-specific parameter, see TS 38.211 [16], clause 6.4.1.1.1.2.

msg3-DeltaPreamble

-- ASN1STOP

Power offset between msg3 and RACH preamble transmission. Actual value = field value * 2 [dB] (see TS 38.213 [13], clause 7.1)

p0-NominalWithGrant

P0 value for PUSCH with grant (except msg3). Value in dBm. Only even values (step size 2) allowed (see TS 38.213 [13], clause 7.1) This field is cell specific

pusch-TimeDomainAllocationList

List of time domain allocations for timing of UL assignment to UL data (see TS 38.214 [19], table 6.1.2.1.1-1).

PUSCH-PowerControl

The IE *PUSCH-PowerControl* is used to configure UE specific power control parameter for PUSCH.

PUSCH-PowerControl information element

```
-- ASN1START
-- TAG-PUSCH-POWERCONTROL-START
PUSCH-PowerControl ::=
                                    SEOUENCE {
    tpc-Accumulation
                                        ENUMERATED { disabled }
                                                                                                                 OPTIONAL, -- Need S
                                                                                                                 OPTIONAL, -- Need S
    msg3-Alpha
                                        Alpha
    p0-NominalWithoutGrant
                                                                                                                 OPTIONAL, -- Need M
                                        INTEGER (-202..24)
    p0-AlphaSets
                                        SEQUENCE (SIZE (1..maxNrofP0-PUSCH-AlphaSets)) OF P0-PUSCH-AlphaSet
                                                                                                                 OPTIONAL, -- Need M
    pathlossReferenceRSToAddModList
                                        SEQUENCE (SIZE (1..maxNrofPUSCH-PathlossReferenceRSs)) OF PUSCH-PathlossReferenceRS
                                                                                                                 OPTIONAL, -- Need N
    pathlossReferenceRSToReleaseList
                                        SEQUENCE (SIZE (1..maxNrofPUSCH-PathlossReferenceRSs)) OF PUSCH-PathlossReferenceRS-Id
                                                                                                                 OPTIONAL, -- Need N
    twoPUSCH-PC-AdjustmentStates
                                        ENUMERATED {twoStates}
                                                                                                                 OPTIONAL, -- Need S
                                                                                                                 OPTIONAL, -- Need S
    deltaMCS
                                        ENUMERATED {enabled}
    sri-PUSCH-MappingToAddModList
                                        SEQUENCE (SIZE (1..maxNrofSRI-PUSCH-Mappings)) OF SRI-PUSCH-PowerControl
                                                                                                                 OPTIONAL, -- Need N
    sri-PUSCH-MappingToReleaseList
                                        SEQUENCE (SIZE (1..maxNrofSRI-PUSCH-Mappings)) OF SRI-PUSCH-PowerControlId
                                                                                                                 OPTIONAL -- Need N
P0-PUSCH-AlphaSet ::=
                                    SEQUENCE {
                                        PO-PUSCH-AlphaSetId,
    p0-PUSCH-AlphaSetId
                                        INTEGER (-16..15)
    0g
                                                                                                                 OPTIONAL, -- Need S
    alpha
                                        Alpha
                                                                                                                 OPTIONAL -- Need S
PO-PUSCH-AlphaSetId ::=
                                    INTEGER (0..maxNrofP0-PUSCH-AlphaSets-1)
PUSCH-PathlossReferenceRS ::=
                                    SEOUENCE {
    pusch-PathlossReferenceRS-Id
                                        PUSCH-PathlossReferenceRS-Id,
    referenceSignal
                                        CHOICE {
       ssb-Index
                                            SSB-Index,
        csi-RS-Index
                                            NZP-CSI-RS-ResourceId
PUSCH-PathlossReferenceRS-Id ::=
                                    INTEGER (0..maxNrofPUSCH-PathlossReferenceRSs-1)
SRI-PUSCH-PowerControl ::=
                                    SEOUENCE {
                                        SRI-PUSCH-PowerControlId,
    sri-PUSCH-PowerControlId
                                        PUSCH-PathlossReferenceRS-Id.
    sri-PUSCH-PathlossReferenceRS-Id
                                        P0-PUSCH-AlphaSetId,
    sri-P0-PUSCH-AlphaSetId
    sri-PUSCH-ClosedLoopIndex
                                        ENUMERATED { i0, i1 }
SRI-PUSCH-PowerControlId ::=
                                    INTEGER (0..maxNrofSRI-PUSCH-Mappings-1)
-- TAG-PUSCH-POWERCONTROL-STOP
-- ASN1STOP
```

P0-PUSCH-AlphaSet field descriptions

alpha

alpha value for PUSCH with grant (except msg3) (see TS 38.213 [13], clause 7.1). When the field is absent the UE applies the value 1.

pΩ

P0 value for PUSCH with grant (except msg3) in steps of 1dB (see TS 38.213 [13], clause 7.1). When the field is absent the UE applies the value 0.

PUSCH-PowerControl field descriptions

deltaMCS

Indicates whether to apply delta MCS. When the field is absent, the UE applies Ks = 0 in delta_TFC formula for PUSCH (see TS 38.213 [13], clause 7.1).

msg3-Alpha

Dedicated alpha value for msg3 PUSCH (see TS 38.213 [13], clause 7.1). When the field is absent the UE applies the value 1.

p0-AlphaSets

configuration {p0-pusch, alpha} sets for PUSCH (except msg3), i.e., { {p0,alpha,index1}, {p0,alpha,index2},...} (see TS 38.213 [13], clause 7.1). When no set is configured, the UE uses the P0-nominal for msg3 PUSCH. P0-UE is set to 0 and alpha is set according to msg3-Alpha configured for msg3 PUSCH.

p0-NominalWithoutGrant

P0 value for UL grant-free/SPS based PUSCH. Value in dBm. Only even values (step size 2) allowed (see TS 38.213 [13], clause 7.1).

pathlossReferenceRSToAddModList

A set of Reference Signals (e.g. a CSI-RS config or a SS block) to be used for PUSCH path loss estimation. Up to maxNrofPUSCH-PathlossReferenceRSs may be configured (see TS 38.213 [13], clause 7.1).

sri-PUSCH-MappingToAddModList

A list of SRI-PUSCH-PowerControl elements among which one is selected by the SRI field in DCI (see TS 38.213 [13], clause 7.1).

tpc-Accumulation

If enabled, UE applies TPC commands via accumulation. If not enabled, UE applies the TPC command without accumulation. If the field is absent, TPC accumulation is enabled (see TS 38.213 [13], clause 7.1).

twoPUSCH-PC-AdjustmentStates

Number of PUSCH power control adjustment states maintained by the UE (i.e., fc(i)). If the field is present (n2) the UE maintains two power control states (i.e., fc(i,0) and fc(i,1)). If the field is absent, it maintains one power control state (i.e., fc(i,0)) (see TS 38.213 [13], clause 7.1).

SRI-PUSCH-PowerControl field descriptions

sri-P0-PUSCH-AlphaSetId

The ID of a P0-PUSCH-AlphaSet as configured in p0-AlphaSets in PUSCH-PowerControl.

sri-PUSCH-ClosedLoopIndex

The index of the closed power control loop associated with this SRI-PUSCH-PowerControl.

sri-PUSCH-PathlossReferenceRS-Id

The ID of PUSCH-PathlossReferenceRS as configured in the pathlossReferenceRSToAddModList in PUSCH-PowerControl.

sri-PUSCH-PowerControlld

The ID of this SRI-PUSCH-PowerControl configuration. It is used as the codepoint (payload) in the SRI DCI field.

PUSCH-ServingCellConfig

The IE *PUSCH-ServingCellConfig* is used to configure UE specific PUSCH parameters that are common across the UE's BWPs of one serving cell.

PUSCH-ServingCellConfig information element

```
-- ASN1START
-- TAG-PUSCH-SERVINGCELLCONFIG-START
PUSCH-ServingCellConfig ::=
    codeBlockGroupTransmission
                                            SetupRelease { PUSCH-CodeBlockGroupTransmission }
                                                                                                    OPTIONAL, -- Need M
                                            ENUMERATED {limitedBufferRM}
                                                                                                                -- Need S
   rateMatching
                                                                                                    OPTIONAL.
   x0verhead
                                            ENUMERATED {xoh6, xoh12, xoh18}
                                                                                                    OPTIONAL, -- Need S
    . . . ,
    ] ]
   maxMIMO-Layers
                                            INTEGER (1..4)
                                                                                                    OPTIONAL,
                                                                                                                -- Need M
    processingType2Enabled
                                                                                                    OPTIONAL -- Need M
                                            BOOLEAN
    11
PUSCH-CodeBlockGroupTransmission ::=
    maxCodeBlockGroupsPerTransportBlock
                                            ENUMERATED {n2, n4, n6, n8},
-- TAG-PUSCH-SERVINGCELLCONFIG-STOP
-- ASN1STOP
```

PUSCH-CodeBlockGroupTransmission field descriptions

maxCodeBlockGroupsPerTransportBlock

Maximum number of code-block-groups (CBGs) per TB (see TS 38.213 [13], clause 9.1).

PUSCH-ServingCellConfig field descriptions

codeBlockGroupTransmission

Enables and configures code-block-group (CBG) based transmission (see TS 38.214 [19], clause 5.1.5).

maxMIMO-Layers

Indicates the maximum MIMO layer to be used for PUSCH in all BWPs of the normal UL of this serving cell (see TS 38.212 [17], clause 5.4.2.1). If present, the network sets maxRank to the same value. For SUL, the maximum number of MIMO layers is always 1, and network does not configure this field.

processingType2Enabled

Enables configuration of advanced processing time capability 2 for PUSCH (see 38.214 [19], clause 6.4).

rateMatching

Enables LBRM (Limited buffer rate-matching). When the field is absent the UE applies FBRM (Full buffer rate-matchingLBRM) (see TS 38.212 [17], clause 5.4.2).

xOverhead .

If the field is absent, the UE applies the value 'xoh0' (see TS 38.214 [19], clause 5.1.3.2).

PUSCH-TimeDomainResourceAllocationList

The IE *PUSCH-TimeDomainResourceAllocation* is used to configure a time domain relation between PDCCH and PUSCH. *PUSCH-TimeDomainResourceAllocationList* contains one or more of such *PUSCH-TimeDomainResourceAllocations*. The network indicates in the UL grant which of the configured time domain allocations the UE shall

apply for that UL grant. The UE determines the bit width of the DCI field based on the number of entries in the *PUSCH-TimeDomainResourceAllocationList*. Value 0 in the DCI field refers to the first element in this list, value 1 in the DCI field refers to the second element in this list, and so on.

PUSCH-TimeDomainResourceAllocation information element

PUSCH-TimeDomainResourceAllocationList field descriptions

k:

Corresponds to L1 parameter 'K2' (see TS 38.214 [19], clause 6.1.2.1) When the field is absent the UE applies the value 1 when PUSCH SCS is 15/30 kHz; the value 2 when PUSCH SCS is 60 kHz, and the value 3 when PUSCH SCS is 120KHz.

mappingTvpe

Mapping type (see TS 38.214 [19], clause 6.1.2.1).

startSymbolAndLength

An index giving valid combinations of start symbol and length (jointly encoded) as start and length indicator (SLIV). The network configures the field so that the allocation does not cross the slot boundary. (see TS 38.214 [19], clause 6.1.2.1).

PUSCH-TPC-CommandConfig

The IE *PUSCH-TPC-CommandConfig* is used to configure the UE for extracting TPC commands for PUSCH from a group-TPC messages on DCI.

PUSCH-TPC-CommandConfig information element

```
-- ASN1START
-- TAG-PUSCH-TPC-COMMANDCONFIG-START
PUSCH-TPC-CommandConfig ::=
                                   SEQUENCE {
    tpc-Index
                                       INTEGER (1..15)
                                                                                                       OPTIONAL, -- Cond SUL
    tpc-IndexSUL
                                       INTEGER (1..15)
                                                                                                       OPTIONAL, -- Cond SUL-Only
    targetCell
                                       ServCellIndex
                                                                                                       OPTIONAL, -- Need S
    . . .
-- TAG-PUSCH-TPC-COMMANDCONFIG-STOP
-- ASN1STOP
```

PUSCH-TPC-CommandConfig field descriptions

targetCell

The serving cell to which the acquired power control commands are applicable. If the value is absent, the UE applies the TPC commands to the serving cell on which the command has been received.

tpc-Index

An index determining the position of the first bit of TPC command inside the DCI format 2-2 payload.

tpc-IndexSUL

An index determining the position of the first bit of TPC command inside the DCI format 2-2 payload.

Conditional Presence	Explanation
SUL-Only	The field is optionally present, Need R, if <i>supplementaryUplink</i> is configured within <i>ServingCellConfig</i> . It is absent otherwise.
SUL	The field is optionally present, Need R, if supplementaryUplink is configured within ServingCellConfig. It is mandatory
	present otherwise.

Q-OffsetRange

The IE *Q-OffsetRange* is used to indicate a cell, beam or measurement object specific offset to be applied when evaluating candidates for cell re-selection or when evaluating triggering conditions for measurement reporting. The value is in dB. Value *dB-24* corresponds to -24 dB, *dB-22* corresponds to -22 dB and so on.

Q-OffsetRange information element

– Q-QualMin

The IE *Q-QualMin* is used to indicate for cell selection/re-selection the required minimum received RSRQ level in the (NR) cell. Corresponds to parameter $Q_{qualmin}$ in TS 38.304 [20]. Actual value $Q_{qualmin}$ = field value [dB].

Q-QualMin information element

```
-- ASN1START
-- TAG-Q-QUALMIN-START

Q-QualMin ::= INTEGER (-43..-12)

-- TAG-Q-QUALMIN-STOP
-- ASN1STOP
```

- Q-RxLevMin

The IE *Q-RxLevMin* is used to indicate for cell selection/ re-selection the required minimum received RSRP level in the (NR) cell. Corresponds to parameter Q_{rxlevmin} in TS 38.304 [20]. Actual value Q_{rxlevmin} = field value * 2 [dBm].

Q-RxLevMin information element

```
-- ASN1START
-- TAG-Q-RXLEVMIN-START

Q-RXLEVMIN ::= INTEGER (-70..-22)

-- TAG-Q-RXLEVMIN-STOP
-- ASN1STOP
```

QuantityConfig

The IE QuantityConfig specifies the measurement quantities and layer 3 filtering coefficients for NR and inter-RAT measurements.

QuantityConfig information element

```
-- ASN1START
-- TAG-QUANTITYCONFIG-START
QuantityConfig ::=
   quantityConfigNR-List
                                      SEQUENCE (SIZE (1..maxNrofQuantityConfig)) OF QuantityConfigNR
                                                                                                            OPTIONAL, -- Need M
   ] ]
   quantityConfigEUTRA
                                      FilterConfig
                                                                                                            OPTIONAL
                                                                                                                       -- Need M
    11
QuantityConfigNR::=
   quantityConfigCell
                                      QuantityConfigRS,
   quantityConfigRS-Index
                                      QuantityConfigRS
                                                                                                            OPTIONAL -- Need M
```

```
OuantityConfigRS ::=
                                    SEOUENCE {
    ssb-FilterConfig
                                        FilterConfig,
    csi-RS-FilterConfig
                                        FilterConfig
FilterConfig ::=
                                    SEOUENCE {
    filterCoefficientRSRP
                                        FilterCoefficient
                                                                                                 DEFAULT fc4,
    filterCoefficientRSRO
                                        FilterCoefficient
                                                                                                 DEFAULT fc4.
    filterCoefficientRS-SINR
                                        FilterCoefficient
                                                                                                 DEFAULT fc4
-- TAG-OUANTITYCONFIG-STOP
```

QuantityConfigNR field descriptions

quantityConfigCell

-- ASN1STOP

Specifies L3 filter configurations for cell measurement results for the configurable RS Types (e.g. SS/PBCH block and CSI-RS) and the configurable measurement quantities (e.g. RSRP, RSRQ and SINR).

quantityConfigRS-Index

Specifies L3 filter configurations for measurement results per RS index for the configurable RS Types (e.g. SS/PBCH block and CSI-RS) and the configurable measurement quantities (e.g. RSRP, RSRQ and SINR).

QuantityConfigRS field descriptions

csi-RS-FilterConfig

CSI-RS based L3 filter configurations:

Specifies L3 filter configurations for CSI-RSRP, CSI-RSRQ and CSI-SINR measurement results from the L1 filter(s), as defined in TS 38.215 [9].

ssb-FilterConfig

SS Block based L3 filter configurations:

Specifies L3 filter configurations for SS-RSRP, SS-RSRQ and SS-SINR measurement results from the L1 filter(s), as defined in TS 38.215 [9].

RACH-ConfigCommon

The IE RACH-ConfigCommon is used to specify the cell specific random-access parameters.

RACH-ConfigCommon information element

```
-- ASN1START
-- TAG-RACH-CONFIGCOMMON-START

RACH-ConfigCommon ::= SEQUENCE {
    rach-ConfigGeneric RACH-ConfigGeneric,
    totalNumberOfRA-Preambles INTEGER (1..63) OPTIONAL, -- Need S
    ssb-perRACH-OccasionAndCB-PreamblesPerSSB CHOICE {
        oneEighth ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},
        oneFourth ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},
```

```
oneHalf
        one
        t.wo
        four
        eight
        sixteen
    groupBconfigured
       ra-Msg3SizeGroupA
       messagePowerOffsetGroupB
       numberOfRA-PreamblesGroupA
    ra-ContentionResolutionTimer
    rsrp-ThresholdSSB
    rsrp-ThresholdSSB-SUL
    prach-RootSequenceIndex
       1839
       1139
    msgl-SubcarrierSpacing
   restrictedSetConfig
   msg3-transformPrecoder
-- TAG-RACH-CONFIGCOMMON-STOP
-- ASN1STOP
```

```
ENUMERATED {n4, n8, n12, n16, n20, n24, n28, n32, n36, n40, n44, n48, n52, n56, n60, n64},
            ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},
            ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32},
            INTEGER (1..16),
            INTEGER (1..8),
            INTEGER (1..4)
                                                                     OPTIONAL.
                                                                                -- Need M
SEQUENCE {
    ENUMERATED {b56, b144, b208, b256, b282, b480, b640,
                b800, b1000, b72, spare6, spare5, spare4, spare3, spare2, spare1},
    ENUMERATED { minusinfinity, dB0, dB5, dB8, dB10, dB12, dB15, dB18},
    INTEGER (1..64)
                                                                     OPTIONAL.
                                                                                  -- Need R
    ENUMERATED { sf8, sf16, sf24, sf32, sf40, sf48, sf56, sf64},
    RSRP-Range
                                                                     OPTIONAL,
                                                                                  -- Need R
    RSRP-Range
                                                                     OPTIONAL,
                                                                                  -- Cond SUL
    CHOICE {
        INTEGER (0..837),
        INTEGER (0..137)
    SubcarrierSpacing
                                                                      OPTIONAL,
                                                                                  -- Cond L139
    ENUMERATED {unrestrictedSet, restrictedSetTypeA, restrictedSetTypeB},
    ENUMERATED {enabled}
                                                                     OPTIONAL,
                                                                                  -- Need R
```

RACH-ConfigCommon field descriptions

messagePowerOffsetGroupB

Threshold for preamble selection. Value is in dB. Value *minusinfinity* corresponds to –infinity. Value *dB0* corresponds to 0 dB, *dB5* corresponds to 5 dB and so on. (see TS 38.321 [3], clause 5.1.2)

msg1-SubcarrierSpacing

Subcarrier spacing of PRACH (see TS 38.211 [16], clause 5.3.2). Only the values 15 or 30 kHz (FR1), and 60 or 120 kHz (FR2) are applicable. If absent, the UE applies the SCS as derived from the *prach-ConfigurationIndex* in *RACH-ConfigGeneric* (see tables Table 6.3.3.1-1, Table 6.3.3.2-2 and Table 6.3.3.2-3, TS 38.211 [16]). The value also applies to contention free random access (*RACH-ConfigDedicated*), to SI-request and to contention-based beam failure recovery (CB-BFR). But it does not apply for contention free beam failure recovery (CF-BFR) (see *BeamFailureRecoveryConfig*).

msg3-transformPrecoder

Enables the transform precoder for Msg3 transmission according to clause 6.1.3 of TS 38.214 [19]. If the field is absent, the UE disables the transformer precoder (see TS 38.213 [13], clause 8.3).

numberOfRA-PreamblesGroupA

The number of CB preambles per SSB in group A. This determines implicitly the number of CB preambles per SSB available in group B. (see TS 38.321 [3], clause 5.1.1). The setting should be consistent with the setting of ssb-perRACH-OccasionAndCB-PreamblesPerSSB.

prach-RootSequenceIndex

PRACH root sequence index (see TS 38.211 [16], clause 6.3.3.1). The value range depends on whether L=839 or L=139. The short/long preamble format indicated in this IE should be consistent with the one indicated in *prach-ConfigurationIndex* in the *RACH-ConfigDedicated* (if configured).

ra-ContentionResolutionTimer

The initial value for the contention resolution timer (see TS 38.321 [3], clause 5.1.5). Value sf8 corresponds to 8 subframes, value sf16 corresponds to 16 subframes, and so on.

ra-Msg3SizeGroupA

Transport Blocks size threshold in bits below which the UE shall use a contention-based RA preamble of group A. (see TS 38.321 [3], clause 5.1.2).

rach-ConfigGeneric

RACH parameters for both regular random access and beam failure recovery.

restrictedSetConfig

Configuration of an unrestricted set or one of two types of restricted sets, see TS 38.211 [16], clause 6.3.3.1.

rsrp-ThresholdSSB

UE may select the SS block and corresponding PRACH resource for path-loss estimation and (re)transmission based on SS blocks that satisfy the threshold (see TS 38.213 [13]).

rsrp-ThresholdSSB-SUL

The UE selects SUL carrier to perform random access based on this threshold (see TS 38.321 [3], clause 5.1.1). The value applies to all the BWPs.

ssb-perRACH-OccasionAndCB-PreamblesPerSSB

The meaning of this field is twofold: the CHOICE conveys the information about the number of SSBs per RACH occasion. Value *oneEighth* corresponds to one SSB associated with 8 RACH occasions, value *oneFourth* corresponds to one SSB associated with 4 RACH occasions, and so on. The ENUMERATED part indicates the number of Contention Based preambles per SSB. Value *n4* corresponds to 4 Contention Based preambles per SSB, value *n8* corresponds to 8 Contention Based preambles per SSB, and so on. The total number of CB preambles in a RACH occasion is given by *CB-preambles-per-SSB** max(1, *SSB-per-rach-occasion*). See TS 38.213 [13].

totalNumberOfRA-Preambles

Total number of preambles used for contention based and contention free random access in the RACH resources defined in *RACH-ConfigCommon*, excluding preambles used for other purposes (e.g. for SI request). If the field is absent, all 64 preambles are available for RA. The setting should be consistent with the setting of *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*, i.e. it should be a multiple of the number of SSBs per RACH occasion.

Conditional Presence	Explanation
L139	The field is mandatory present if <i>prach-RootSequenceIndex</i> L=139, otherwise the field is absent, Need S.
SUL	The field is mandatory present in initialUplinkBWP if supplementaryUplink is configured in ServingCellConfigCommonSIB or
	if supplementaryUplinkConfig is configured in ServingCellConfigCommon; otherwise, the field is absent.

RACH-ConfigDedicated

The IE RACH-ConfigDedicated is used to specify the dedicated random access parameters.

RACH-ConfigDedicated information element

```
-- ASN1START
-- TAG-RACH-CONFIGDEDICATED-START
RACH-ConfigDedicated ::=
                                SEQUENCE {
                                    CFRA
                                                                                                             OPTIONAL, -- Need S
    cfra
    ra-Prioritization
                                    RA-Prioritization
                                                                                                             OPTIONAL, -- Need N
                            SEQUENCE {
CFRA ::=
    occasions
                                    SEQUENCE {
        rach-ConfigGeneric
                                        RACH-ConfigGeneric,
        ssb-perRACH-Occasion
                                        ENUMERATED {oneEighth, oneFourth, oneHalf, one, two, four, eight, sixteen}
                                                                                                             OPTIONAL -- Cond Mandatory
                                                                                                             OPTIONAL, -- Need S
    resources
                                    CHOICE {
       ssb
                                        SEQUENCE
            ssb-ResourceList
                                            SEQUENCE (SIZE(1..maxRA-SSB-Resources)) OF CFRA-SSB-Resource,
            ra-ssb-OccasionMaskIndex
                                            INTEGER (0..15)
        },
        csirs
                                        SEQUENCE {
            csirs-ResourceList
                                            SEQUENCE (SIZE(1..maxRA-CSIRS-Resources)) OF CFRA-CSIRS-Resource,
            rsrp-ThresholdCSI-RS
                                            RSRP-Range
    totalNumberOfRA-Preambles INTEGER (1..63)
                                                                                                       OPTIONAL -- Cond Occasions
    ]]
CFRA-SSB-Resource ::=
                                SEQUENCE {
    ssb
                                    SSB-Index,
    ra-PreambleIndex
                                    INTEGER (0..63),
CFRA-CSIRS-Resource ::=
                                SEQUENCE {
```

CFRA-CSIRS-Resource field descriptions

csi-RS

-- ASN1STOP

The ID of a CSI-RS resource defined in the measurement object associated with this serving cell.

ra-OccasionList

RA occasions that the UE shall use when performing CF-RA upon selecting the candidate beam identified by this CSI-RS. The network ensures that the RA occasion indexes provided herein are also configured by prach-ConfigurationIndex and msg1-FDM. Each RACH occasion is sequentially numbered, first, in increasing order of frequency resource indexes for frequency multiplexed PRACH occasions; second, in increasing order of time resource indexes for time multiplexed PRACH occasions within a PRACH slot and Third, in increasing order of indexes for PRACH slots.

ra-PreambleIndex

The RA preamble index to use in the RA occasions associated with this CSI-RS.

CFRA field descriptions

occasions

RA occasions for contention free random access. If the field is absent, the UE uses the RA occasions configured in RACH-ConfigCommon in the first active UL BWP.

ra-ssb-OccasionMaskIndex

Explicitly signalled PRACH Mask Index for RA Resource selection in TS 38.321 [3]. The mask is valid for all SSB resources signalled in ssb-ResourceList.

rach-ConfigGeneric

Configuration of contention free random access occasions for CFRA. The UE shall ignore preambleReceivedTargetPower, preambleTransMax, powerRampingStep, ra-ResponseWindow signaled within this field and use the corresponding values provided in RACH-ConfigCommon.

ssb-perRACH-Occasion

Number of SSBs per RACH occasion.

totalNumberOfRA-Preambles

Total number of preambles used for contention free random access in the RACH resources defined in CFRA, excluding preambles used for other purposes (e.g. for SI request). If the field is absent but the field *occasions* is present, the UE may assume all the 64 preambles are for RA. The setting should be consistent with the setting of *ssb-perRACH-Occasion*, if present, i.e. it should be a multiple of the number of SSBs per RACH occasion.

CFRA-SSB-Resource field descriptions

ra-PreambleIndex

The preamble index that the UE shall use when performing CF-RA upon selecting the candidate beams identified by this SSB.

cch

The ID of an SSB transmitted by this serving cell.

RACH-ConfigDedicated field descriptions cfra Parameters for contention free random access to a given target cell. If the field is absent, the UE performs contention based random access. ra-prioritization Parameters which apply for prioritized random access procedure to a given target cell (see TS 38.321 [3], clause 5.1.1).

Conditional Presence	Explanation
Mandatory	The field is mandatory present.
Occasions	The field is optionally present, Need S, if the field occasions is present, otherwise it is absent.

RACH-ConfigGeneric

The IE RACH-ConfigGeneric is used to specify the random-access parameters both for regular random access as well as for beam failure recovery.

RACH-ConfigGeneric information element

```
-- ASN1START
-- TAG-RACH-CONFIGGENERIC-START
RACH-ConfigGeneric ::=
                                    SEQUENCE {
   prach-ConfigurationIndex
                                        INTEGER (0..255),
   msg1-FDM
                                        ENUMERATED {one, two, four, eight},
                                        INTEGER (0..maxNrofPhysicalResourceBlocks-1),
   msg1-FrequencyStart
                                        INTEGER(0..15),
    zeroCorrelationZoneConfig
    preambleReceivedTargetPower
                                        INTEGER (-202..-60),
    preambleTransMax
                                        ENUMERATED {n3, n4, n5, n6, n7, n8, n10, n20, n50, n100, n200},
    powerRampingStep
                                        ENUMERATED {dB0, dB2, dB4, dB6},
                                        ENUMERATED {sl1, sl2, sl4, sl8, sl10, sl20, sl40, sl80},
    ra-ResponseWindow
-- TAG-RACH-CONFIGGENERIC-STOP
-- ASN1STOP
```

RACH-ConfigGeneric field descriptions

msg1-FDM

The number of PRACH transmission occasions FDMed in one time instance. (see TS 38.211 [16], clause 6.3.3.2).

msg1-FrequencyStart

Offset of lowest PRACH transmission occasion in frequency domain with respective to PRB 0. The value is configured so that the corresponding RACH resource is entirely within the bandwidth of the UL BWP. (see TS 38.211 [16], clause 6.3.3.2).

powerRampingStep

Power ramping steps for PRACH (see TS 38.321 [3],5.1.3).

prach-ConfigurationIndex

PRACH configuration index. For *prach-ConfigurationIndex* configured under *beamFailureRecovery-Config*, the *prach-ConfigurationIndex* can only correspond to the short preamble format, (see TS 38.211 [16], clause 6.3.3.2).

preambleReceivedTargetPower

The target power level at the network receiver side (see TS 38.213 [13], clause 7.4, TS 38.321 [3], clauses 5.1.2, 5.1.3). Only multiples of 2 dBm may be chosen (e.g. -202, -200, -198, ...).

preambleTransMax

Max number of RA preamble transmission performed before declaring a failure (see TS 38.321 [3], clauses 5.1.4, 5.1.5).

ra-ResponseWindow

Msg2 (RAR) window length in number of slots. The network configures a value lower than or equal to 10 ms (see TS 38.321 [3], clause 5.1.4). UE ignores the field if included in SCellConfig.

zeroCorrelationZoneConfig

N-CS configuration, see Table 6.3.3.1-5 in TS 38.211 [16].

RA-Prioritization

The IE RA-Prioritization is used to configure prioritized random access.

RA-Prioritization information element

```
-- ASN1START
-- TAG-RA-PRIORITIZATION-START

RA-Prioritization ::= SEQUENCE {
    powerRampingStepHighPriority ENUMERATED {dB0, dB2, dB4, dB6},
    scalingFactorBI ENUMERATED {zero, dot25, dot5, dot75}
    ...
}

-- TAG-RA-PRIORITIZATION-STOP
-- ASN1STOP
```

RA-Prioritization field descriptions

powerRampingStepHighPrioritiy

Power ramping step applied for prioritized random access procedure.

scalingFactorBI

Scaling factor for the backoff indicator (BI) for the prioritized random access procedure. (see TS 38.321 [3], clause 5.1.4). Value zero corresponds to 0, value dot25 corresponds to 0.25 and so on.

RadioBearerConfig

The IE *RadioBearerConfig* is used to add, modify and release signalling and/or data radio bearers. Specifically, this IE carries the parameters for PDCP and, if applicable, SDAP entities for the radio bearers.

RadioBearerConfig information element

```
-- ASN1START
-- TAG-RADIOBEARERCONFIG-START
RadioBearerConfig ::=
                                       SEQUENCE {
    srb-ToAddModList
                                           SRB-ToAddModList
                                                                                                   OPTIONAL, -- Cond HO-Conn
                                                                                                   OPTIONAL, -- Need N
    srb3-ToRelease
                                           ENUMERATED { true }
                                           DRB-ToAddModList
                                                                                                   OPTIONAL, -- Cond HO-toNR
   drb-ToAddModList
                                                                                                   OPTIONAL, -- Need N
   drb-ToReleaseList
                                           DRB-ToReleaseList
    securityConfig
                                           SecurityConfig
                                                                                                   OPTIONAL, -- Need M
    . . .
SRB-ToAddModList ::=
                                       SEQUENCE (SIZE (1..2)) OF SRB-ToAddMod
SRB-ToAddMod ::=
                                       SEOUENCE
    srb-Identity
                                           SRB-Identity,
   reestablishPDCP
                                           ENUMERATED{true}
                                                                                                   OPTIONAL, -- Need N
   discardOnPDCP
                                           ENUMERATED{true}
                                                                                                   OPTIONAL, -- Need N
                                                                                                   OPTIONAL, -- Cond PDCP
   pdcp-Config
                                           PDCP-Config
DRB-ToAddModList ::=
                                       SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod
DRB-ToAddMod ::=
                                       SEOUENCE {
                                           CHOICE {
    cnAssociation
       eps-BearerIdentity
                                               INTEGER (0..15),
                                               SDAP-Config
       sdap-Config
                                                                                                   OPTIONAL, -- Cond DRBSetup
    drb-Identity
                                           DRB-Identity,
   reestablishPDCP
                                           ENUMERATED{true}
                                                                                                   OPTIONAL, -- Need N
                                           ENUMERATED{true}
                                                                                                   OPTIONAL, -- Need N
   recoverPDCP
                                           PDCP-Config
                                                                                                   OPTIONAL, -- Cond PDCP
   pdcp-Config
DRB-ToReleaseList ::=
                                       SEQUENCE (SIZE (1..maxDRB)) OF DRB-Identity
```

OPTIONAL, -- Cond RBTermChange1
OPTIONAL, -- Cond RBTermChange

DRB-ToAddMod field descriptions

cnAssociation

Indicates if the bearer is associated with the eps-bearerIdentity (when connected to EPC) or sdap-Config (when connected to 5GC).

drb-Identity

In case of DC, the DRB identity is unique within the scope of the UE, i.e. an MCG DRB cannot use the same value as a split DRB. For a split DRB the same identity is used for the MCG and SCG parts of the configuration.

eps-BearerIdentity

The EPS bearer ID determines the EPS bearer.

reestablishPDCP

Indicates that PDCP should be re-established. Network sets this to *true* whenever the security key used for this radio bearer changes. Key change could for example be due to termination point change for the bearer, reconfiguration with sync, resuming an RRC connection, or the first reconfiguration after reestablishment. It is also applicable for LTE procedures when NR PDCP is configured.

recoverPDCP

Indicates that PDCP should perform recovery according to TS 38.323 [5].

sdap-Config

The SDAP configuration determines how to map QoS flows to DRBs when NR or E-UTRA connects to the 5GC and presence/absence of UL/DL SDAP headers.

RadioBearerConfig field descriptions

securityConfia

Indicates the security algorithm and key to use for the signalling and data radio bearers configured with the list in this IE *RadioBearerConfig*. When the field is not included after AS security has been activated, the UE shall continue to use the currently configured *keyToUse* and security algorithm for the radio bearers reconfigured with the lists in this IE *RadioBearerConfig*. The field is not included when configuring SRB1 before AS security is activated.

srb3-ToRelease

Release SRB3. SRB3 release can only be done over SRB1 and only at SCG release and reconfiguration with sync.

SecurityConfig field descriptions

keyToUse

Indicates if the bearers configured with the list in this IE *RadioBearerConfig* are using the master key or the secondary key for deriving ciphering and/or integrity protection keys. For MR-DC, network should not configure SRB1 and SRB2 with secondary key and SRB3 with the master key. When the field is not included, the UE shall continue to use the currently configured *keyToUse* for the radio bearers reconfigured with the lists in this IE *RadioBearerConfig*.

securityAlgorithmConfig

Indicates the security algorithm for the signalling and data radio bearers configured with the list in this IE *RadioBearerConfig*. When the field is not included, the UE shall continue to use the currently configured security algorithm for the radio bearers reconfigured with the lists in this IE *RadioBearerConfig*.

SRB-ToAddMod field descriptions

discardOnPDCP

Indicates that PDCP should discard stored SDU and PDU according to TS 38.323 [5].

reestablishPDCP

Indicates that PDCP should be re-established. Network sets this to *true* whenever the security key used for this radio bearer changes. Key change could for example be due to reconfiguration with sync, for SRB2 when resuming an RRC connection, or at the first reconfiguration after RRC connection reestablishment in NR. For SRB1, when resuming an RRC connection, or at the first reconfiguration after RRC connection reestablishment in NR, the network does not set this field to *true*. For LTE SRBs using NR PDCP, it could be for handover, RRC connection reestablishment or resume.

srb-Identity

Value 1 is applicable for SRB1 only. Value 2 is applicable for SRB2 only. Value 3 is applicable for SRB3 only.

Conditional Presence	Explanation
RBTermChange	The field is mandatory present in case of:
	- set up of signalling,
	 data radio bearer and change of termination point for the radio bearer between MN and SN.
	It is optionally present otherwise, Need S.
RBTermChange1	The field is mandatory present in case of:
	- set up of signalling and data radio bearer,
	- change of termination point for the radio bearer between MN and SN,
	- handover from E-UTRA/EPC or E-UTRA/5GC to NR,
	 handover from NR or E-UTRA/EPC to E-UTRA/5GC if the UE supports NGEN-DC.
	It is optionally present otherwise, Need S.
PDCP	The field is mandatory present if the corresponding DRB is being setup or corresponding DRB is reconfigured with NR
	PDCP or corresponding SRB associated with two RLC entities is being setup or if the number of RLC bearers associated
	with the DRB or SRB is changed. The field is optionally present, Need S, if the corresponding SRB associated with one RLC
	entity is being setup or corresponding SRB is reconfigured with NR PDCP; otherwise the field is optionally present, need M.
DRBSetup	The field is mandatory present if the corresponding DRB is being setup; otherwise the field is optionally present, need M.
HO-Conn	The field is mandatory present
	 in case of inter-system handover from E-UTRA/EPC to E-UTRA/5GC or NR,
	- or when the fullConfig is included in the RRCReconfiguration message and NE-DC/NR-DC is not configured,
	- or in case of RRCSetup.
	Otherwise the field is optionally present, need N.
	Upon RRCSetup, only SRB1 can be present.
HO-toNR	The field is mandatory present
	 in case of inter-system handover from E-UTRA/EPC to E-UTRA/5GC or NR,
	- or when the <i>fullConfig</i> is included in the <i>RRCReconfiguration</i> message and NE-DC/NR-DC is not configured.
	In case of <i>RRCSetup</i> , the field is absent; otherwise the field is optionally present, need N.

RadioLinkMonitoringConfig

The IE RadioLinkMonitoringConfig is used to configure radio link monitoring for detection of beam- and/or cell radio link failure. See also TS 38.321 [3], clause 5.1.1.

RadioLinkMonitoringConfig information element

```
-- ASN1START
-- TAG-RADIOLINKMONITORINGCONFIG-START
RadioLinkMonitoringConfig ::=
    failureDetectionResourcesToAddModList
                                           SEQUENCE (SIZE(1..maxNrofFailureDetectionResources)) OF RadioLinkMonitoringRS
                                                                                                                 OPTIONAL, -- Need N
    failureDetectionResourcesToReleaseList SEOUENCE (SIZE(1..maxNrofFailureDetectionResources)) OF RadioLinkMonitoringRS-Id
                                                                                                                 OPTIONAL, -- Need N
    beamFailureInstanceMaxCount
                                           ENUMERATED {n1, n2, n3, n4, n5, n6, n8, n10}
                                                                                                                 OPTIONAL, -- Need R
    beamFailureDetectionTimer
                                           ENUMERATED {pbfd1, pbfd2, pbfd3, pbfd4, pbfd5, pbfd6, pbfd8, pbfd10} OPTIONAL, -- Need R
RadioLinkMonitoringRS ::=
                                   SEOUENCE {
    radioLinkMonitoringRS-Id
                                       RadioLinkMonitoringRS-Id,
                                       ENUMERATED {beamFailure, rlf, both},
                                       CHOICE {
   detectionResource
       ssb-Index
                                           SSB-Index,
       csi-RS-Index
                                           NZP-CSI-RS-ResourceId
-- TAG-RADIOLINKMONITORINGCONFIG-STOP
-- ASN1STOP
```

RadioLinkMonitoringConfig field descriptions

beamFailureDetectionTimer

Timer for beam failure detection (see TS 38.321 [3], clause 5.17). See also the *BeamFailureRecoveryConfig* IE. Value in number of "Qout,LR reporting periods of Beam Failure Detection" Reference Signal (see TS 38.213 [13], clause 6). Value *pbfd1* corresponds to 1 Qout,LR reporting period of Beam Failure Detection Reference Signal, value *pbfd2* corresponds to 2 Qout,LR reporting periods of Beam Failure Detection Reference Signal and so on.

beamFailureInstanceMaxCount

This field determines after how many beam failure events the UE triggers beam failure recovery (see TS 38.321 [3], clause 5.17). Value n1 corresponds to 1 beam failure instance, value n2 corresponds to 2 beam failure instances and so on.

failureDetectionResourcesToAddModList

A list of reference signals for detecting beam failure and/or cell level radio link failure (RLF). The limits of the reference signals that the network can configure are specified in TS 38.213 [13], table 5-1. The network configures at most two detectionResources per BWP for the purpose *beamFailure* or *both*. If no RSs are provided for the purpose of beam failure detection, the UE performs beam monitoring based on the activated *TCI-State* for PDCCH as described in TS 38.213 [13], clause 6. If no RSs are provided in this list for the purpose of RLF detection, the UE performs Cell-RLM based on the activated *TCI-State* of PDCCH as described in TS 38.213 [13], clause 5. The network ensures that the UE has a suitable set of reference signals for performing cell-RLM.

RadioLinkMonitoringRS field descriptions

detectionResource

A reference signal that the UE shall use for radio link monitoring or beam failure detection (depending on the indicated purpose).

purpose

Determines whether the UE shall monitor the associated reference signal for the purpose of cell- and/or beam failure detection.

RadioLinkMonitoringRS-Id

The IE RadioLinkMonitoringRS-Id is used to identify one RadioLinkMonitoringRS.

RadioLinkMonitoringRS-Id information element

- -- ASN1START
- -- TAG-RADIOLINKMONITORINGRS-ID-START

RadioLinkMonitoringRS-Id ::=

INTEGER (0..maxNrofFailureDetectionResources-1)

- -- TAG-RADIOLINKMONITORINGRS-ID-STOP
- -- ASN1STOP

RAN-AreaCode

The IE RAN-AreaCode is used to identify a RAN area within the scope of a tracking area.

RAN-AreaCode information element

- -- ASN1START
- -- TAG-RAN-AREACODE-START

RAN-AreaCode ::= INTEGER (0..255)

- -- TAG-RAN-AREACODE-STOP
- -- ASN1STOP

RateMatchPattern

The IE RateMatchPattern is used to configure one rate matching pattern for PDSCH, see TS 38.214 [19], clause 5.1.4.1.

RateMatchPattern information element

- -- ASN1START
- -- TAG-RATEMATCHPATTERN-START

```
SEOUENCE {
RateMatchPattern ::=
    rateMatchPatternId
                                       RateMatchPatternId,
                                       CHOICE {
    patternType
       bitmaps
                                           SEQUENCE {
           resourceBlocks
                                                BIT STRING (SIZE (275)),
           symbolsInResourceBlock
                                                CHOICE {
               oneSlot
                                                    BIT STRING (SIZE (14)),
                twoSlots
                                                    BIT STRING (SIZE (28))
           periodicityAndPattern
                                               CHOICE {
                                                    BIT STRING (SIZE (2)),
                n4
                                                   BIT STRING (SIZE (4)),
               n5
                                                   BIT STRING (SIZE (5)),
               n8
                                                   BIT STRING (SIZE (8)),
               n10
                                                   BIT STRING (SIZE (10)),
               n20
                                                    BIT STRING (SIZE (20)),
               n40
                                                   BIT STRING (SIZE (40))
       controlResourceSet
                                           ControlResourceSetId
    subcarrierSpacing
                                        SubcarrierSpacing
                                        ENUMERATED { dynamic, semiStatic },
    dummy
-- TAG-RATEMATCHPATTERN-STOP
-- ASN1STOP
```

```
OPTIONAL, -- Need S

OPTIONAL, -- Cond CellLevel
```

RateMatchPattern field descriptions

bitmaps

Indicates rate matching pattern by a pair of bitmaps *resourceBlocks* and *symbolsInResourceBlock* to define the rate match pattern within one or two slots, and a third bitmap *periodicityAndPattern* to define the repetition pattern with which the pattern defined by the above bitmap pair occurs.

controlResourceSet

This ControlResourceSet is used as a PDSCH rate matching pattern, i.e., PDSCH reception rate matches around it. In frequency domain, the resource is determined by the frequency domain resource of the CORESET with the corresponding CORESET ID. Time domain resource is determined by the parameters of the associated search space of the CORESET.

periodicityAndPattern

A time domain repetition pattern at which the pattern defined by symbolsInResourceBlock and resourceBlocks recurs. This slot pattern repeats itself continuously. Absence of this field indicates the value n1 (see TS 38.214 [19], clause 5.1.4.1).

resourceBlocks

A resource block level bitmap in the frequency domain. A bit in the bitmap set to 1 indicates that the UE shall apply rate matching in the corresponding resource block in accordance with the *symbolsInResourceBlock* bitmap. If used as cell-level rate matching pattern, the bitmap identifies "common resource blocks (CRB)". If used as BWP-level rate matching pattern, the bitmap identifies "physical resource blocks" inside the BWP. The first/ leftmost bit corresponds to resource block 0, and so on (see TS 38.214 [19], clause 5.1.4.1).

subcarrierSpacing

The SubcarrierSpacing for this resource pattern. If the field is absent, the UE applies the SCS of the associated BWP. The value kHz15 corresponds to μ =0, the value kHz30 corresponds to μ =1, and so on. Only the values 15 kHz, 30 kHz or 60 kHz (FR1), and 60 kHz or 120 kHz (FR2) are applicable (see TS 38.214 [19], clause 5.1.4.1).

symbolsInResourceBlock

A symbol level bitmap in time domain. It indicates with a bit set to true that the UE shall rate match around the corresponding symbol. This pattern recurs (in time domain) with the configured periodicityAndPattern (see TS 38.214 [19], clause 5.1.4.1).

For one Slot, if ECP is configured, the first 12 bits represent the symbols within the slot and the last two bits within the bitstring are ignored by the UE; Otherwise, the 14 bits represent the symbols within the slot.

For *twoSlots*, if ECP is configured, the first 12 bits represent the symbols within the first slot and the next 12 bits represent the symbols in the second slot and the last four bits within the bit string are ignored by the UE; Otherwise, the first 14 bits represent the symbols within the first slot and the next 14 bits represent the symbols in the second slot. For the bits representing symbols in a slot, the most significant bit of the bit string represents the first symbol in the slot and the second most significant bit represents the second symbol in the slot and so on.

Conditional Presence	Explanation
CellLevel	The field is mandatory present if the RateMatchPattern is defined on cell level. The field is absent when the RateMatchPattern is defined on BWP level. If the RateMatchPattern is defined on BWP level, the UE applies the SCS of the
	BWP.

RateMatchPatternId

The IE RateMatchPatternId identifies one RateMatchMattern (see TS 38.214 [19], clause 5.1.4.2).

RateMatchPatternId information element

```
-- ASN1START
-- TAG-RATEMATCHPATTERNID-START
```

RateMatchPatternId ::= INTEGER (0..maxNrofRateMatchPatterns-1)

```
-- TAG-RATEMATCHPATTERNID-STOP
-- ASN1STOP
```

RateMatchPatternLTE-CRS

The IE RateMatchPatternLTE-CRS is used to configure a pattern to rate match around LTE CRS. See TS 38.214 [19], clause 5.1.4.2.

RateMatchPatternLTE-CRS information element

```
-- ASN1START
-- TAG-RATEMATCHPATTERNLTE-CRS-START
RateMatchPatternLTE-CRS ::=
                                    SEOUENCE {
                                        INTEGER (0..16383),
   carrierFreqDL
   carrierBandwidthDL
   carrierBandwidthDL
mbsfn-SubframeConfigList
                                        ENUMERATED {n6, n15, n25, n50, n75, n100, spare2, spare1},
                                        EUTRA-MBSFN-SubframeConfigList
                                                                                                                 OPTIONAL. -- Need M
   nrofCRS-Ports
                                        ENUMERATED {n1, n2, n4},
   v-Shift
                                        ENUMERATED {n0, n1, n2, n3, n4, n5}
-- TAG-RATEMATCHPATTERNLTE-CRS-STOP
-- ASN1STOP
```

RateMatchPatternLTE-CRS field descriptions

carrierBandwidthDL

BW of the LTE carrier in number of PRBs (see TS 38.214 [19], clause 5.1.4.2).

carrierFreqDL

Center of the LTE carrier (see TS 38.214 [19], clause 5.1.4.2).

mbsfn-SubframeConfigList

LTE MBSFN subframe configuration (see TS 38.214 [19], clause 5.1.4.2).

nrofCRS-Ports

Number of LTE CRS antenna port to rate-match around (see TS 38.214 [19], clause 5.1.4.2).

v-Shift

Shifting value v-shift in LTE to rate match around LTE CRS (see TS 38.214 [19], clause 5.1.4.2).

– RejectWaitTime

The IE *RejectWaitTime* is used to provide the value in seconds for timer T302.

RejectWaitTime information element

```
-- TAG-REJECTWAITTIME-START

RejectWaitTime ::= INTEGER (1..16)

-- TAG-REJECTWAITTIME-STOP

-- ASN1STOP
```

ReportConfigld

The IE *ReportConfigId* is used to identify a measurement reporting configuration.

ReportConfigId information element

```
-- ASN1START
-- TAG-REPORTCONFIGID-START

ReportConfigId ::= INTEGER (1..maxReportConfigId)
-- TAG-REPORTCONFIGID-STOP
-- ASN1STOP
```

ReportConfigInterRAT

The IE *ReportConfigInterRAT* specifies criteria for triggering of an inter-RAT measurement reporting event. The inter-RAT measurement reporting events for E-UTRA are labelled BN with N equal to 1, 2 and so on.

Event B1: Neighbour becomes better than absolute threshold;

Event B2: PCell becomes worse than absolute threshold1 AND Neighbour becomes better than another absolute threshold2;

ReportConfigInterRAT information element

```
-- ASN1START
-- TAG-REPORTCONFIGINTERRAT-START
ReportConfigInterRAT ::=
                                            SEQUENCE {
    reportType
       periodical
                                                    PeriodicalReportConfigInterRAT,
       eventTriggered
                                                    EventTriggerConfigInterRAT,
       reportCGI
                                                    ReportCGI-EUTRA,
       reportSFTD
                                                    ReportSFTD-EUTRA
ReportCGI-EUTRA ::=
                                            SEQUENCE {
    cellForWhichToReportCGI
                                    EUTRA-PhysCellId,
```

```
ReportSFTD-EUTRA ::=
                                          SEQUENCE {
    reportSFTD-Meas
                                                BOOLEAN,
    reportRSRP
                                                BOOLEAN,
    . . .
EventTriggerConfigInterRAT ::=
                                            SEQUENCE {
    eventId
                                                 CHOICE {
        eventB1
                                                     SEQUENCE {
            b1-ThresholdEUTRA
                                                         MeasTriggerQuantityEUTRA,
            reportOnLeave
                                                         BOOLEAN,
            hysteresis
                                                         Hysteresis,
            timeToTrigger
                                                         TimeToTrigger,
        eventB2
                                                     SEOUENCE {
            b2-Threshold1
                                                         MeasTriggerQuantity,
            b2-Threshold2EUTRA
                                                         MeasTriggerQuantityEUTRA,
            reportOnLeave
                                                         BOOLEAN,
            hysteresis
                                                         Hysteresis,
            timeToTrigger
                                                         TimeToTrigger,
        },
        . . .
                                        NR-RS-Type,
    rsType
    reportInterval
                                        ReportInterval,
    reportAmount
                                        ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity},
    reportQuantity
                                        MeasReportQuantity,
    maxReportCells
                                        INTEGER (1..maxCellReport),
    . . .
PeriodicalReportConfigInterRAT ::=
                                                 SEQUENCE {
    reportInterval
                                                     ReportInterval,
                                                     ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity},
    reportAmount
                                                     MeasReportQuantity,
    reportQuantity
    maxReportCells
                                                     INTEGER (1..maxCellReport),
-- TAG-REPORTCONFIGINTERRAT-STOP
-- ASN1STOP
```

ReportConfigInterRAT field descriptions

reportType

Type of the configured measurement report. In (NG)EN-DC and NR-DC, network does not configure report of type ReportCGI-EUTRA for SCG.

EventTriggerConfigInterRAT field descriptions

b2-Threshold1

NR threshold to be used in inter RAT measurement report triggering condition for event B2.

bN-ThresholdEUTRA

E-UTRA threshold value associated with the selected trigger quantity (RSRP, RSRQ, SINR) to be used in inter RAT measurement report triggering condition for event number bN. In the same eventB2, the network configures the same CHOICE name (rsrp, rsrq or sinr) for the MeasTriggerQuantity of the b2-Threshold1 and for the MeasTriggerQuantityEUTRA of the b2-Threshold2EUTRA.

eventld

Choice of inter RAT event triggered reporting criteria.

maxReportCells

Max number of non-serving cells to include in the measurement report.

reportAmount

Number of measurement reports applicable for eventTriggered as well as for periodical report types

reportOnLeave

Indicates whether or not the UE shall initiate the measurement reporting procedure when the leaving condition is met for a cell in cellsTriggeredList, as specified in 5.5.4.1.

reportQuantity

The cell measurement quantities to be included in the measurement report.

timeToTrigger

Time during which specific criteria for the event needs to be met in order to trigger a measurement report.

PeriodicalReportConfigInterRAT field descriptions

maxReportCells

Max number of non-serving cells to include in the measurement report.

reportAmount

Number of measurement reports applicable for eventTriggered as well as for periodical report types

reportQuantity

The cell measurement quantities to be included in the measurement report.

ReportConfigNR

The IE *ReportConfigNR* specifies criteria for triggering of an NR measurement reporting event. Measurement reporting events are based on cell measurement results, which can either be derived based on SS/PBCH block or CSI-RS. These events are labelled AN with N equal to 1, 2 and so on.

- Event A1: Serving becomes better than absolute threshold;
- Event A2: Serving becomes worse than absolute threshold;
- Event A3: Neighbour becomes amount of offset better than PCell/PSCell;

- Event A4: Neighbour becomes better than absolute threshold;
- Event A5: PCell/PSCell becomes worse than absolute threshold1 AND Neighbour/SCell becomes better than another absolute threshold2;
- Event A6: Neighbour becomes amount of offset better than SCell.

ReportConfigNR information element

```
-- ASN1START
-- TAG-REPORTCONFIGNR-START
ReportConfigNR ::=
                                            SEQUENCE {
   reportType
                                                CHOICE
       periodical
                                                     PeriodicalReportConfig,
                                                     EventTriggerConfig,
       eventTriggered
       reportCGI
                                                     ReportCGI,
       reportSFTD
                                                     ReportSFTD-NR
ReportCGI ::=
                                  SEOUENCE {
                                     PhysCellId,
    cellForWhichToReportCGI
ReportSFTD-NR ::=
                                  SEQUENCE {
   reportSFTD-Meas
                                     BOOLEAN,
   reportRSRP
                                     BOOLEAN,
    . . . ,
    [ [
    reportSFTD-NeighMeas
                                     ENUMERATED {true}
                                                                                       OPTIONAL,
                                                                                                   -- Need R
                                                                                       OPTIONAL, -- Need R
    drx-SFTD-NeighMeas
                                     ENUMERATED {true}
                                                                                                   -- Need R
    cellsForWhichToReportSFTD
                                     SEQUENCE (SIZE (1..maxCellSFTD)) OF PhysCellId
                                                                                       OPTIONAL
    ]]
EventTriggerConfig::=
                                            SEQUENCE {
    eventId
                                                CHOICE {
       eventA1
                                                     SEQUENCE {
           al-Threshold
                                                        MeasTriggerQuantity,
           reportOnLeave
                                                        BOOLEAN,
           hysteresis
                                                        Hysteresis,
           timeToTrigger
                                                        TimeToTrigger
        eventA2
                                                     SEQUENCE {
           a2-Threshold
                                                        MeasTriggerQuantity,
           reportOnLeave
                                                        BOOLEAN,
           hysteresis
                                                        Hysteresis,
           timeToTrigger
                                                        TimeToTrigger
       eventA3
                                                     SEQUENCE {
           a3-Offset
                                                        MeasTriggerQuantityOffset,
```

```
reportOnLeave
                                                         BOOLEAN,
           hysteresis
                                                        Hysteresis,
           timeToTrigger
                                                        TimeToTrigger,
           useWhiteCellList
                                                        BOOLEAN
        },
       event.A4
                                                     SEQUENCE {
            a4-Threshold
                                                        MeasTriggerOuantity,
                                                         BOOLEAN.
           reportOnLeave
           hysteresis
                                                        Hysteresis,
           timeToTrigger
                                                        TimeToTrigger,
           useWhiteCellList
                                                        BOOLEAN
       },
       eventA5
                                                     SEOUENCE {
            a5-Threshold1
                                                        MeasTriggerQuantity,
                                                        MeasTriggerQuantity,
           a5-Threshold2
           reportOnLeave
                                                        BOOLEAN,
           hysteresis
                                                        Hysteresis,
           timeToTrigger
                                                        TimeToTrigger,
           useWhiteCellList
                                                        BOOLEAN
       eventA6
                                                     SEQUENCE {
           a6-Offset
                                                        MeasTriggerQuantityOffset,
           reportOnLeave
                                                         BOOLEAN,
           hysteresis
                                                        Hysteresis,
           timeToTrigger
                                                        TimeToTrigger,
           useWhiteCellList
                                                        BOOLEAN
    rsType
                                                NR-RS-Type,
    reportInterval
                                                ReportInterval,
    reportAmount
                                                ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity},
    reportQuantityCell
                                                MeasReportQuantity,
    maxReportCells
                                                INTEGER (1..maxCellReport),
    reportQuantityRS-Indexes
                                                 MeasReportQuantity
                                                                                                                 OPTIONAL, -- Need R
    maxNrofRS-IndexesToReport
                                                INTEGER (1..maxNrofIndexesToReport)
                                                                                                                 OPTIONAL,
                                                                                                                            -- Need R
    includeBeamMeasurements
                                                BOOLEAN,
                                                ENUMERATED {setup}
    reportAddNeighMeas
                                                                                                                 OPTIONAL.
                                                                                                                            -- Need R
PeriodicalReportConfig ::=
                                            SEQUENCE {
   rsType
                                                NR-RS-Type,
    reportInterval
                                                ReportInterval,
                                                ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity},
    reportAmount
    reportOuantityCell
                                                MeasReportQuantity,
    maxReportCells
                                                INTEGER (1..maxCellReport),
```

```
reportOuantityRS-Indexes
                                                MeasReportOuantity
    maxNrofRS-IndexesToReport
                                                INTEGER (1..maxNrofIndexesToReport)
    includeBeamMeasurements
                                                BOOLEAN,
    useWhiteCellList
                                                BOOLEAN,
                                            ENUMERATED {ssb, csi-rs}
NR-RS-Type ::=
MeasTriggerQuantity ::=
                                            CHOICE {
    rsrp
                                                RSRP-Range,
                                                RSRQ-Range,
    rsrq
    sinr
                                                SINR-Range
MeasTriggerQuantityOffset ::=
                                            CHOICE {
                                                INTEGER (-30..30),
    rsrp
                                                INTEGER (-30..30),
    rsrq
    sinr
                                                INTEGER (-30..30)
MeasReportQuantity ::=
                                            SEQUENCE {
    rsrp
                                                BOOLEAN,
    rsrq
                                                BOOLEAN,
    sinr
                                                BOOLEAN
-- TAG-REPORTCONFIGNR-STOP
-- ASN1STOP
```

```
OPTIONAL, -- Need R
OPTIONAL, -- Need R
```

ReportConfigNR field descriptions

reportType

Type of the configured measurement report. In MR-DC, network does not configure report of type reportCGI using SRB3.

EventTriggerConfig field descriptions

a3-Offset/a6-Offset

Offset value(s) to be used in NR measurement report triggering condition for event a3/a6. The actual value is field value * 0.5 dB.

aN-ThresholdM

Threshold value associated to the selected trigger quantity (e.g. RSRP, RSRQ, SINR) per RS Type (e.g. SS/PBCH block, CSI-RS) to be used in NR measurement report triggering condition for event number aN. If multiple thresholds are defined for event number aN, the thresholds are differentiated by M. The network configures aN-Threshold1 only for events A1, A2, A4, A5 and a5-Threshold2 only for event A5. In the same eventA5, the network configures the same quantity for the MeasTriggerQuantity of the a5-Threshold1 and for the MeasTriggerQuantity of the a5-Threshold2.

eventld

Choice of NR event triggered reporting criteria.

maxNrofRS-IndexesToReport

Max number of RS indexes to include in the measurement report for A1-A6 events.

maxReportCells

Max number of non-serving cells to include in the measurement report.

reportAddNeighMeas

Indicates that the UE shall include the best neighbour cells per serving frequency.

reportAmount

Number of measurement reports applicable for eventTriggered as well as for periodical report types.

reportOnLeave

Indicates whether or not the UE shall initiate the measurement reporting procedure when the leaving condition is met for a cell in cellsTriggeredList, as specified in 5.5.4.1.

reportQuantitvCell

The cell measurement quantities to be included in the measurement report.

reportQuantitvRS-Indexes

Indicates which measurement information per RS index the UE shall include in the measurement report.

timeToTrigger

Time during which specific criteria for the event needs to be met in order to trigger a measurement report.

useWhiteCellList

Indicates whether only the cells included in the white-list of the associated measObject are applicable as specified in 5.5.4.1.

PeriodicalReportConfig field descriptions

maxNrofRS-IndexesToReport

Max number of RS indexes to include in the measurement report.

maxReportCells

Max number of non-serving cells to include in the measurement report.

reportAmount

Number of measurement reports applicable for eventTriggered as well as for periodical report types

reportQuantitvCell

The cell measurement quantities to be included in the measurement report.

reportQuantityRS-Indexes

Indicates which measurement information per RS index the UE shall include in the measurement report.

useWhiteCellList

Indicates whether only the cells included in the white-list of the associated measObject are applicable as specified in 5.5.4.1.

ReportSFTD-NR field descriptions

cellForWhichToReportSFTD

Indicates the target NR neighbour cells for SFTD measurement between PCell and NR neighbour cells.

drx-SFTD-NeighMeas

Indicates that the UE shall use available idle periods (i.e. DRX off periods) for the SFTD measurement in NR standalone. The network only includes drx-SFTD-NeighMeas field when reprtSFTD-NeighMeas is set to true.

reportSFTD-Meas

Indicates whether UE is required to perform SFTD measurement between PCell and NR PSCell in NR-DC.

reportSFTD-NeighMeas

Indicates whether UE is required to perform SFTD measurement between PCell and NR neighbour cells in NR standalone. The network does not include this field if reportSFTD-Meas is set to true.

reportRSRP

Indicates whether UE is required to include RSRP result of NR PSCell or NR neighbour cells in SFTD measurement result, derived based on SSB. If it is set to true, the network should ensure that ssb-ConfigMobility is included in the measurement object for NR PSCell or NR neighbour cells.

ReportConfigToAddModList

The IE ReportConfigToAddModList concerns a list of reporting configurations to add or modify.

ReportConfigToAddModList information element

```
-- ASN1START
-- TAG-REPORTCONFIGTOADDMODLIST-START
                                    SEQUENCE (SIZE (1..maxReportConfigId)) OF ReportConfigToAddMod
ReportConfigToAddModList ::=
ReportConfigToAddMod ::=
                                   SEQUENCE {
                                       ReportConfigId,
   reportConfigId
   reportConfig
                                        CHOICE {
       reportConfigNR
                                            ReportConfigNR,
        reportConfigInterRAT
                                            ReportConfigInterRAT
-- TAG-REPORTCONFIGTOADDMODLIST-STOP
-- ASN1STOP
```

ReportInterval

The IE *ReportInterval* indicates the interval between periodical reports. The *ReportInterval* is applicable if the UE performs periodical reporting (i.e. when *reportAmount* exceeds 1), for *triggerTypeevent* as well as for *triggerTypeeviodical*. Value *ms120* corresponds to 120 ms, value *ms240* corresponds to 240 ms and so on, while value *min1* corresponds to 1 min, *min6* corresponds to 6 min and so on.

ReportInterval information element

ReselectionThreshold

The IE ReselectionThreshold is used to indicate an Rx level threshold for cell reselection. Actual value of threshold = field value * 2 [dB].

ReselectionThreshold information element

```
-- ASN1START
-- TAG-RESELECTIONTHRESHOLD-START

ReselectionThreshold ::= INTEGER (0..31)

-- TAG-RESELECTIONTHRESHOLD-STOP
-- ASN1STOP
```

ReselectionThresholdQ

The IE *ReselectionThresholdQ* is used to indicate a quality level threshold for cell reselection. Actual value of threshold = field value [dB].

ReselectionThresholdQ information element

```
-- ASN1START
-- TAG-RESELECTIONTHRESHOLDQ-START

ReselectionThresholdQ ::= INTEGER (0..31)

-- TAG-RESELECTIONTHRESHOLDQ-STOP
-- ASN1STOP
```

ResumeCause

The IE ResumeCause is used to indicate the resume cause in RRCResumeRequest and RRCResumeRequest1.

ResumeCause information element

RLC-BearerConfig

The IE *RLC-BearerConfig* is used to configure an RLC entity, a corresponding logical channel in MAC and the linking to a PDCP entity (served radio bearer).

RLC-BearerConfig information element

```
-- ASN1START
-- TAG-RLC-BEARERCONFIG-START
RLC-BearerConfig ::=
   logicalChannelIdentity
                                               LogicalChannelIdentity,
    servedRadioBearer
                                               CHOICE {
       srb-Identity
                                                   SRB-Identity,
       drb-Identity
                                                   DRB-Identity
                                                                                                   OPTIONAL, -- Cond LCH-SetupOnly
   reestablishRLC
                                               ENUMERATED {true}
                                                                                                   OPTIONAL, -- Need N
                                                                                                   OPTIONAL, -- Cond LCH-Setup
   rlc-Config
                                               RLC-Config
                                                                                                   OPTIONAL, -- Cond LCH-Setup
   mac-LogicalChannelConfig
                                               LogicalChannelConfig
-- TAG-RLC-BEARERCONFIG-STOP
-- ASN1STOP
```

RLC-BearerConfig field descriptions

logicalChannelIdentity

ID used commonly for the MAC logical channel and for the RLC bearer.

reestablishRLC

Indicates that RLC should be re-established. Network sets this to *true* at least whenever the security key used for the radio bearer associated with this RLC entity changes. For SRB2 and DRBs, unless full configuration is used, it is also set to *true* during the resumption of the RRC connection or the first reconfiguration after reestablishment. For SRB1, when resuming an RRC connection, or at the first reconfiguration after RRC connection reestablishment, the network does not set this field to *true*.

rlc-Config

Determines the RLC mode (UM, AM) and provides corresponding parameters. RLC mode reconfiguration can only be performed by DRB release/addition or full configuration.

servedRadioBearer

Associates the RLC Bearer with an SRB or a DRB. The UE shall deliver DL RLC SDUs received via the RLC entity of this RLC bearer to the PDCP entity of the servedRadioBearer. Furthermore, the UE shall advertise and deliver uplink PDCP PDUs of the uplink PDCP entity of the servedRadioBearer to the uplink RLC entity of this RLC bearer unless the uplink scheduling restrictions (moreThanOneRLC in PDCP-Config and the restrictions in LogicalChannelConfig) forbid it to do so.

Conditional Presence	Explanation
LCH-Setup	This field is mandatory present upon creation of a new logical channel for a DRB. This field is optionally present, Need S, upon creation of a
	new logical channel for an SRB. It is optionally present, Need M, otherwise.
LCH-SetupOnly	This field is mandatory present upon creation of a new logical channel. It is absent, Need M otherwise.

RLC-Config

The IE RLC-Config is used to specify the RLC configuration of SRBs and DRBs.

RLC-Config information element

```
-- ASN1START
-- TAG-RLC-CONFIG-START
RLC-Config ::=
                                    CHOICE {
                                        SEQUENCE {
       ul-AM-RLC
                                            UL-AM-RLC,
       dl-AM-RLC
                                            DL-AM-RLC
                                        SEQUENCE {
    um-Bi-Directional
       ul-UM-RLC
                                            UL-UM-RLC,
       dl-UM-RLC
                                            DL-UM-RLC
    um-Uni-Directional-UL
                                        SEQUENCE {
       ul-UM-RLC
                                            UL-UM-RLC
    um-Uni-Directional-DL
                                        SEQUENCE {
       dl-UM-RLC
                                            DL-UM-RLC
UL-AM-RLC ::=
                                    SEQUENCE {
```

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```
sn-FieldLength
                                        SN-FieldLengthAM
                                                                                             OPTIONAL, -- Cond Reestab
    t-PollRetransmit
                                        T-PollRetransmit,
    Uddllod
                                        PollPDU.
    pollByte
                                        PollByte,
    maxRetxThreshold
                                        ENUMERATED { t1, t2, t3, t4, t6, t8, t16, t32 }
DL-AM-RLC ::=
                                    SEOUENCE {
    sn-FieldLength
                                        SN-FieldLengthAM
                                                                                             OPTIONAL, -- Cond Reestab
    t-Reassembly
                                        T-Reassembly,
    t-StatusProhibit
                                        T-StatusProhibit
UL-UM-RLC ::=
                                    SEOUENCE {
    sn-FieldLength
                                        SN-FieldLengthUM
                                                                                                         -- Cond Reestab
                                                                                             OPTIONAL
DL-UM-RLC ::=
                                    SEOUENCE {
    sn-FieldLength
                                        SN-FieldLengthUM
                                                                                             OPTIONAL,
                                                                                                        -- Cond Reestab
    t-Reassembly
                                        T-Reassembly
T-PollRetransmit ::=
                                    ENUMERATED {
                                        ms5, ms10, ms15, ms20, ms25, ms30, ms35,
                                        ms40, ms45, ms50, ms55, ms60, ms65, ms70,
                                        ms75, ms80, ms85, ms90, ms95, ms100, ms105,
                                        ms110, ms115, ms120, ms125, ms130, ms135,
                                        ms140, ms145, ms150, ms155, ms160, ms165,
                                        ms170, ms175, ms180, ms185, ms190, ms195,
                                        ms200, ms205, ms210, ms215, ms220, ms225,
                                        ms230, ms235, ms240, ms245, ms250, ms300,
                                        ms350, ms400, ms450, ms500, ms800, ms1000,
                                        ms2000, ms4000, spare5, spare4, spare3,
                                        spare2, spare1}
PollPDU ::=
                                    ENUMERATED {
                                        p4, p8, p16, p32, p64, p128, p256, p512, p1024, p2048, p4096, p6144, p8192, p12288, p16384, p20480,
                                        p24576, p28672, p32768, p40960, p49152, p57344, p65536, infinity, spare8, spare7, spare6, spare5, spare4,
                                        spare3, spare2, spare1}
PollByte ::=
                                    ENUMERATED {
                                        kB1, kB2, kB5, kB8, kB10, kB15, kB25, kB50, kB75,
                                        kB100, kB125, kB250, kB375, kB500, kB750, kB1000,
                                        kB1250, kB1500, kB2000, kB3000, kB4000, kB4500,
                                        kB5000, kB5500, kB6000, kB6500, kB7000, kB7500,
                                        mB8, mB9, mB10, mB11, mB12, mB13, mB14, mB15,
                                        mB16, mB17, mB18, mB20, mB25, mB30, mB40, infinity,
                                        spare20, spare19, spare18, spare17, spare16,
                                        spare15, spare14, spare13, spare12, spare11,
                                        spare10, spare9, spare8, spare7, spare6, spare5,
                                        spare4, spare3, spare2, spare1}
T-Reassembly ::=
                                    ENUMERATED {
```

```
ms0, ms5, ms10, ms15, ms20, ms25, ms30, ms35,
                                        ms40, ms45, ms50, ms55, ms60, ms65, ms70,
                                        ms75, ms80, ms85, ms90, ms95, ms100, ms110,
                                        ms120, ms130, ms140, ms150, ms160, ms170,
                                        ms180, ms190, ms200, spare1}
T-StatusProhibit ::=
                                    ENUMERATED {
                                        ms0, ms5, ms10, ms15, ms20, ms25, ms30, ms35,
                                        ms40, ms45, ms50, ms55, ms60, ms65, ms70,
                                        ms75, ms80, ms85, ms90, ms95, ms100, ms105,
                                        ms110, ms115, ms120, ms125, ms130, ms135,
                                        ms140, ms145, ms150, ms155, ms160, ms165,
                                        ms170, ms175, ms180, ms185, ms190, ms195,
                                        ms200, ms205, ms210, ms215, ms220, ms225,
                                        ms230, ms235, ms240, ms245, ms250, ms300,
                                        ms350, ms400, ms450, ms500, ms800, ms1000,
                                        ms1200, ms1600, ms2000, ms2400, spare2, spare1}
SN-FieldLengthUM ::=
                                    ENUMERATED {size6, size12}
SN-FieldLengthAM ::=
                                    ENUMERATED {size12, size18}
-- TAG-RLC-CONFIG-STOP
-- ASN1STOP
```

RLC-Config field descriptions

maxRetxThreshold

Parameter for RLC AM in TS 38.322 [4]. Value t1 corresponds to 1 retransmission, value t2 corresponds to 2 retransmissions and so on.

pollByte

Parameter for RLC AM in TS 38.322 [4]. Value kB25 corresponds to 25 kBytes, value kB50 corresponds to 50 kBytes and so on. infinity corresponds to an infinite amount of kBytes.

pollPDU

Parameter for RLC AM in TS 38.322 [4]. Value p4 corresponds to 4 PDUs, value p8 corresponds to 8 PDUs and so on. infinity corresponds to an infinite number of PDUs.

sn-FieldLength

Indicates the RLC SN field size, see TS 38.322 [4], in bits. Value *size6* means 6 bits, value *size12* means 12 bits, value *size18* means 18 bits. The value of *sn-FieldLength* for a DRB shall be changed only using reconfiguration with sync. The network configures only value *size12* in *SN-FieldLengthAM* for SRB.

t-PollRetransmit

Timer for RLC AM in TS 38.322 [4], in milliseconds. Value ms5 means 5 ms, value ms10 means 10 ms and so on.

t-Reassembly

Timer for reassembly in TS 38.322 [4], in milliseconds. Value ms0 means 0 ms, value ms5 means 5 ms and so on.

t-StatusProhibit

Timer for status reporting in TS 38.322 [4], in milliseconds. Value ms0 means 0 ms, value ms5 means 5 ms and so on.

Conditional Presence	Explanation
Reestab	The field is mandatory present at bearer setup. It is optionally present, need M, at RLC re-establishment. Otherwise it is
	absent. Need M.

RLF-TimersAndConstants

The IE *RLF-TimersAndConstants* is used to configure UE specific timers and constants.

RLF-TimersAndConstants information element

```
-- ASN1START
-- TAG-RLF-TIMERSANDCONSTANTS-START
RLF-TimersAndConstants ::=
                                    SEOUENCE {
    t.310
                                        ENUMERATED {ms0, ms50, ms100, ms200, ms500, ms1000, ms2000, ms4000, ms6000},
   n310
                                        ENUMERATED {n1, n2, n3, n4, n6, n8, n10, n20},
   n311
                                        ENUMERATED {n1, n2, n3, n4, n5, n6, n8, n10},
    11
    t311
                                        ENUMERATED {ms1000, ms3000, ms5000, ms10000, ms15000, ms20000, ms30000}
    11
-- TAG-RLF-TIMERSANDCONSTANTS-STOP
-- ASN1STOP
```

RLF-TimersAndConstants field descriptions

n3xy

Constants are described in clause 7.3. Value n1 corresponds to 1, value n2 corresponds to 2 and so on.

t3xy

Timers are described in clause 7.1. Value ms0 corresponds to 0 ms, value ms50 corresponds to 50 ms and so on.

– RNTI-Value

The IE $\ensuremath{\textit{RNTI-Value}}$ represents a Radio Network Temporary Identity.

RNTI-Value information element

```
-- ASN1START
-- TAG-RNTI-VALUE-START

RNTI-Value ::= INTEGER (0..65535)

-- TAG-RNTI-VALUE-STOP
-- ASN1STOP
```

- RSRP-Range

The IE *RSRP-Range* specifies the value range used in RSRP measurements and thresholds. For measurements, integer value for RSRP measurements is according to Table 10.1.6.1-1 in TS 38.133 [14]. For thresholds, the actual value is (IE value – 156) dBm, except for the IE value 127, in which case the actual value is infinity.

RSRP-Range information element

```
-- ASN1START
-- TAG-RSRP-RANGE-START

RSRP-Range ::= INTEGER(0..127)

-- TAG-RSRP-RANGE-STOP
-- ASN1STOP
```

- RSRQ-Range

The IE RSRQ-Range specifies the value range used in RSRQ measurements and thresholds. For measurements, integer value for RSRQ measurements is according to Table 10.1.11.1-1 in TS 38.133 [14]. For thresholds, the actual value is (IE value -87) / 2 dB.

RSRQ-Range information element

```
-- ASN1START
-- TAG-RSRQ-RANGE-START

RSRQ-Range ::= INTEGER(0..127)

-- TAG-RSRQ-RANGE-STOP
-- ASN1STOP
```

SCellIndex

The IE SCellIndex concerns a short identity, used to identify an SCell. The value range is shared across the Cell Groups.

SCellIndex information element

```
-- ASN1START
-- TAG-SCELLINDEX-START

SCellIndex ::= INTEGER (1..31)

-- TAG-SCELLINDEX-STOP
-- ASN1STOP
```

SchedulingRequestConfig

The IE SchedulingRequestConfig is used to configure the parameters, for the dedicated scheduling request (SR) resources.

SchedulingRequestConfig information element

```
-- ASN1START
-- TAG-SCHEDULINGREOUESTCONFIG-START
SchedulingRequestConfig ::=
                                   SEOUENCE {
    schedulingRequestToAddModList
                                       SEQUENCE (SIZE (1..maxNrofSR-ConfigPerCellGroup)) OF SchedulingRequestToAddMod
                                                                                                          OPTIONAL, -- Need N
    schedulingRequestToReleaseList
                                       SEQUENCE (SIZE (1..maxNrofSR-ConfigPerCellGroup)) OF SchedulingRequestId
                                                                                                          OPTIONAL -- Need N
SchedulingRequestToAddMod ::=
                                   SEOUENCE {
    schedulingRequestId
                                       SchedulingRequestId,
                                       ENUMERATED {ms1, ms2, ms4, ms8, ms16, ms32, ms64, ms128}
    sr-ProhibitTimer
                                                                                                          OPTIONAL, -- Need S
    sr-TransMax
                                       ENUMERATED { n4, n8, n16, n32, n64, spare3, spare2, spare1}
-- TAG-SCHEDULINGREQUESTCONFIG-STOP
-- ASN1STOP
```

SchedulingRequestConfig field descriptions

schedulingRequestToAddModList

List of Scheduling Request configurations to add or modify.

schedulingRequestToReleaseList

List of Scheduling Request configurations to release.

SchedulingRequestToAddMod field descriptions

schedulingRequestId

Used to modify a SR configuration and to indicate, in *LogicalChannelConfig*, the SR configuration to which a logical channel is mapped and to indicate, in *SchedulingRequestresourceConfig*, the SR configuration for which a scheduling request resource is used.

sr-ProhibitTimer

Timer for SR transmission on PUCCH in TS 38.321 [3]. Value is in ms. Value ms1 corresponds to 1ms, value ms2 corresponds to 2ms, and so on. When the field is absent, the UE applies the value 0.

sr-TransMax

Maximum number of SR transmissions as described in TS 38.321 [3]. Value n4 corresponds to 4, value n8 corresponds to 8, and so on.

SchedulingRequestId

The IE Scheduling RequestId is used to identify a Scheduling Request instance in the MAC layer.

SchedulingRequestId information element

```
-- ASN1START
-- TAG-SCHEDULINGREQUESTID-START

SchedulingRequestId ::= INTEGER (0..7)

-- TAG-SCHEDULINGREQUESTID-STOP
-- ASN1STOP
```

SchedulingRequestResourceConfig

The IE *SchedulingRequestResourceConfig* determines physical layer resources on PUCCH where the UE may send the dedicated scheduling request (D-SR) (see TS 38.213 [13], clause 9.2.4).

SchedulingRequestResourceConfig information element

```
-- ASN1START
-- TAG-SCHEDULINGREQUESTRESOURCECONFIG-START
                                        SEQUENCE {
SchedulingRequestResourceConfig ::=
    schedulingRequestResourceId
                                            SchedulingRequestResourceId,
    schedulingRequestID
                                            SchedulingRequestId,
   periodicityAndOffset
                                            CHOICE {
        sym2
                                                NULL,
                                                NULL,
        sym6or7
        sl1
                                                NULL,
                                                                             -- Recurs in every slot
        sl2
                                                INTEGER (0..1),
        sl4
                                                INTEGER (0..3),
        s15
                                                INTEGER (0..4),
        sl8
                                                INTEGER (0..7),
       s110
                                                INTEGER (0..9),
        s116
                                                 INTEGER (0..15),
        s120
                                                INTEGER (0..19),
        s140
                                                 INTEGER (0..39),
        s180
                                                 INTEGER (0..79),
        s1160
                                                 INTEGER (0..159),
        s1320
                                                 INTEGER (0..319),
        s1640
                                                 INTEGER (0..639)
                                                                                                              OPTIONAL,
                                                                                                                          -- Need M
                                            PUCCH-ResourceId
                                                                                                              OPTIONAL
                                                                                                                         -- Need M
    resource
-- TAG-SCHEDULINGREOUESTRESOURCECONFIG-STOP
-- ASN1STOP
```

SchedulingRequestResourceConfig field descriptions

periodicityAndOffset

SR periodicity and offset in number of symbols or slots (see TS 38.213 [13], clause 9.2.4) The following periodicities may be configured depending on the chosen subcarrier spacing:

SCS = 15 kHz: 2sym, 7sym, 1sl, 2sl, 4sl, 5sl, 8sl, 10sl, 16sl, 20sl, 40sl, 80sl

SCS = 30 kHz: 2sym, 7sym, 1sl, 2sl, 4sl, 8sl, 10sl, 16sl, 20sl, 40sl, 80sl, 160sl

SCS = 60 kHz: 2sym, 7sym/6sym, 1sl, 2sl, 4sl, 8sl, 16sl, 20sl, 40sl, 80sl, 16osl, 320sl

SCS = 120 kHz: 2sym, 7sym, 1sl, 2sl, 4sl, 8sl, 16sl, 40sl, 80sl, 160sl, 320sl, 640sl

sym6or7 corresponds to 6 symbols if extended cyclic prefix and a SCS of 60 kHz are configured, otherwise it corresponds to 7 symbols.

For periodicities 2sym, 7sym and sl1 the UE assumes an offset of 0 slots.

resource

ID of the PUCCH resource in which the UE shall send the scheduling request. The actual *PUCCH-Resource* is configured in *PUCCH-Config* of the same UL BWP and serving cell as this *SchedulingRequestResourceConfig*. The network configures a *PUCCH-Resource* of *PUCCH-format0* or *PUCCH-format1* (other formats not supported) (see TS 38.213 [13], clause 9.2.4)

schedulingRequestID

The ID of the SchedulingRequestConfig that uses this scheduling request resource.

SchedulingRequestResourceId

The IE SchedulingRequestResourceId is used to identify scheduling request resources on PUCCH.

SchedulingRequestResourceld information element

```
-- ASN1START
```

-- TAG-SCHEDULINGREQUESTRESOURCEID-START

SchedulingRequestResourceId ::= INTEGER (1..maxNrofSR-Resources)

- -- TAG-SCHEDULINGREOUESTRESOURCEID-STOP
- -- ASN1STOP

- ScramblingId

The IE *ScramblingID* is used for scrambling channels and reference signals.

ScramblingId information element

```
-- ASN1START
```

-- TAG-SCRAMBLINGID-START

ScramblingId ::= INTEGER(0..1023)

```
-- TAG-SCRAMBLINGID-STOP
-- ASN1STOP
```

SCS-SpecificCarrier

The IE SCS-SpecificCarrier provides parameters determining the location and width of the actual carrier or the carrier bandwidth. It is defined specifically for a numerology (subcarrier spacing (SCS)) and in relation (frequency offset) to Point A.

SCS-SpecificCarrier information element

```
-- ASN1START
-- TAG-SCS-SPECIFICCARRIER-START
SCS-SpecificCarrier ::=
                                    SEOUENCE {
    offsetToCarrier
                                        INTEGER (0..2199),
    subcarrierSpacing
                                        SubcarrierSpacing,
    carrierBandwidth
                                        INTEGER (1..maxNrofPhysicalResourceBlocks),
    ] ]
    txDirectCurrentLocation
                                    INTEGER (0..4095)
                                                                                             OPTIONAL
                                                                                                                 -- Need S
    11
-- TAG-SCS-SPECIFICCARRIER-STOP
-- ASN1STOP
```

SCS-SpecificCarrier field descriptions

carrierBandwidth

Width of this carrier in number of PRBs (using the subcarrierSpacing defined for this carrier) (see TS 38.211 [16], clause 4.4.2).

offsetToCarrier

Offset in frequency domain between Point A (lowest subcarrier of common RB 0) and the lowest usable subcarrier on this carrier in number of PRBs (using the subcarrierSpacing defined for this carrier). The maximum value corresponds to 275*8-1. See TS 38.211 [16], clause 4.4.2.

txDirectCurrentLocation

Indicates the downlink Tx Direct Current location for the carrier. A value in the range 0..3299 indicates the subcarrier index within the carrier. The values in the value range 3301..4095 are reserved and ignored by the UE. If this field is absent for downlink within ServingCellConfigCommon and ServingCellConfigCommonSIB, the UE assumes the default value of 3300 (i.e. "Outside the carrier"). (see TS 38.211 [16], clause 4.4.2). Network does not configure this field via ServingCellConfig or for uplink carriers.

subcarrierSpacing

Subcarrier spacing of this carrier. It is used to convert the offsetToCarrier into an actual frequency. Only the values 15 kHz, 30 kHz or 60 kHz (FR1), and 60 kHz or 120 kHz (FR2) are applicable.

SDAP-Config

The IE SDAP-Config is used to set the configurable SDAP parameters for a data radio bearer. All configured instances of SDAP-Config with the same value of pdu-Session correspond to the same SDAP entity as specified in TS 37.324 [24].

SDAP-Config information element

```
-- ASN1START
-- TAG-SDAP-CONFIG-START
SDAP-Config ::=
                                    SEOUENCE {
   pdu-Session
                                        PDU-SessionID,
    sdap-HeaderDL
                                        ENUMERATED {present, absent},
    sdap-HeaderUL
                                        ENUMERATED {present, absent},
    defaultDRB
                                        BOOLEAN.
   mappedOoS-FlowsToAdd
                                        SEQUENCE (SIZE (1..maxNrofOFIs)) OF OFI
                                                                                                                OPTIONAL, -- Need N
   mappedOoS-FlowsToRelease
                                        SEQUENCE (SIZE (1..maxNrofOFIs)) OF OFI
                                                                                                                OPTIONAL, -- Need N
OFI ::=
                                    INTEGER (0..maxOFI)
PDU-SessionID ::=
                                    INTEGER (0..255)
-- TAG-SDAP-CONFIG-STOP
-- ASN1STOP
```

SDAP-Config field descriptions

defaultDRB

Indicates whether or not this is the default DRB for this PDU session. Among all configured instances of SDAP-Config with the same value of pdu-Session, this field shall be set to true in at most one instance of SDAP-Config and to false in all other instances.

mappedQoS-FlowsToAdd

Indicates the list of QFIs of UL QoS flows of the PDU session to be additionally mapped to this DRB. A QFI value can be included at most once in all configured instances of SDAP-Config with the same value of pdu-Session. For QoS flow remapping, the QFI value of the remapped QoS flow is only included in mappedQoS-FlowsToAdd in sdap-Config corresponding to the new DRB and not included in mappedQoS-FlowsToRelease in sdap-Config corresponding to the old DRB.

mappedQoS-FlowsToRelease

Indicates the list of QFIs of QoS flows of the PDU session to be released from existing QoS flow to DRB mapping of this DRB.

pdu-Session

Identity of the PDU session whose QoS flows are mapped to the DRB.

sdap-HeaderUL

Indicates whether or not a SDAP header is present for UL data on this DRB. The field cannot be changed after a DRB is established. The network sets this field to *present* if the field *defaultDRB* is set to *true*.

sdap-HeaderDL

Indicates whether or not a SDAP header is present for DL data on this DRB. The field cannot be changed after a DRB is established.

SearchSpace

The IE *SearchSpace* defines how/where to search for PDCCH candidates. Each search space is associated with one *ControlResourceSet*. For a scheduled cell in the case of cross carrier scheduling, except for *nrofCandidates*, all the optional fields are absent (regardless of their presence conditions).

SearchSpace information element

```
-- ASN1START
-- TAG-SEARCHSPACE-START
SearchSpace ::=
                                        SEOUENCE {
    searchSpaceId
                                            SearchSpaceId,
    controlResourceSetId
                                            ControlResourceSetId
                                                                                                          OPTIONAL, -- Cond SetupOnly
    monitoringSlotPeriodicityAndOffset
                                            CHOICE {
                                                NULL.
                                                INTEGER (0..1),
        s12
        s14
                                                INTEGER (0..3),
        s15
                                                INTEGER (0..4),
        s18
                                                INTEGER (0..7),
        s110
                                                INTEGER (0..9),
        s116
                                                INTEGER (0..15),
        s120
                                                INTEGER (0..19),
        s140
                                                INTEGER (0..39),
        s180
                                                INTEGER (0..79),
        s1160
                                                INTEGER (0..159),
       s1320
                                                INTEGER (0..319),
        s1640
                                                INTEGER (0..639),
       s11280
                                                INTEGER (0..1279),
        s12560
                                                INTEGER (0..2559)
                                                                                                          OPTIONAL,
                                                                                                                      -- Cond Setup
    duration
                                                                                                          OPTIONAL,
                                                                                                                     -- Need S
                                            INTEGER (2..2559)
    monitoringSymbolsWithinSlot
                                            BIT STRING (SIZE (14))
                                                                                                          OPTIONAL,
                                                                                                                    -- Cond Setup
    nrofCandidates
                                            SEQUENCE {
        aggregationLevel1
                                                ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},
        aggregationLevel2
                                                ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},
                                                ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},
        aggregationLevel4
        aggregationLevel8
                                                ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},
        aggregationLevel16
                                                ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8}
                                                                                                          OPTIONAL,
                                                                                                                     -- Cond Setup
                                            CHOICE {
    searchSpaceType
                                                SEOUENCE {
            dci-Format0-0-AndFormat1-0
                                                     SEOUENCE {
                                                                                                          OPTIONAL,
                                                                                                                     -- Need R
           dci-Format2-0
                                                     SEQUENCE {
                nrofCandidates-SFI
                                                         SEQUENCE {
                    aggregationLevel1
                                                             ENUMERATED {n1, n2}
                                                                                                          OPTIONAL,
                                                                                                                      -- Need R
                                                             ENUMERATED {n1, n2}
                    aggregationLevel2
                                                                                                          OPTIONAL,
                                                                                                                     -- Need R
                                                             ENUMERATED {n1, n2}
                    aggregationLevel4
                                                                                                          OPTIONAL,
                                                                                                                     -- Need R
                    aggregationLevel8
                                                             ENUMERATED {n1, n2}
                                                                                                          OPTIONAL, -- Need R
                    aggregationLevel16
                                                             ENUMERATED {n1, n2}
                                                                                                          OPTIONAL
                                                                                                                      -- Need R
                . . .
                                                                                                          OPTIONAL,
                                                                                                                     -- Need R
                                                     SEQUENCE {
            dci-Format2-1
                                                                                                          OPTIONAL,
                                                                                                                     -- Need R
            dci-Format2-2
                                                     SEOUENCE {
                . . .
```

```
SEQUENCE {
   ENUMERATED {sl1, sl2, sl4, sl5, sl8, sl10, sl16, sl20} OPTIONAL, -- Cond Setup ENUMERATED {n1, n2},

   OPTIONAL -- Need R

SEQUENCE {
   ENUMERATED {formats0-0-And-1-0, formats0-1-And-1-1},

   OPTIONAL -- Cond Setup
```

SearchSpace field descriptions

common

Configures this search space as common search space (CSS) and DCI formats to monitor.

controlResourceSetId

The CORESET applicable for this SearchSpace. Value 0 identifies the common CORESET#0 configured in MIB and in *ServingCellConfigCommon*. Values 1...maxNrofControlResourceSets-1 identify CORESETs configured in System Information or by dedicated signalling. The CORESETs with non-zero controlResourceSetId are configured in the same BWP as this *SearchSpace*.

dummy1, dummy2

This field is not used in the specification. If received it shall be ignored by the UE.

dci-Format0-0-AndFormat1-0

If configured, the UE monitors the DCI formats 0_0 and 1_0 according to TS 38.213 [13], clause 10.1.

dci-Format2-0

If configured, UE monitors the DCI format 2_0 according to TS 38.213 [13], clause 10.1, 11.1.1.

dci-Format2-1

If configured, UE monitors the DCI format 2_1 according to TS 38.213 [13], clause 10.1, 11.2.

dci-Format2-2

If configured, UE monitors the DCI format 2_2 according to TS 38.213 [13], clause 10.1, 11.3.

dci-Format2-3

If configured, UE monitors the DCI format 2_3 according to TS 38.213 [13], clause 10.1, 11.4

dci-Formats

Indicates whether the UE monitors in this USS for DCI formats 0-0 and 1-0 or for formats 0-1 and 1-1.

duration

Number of consecutive slots that a SearchSpace lasts in every occasion, i.e., upon every period as given in the *periodicityAndOffset*. If the field is absent, the UE applies the value 1 slot, except for DCI format 2_0. The UE ignores this field for DCI format 2_0. The maximum valid duration is periodicity-1 (periodicity as given in the *monitoringSlotPeriodicityAndOffset*).

monitoringSlotPeriodicitvAndOffset

Slots for PDCCH Monitoring configured as periodicity and offset. If the UE is configured to monitor DCI format 2_1, only the values 'sl1', 'sl2' or 'sl4' are applicable. If the UE is configured to monitor DCI format 2_0, only the values 'sl1', 'sl2', 'sl4', 'sl5', 'sl10', 'sl10', 'sl10', and 'sl20' are applicable (see TS 38.213 [13], clause 10).

monitoringSymbolsWithinSlot

The first symbol(s) for PDCCH monitoring in the slots configured for PDCCH monitoring (see *monitoringSlotPeriodicityAndOffset* and *duration*). The most significant (left) bit represents the first OFDM in a slot, and the second most significant (left) bit represents the second OFDM symbol in a slot and so on. The bit(s) set to one identify the first OFDM symbol(s) of the control resource set within a slot. If the cyclic prefix of the BWP is set to extended CP, the last two bits within the bit string shall be ignored by the UE. For DCI format 2_0, the first one symbol applies if the *duration* of CORESET (in the IE *ControlResourceSet*) identified by *controlResourceSetId* indicates 3 symbols, the first two symbols apply if the *duration* of CORESET identified by *controlResourceSetId* indicates 1 symbol.

See TS 38.213 [13], clause 10.

nrofCandidates-SFI

The number of PDCCH candidates specifically for format 2-0 for the configured aggregation level. If an aggregation level is absent, the UE does not search for any candidates with that aggregation level. The network configures only one aggregationLevel and the corresponding number of candidates (see TS 38.213 [13], clause 11.1.1).

nrofCandidates

Number of PDCCH candidates per aggregation level. The number of candidates and aggregation levels configured here applies to all formats unless a particular value is specified or a format-specific value is provided (see inside *searchSpaceType*). If configured in the *SearchSpace* of a cross carrier scheduled cell, this field determines the number of candidates and aggregation levels to be used on the linked scheduling cell (see TS 38.213 [13], clause 10).

searchSpaceId

Identity of the search space. SearchSpaceId = 0 identifies the searchSpaceZero configured via PBCH (MIB) or ServingCellConfigCommon and may hence not be used in the SearchSpace IE. The searchSpaceId is unique among the BWPs of a Serving Cell. In case of cross carrier scheduling, search spaces with the same searchSpaceId in scheduled cell and scheduling cell are linked to each other. The UE applies the search space for the scheduled cell only if the DL BWPs in which the linked search spaces are configured in scheduling cell and scheduled cell are both active.

searchSpaceType

Indicates whether this is a common search space (present) or a UE specific search space as well as DCI formats to monitor for.

ue-Specific

Configures this search space as UE specific search space (USS). The UE monitors the DCI format with CRC scrambled by C-RNTI, CS-RNTI (if configured), and SP-CSI-RNTI (if configured)

Conditional Presence	Explanation
Setup	This field is mandatory present upon creation of a new SearchSpace. It is optionally present, Need M, otherwise.
SetupOnly	This field is mandatory present upon creation of a new SearchSpace. It is absent, Need M, otherwise.

SearchSpaceId

The IE SearchSpaceId is used to identify Search Spaces. The ID space is used across the BWPs of a Serving Cell. The search space with the SearchSpaceId = 0 identifies the search space configured via PBCH (MIB) and in ServingCellConfigCommon (searchSpaceZero). The number of Search Spaces per BWP is limited to 10 including the common and UE specific Search Spaces.

SearchSpaceId information element

```
-- ASN1START
-- TAG-SEARCHSPACEID-START

SearchSpaceId ::= INTEGER (0..maxNrofSearchSpaces-1)
-- TAG-SEARCHSPACEID-STOP
-- ASN1STOP
```

- SearchSpaceZero

The IE SearchSpaceZero is used to configure SearchSpace#0 of the initial BWP (see TS 38.213 [13], clause 13).

SearchSpaceZero information element

```
-- ASN1START
-- TAG-SEARCHSPACEZERO-START

SearchSpaceZero ::= INTEGER (0..15)

-- TAG-SEARCHSPACEZERO-STOP
-- ASN1STOP
```

SecurityAlgorithmConfig

The IE SecurityAlgorithmConfig is used to configure AS integrity protection algorithm and AS ciphering algorithm for SRBs and DRBs.

SecurityAlgorithmConfig information element

```
-- ASN1START
-- TAG-SECURITYALGORITHMCONFIG-START
                                    SEOUENCE {
SecurityAlgorithmConfig ::=
    cipheringAlgorithm
                                        CipheringAlgorithm,
   cipheringAlgorithm
integrityProtAlgorithm
                                        IntegrityProtAlgorithm
                                                                        OPTIONAL, -- Need R
IntegrityProtAlgorithm ::=
                                        nia0, nia1, nia2, nia3, spare4, spare3,
                                        spare2, spare1, ...}
CipheringAlgorithm ::=
                                    ENUMERATED {
                                        nea0, nea1, nea2, nea3, spare4, spare3,
                                        spare2, spare1, ...}
-- TAG-SECURITYALGORITHMCONFIG-STOP
-- ASN1STOP
```

SecurityAlgorithmConfig field descriptions

cipheringAlgorithm

Indicates the ciphering algorithm to be used for SRBs and DRBs, as specified in TS 33.501 [11]. The algorithms *nea0-nea3* are identical to the LTE algorithms eea0-3. The algorithms configured for all bearers using master key shall be the same, and the algorithms configured for all bearers using secondary key, if any, shall be the same. If UE is connected to E-UTRA/EPC, this field indicates the ciphering algorithm to be used for RBs configured with NR PDCP, as specified in TS 33.501 [11].

integrityProtAlgorithm

Indicates the integrity protection algorithm to be used for SRBs and DRBs, as specified in TS 33.501 [11]. The algorithms *nia0-nia3* are identical to the E-UTRA algorithms *eia0-3*. The algorithms configured for all bearers using master key shall be the same and the algorithms configured for all bearers using secondary key, if any, shall be the same. The network does not configure *nia0* except for unauthenticated emergency sessions for unauthenticated UEs in LSM (limited service mode). If UE is connected to E-UTRA/EPC, this field indicates the integrity protection algorithm to be used for SRBs configured with NR PDCP, as specified in TS 33.501 [11]. The network does not configure *nia0* for SRB3.

ServCellIndex

The IE ServCellIndex concerns a short identity, used to uniquely identify a serving cell (i.e. the PCell, the PSCell or an SCell) across the cell groups. Value 0 applies for the PCell, while the SCellIndex that has previously been assigned applies for SCells.

ServCellIndex information element

```
-- ASN1START
-- TAG-SERVCELLINDEX-START

ServCellIndex ::= INTEGER (0..maxNrofServingCells-1)
-- TAG-SERVCELLINDEX-STOP
-- ASN1STOP
```

ServingCellConfig

The IE ServingCellConfig is used to configure (add or modify) the UE with a serving cell, which may be the SpCell or an SCell of an MCG or SCG. The parameters herein are mostly UE specific but partly also cell specific (e.g. in additionally configured bandwidth parts). Reconfiguration between a PUCCH and PUCCHless SCell is only supported using an SCell release and add.

ServingCellConfig information element

```
-- ASN1START
-- TAG-SERVINGCELLCONFIG-START
ServingCellConfig ::=
                                   SEOUENCE {
    tdd-UL-DL-ConfigurationDedicated
                                       TDD-UL-DL-ConfigDedicated
                                                                                                   OPTIONAL.
                                                                                                              -- Cond TDD
    initialDownlinkBWP
                                       BWP-DownlinkDedicated
                                                                                                   OPTIONAL, -- Need M
                                                                                                   OPTIONAL, -- Need N
    downlinkBWP-ToReleaseList
                                       SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Id
                                                                                                   OPTIONAL, -- Need N
    downlinkBWP-ToAddModList
                                       SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Downlink
    firstActiveDownlinkBWP-Id
                                       BWP-Id
                                                                                                   OPTIONAL, -- Cond SyncAndCellAdd
    bwp-InactivityTimer
                                       ENUMERATED {ms2, ms3, ms4, ms5, ms6, ms8, ms10, ms20, ms30,
                                                   ms40, ms50, ms60, ms80, ms100, ms200, ms300, ms500,
                                                   ms750, ms1280, ms1920, ms2560, spare10, spare9, spare8,
                                                   spare7, spare6, spare5, spare4, spare3, spare2, spare1 }
                                                                                                              OPTIONAL,
                                                                                                                          --Need R
    defaultDownlinkBWP-Id
                                       BWP-Id
                                                                                                              OPTIONAL, -- Need S
                                                                                                              OPTIONAL, -- Need M
    uplinkConfig
                                       UplinkConfig
                                                                                                                          -- Need M
    supplementaryUplink
                                       UplinkConfig
                                                                                                              OPTIONAL,
                                       SetupRelease { PDCCH-ServingCellConfig
                                                                                                              OPTIONAL,
                                                                                                                          -- Need M
    pdcch-ServingCellConfig
                                       SetupRelease { PDSCH-ServingCellConfig }
                                                                                                              OPTIONAL,
                                                                                                                          -- Need M
    pdsch-ServingCellConfig
    csi-MeasConfig
                                       SetupRelease { CSI-MeasConfig }
                                                                                                              OPTIONAL,
                                                                                                                          -- Need M
    sCellDeactivationTimer
                                       ENUMERATED {ms20, ms40, ms80, ms160, ms200, ms240,
                                                   ms320, ms400, ms480, ms520, ms640, ms720,
                                                   ms840, ms1280, spare2, spare1 OPTIONAL, -- Cond ServingCellWithoutPUCCH
    crossCarrierSchedulingConfig
                                       CrossCarrierSchedulingConfig
                                                                                                      OPTIONAL, -- Need M
    tag-Id
                                       TAG-Id,
                                       ENUMERATED {enabled}
                                                                                                       OPTIONAL, -- Need R
    dummy
                                       ENUMERATED {spCell, sCell}
    pathlossReferenceLinking
                                                                                                       OPTIONAL, -- Cond SCellOnly
    servingCellMO
                                       MeasObjectId
                                                                                                       OPTIONAL, -- Cond MeasObject
    . . . ,
                                       SetupRelease { RateMatchPatternLTE-CRS }
    lte-CRS-ToMatchAround
                                                                                                              OPTIONAL, -- Need M
                                                                                                              OPTIONAL, -- Need N
    rateMatchPatternToAddModList
                                       SEOUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPattern
    rateMatchPatternToReleaseList
                                       SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPatternId
                                                                                                              OPTIONAL, -- Need N
```

-- TAG-SERVINGCELLCONFIG-STOP

-- ASN1STOP

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```
downlinkChannelBW-PerSCS-List
                                       SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier
                                                                                                               OPTIONAL
                                                                                                                          -- Need S
    11
UplinkConfig ::=
                                    SEOUENCE {
    initialUplinkBWP
                                       BWP-UplinkDedicated
                                                                                                   OPTIONAL,
                                                                                                               -- Need M
    uplinkBWP-ToReleaseList
                                       SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Id
                                                                                                   OPTIONAL,
                                                                                                               -- Need N
    uplinkBWP-ToAddModList
                                       SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Uplink
                                                                                                   OPTIONAL, -- Need N
                                                                                                   OPTIONAL, -- Cond SyncAndCellAdd
    firstActiveUplinkBWP-Id
                                       BWP-Id
                                                                                                               -- Need M
    pusch-ServingCellConfig
                                       SetupRelease { PUSCH-ServingCellConfig }
                                                                                                   OPTIONAL,
    carrierSwitching
                                       SetupRelease { SRS-CarrierSwitching }
                                                                                                   OPTIONAL, -- Need M
    . . . ,
    ]]
    powerBoostPi2BPSK
                                       BOOLEAN
                                                                                                   OPTIONAL,
                                                                                                               -- Need M
    uplinkChannelBW-PerSCS-List
                                       SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier
                                                                                                   OPTIONAL
                                                                                                               -- Need S
    ]]
```

ServingCellConfig field descriptions

bwp-InactivityTimer

The duration in ms after which the UE falls back to the default Bandwidth Part (see TS 38.321 [3], clause 5.15). When the network releases the timer configuration, the UE stops the timer without switching to the default BWP.

crossCarrierSchedulingConfig

Indicates whether this serving cell is cross-carrier scheduled by another serving cell or whether it cross-carrier schedules another serving cell.

defaultDownlinkBWP-Id

The initial bandwidth part is referred to by BWP-Id = 0. ID of the downlink bandwidth part to be used upon expiry of the BWP inactivity timer. This field is UE specific. When the field is absent the UE uses the initial BWP as default BWP. (see TS 38.213 [13], clause 12 and TS 38.321 [3], clause 5.15).

downlinkBWP-ToAddModList

List of additional downlink bandwidth parts to be added or modified. (see TS 38.213 [13], clause 12).

downlinkBWP-ToReleaseList

List of additional downlink bandwidth parts to be released. (see TS 38.213 [13], clause 12).

downlinkChannelBW-PerSCS-List

A set of UE specific channel bandwidth and location configurations for different subcarrier spacings (numerologies). Defined in relation to Point A. The UE uses the configuration provided in this field only for the purpose of channel bandwidth and location determination. If absent, UE uses the configuration indicated in scs-SpecificCarrierList in DownlinkConfigCommon / DownlinkConfigCommonSIB. Network only configures channel bandwidth that corresponds to the channel bandwidth values defined in TS 38.101-1 [15] and TS 38.101-2 [39].

firstActiveDownlinkBWP-Id

If configured for an SpCell, this field contains the ID of the DL BWP to be activated upon performing the RRC (re-)configuration. If the field is absent, the RRC (re-)configuration does not impose a BWP switch.

If configured for an SCell, this field contains the ID of the downlink bandwidth part to be used upon MAC-activation of an SCell. The initial bandwidth part is referred to by BWP-Id = 0.

Upon reconfiguration with reconfigurationWithSync, the network sets the firstActiveDownlinkBWP-Id and firstActiveUplinkBWP-Id to the same value.

initialDownlinkBWP

The dedicated (UE-specific) configuration for the initial downlink bandwidth-part (i.e. DL BWP#0). If any of the optional IEs are configured within this IE, the UE considers the BWP#0 to be an RRC configured BWP (from UE capability viewpoint). Otherwise, the UE does not consider the BWP#0 as an RRC configured BWP (from UE capability viewpoint). Network always configures the UE with a value for this field if no other BWPs are configured. NOTE1

Ite-CRS-ToMatchAround

Parameters to determine an LTE CRS pattern that the UE shall rate match around.

pathlossReferenceLinking

Indicates whether UE shall apply as pathloss reference either the downlink of SpCell (PCell for MCG or PSCell for SCG) or of SCell that corresponds with this uplink (see TS 38.213 [13], clause 7).

pdsch-ServingCellConfig

PDSCH related parameters that are not BWP-specific.

rateMatchPatternToAddModList

Resources patterns which the UE should rate match PDSCH around. The UE rate matches around the union of all resources indicated in the rate match patterns. Rate match patterns defined here on cell level apply only to PDSCH of the same numerology. See TS 38.214 [19], clause 5.1.4.1.

sCellDeactivationTimer

SCell deactivation timer in TS 38.321 [3]. If the field is absent, the UE applies the value infinity.

servingCelIMO

measObjectId of the MeasObjectNR in MeasConfig which is associated to the serving cell. For this MeasObjectNR, the following relationship applies between this MeasObjectNR and frequencyInfoDL in ServingCellConfigCommon of the serving cell: if ssbFrequency is configured, its value is the same as the absoluteFrequencySSB and if csi-rs-ResourceConfigMobility is configured, the value of its subcarrierSpacing is present in one entry of the scs-SpecificCarrierList, csi-RS-CellListMobility includes an entry corresponding to the serving cell (with cellId equal to physCellId in ServingCellConfigCommon) and the frequency range indicated by the csi-rs-MeasurementBW of the entry in csi-RS-CellListMobility is included in the frequency range indicated by in the entry of the scs-SpecificCarrierList.

supplementaryUplink

Network may configure this field only when *supplementaryUplinkConfig* is configured in *ServingCellConfigCommon* or *supplementaryUplink* is configured in *ServingCellConfigCommonSIB*.

tag-ld

Timing Advance Group ID, as specified in TS 38.321 [3], which this cell belongs to.

uplinkConfig

Network may configure this field only when *uplinkConfigCommon* is configured in *ServingCellConfigCommon* or *ServingCellConfigCommonSIB*. Addition or release of this field can only be done upon SCell addition or release (respectively).

UplinkConfig field descriptions

carrierSwitching

Includes parameters for configuration of carrier based SRS switching (see TS 38.214 [19], clause 6.2.1.3.

firstActiveUplinkBWP-Id

If configured for an SpCell, this field contains the ID of the UL BWP to be activated upon performing the RRC (re-)configuration. If the field is absent, the RRC (re-)configuration does not impose a BWP switch.

If configured for an SCell, this field contains the ID of the uplink bandwidth part to be used upon MAC-activation of an SCell. The initial bandwidth part is referred to by BandiwdthPartId = 0.

initialUplinkBWP

The dedicated (UE-specific) configuration for the initial uplink bandwidth-part (i.e. UL BWP#0). If any of the optional IEs are configured within this IE as part of the IE uplinkConfig, the UE considers the BWP#0 to be an RRC configured BWP (from UE capability viewpoint). Otherwise, the UE does not consider the BWP#0 as an RRC configured BWP (from UE capability viewpoint). Network always configures the UE with a value for this field if no other BWPs are configured. NOTE1

powerBoostPi2BPSK

If this field is set to true, the UE determines the maximum output power for PUCCH/PUSCH transmissions that use pi/2 BPSK modulation according to TS 38.101-1 [15], clause 6.2.4.

pusch-ServingCellConfig

PUSCH related parameters that are not BWP-specific.

uplinkBWP-ToAddModList

The additional bandwidth parts for uplink to be added or modified. In case of TDD uplink- and downlink BWP with the same bandwidthPartId are considered as a BWP pair and must have the same center frequency.

uplinkBWP-ToReleaseList

The additional bandwidth parts for uplink to be released.

uplinkChannelBW-PerSCS-List

A set of UE specific channel bandwidth and location configurations for different subcarrier spacings (numerologies). Defined in relation to Point A. The UE uses the configuration provided in this field only for the purpose of channel bandwidth and location determination. If absent, UE uses the configuration indicated in scs-SpecificCarrierList in UplinkConfigCommon / UplinkConfigCommonSIB. Network only configures channel bandwidth that corresponds to the channel bandwidth values defined in TS 38.101-1 [15] and TS 38.101-2 [39].

NOTE 1: If the dedicated part of initial UL/DL BWP configuration is absent, the initial BWP can be used but with some limitations. For example, changing to another BWP requires *RRCReconfiguration* since DCI format 1_0 doesn't support DCI-based switching.

Conditional Presence	Explanation
MeasObject	This field is mandatory present for the SpCell if the UE has a measConfig, and it is optionally present, Need M, for SCells.
SCellOnly	This field is optionally present, Need R, for SCells. It is absent otherwise.
ServingCellWithoutPUCCH	This field is optionally present, Need S, for SCells except PUCCH SCells. It is absent otherwise.
SyncAndCellAdd	This field is mandatory present for a SpCell upon reconfiguration with reconfigurationWithSync and upon
	RRCSetup/RRCResume.
	The field is optionally present for a SpCell, Need N, upon reconfiguration without reconfigurationWithSync.
	The field is mandatory present for an SCell upon addition, and absent for SCell in other cases, Need M.
TDD	This field is optionally present, Need R, for TDD cells. It is absent otherwise.

ServingCellConfigCommon

The IE ServingCellConfigCommon is used to configure cell specific parameters of a UE's serving cell. The IE contains parameters which a UE would typically acquire from SSB, MIB or SIBs when accessing the cell from IDLE. With this IE, the network provides this information in dedicated signalling when configuring a UE with a SCells or with an additional cell group (SCG). It also provides it for SpCells (MCG and SCG) upon reconfiguration with sync.

ServingCellConfigCommon information element

```
-- ASN1START
-- TAG-SERVINGCELLCONFIGCOMMON-START
ServingCellConfigCommon ::=
                                    SEOUENCE {
    physCellId
                                        PhysCellId
                                                                                                                       -- Cond HOAndServCellAdd,
                                                                                                            OPTIONAL,
    downlinkConfigCommon
                                        DownlinkConfigCommon
                                                                                                            OPTIONAL, -- Cond HOAndServCellAdd
    uplinkConfigCommon
                                        UplinkConfigCommon
                                                                                                            OPTIONAL,
                                                                                                                       -- Need M
    supplementaryUplinkConfig
                                        UplinkConfigCommon
                                                                                                            OPTIONAL,
                                                                                                                      -- Need S
    n-TimingAdvanceOffset
                                        ENUMERATED { n0, n25600, n39936 }
                                                                                                            OPTIONAL, -- Need S
    ssb-PositionsInBurst
                                        CHOICE {
        shortBitmap
                                           BIT STRING (SIZE (4)).
       mediumBitmap
                                           BIT STRING (SIZE (8)),
        longBitmap
                                           BIT STRING (SIZE (64))
                                                                                                            OPTIONAL, -- Cond AbsFreqSSB
    ssb-periodicityServingCell
                                        ENUMERATED { ms5, ms10, ms20, ms40, ms80, ms160, spare2, spare1 }
                                                                                                            OPTIONAL, -- Need S
                                        ENUMERATED {pos2, pos3},
    dmrs-TypeA-Position
    lte-CRS-ToMatchAround
                                        SetupRelease { RateMatchPatternLTE-CRS }
                                                                                                            OPTIONAL, -- Need M
                                                                                                            OPTIONAL, -- Need N
    rateMatchPatternToAddModList
                                        SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPattern
    rateMatchPatternToReleaseList
                                        SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPatternId OPTIONAL, -- Need N
                                        SubcarrierSpacing
                                                                                                            OPTIONAL, -- Cond HOAndServCellWithSSB
    ssbSubcarrierSpacing
                                        TDD-UL-DL-ConfigCommon
                                                                                                            OPTIONAL, -- Cond TDD
    tdd-UL-DL-ConfigurationCommon
    ss-PBCH-BlockPower
                                        INTEGER (-60..50),
-- TAG-SERVINGCELLCONFIGCOMMON-STOP
-- ASN1STOP
```

ServingCellConfigCommon field descriptions

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dmrs-TypeA-Position

Position of (first) DM-RS for downlink (see TS 38.211 [16], clause 7.4.1.1.1) and uplink (TS 38.211 [16], clause 6.4.1.1.3).

downlinkConfigCommon

The common downlink configuration of the serving cell, including the frequency information configuration and the initial downlink BWP common configuration. The parameters provided herein should match the parameters configured by MIB and SIB1 (if provided) of the serving cell, with the exception of *controlResourceSetZero* and *searchSpaceZero* which can be configured in *ServingCellConfigCommon* even if MIB indicates that they are absent.

IongBitmap

Bitmap when maximum number of SS/PBCH blocks per half frame equals to 64 as defined in TS 38.213 [13], clause 4.1.

Ite-CRS-ToMatchAround

Parameters to determine an LTE CRS pattern that the UE shall rate match around.

mediumBitmap

Bitmap when maximum number of SS/PBCH blocks per half frame equals to 8 as defined in TS 38.213 [13], clause 4.1.

n-TimingAdvanceOffset

The N_TA-Offset to be applied for all uplink transmissions on this serving cell. If the field is absent, the UE applies the value defined for the duplex mode and frequency range of this serving cell. See TS 38.133 [14], table 7.1.2-2.

rateMatchPatternToAddModList

Resources patterns which the UE should rate match PDSCH around. The UE rate matches around the union of all resources indicated in the rate match patterns. Rate match patterns defined here on cell level apply only to PDSCH of the same numerology (see TS 38.214 [19], clause 5.1.4,1).

shortBitmap

Bitmap when maximum number of SS/PBCH blocks per half frame equals to 4 as defined in TS 38.213 [13], clause 4.1.

ss-PBCH-BlockPower

Average EPRE of the resources elements that carry secondary synchronization signals in dBm that the NW used for SSB transmission, see TS 38.213 [13], clause 7.

ssb-periodicityServingCell

The SSB periodicity in ms for the rate matching purpose. If the field is absent, the UE applies the value ms5. (see TS 38.213 [13], clause 4.1)

ssb-PositionsInBurst

Indicates the time domain positions of the transmitted SS-blocks in a half frame with SS/PBCH blocks as defined in TS 38.213 [13], clause 4.1. The first/ leftmost bit corresponds to SS/PBCH block index 0, the second bit corresponds to SS/PBCH block index 1, and so on. Value 0 in the bitmap indicates that the corresponding SS/PBCH block is not transmitted while value 1 indicates that the corresponding SS/PBCH block is transmitted. The network configures the same pattern in this field as in the corresponding field in ServingCellConfigCommonSIB.

ssbSubcarrierSpacing

Subcarrier spacing of SSB. Only the values 15 kHz or 30 kHz (FR1), and 120 kHz or 240 kHz (FR2) are applicable.

supplementary Uplink Config

The network configures this field only if *uplinkConfigCommon* is configured. If this field is absent, the UE shall release the *supplementaryUplinkConfig* and the *supplementaryUplink* configured in *ServingCellConfig* of this serving cell, if configured.

tdd-UL-DL-ConfigurationCommon

A cell-specific TDD UL/DL configuration, see TS 38,213 [13], clause 11.1.

Conditional Presence	Explanation
AbsFreqSSB	The field is absent when absoluteFrequencySSB in frequencyInfoDL is absent, otherwise the field is mandatory present.
HOAndServCellAdd	This field is mandatory present upon SpCell change and upon serving cell (PSCell/SCell) addition. Otherwise, the field is absent.
HOAndServCellWithSSB	This field is mandatory present upon SpCell change and upon serving cell (SCell with SSB or PSCell) addition. Otherwise, the field is absent.
TDD	The field is optionally present, Need R, for TDD cells; otherwise it is absent.

ServingCellConfigCommonSIB

The IE ServingCellConfigCommonSIB is used to configure cell specific parameters of a UE's serving cell in SIB1.

ServingCellConfigCommonSIB information element

```
-- ASN1START
-- TAG-SERVINGCELLCONFIGCOMMONSIB-START
ServingCellConfigCommonSIB ::=
                                   SEQUENCE {
    downlinkConfigCommon
                                       DownlinkConfigCommonSIB,
    uplinkConfigCommon
                                       UplinkConfigCommonSIB
                                                                                                    OPTIONAL, -- Need R
    supplementaryUplink
                                       UplinkConfigCommonSIB
                                                                                                    OPTIONAL, -- Need R
                                       ENUMERATED { n0, n25600, n39936 }
    n-TimingAdvanceOffset
                                                                                                    OPTIONAL, -- Need S
    ssb-PositionsInBurst
                                       SEQUENCE {
       inOneGroup
                                           BIT STRING (SIZE (8)),
       groupPresence
                                           BIT STRING (SIZE (8))
                                                                                                    OPTIONAL -- Cond FR2-Only
    ssb-PeriodicityServingCell
                                       ENUMERATED {ms5, ms10, ms20, ms40, ms80, ms160},
    tdd-UL-DL-ConfigurationCommon
                                       TDD-UL-DL-ConfigCommon
                                                                                                    OPTIONAL, -- Cond TDD
    ss-PBCH-BlockPower
                                       INTEGER (-60..50),
-- TAG-SERVINGCELLCONFIGCOMMONSIB-STOP
-- ASN1STOP
```

ServingCellConfigCommonSIB field descriptions

groupPresence

This field is present when maximum number of SS/PBCH blocks per half frame equals to 64 as defined in TS 38.213 [13], clause 4.1. The first/leftmost bit corresponds to the SS/PBCH index 0-7, the second bit corresponds to SS/PBCH block 8-15, and so on. Value 0 in the bitmap indicates that the SSBs according to *inOneGroup* are absent. Value 1 indicates that the SS/PBCH blocks are transmitted in accordance with *inOneGroup*.

inOneGroup

When maximum number of SS/PBCH blocks per half frame equals to 4 as defined in TS 38.213 [13], clause 4.1, only the 4 leftmost bits are valid; the UE ignores the 4 rightmost bits. When maximum number of SS/PBCH blocks per half frame equals to 8 as defined in TS 38.213 [13], clause 4.1, all 8 bits are valid. The first/ leftmost bit corresponds to SS/PBCH block index 0, the second bit corresponds to SS/PBCH block index 1, and so on. When maximum number of SS/PBCH blocks per half frame equals to 64 as defined in TS 38.213 [13], clause 4.1, all 8 bit are valid; The first/ leftmost bit corresponds to the first SS/PBCH block index in the group (i.e., to SSB index 0, 8, and so on); the second bit corresponds to the second SS/PBCH block index in the group (i.e., to SSB index 1, 9, and so on), and so on. Value 0 in the bitmap indicates that the corresponding SS/PBCH block is not transmitted while value 1 indicates that the corresponding SS/PBCH block is transmitted.

n-TimingAdvanceOffset

The N_TA-Offset to be applied for random access on this serving cell. If the field is absent, the UE applies the value defined for the duplex mode and frequency range of this serving cell. See TS 38.133 [14], table 7.1.2-2.

ssb-PositionsInBurst

Time domain positions of the transmitted SS-blocks in an SS-burst as defined in TS 38.213 [13], clause 4.1.

ss-PBCH-BlockPower

Average EPRE of the resources elements that carry secondary synchronization signals in dBm that the NW used for SSB transmission, see TS 38.213 [13], clause 7.

Conditional Presence	Explanation
FR2-Only	This field is mandatory present for an FR2 carrier frequency. It is absent otherwise and UE releases any configured value.
TDD	The field is optionally present, Need R, for TDD cells; otherwise it is absent.

ShortI-RNTI-Value

The IE ShortI-RNTI-Value is used to identify the suspended UE context of a UE in RRC_INACTIVE using fewer bits compared to I-RNTI-Value.

Shortl-RNTI-Value information element

```
-- ASN1START
-- TAG-SHORTI-RNTI-VALUE-START

ShortI-RNTI-Value ::= BIT STRING (SIZE(24))
-- TAG-SHORTI-RNTI-VALUE-STOP
-- ASN1STOP
```

ShortMAC-I

The IE *ShortMAC-I* is used to identify and verify the UE at RRC connection re-establishment. The 16 least significant bits of the MAC-I calculated using the AS security configuration of the source PCell, as specified in 5.3.7.4.

ShortMAC-I information element

```
-- ASN1START
-- TAG-SHORTMAC-I-START

ShortMAC-I ::= BIT STRING (SIZE (16))
-- TAG-SHORTMAC-I-STOP
-- ASN1STOP
```

- SINR-Range

The IE SINR-Range specifies the value range used in SINR measurements and thresholds. For measurements, integer value for SINR measurements is according to Table 10.1.16.1-1 in TS 38.133 [14]. For thresholds, the actual value is (IE value -46) / 2 dB.

SINR-Range information element

```
-- ASN1START
-- TAG-SINR-RANGE-START

SINR-Range ::= INTEGER(0..127)

-- TAG-SINR-RANGE-STOP
-- ASN1STOP
```

- SI-SchedulingInfo

The IE SI-SchedulingInfo contains information needed for acquisition of SI messages.

SI-SchedulingInfo information element

```
-- ASN1START
-- TAG-SI-SCHEDULINGINFO-START
SI-SchedulingInfo ::=
                                   SEQUENCE {
    schedulingInfoList
                                       SEQUENCE (SIZE (1..maxSI-Message)) OF SchedulingInfo,
    si-WindowLength
                                       ENUMERATED {s5, s10, s20, s40, s80, s160, s320, s640, s1280},
    si-RequestConfig
                                       SI-RequestConfig
                                                                                                       OPTIONAL, -- Cond MSG-1
                                                                                                       OPTIONAL, -- Cond SUL-MSG-1
    si-RequestConfigSUL
                                       SI-RequestConfig
                                       BIT STRING (SIZE (24))
                                                                                                       OPTIONAL, -- Need R
    systemInformationAreaID
SchedulingInfo ::=
    si-BroadcastStatus
                                       ENUMERATED {broadcasting, notBroadcasting},
                                       ENUMERATED {rf8, rf16, rf32, rf64, rf128, rf256, rf512},
    si-Periodicity
    sib-MappingInfo
                                       SIB-Mapping
```

```
SIB-Mapping ::=
                                   SEQUENCE (SIZE (1..maxSIB)) OF SIB-TypeInfo
SIB-TypeInfo ::=
                                   SEOUENCE {
                                       ENUMERATED {sibType2, sibType3, sibType4, sibType5, sibType6, sibType7, sibType8, sibType9,
    type
                                                   spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1,...},
                                                                                                        OPTIONAL, -- Cond SIB-TYPE
    valueTag
                                       INTEGER (0..31)
    areaScope
                                       ENUMERATED {true}
                                                                                                        OPTIONAL -- Need S
-- Configuration for Msgl based SI Request
SI-RequestConfig ::=
                                   SEOUENCE {
    rach-OccasionsSI
                                       SEOUENCE {
       rach-ConfigSI
                                           RACH-ConfigGeneric,
       ssb-perRACH-Occasion
                                           ENUMERATED {one Eighth, one Fourth, one Half, one, two, four, eight, sixteen}
                                                                                                           OPTIONAL, -- Need R
    si-RequestPeriod
                                       ENUMERATED {one, two, four, six, eight, ten, twelve, sixteen}
                                                                                                           OPTIONAL, -- Need R
    si-RequestResources
                                       SEQUENCE (SIZE (1..maxSI-Message)) OF SI-RequestResources
                                   SEQUENCE {
SI-RequestResources ::=
    ra-PreambleStartIndex
                                       INTEGER (0..63),
                                       INTEGER (0..15)
    ra-AssociationPeriodIndex
                                                                                                           OPTIONAL, -- Need R
    ra-ssb-OccasionMaskIndex
                                       INTEGER (0..15)
                                                                                                           OPTIONAL
                                                                                                                      -- Need R
-- TAG-SI-SCHEDULINGINFO-STOP
-- ASN1STOP
```

SchedulingInfo field descriptions

areaScope

Indicates that a SIB is area specific. If the field is absent, the SIB is cell specific.

si-BroadcastStatus

Indicates if the SI message is being broadcasted or not. Change of *si-BroadcastStat*us should not result in system information change notifications in Short Message transmitted with P-RNTI over DCI (see clause 6.5). The value of the indication is valid until the end of the BCCH modification period when set to *broadcasting*.

si-Periodicity

Periodicity of the SI-message in radio frames. Value rf8 corresponds to 8 radio frames, value rf16 corresponds to 16 radio frames, and so on.

SI-RequestConfig field descriptions

rach-OccasionsSI

Configuration of dedicated RACH Occassions for SI. If the field is absent, the UE uses the corresponding parameters configured in *rach-ConfigCommon* of the initial uplink BWP.

si-RequestPeriod

Periodicity of the SI-Request configuration in number of association periods.

si-RequestResources

If there is only one entry in the list, the configuration is used for all SI messages for which *si-BroadcastStatus* is set to *notBroadcasting*. Otherwise the 1st entry in the list corresponds to the first SI message in *schedulingInfoList* for which *si-BroadcastStatus* is set to *notBroadcasting*, 2nd entry in the list corresponds to the second SI message in *schedulingInfoList* for which *si-BroadcastStatus* is set to *notBroadcastIng* and so on. Change of *si-RequestResources* should not result in system information change notification.

SI-RequestResources field descriptions

ra-AssociationPeriodIndex

Index of the association period in the si-RequestPeriod in which the UE can send the SI request for SI message(s) corresponding to this SI-RequestResources, using the preambles indicated by ra-PreambleStartIndex and rach occasions indicated by ra-ssb-OccasionMaskIndex.

ra-PreambleStartIndex

If N SSBs are associated with a RACH occasion, where N > 1, for the i-th SSB (i=0, ..., N-1) the preamble with preamble index = ra-PreambleStartIndex + i is used for SI request; For N < 1, the preamble with preamble index = ra-PreambleStartIndex is used for SI request.

SI-SchedulingInfo field descriptions

si-RequestConfig

Configuration of Msg1 resources that the UE uses for requesting SI-messages for which si-BroadcastStatus is set to notBroadcasting.

si-RequestConfigSUL

Configuration of Msg1 resources that the UE uses for requesting SI-messages for which si-BroadcastStatus is set to notBroadcasting.

si-WindowLenath

The length of the SI scheduling window. Value s5 corresponds to 5 slots, value s10 corresponds to 10 slots and so on. The network always configures si-WindowLength to be shorter than or equal to the si-Periodicity.

systemInformationArealD

Indicates the system information area that the cell belongs to, if any. Any SIB with areaScope within the SI is considered to belong to this systemInformationAreaID. The systemInformationAreaID is unique within a PLMN.

Conditional presence	Explanation
MSG-1	The field is optionally present, Need R, if si-BroadcastStatus is set to notBroadcasting for any SI-message included in SchedulingInfo. It is absent
	otherwise.
SIB-TYPE	The field is mandatory present if the SIB type is different from SIB6, SIB7 or SIB8. For SIB6, SIB7 and SIB8 it is absent.
SUL-MSG-1	The field is optionally present, Need R, if supplementaryUplink is configured in ServingCellConfigCommonSIB and if si-BroadcastStatus is set to
	notBroadcasting for any SI-message included in SchedulingInfo. It is absent otherwise.

– SK-Counter

The IE SK-Counter is a counter used upon initial configuration of SN security for NR-DC and NE-DC, as well as upon refresh of S-K_{gNB} or S-K_{eNB} based on the current or newly derived K_{gNB} during RRC Resume or RRC Reconfiguration, as defined in TS 33.501 [11].

```
-- ASN1START
-- TAG-SKCOUNTER-START

SK-Counter ::= INTEGER (0..65535)

-- TAG-SKCOUNTER-STOP
-- ASN1STOP
```

SlotFormatCombinationsPerCell

The IE SlotFormatCombinationsPerCell is used to configure the SlotFormatCombinations applicable for one serving cell (see TS 38.213 [13], clause 11.1.1).

SlotFormatCombinationsPerCell information element

```
-- ASN1START
-- TAG-SLOTFORMATCOMBINATIONSPERCELL-START
SlotFormatCombinationsPerCell ::= SEOUENCE {
    servingCellId
                                       ServCellIndex,
                                       SubcarrierSpacing,
    subcarrierSpacing
    subcarrierSpacing2
                                       SubcarrierSpacing
                                                                                                                  OPTIONAL, -- Need R
    slotFormatCombinations
                                       SEQUENCE (SIZE (1..maxNrofSlotFormatCombinationsPerSet)) OF SlotFormatCombination
                                                                                                                  OPTIONAL, -- Need M
                                                                                                                  OPTIONAL, -- Need M
    positionInDCI
                                       INTEGER(0..maxSFI-DCI-PayloadSize-1)
SlotFormatCombination ::=
    slotFormatCombinationId
                                       SlotFormatCombinationId,
                                       SEQUENCE (SIZE (1..maxNrofSlotFormatsPerCombination)) OF INTEGER (0..255)
    slotFormats
SlotFormatCombinationId ::=
                                   INTEGER (0..maxNrofSlotFormatCombinationsPerSet-1)
-- TAG-SLOTFORMATCOMBINATIONSPERCELL-STOP
-- ASN1STOP
```

SlotFormatCombination field descriptions

slotFormatCombinationId

This ID is used in the DCI payload to dynamically select this SlotFormatCombination, see TS 38.213 [13], clause 11.1.1.

slotFormats

Slot formats that occur in consecutive slots in time domain order as listed here (see TS 38.213 [13], clause 11.1.1).

SlotFormatCombinationsPerCell field descriptions

positionInDCI

The (starting) position (bit) of the slotFormatCombinationId (SFI-Index) for this serving cell (servingCellId) within the DCI payload (see TS 38.213 [13], clause 11.1.1).

servingCellId

The ID of the serving cell for which the slotFormatCombinations are applicable.

slotFormatCombinations 5 1 1

A list with SlotFormatCombinations. Each SlotFormatCombination comprises of one or more SlotFormats (see TS 38.211 [16], clause 4.3.2). The total number of slotFormats in the slotFormatCombinations list does not exceed 512.

subcarrierSpacing2

Reference subcarrier spacing for a Slot Format Combination on an FDD or SUL cell (see TS 38.213 [13], clause 11.1.1). For FDD, subcarrierSpacing (SFI-scs) is the reference SCS for DL BWP and subcarrierSpacing2 (SFI-scs2) is the reference SCS for UL BWP. For SUL, subcarrierSpacing (SFI-scs2) is the reference SCS for non-SUL carrier and subcarrierSpacing2 (SFI-scs2) is the reference SCS for SUL carrier. The network configures a value that is smaller than or equal to any SCS of configured BWPs of the serving cell that the command applies to. And the network configures a value that is smaller than or equal to the SCS of the serving cell which the UE monitors for SFI indications.

subcarrierSpacing

Reference subcarrier spacing for this Slot Format Combination. The network configures a value that is smaller than or equal to any SCS of configured BWPs of the serving cell that the command applies to. And the network configures a value that is smaller than or equal to the SCS of the serving cell which the UE monitors for SFI indications (see TS 38.213 [13], clause 11.1.1).

SlotFormatIndicator

The IE SlotFormatIndicator is used to configure monitoring a Group-Common-PDCCH for Slot-Format-Indicators (SFI).

SlotFormatIndicator information element

SlotFormatIndicator field descriptions dci-PavloadSize Total length of the DCI payload scrambled with SFI-RNTI (see TS 38.213 [13], clause 11.1.1). sfi-RNTI RNTI used for SFI on the given cell (see TS 38.213 [13], clause 11.1.1). slotFormatCombToAddModList A list of SlotFormatCombinations for the UE's serving cells (see TS 38.213 [13], clause 11.1.1).

S-NSSAI

The IE S-NSSAI (Single Network Slice Selection Assistance Information) identifies a Network Slice end to end and comprises a slice/service type and a slice differentiator, see TS 23.003 [21].

S-NSSAI information element

```
-- ASN1START
-- TAG-S-NSSAI-START
S-NSSAI ::=
                                        BIT STRING (SIZE (8)),
    sst
    sst-SD
                                        BIT STRING (SIZE (32))
-- TAG-S-NSSAI-STOP
-- ASN1STOP
```

S-NSSAI field descriptions Indicates the S-NSSAI consisting of Slice/Service Type, see TS 23.003 [21].

sst-SD

Indicates the S-NSSAI consisting of Slice/Service Type and Slice Differentiator, see TS 23.003 [21].

SpeedStateScaleFactors

The IE SpeedStateScaleFactors concerns factors, to be applied when the UE is in medium or high speed state, used for scaling a mobility control related parameter.

SpeedStateScaleFactors information element

```
-- ASN1START
-- TAG-SPEEDSTATESCALEFACTORS-START
SpeedStateScaleFactors ::=
                                    SEQUENCE {
    sf-Medium
                                        ENUMERATED {oDot25, oDot5, oDot75, 1Dot0},
    sf-High
                                        ENUMERATED {oDot25, oDot5, oDot75, 1Dot0}
```

```
}
-- TAG-SPEEDSTATESCALEFACTORS-STOP
-- ASN1STOP
```

SpeedStateScaleFactors field descriptions

sf-High

The concerned mobility control related parameter is multiplied with this factor if the UE is in High Mobility state as defined in TS 38.304 [20]. Value *oDot25* corresponds to 0.25, value *oDot5* corresponds to 0.5, *oDot75* corresponds to 0.75 and so on.

sf-Medium

The concerned mobility control related parameter is multiplied with this factor if the UE is in Medium Mobility state as defined in TS 38.304 [20]. Value *oDot25* corresponds to 0.25, value *oDot5* corresponds to 0.5, value *oDot75* corresponds to 0.75, and so on.

SPS-Config

The IE SPS-Config is used to configure downlink semi-persistent transmission. Downlink SPS may be configured on the SpCell as well as on SCells. The network ensures SPS-Config is configured for at most one cell in a cell group.

SPS-Config information element

```
-- ASN1START
-- TAG-SPS-CONFIG-START

SPS-Config ::= periodicity

nrofHARQ-Processes
n1PUCCH-AN
mcs-Table
...
}

-- TAG-SPS-CONFIG-STOP
-- ASN1STOP
```

SPS-Config field descriptions

mcs-Table

Indicates the MCS table the UE shall use for DL SPS (see TS 38.214 [19], clause 5.1.3.1. If present, the UE shall use the MCS table of low-SE 64QAM table indicated in Table 5.1.3.1-3 of TS 38.214 [19]. If this field is absent and field mcs-table in PDSCH-Config is set to 'qam256' and the activating DCI is of format 1_1, the UE applies the 256QAM table indicated in Table 5.1.3.1-2 of TS 38.214 [19]. Otherwise, the UE applies the non-low-SE 64QAM table indicated in Table 5.1.3.1-1 of TS 38.214 [19].

n1PUCCH-AN

HARQ resource for PUCCH for DL SPS. The network configures the resource either as format0 or format1. The actual *PUCCH-Resource* is configured in *PUCCH-Config* and referred to by its ID. See TS 38.213 [13], clause 9.2.3.

nrofHARQ-Processes

Number of configured HARQ processes for SPS DL (see TS 38.321 [3], clause 5.8.1).

periodicity

Periodicity for DL SPS (see TS 38.214 [19] and TS 38.321 [3], clause 5.8.1).

SRB-Identity

The IE SRB-Identity is used to identify a Signalling Radio Bearer (SRB) used by a UE.

SRB-Identity information element

```
-- ASN1START
-- TAG-SRB-IDENTITY-START

SRB-Identity ::= INTEGER (1..3)

-- TAG-SRB-IDENTITY-STOP
-- ASN1STOP
```

SRS-CarrierSwitching

The IE SRS-CarrierSwitching is used to configure for SRS carrier switching when PUSCH is not configured and independent SRS power control from that of PUSCH.

SRS-CarrierSwitching information element

```
-- ASN1START
-- TAG-SRS-CARRIERSWITCHING-START
SRS-CarrierSwitching ::=
                                   SEOUENCE {
    srs-SwitchFromServCellIndex
                                      INTEGER (0..31)
                                                                                                             OPTIONAL, -- Need M
                                      ENUMERATED {sUL, nUL},
   srs-SwitchFromCarrier
   srs-TPC-PDCCH-Group
                                      CHOICE {
                                          SEQUENCE (SIZE (1..32)) OF SRS-TPC-PDCCH-Config,
       typeA
       typeB
                                           SRS-TPC-PDCCH-Config
                                                                                                             OPTIONAL, -- Need M
```

```
SEQUENCE (SIZE (1..maxNrofServingCells)) OF ServCellIndex
   monitoringCells
                                                                                                             OPTIONAL, -- Need M
SRS-TPC-PDCCH-Config ::=
                                   SEQUENCE {
    srs-CC-SetIndexlist
                                      SEQUENCE (SIZE(1..4)) OF SRS-CC-SetIndex
                                                                                                             OPTIONAL -- Need M
SRS-CC-SetIndex ::=
                                   SEOUENCE {
                                      INTEGER (0..3)
   cc-SetIndex
                                                                                                             OPTIONAL, -- Need M
   cc-IndexInOneCC-Set
                                      INTEGER (0..7)
                                                                                                             OPTIONAL -- Need M
-- TAG-SRS-CARRIERSWITCHING-STOP
-- ASN1STOP
```

SRS-CC-SetIndex field descriptions

cc-IndexInOneCC-Set

Indicates the CC index in one CC set for Type A (see TS 38.212 [17], TS 38.213 [13], clause 7.3.1, 11.4). The network always includes this field when the *srs-TPC-PDCCH-Group* is set to *typeA*.

cc-SetIndex

Indicates the CC set index for Type A associated (see TS 38.212 [17], TS 38.213 [13], clause 7.3.1, 11.4). The network always includes this field when the *srs-TPC-PDCCH-Group* is set to *typeA*. The network does not configure this field to 3 in this release of specification.

SRS-CarrierSwitching field descriptions

monitoringCells

A set of serving cells for monitoring PDCCH conveying SRS DCI format with CRC scrambled by TPC-SRS-RNTI (see TS 38.212 [17], TS 38.213 [13], clause 7.3.1, 11.3).

srs-SwitchFromServCellIndex

Indicates the serving cell whose UL transmission may be interrupted during SRS transmission on a PUSCH-less SCell. During SRS transmission on a PUSCH-less SCell, the UE may temporarily suspend the UL transmission on a serving cell with PUSCH in the same CG to allow the PUSCH-less SCell to transmit SRS. (see TS 38.214 [19], clause 6.2.1.3).

srs-TPC-PDCCH-Group

Network configures the UE with either typeA-SRS-TPC-PDCCH-Group or typeB-SRS-TPC-PDCCH-Group, if any.

typeA

Type A trigger configuration for SRS transmission on a PUSCH-less SCell (see TS 38.213 [13], clause 11.4). In this release, the network configures at most one entry (the first entry) of *typeA*, and the first entry corresponds to the serving cell in which the *SRS-CarrierSwitching* field is configured. SRS carrier switching to SUL carrier is not supported in this version of the specification.

typeB

Type B trigger configuration for SRS transmission on a PUSCH-less SCell (see TS 38.213 [13], clause 11.4).

SRS-TPC-PDCCH-Config field descriptions

srs-CC-SetIndexlist

A list of pairs of [cc-SetIndex; cc-IndexInOneCC-Set] (see TS 38.212 [17], TS 38.213 [13], clause 7.3.1, 11.4). The network does not configure this field for typeB.

- SRS-Config

The IE SRS-Config is used to configure sounding reference signal transmissions. The configuration defines a list of SRS-Resources and a list of SRS-ResourceSets. Each resource set defines a set of SRS-Resources. The network triggers the transmission of the set of SRS-Resources using a configured aperiodicSRS-ResourceTrigger (L1 DCI).

SRS-Config information element

```
-- ASN1START
-- TAG-SRS-CONFIG-START
SRS-Config ::=
                                        SEOUENCE {
    srs-ResourceSetToReleaseList
                                            SEQUENCE (SIZE(1..maxNrofSRS-ResourceSets)) OF SRS-ResourceSetId
                                                                                                                OPTIONAL,
                                                                                                                           -- Need N
    srs-ResourceSetToAddModList
                                            SEOUENCE (SIZE(1..maxNrofSRS-ResourceSets)) OF SRS-ResourceSet
                                                                                                                OPTIONAL,
                                                                                                                            -- Need N
                                                                                                                            -- Need N
    srs-ResourceToReleaseList
                                            SEQUENCE (SIZE(1..maxNrofSRS-Resources)) OF SRS-ResourceId
                                                                                                                OPTIONAL,
                                            SEQUENCE (SIZE(1..maxNrofSRS-Resources)) OF SRS-Resource
                                                                                                                OPTIONAL,
                                                                                                                            -- Need N
    srs-ResourceToAddModList
    tpc-Accumulation
                                            ENUMERATED {disabled}
                                                                                                                OPTIONAL, -- Need S
SRS-ResourceSet ::=
                                        SEOUENCE {
    srs-ResourceSetId
                                            SRS-ResourceSetId,
    srs-ResourceIdList
                                            SEQUENCE (SIZE(1..maxNrofSRS-ResourcesPerSet)) OF SRS-ResourceId
                                                                                                                OPTIONAL, -- Cond Setup
    resourceType
                                            CHOICE {
        aperiodic
                                                SEOUENCE {
                                                    INTEGER (1..maxNrofSRS-TriggerStates-1),
           aperiodicSRS-ResourceTrigger
           csi-RS
                                                    NZP-CSI-RS-ResourceId
                                                                                                         OPTIONAL, -- Cond NonCodebook
           slotOffset
                                                    INTEGER (1..32)
                                                                                                         OPTIONAL, -- Need S
            . . . ,
           ] ]
            aperiodicSRS-ResourceTriggerList
                                                        SEQUENCE (SIZE(1..maxNrofSRS-TriggerStates-2))
                                                            OF INTEGER (1..maxNrofSRS-TriggerStates-1) OPTIONAL -- Need M
           ]]
        semi-persistent
                                                SEOUENCE {
           associatedCSI-RS
                                                    NZP-CSI-RS-ResourceId
                                                                                                         OPTIONAL, -- Cond NonCodebook
       periodic
                                                SEQUENCE {
           associatedCSI-RS
                                                    NZP-CSI-RS-ResourceId
                                                                                                        OPTIONAL, -- Cond NonCodebook
                                            ENUMERATED {beamManagement, codebook, nonCodebook, antennaSwitching},
    usage
    alpha
                                            Alpha
                                                                                                         OPTIONAL, -- Need S
                                            INTEGER (-202..24)
                                                                                                         OPTIONAL, -- Cond Setup
    pathlossReferenceRS
                                            CHOICE {
       ssb-Index
                                                SSB-Index,
        csi-RS-Index
                                                NZP-CSI-RS-ResourceId
                                                                                                         OPTIONAL, -- Need M
    srs-PowerControlAdjustmentStates
                                            ENUMERATED { sameAsFci2, separateClosedLoop}
                                                                                                        OPTIONAL, -- Need S
```

```
INTEGER (0..maxNrofSRS-ResourceSets-1)
SRS-ResourceSetId ::=
SRS-Resource ::=
                                        SEOUENCE {
    srs-ResourceId
                                            SRS-ResourceId,
   nrofSRS-Ports
                                            ENUMERATED {port1, ports2, ports4},
   ptrs-PortIndex
                                            ENUMERATED {n0, n1 }
                                                                                                        OPTIONAL, -- Need R
    transmissionComb
                                            CHOICE {
                                                SEQUENCE {
       n2
           combOffset-n2
                                                    INTEGER (0..1),
           cyclicShift-n2
                                                    INTEGER (0..7)
       },
                                                SEQUENCE {
            combOffset-n4
                                                    INTEGER (0..3),
           cyclicShift-n4
                                                    INTEGER (0..11)
    resourceMapping
                                            SEOUENCE {
       startPosition
                                                INTEGER (0..5),
       nrofSymbols
                                                ENUMERATED {n1, n2, n4},
       repetitionFactor
                                                ENUMERATED {n1, n2, n4}
    freqDomainPosition
                                            INTEGER (0..67),
    freqDomainShift
                                            INTEGER (0..268),
    freqHopping
                                            SEQUENCE {
       c-SRS
                                                INTEGER (0..63),
       b-SRS
                                                INTEGER (0..3),
       b-hop
                                                INTEGER (0..3)
    groupOrSequenceHopping
                                            ENUMERATED { neither, groupHopping, sequenceHopping },
    resourceType
                                            CHOICE {
       aperiodic
                                                SEQUENCE {
        semi-persistent
                                                SEQUENCE {
           periodicityAndOffset-sp
                                                        SRS-PeriodicityAndOffset,
            . . .
       periodic
                                                SEOUENCE {
           periodicityAndOffset-p
                                                        SRS-PeriodicityAndOffset,
    sequenceId
                                            INTEGER (0..1023),
    spatialRelationInfo
                                            SRS-SpatialRelationInfo
                                                                                                     OPTIONAL, -- Need R
SRS-SpatialRelationInfo ::=
                                SEQUENCE {
                                        ServCellIndex
    servingCellId
                                                                                                     OPTIONAL, -- Need S
    referenceSignal
                                        CHOICE {
       ssb-Index
                                            SSB-Index,
        csi-RS-Index
                                            NZP-CSI-RS-ResourceId,
       srs
                                            SEQUENCE {
                                                SRS-ResourceId,
           resourceId
```

```
uplinkBWP
                                                 BWP-Id
SRS-ResourceId ::=
                                         INTEGER (0..maxNrofSRS-Resources-1)
SRS-PeriodicityAndOffset ::=
                                         CHOICE {
    sl1
                                             NULL,
    sl2
                                             INTEGER(0..1),
    sl4
                                             INTEGER(0..3),
    sl5
                                             INTEGER(0..4),
    sl8
                                             INTEGER(0..7),
    s110
                                             INTEGER(0..9),
    s116
                                             INTEGER(0..15),
    s120
                                             INTEGER(0..19),
    s132
                                             INTEGER(0..31),
    s140
                                             INTEGER(0..39),
    s164
                                             INTEGER(0..63),
    s180
                                             INTEGER(0..79),
    s1160
                                             INTEGER(0..159),
    s1320
                                             INTEGER(0..319),
                                             INTEGER(0..639),
    s1640
    s11280
                                             INTEGER(0..1279),
                                             INTEGER(0..2559)
    s12560
-- TAG-SRS-CONFIG-STOP
-- ASN1STOP
```

SRS-Config field descriptions

tpc-Accumulation

If the field is absent, UE applies TPC commands via accumulation. If disabled, UE applies the TPC command without accumulation (this applies to SRS when a separate closed loop is configured for SRS) (see TS 38.213 [13], clause 7.3).

SRS-Resource field descriptions

cyclicShift-n2

Cyclic shift configuration (see TS 38.214 [19], clause 6.2.1).

cyclicShift-n4

Cyclic shift configuration (see TS 38.214 [19], clause 6.2.1).

freqHopping

Includes parameters capturing SRS frequency hopping (see TS 38.214 [19], clause 6.2.1).

groupOrSequenceHopping

Parameter(s) for configuring group or sequence hopping (see TS 38.211 [16], clause 6.4.1.4.2).

periodicityAndOffset-p

Periodicity and slot offset for this SRS resource. All values are in "number of slots". Value *sl1* corresponds to a periodicity of 1 slot, value *sl2* corresponds to a periodicity of 2 slots, and so on. For each periodicity the corresponding offset is given in number of slots. For periodicity *sl1* the offset is 0 slots (see TS 38.214 [19], clause 6.2.1).

periodicityAndOffset-sp

Periodicity and slot offset for this SRS resource. All values are in "number of slots". Value *sl1* corresponds to a periodicity of 1 slot, value *sl2* corresponds to a periodicity of 2 slots, and so on. For each periodicity the corresponding offset is given in number of slots. For periodicity *sl1* the offset is 0 slots (see TS 38.214 [19], clause 6.2.1).

ptrs-PortIndex

The PTRS port index for this SRS resource for non-codebook based UL MIMO. This is only applicable when the corresponding *PTRS-UplinkConfig* is set to CP-OFDM. The *ptrs-PortIndex* configured here must be smaller than the *maxNrofPorts* configured in the *PTRS-UplinkConfig* (see TS 38.214 [19], clause 6.2.3.1).

resourceMapping

OFDM symbol location of the SRS resource within a slot including *nrofSymbols* (number of OFDM symbols), *startPosition* (value 0 refers to the last symbol, value 1 refers to the second last symbol, and so on) and *repetitionFactor* (see TS 38.214 [19], clause 6.2.1 and TS 38.211 [16], clause 6.4.1.4). The configured SRS resource does not exceed the slot boundary.

resourceType

Periodicity and offset for semi-persistent and periodic SRS resource (see TS 38.214 [19], clause 6.2.1).

seguenceld

Sequence ID used to initialize pseudo random group and sequence hopping (see TS 38.214 [19], clause 6.2.1).

spatialRelationInfo

Configuration of the spatial relation between a reference RS and the target SRS. Reference RS can be SSB/CSI-RS/SRS (see TS 38.214 [19], clause 6.2.1).

transmissionComb

Comb value (2 or 4) and comb offset (0..combValue-1) (see TS 38.214 [19], clause 6.2.1).

SRS-ResourceSet field descriptions

alpha

alpha value for SRS power control (see TS 38.213 [13], clause 7.3). When the field is absent the UE applies the value 1.

aperiodicSRS-ResourceTriggerList

An additional list of DCI "code points" upon which the UE shall transmit SRS according to this SRS resource set configuration (see TS 38.214 [19], clause 6). When the field is not included during a reconfiguration of SRS-ResourceSet of resourceType set to aperiodic, UE maintains this value based on the Need M; that is, this list is not considered as an extension of aperiodicSRS-ResourceTrigger for purpose of applying the general rule for extended list in clause 6.1.3.

aperiodicSRS-ResourceTrigger

The DCI "code point" upon which the UE shall transmit SRS according to this SRS resource set configuration (see TS 38.214 [19], clause 6).

associatedCSI-RS

ID of CSI-RS resource associated with this SRS resource set in non-codebook based operation (see TS 38.214 [19], clause 6.1.1.2).

csi-RS

ID of CSI-RS resource associated with this SRS resource set. (see TS 38.214 [19], clause 6.1.1.2).

p0

P0 value for SRS power control. The value is in dBm. Only even values (step size 2) are allowed (see TS 38.213 [13], clause 7.3).

pathlossReferenceRS

A reference signal (e.g. a CSI-RS config or a SS block) to be used for SRS path loss estimation (see TS 38.213 [13], clause 7.3).

resourceType

Time domain behavior of SRS resource configuration, see TS 38.214 [19], clause 6.2.1. The network configures SRS resources in the same resource set with the same time domain behavior on periodic, aperiodic and semi-persistent SRS.

slotOffset

An offset in number of slots between the triggering DCI and the actual transmission of this SRS-ResourceSet. If the field is absent the UE applies no offset (value 0).

srs-PowerControlAdjustmentStates

Indicates whether hsrs,c(i) = fc(i,1) or hsrs,c(i) = fc(i,2) (if twoPUSCH-PC-AdjustmentStates are configured) or separate close loop is configured for SRS. This parameter is applicable only for Uls on which UE also transmits PUSCH. If absent or release, the UE applies the value sameAs-Fci1 (see TS 38.213 [13], clause 7.3).

srs-ResourceldList

The IDs of the SRS-Resources used in this SRS-ResourceSet. If this SRS-ResourceSet is configured with usage set to codebook, the srs-ResourceIdList contains at most 2 entries. If this SRS-ResourceSet is configured with usage set to nonCodebook, the srs-ResourceIdList contains at most 4 entries.

srs-ResourceSetId

The ID of this resource set. It is unique in the context of the BWP in which the parent SRS-Config is defined.

usage

Indicates if the SRS resource set is used for beam management, codebook based or non-codebook based transmission or antenna switching. See TS 38.214 [19], clause 6.2.1. Reconfiguration between codebook based and non-codebook based transmission is not supported.

Conditional Presence	Explanation
Setup	This field is mandatory present upon configuration of SRS-ResourceSet or SRS-Resource and optionally present, Need M,
	otherwise.
NonCodebook	This field is optionally present, Need M, in case of non-codebook based transmission, otherwise the field is absent.

SRS-TPC-CommandConfig

The IE SRS-TPC-CommandConfig is used to configure the UE for extracting TPC commands for SRS from a group-TPC messages on DCI

SRS-TPC-CommandConfig information element

```
-- ASN1START
-- TAG-SRS-TPC-COMMANDCONFIG-START
SRS-TPC-CommandConfig ::=
                                     INTEGER (1..31)
   startingBitOfFormat2-3
                                                                                                           OPTIONAL, -- Need R
   fieldTypeFormat2-3
                                          INTEGER (0..1)
                                                                                                           OPTIONAL, -- Need R
   11
    startingBitOfFormat2-3SUL
                                      INTEGER (1..31)
                                                                                                           OPTIONAL -- Need R
    11
-- TAG-SRS-TPC-COMMANDCONFIG-STOP
-- ASN1STOP
```

SRS-TPC-CommandConfig field descriptions

fieldTypeFormat2-3

The type of a field within the group DCI with SRS request fields (optional), which indicates how many bits in the field are for SRS request (0 or 2).

Note that for Type A, there is a common SRS request field for all SCells in the set, but each SCell has its own TPC command bits. See TS 38.212 [17] clause 7.3.1 and , TS 38.213 [13], clause 11.3.

startingBitOfFormat2-3

The starting bit position of a block within the group DCI with SRS request fields (optional) and TPC commands. The value 1 of the field corresponds to the first/left most bit of format2-3. The value 2 of the field corresponds to the second bit format2-3, and so on (see TS 38.212 [17], clause 7.3.1 and TS 38.213 [13], clause 11.3).

startingBitOfFormat2-3SUL

The starting bit position of a block within the group DCI with SRS request fields (optional) and TPC commands for SUL carrier (see TS 38.212 [17], clause 7.3.1 and TS 38.213 [13], clause 11.3).

- SSB-Index

The IE SSB-Index identifies an SS-Block within an SS-Burst. See TS 38.213 [13], clause 4.1.

SSB-Index information element

```
-- ASN1START
-- TAG-SSB-INDEX-START

SSB-Index ::= INTEGER (0..maxNrofSSBs-1)

-- TAG-SSB-INDEX-STOP
-- ASN1STOP
```

- SSB-MTC

The IE SSB-MTC is used to configure measurement timing configurations, i.e., timing occasions at which the UE measures SSBs.

SSB-MTC information element

```
-- ASN1START
-- TAG-SSB-MTC-START
SSB-MTC ::=
                                        SEOUENCE {
   periodicityAndOffset
                                            CHOICE {
       sf5
                                            INTEGER (0..4),
       sf10
                                                INTEGER (0..9),
       sf20
                                                INTEGER (0..19),
       sf40
                                                INTEGER (0..39),
       sf80
                                                INTEGER (0..79),
       sf160
                                                INTEGER (0..159)
                                            ENUMERATED { sf1, sf2, sf3, sf4, sf5 }
    duration
SSB-MTC2 ::=
                                    SEOUENCE {
   pci-List
                                        SEQUENCE (SIZE (1..maxNrofPCIsPerSMTC)) OF PhysCellId
                                                                                                                OPTIONAL, -- Need M
   periodicity
                                        ENUMERATED {sf5, sf10, sf20, sf40, sf80, spare3, spare2, spare1}
-- TAG-SSB-MTC-STOP
-- ASN1STOP
```

SSB-MTC field descriptions

duration

Duration of the measurement window in which to receive SS/PBCH blocks. It is given in number of subframes (see TS 38.213 [13], clause 4.1).

periodicityAndOffset

Periodicity and offset of the measurement window in which to receive SS/PBCH blocks, see 5.5.2.10. Periodicity and offset are given in number of subframes.

SSB-MTC2 field descriptions

pci-List

PCIs that are known to follow this SMTC.

SSB-ToMeasure

The IE SSB-ToMeasure is used to configure a pattern of SSBs.

SSB-ToMeasure information element

```
-- TAG-SSB-TOMEASURE-START

SSB-TOMeasure ::= CHOICE {
    shortBitmap BIT STRING (SIZE (4)),
    neediumBitmap BIT STRING (SIZE (8)),
    longBitmap BIT STRING (SIZE (64))
}

-- TAG-SSB-TOMEASURE-STOP
-- ASN1STOP
```

SSB-ToMeasure field descriptions

longBitmap

Bitmap when maximum number of SS/PBCH blocks per half frame equals to 64 as defined in TS 38.213 [13], clause 4.1.

mediumBitmap

Bitmap when maximum number of SS/PBCH blocks per half frame equals to 8 as defined in TS 38.213 [13], clause 4.1.

shortBitmap

Bitmap when maximum number of SS/PBCH blocks per half frame equals to 4 as defined in TS 38.213 [13], clause 4.1.

SS-RSSI-Measurement

The IE SS-RSSI-Measurement is used to configure RSSI measurements based on synchronization reference signals.

SS-RSSI-Measurement information element

```
-- ASN1START
-- TAG-SS-RSSI-MEASUREMENT-START

SS-RSSI-Measurement ::= SEQUENCE {
    measurementSlots BIT STRING (SIZE (1..80)),
    endSymbol INTEGER(0..3)
}

-- TAG-SS-RSSI-MEASUREMENT-STOP
-- ASN1STOP
```

SS-RSSI-Measurement field descriptions

endSymbol

Within a slot that is configured for RSSI measurements (see *measurementSlots*) the UE measures the RSSI from symbol 0 to symbol *endSymbol*. This field identifies the entry in Table 5.1.3-1 in TS 38.215 [9], which determines the actual end symbol.

measurementSlots

Indicates the slots in which the UE can perform RSSI measurements. The length of the BIT STRING is equal to the number of slots in the configured SMTC window (determined by the duration and by the subcarrierSpacing). The first (left-most / most significant) bit in the bitmap corresponds to the first slot in the SMTC window, the second bit in the bitmap corresponds to the second slot in the SMTC window, and so on. The UE measures in slots for which the corresponding bit in the bitmap is set to 1.

SubcarrierSpacing

The IE Subcarrier Spacing determines the subcarrier spacing. Restrictions applicable for certain frequencies, channels or signals are clarified in the fields that use this IE.

SubcarrierSpacing information element

```
-- ASN1START
-- TAG-SUBCARRIERSPACING-START

SubcarrierSpacing ::= ENUMERATED {kHz15, kHz30, kHz60, kHz120, kHz240, spare3, spare2, spare1}

-- TAG-SUBCARRIERSPACING-STOP
-- ASN1STOP
```

TAG-Config

The IE *TAG-Config* is used to configure parameters for a time-alignment group.

TAG-Config information element

```
-- ASN1START
-- TAG-TAG-CONFIG-START
TAG-Config ::=
                                    SEOUENCE {
    tag-ToReleaseList
                                       SEQUENCE (SIZE (1..maxNrofTAGs)) OF TAG-Id
                                                                                                            OPTIONAL,
                                                                                                                      -- Need N
    taq-ToAddModList
                                       SEQUENCE (SIZE (1..maxNrofTAGs)) OF TAG
                                                                                                            OPTIONAL
                                                                                                                      -- Need N
TAG
                                    SEQUENCE {
                                       TAG-Id,
    tag-Id
    timeAlignmentTimer
                                       TimeAlignmentTimer,
TAG-Id ::=
                                   INTEGER (0..maxNrofTAGs-1)
-- TAG-TAG-CONFIG-STOP
-- ASN1STOP
```

TAG field descriptions

tag-ld

Indicates the TAG of the SpCell or an SCell, see TS 38.321 [3]. Uniquely identifies the TAG within the scope of a Cell Group (i.e. MCG or SCG).

timeAlignmentTimer

The timeAlignmentTimer for TAG with ID tag-Id, as specified in TS 38.321 [3].

TCI-State

The IE TCI-State associates one or two DL reference signals with a corresponding quasi-colocation (QCL) type.

TCI-State information element

```
-- ASN1START
-- TAG-TCI-STATE-START
TCI-State ::=
                                    SEOUENCE {
    tci-StateId
                                       TCI-StateId,
   qcl-Type1
                                        QCL-Info,
   qcl-Type2
                                        OCL-Info
                                                                                                    OPTIONAL, -- Need R
    . . .
OCL-Info ::=
                                    SEOUENCE {
    cell
                                        ServCellIndex
                                                                                                    OPTIONAL, -- Need R
                                        BWP-Id
                                                                                                    OPTIONAL, -- Cond CSI-RS-Indicated
    bwp-Id
    referenceSignal
                                        CHOICE {
       csi-rs
                                            NZP-CSI-RS-ResourceId,
       ssb
                                            SSB-Index
                                        ENUMERATED {typeA, typeB, typeC, typeD},
    qcl-Type
-- TAG-TCI-STATE-STOP
-- ASN1STOP
```

QCL-Info field descriptions

bwp-ld

The DL BWP which the RS is located in.

cell

The UE's serving cell in which the *referenceSignal* is configured. If the field is absent, it applies to the serving cell in which the *TCI-State* is configured. The RS can be located on a serving cell other than the serving cell in which the *TCI-State* is configured only if the *qcI-Type* is configured as *typeC* or *typeD*. See TS 38.214 [19] clause 5.1.5.

referenceSignal

Reference signal with which quasi-collocation information is provided as specified in TS 38.214 [19] clause 5.1.5.

qcl-Type

QCL type as specified in TS 38.214 [19] clause 5.1.5.

Conditional Presence	Explanation
CSI-RS-Indicated	This field is mandatory present if csi-rs is included, absent otherwise

- TCI-StateId

The IE TCI-StateId is used to identify one TCI-State configuration.

TCI-StateId information element

```
-- ASN1START
-- TAG-TCI-STATEID-START

TCI-StateId ::= INTEGER (0..maxNrofTCI-States-1)
-- TAG-TCI-STATEID-STOP
-- ASN1STOP
```

TDD-UL-DL-ConfigCommon

The IE TDD-UL-DL-ConfigCommon determines the cell specific Uplink/Downlink TDD configuration.

TDD-UL-DL-ConfigCommon information element

```
-- ASN1START
-- TAG-TDD-UL-DL-CONFIGCOMMON-START
TDD-UL-DL-ConfigCommon ::=
                                    SEQUENCE {
    referenceSubcarrierSpacing
                                       SubcarrierSpacing,
   pattern1
                                       TDD-UL-DL-Pattern,
   pattern2
                                       TDD-UL-DL-Pattern
                                                                                                                OPTIONAL, -- Need R
TDD-UL-DL-Pattern ::=
                                   SEQUENCE {
   dl-UL-TransmissionPeriodicity
                                       ENUMERATED {ms0p5, ms0p625, ms1, ms1p25, ms2, ms2p5, ms5, ms10},
   nrofDownlinkSlots
                                       INTEGER (0..maxNrofSlots),
   nrofDownlinkSymbols
                                       INTEGER (0..maxNrofSymbols-1),
   nrofUplinkSlots
                                       INTEGER (0..maxNrofSlots),
                                       INTEGER (0..maxNrofSymbols-1),
   nrofUplinkSymbols
    ] ]
    dl-UL-TransmissionPeriodicity-v1530
                                           ENUMERATED {ms3, ms4}
                                                                                                                OPTIONAL -- Need R
    ]]
-- TAG-TDD-UL-DL-CONFIGCOMMON-STOP
-- ASN1STOP
```

TDD-UL-DL-ConfigCommon field descriptions

referenceSubcarrierSpacing

Reference SCS used to determine the time domain boundaries in the UL-DL pattern which must be common across all subcarrier specific carriers, i.e., independent of the actual subcarrier spacing using for data transmission. Only the values 15, 30 or 60 kHz (FR1), and 60 or 120 kHz (FR2) are applicable. The network configures a not larger than any SCS of configured BWPs for the serving cell. See TS 38.213 [13], clause 11.1.

TDD-UL-DL-Pattern field descriptions

dl-UL-TransmissionPeriodicity

Periodicity of the DL-UL pattern, see TS 38.213 [13], clause 11.1. If the *dl-UL-TransmissionPeriodicity-v1530* is signalled, UE shall ignore the *dl-UL-TransmissionPeriodicity* (without suffix).

nrofDownlinkSlots

Number of consecutive full DL slots at the beginning of each DL-UL pattern, see TS 38.213 [13], clause 11.1. In this release, the maximum value for this field is 80.

nrofDownlinkSymbols

Number of consecutive DL symbols in the beginning of the slot following the last full DL slot (as derived from *nrofDownlinkSlots*). The value 0 indicates that there is no partial-downlink slot. (see TS 38.213 [13], clause 11.1).

nrofUplinkSlots

Number of consecutive full UL slots at the end of each DL-UL pattern, see TS 38.213 [13], clause 11.1. In this release, the maximum value for this field is 80.

nrofUplinkSymbols

Number of consecutive UL symbols in the end of the slot preceding the first full UL slot (as derived from *nrofUplinkSlots*). The value 0 indicates that there is no partial-uplink slot. (see TS 38.213 [13], clause 11.1).

TDD-UL-DL-ConfigDedicated

The IE *TDD-UL-DL-ConfigDedicated* determines the UE-specific Uplink/Downlink TDD configuration.

TDD-UL-DL-ConfigDedicated information element

```
-- ASN1START
-- TAG-TDD-UL-DL-CONFIGDEDICATED-START
TDD-UL-DL-ConfigDedicated ::=
                                   SEQUENCE {
    slotSpecificConfigurationsToAddModList
                                                SEQUENCE (SIZE (1..maxNrofSlots)) OF TDD-UL-DL-SlotConfig
                                                                                                                OPTIONAL, -- Need N
    slotSpecificConfigurationsToReleaseList
                                                SEQUENCE (SIZE (1..maxNrofSlots)) OF TDD-UL-DL-SlotIndex
                                                                                                                OPTIONAL, -- Need N
    . . .
TDD-UL-DL-SlotConfig ::=
    slotIndex
                                       TDD-UL-DL-SlotIndex,
    symbols
                                        CHOICE {
       allDownlink
                                           NULL.
       allUplink
                                           NULL.
       explicit
                                           SEQUENCE {
           nrofDownlinkSymbols
                                                INTEGER (1..maxNrofSymbols-1)
                                                                                                                OPTIONAL, -- Need S
           nrofUplinkSymbols
                                               INTEGER (1..maxNrofSymbols-1)
                                                                                                                OPTIONAL -- Need S
```

```
}
TDD-UL-DL-SlotIndex ::= INTEGER (0..maxNrofSlots-1)
-- TAG-TDD-UL-DL-CONFIGDEDICATED-STOP
-- ASN1STOP
```

TDD-UL-DL-ConfigDedicated field descriptions

slotSpecificConfigurationsToAddModList

The slotSpecificConfigurationToAddModList allows overriding UL/DL allocations provided in tdd-UL-DL-configurationCommon, see TS 38.213 [13], clause 11.1.

TDD-UL-DL-SlotConfig field descriptions

nrofDownlinkSymbols

Number of consecutive DL symbols in the beginning of the slot identified by *slotIndex*. If the field is absent the UE assumes that there are no leading DL symbols. (see TS 38.213 [13], clause 11.1).

nrofUplinkSymbols

Number of consecutive UL symbols in the end of the slot identified by *slotIndex*. If the field is absent the UE assumes that there are no trailing UL symbols. (see TS 38.213 [13], clause 11.1).

slotIndex

Identifies a slot within a slot configuration period given in tdd-UL-DL-configurationCommon, see TS 38.213 [13], clause 11.1.

symbols

The direction (downlink or uplink) for the symbols in this slot. Value *allDownlink* indicates that all symbols in this slot are used for downlink; value *explicit* indicates that all symbols in the beginning and end of this slot are allocated to downlink and uplink, respectively.

TrackingAreaCode

The IE TrackingAreaCode is used to identify a tracking area within the scope of a PLMN, see TS 24.501 [23].

TrackingAreaCode information element

```
-- ASN1START
-- TAG-TRACKINGAREACODE-START

TrackingAreaCode ::= BIT STRING (SIZE (24))

-- TAG-TRACKINGAREACODE-STOP
-- ASN1STOP
```

T-Reselection

The IE *T-Reselection* concerns the cell reselection timer Treselection_{RAT} for NR and E-UTRA Value in seconds. For value 0, behaviour as specified in 7.1.2 applies.

T-Reselection information element

```
-- ASN1START
-- TAG-TRESELECTION-START

T-Reselection ::= INTEGER (0..7)

-- TAG-TRESELECTION-STOP
-- ASN1STOP
```

- TimeAlignmentTimer

The IE *TimeAlignmentTimer* is used to configure the time alignment timer as specified in TS 38.321 [3]. The values are in ms.

TimeAlignmentTimer information element

```
-- ASN1START
-- TAG-TIMEALIGNMENTTIMER-START

TimeAlignmentTimer ::= ENUMERATED {ms500, ms750, ms1280, ms1920, ms2560, ms5120, ms10240, infinity}

-- TAG-TIMEALIGNMENTTIMER-STOP
-- ASN1STOP
```

- TimeToTrigger

The IE *TimeToTrigger* specifies the value range used for time to trigger parameter, which concerns the time during which specific criteria for the event needs to be met in order to trigger a measurement report. Value *ms0* corresponds to 0 ms and behaviour as specified in 7.1.2 applies, value *ms40* corresponds to 40 ms, and so on.

TimeToTrigger information element

UAC-BarringInfoSetIndex

The IE *UAC-BarringInfoSetIndex* provides the index of the entry in *uac-BarringInfoSetList*. Value 1 corresponds to the first entry in *uac-BarringInfoSetList*, value 2 corresponds to the second entry in this list and so on. An index value referring to an entry not included in *uac-BarringInfoSetList* indicates no barring.

UAC-BarringInfoSetIndex information element

```
-- ASN1START
-- TAG-UAC-BARRINGINFOSETINDEX-START

UAC-BarringInfoSetIndex ::= INTEGER (1..maxBarringInfoSet)
-- TAG-UAC-BARRINGINFOSETINDEX-STOP
-- ASN1STOP
```

UAC-BarringInfoSetList

The IE *UAC-BarringInfoSetList* provides a list of access control parameter sets. An access category can be configured with access parameters according to one of the sets.

UAC-BarringInfoSetList information element

UAC-BarringInfoSetList field descriptions

uac-BarringInfoSetList

List of access control parameter sets. Each access category can be configured with access parameters corresponding to a particular set by *uac-barringInfoSetIndex*. Association of an access category with an index that has no corresponding entry in the *uac-BarringInfoSetList* is valid configuration and indicates no barring.

uac-BarringForAccessIdentity

Indicates whether access attempt is allowed for each Access Identity. The leftmost bit, bit 0 in the bit string corresponds to Access Identity 1, bit 1 in the bit string corresponds to Access Identity 2, bit 2 in the bit string corresponds to Access Identity 11, bit 3 in the bit string corresponds to Access Identity 12, bit 4 in the bit string corresponds to Access Identity 13, bit 5 in the bit string corresponds to Access Identity 14, and bit 6 in the bit string corresponds to Access Identity 15. Value 0 means that access attempt is allowed for the corresponding access identity.

uac-BarringFactor

Represents the probability that access attempt would be allowed during access barring check.

uac-BarringTime

The average time in seconds before a new access attempt is to be performed after an access attempt was barred at access barring check for the same access category, see 5.3.14.5.

UAC-BarringPerCatList

The IE *UAC-BarringPerCatList* provides access control parameters for a list of access categories.

UAC-BarringPerCatList information element

```
-- ASN1START
-- TAG-UAC-BARRINGPERCATLIST-START

UAC-BarringPerCatList ::= SEQUENCE (SIZE (1..maxAccessCat-1)) OF UAC-BarringPerCat

UAC-BarringPerCat ::= SEQUENCE {
    accessCategory INTEGER (1..maxAccessCat-1),
    uac-barringInfoSetIndex
}

-- TAG-UAC-BARRINGPERCATLIST-STOP
-- ASN1STOP
```

UAC-BarringPerCatList field descriptions

accessCategory

The Access Category according to TS 22.261 [25].

UAC-BarringPerPLMN-List

The IE UAC-BarringPerPLMN-List provides access category specific access control parameters, which are configured per PLMN.

UAC-BarringPerPLMN-List information element

```
-- ASN1START
-- TAG-UAC-BARRINGPERPLMN-LIST-START
UAC-BarringPerPLMN-List ::=
                                    SEQUENCE (SIZE (1.. maxPLMN)) OF UAC-BarringPerPLMN
UAC-BarringPerPLMN ::=
                                    SEQUENCE {
   plmn-IdentityIndex
                                       INTEGER (1..maxPLMN),
    uac-ACBarringListType
                                        CHOICE {
       uac-ImplicitACBarringList
                                            SEQUENCE (SIZE(maxAccessCat-1)) OF UAC-BarringInfoSetIndex,
       uac-ExplicitACBarringList
                                            UAC-BarringPerCatList
                                                                                                          OPTIONAL
                                                                                                                       -- Need S
-- TAG-UAC-BARRINGPERPLMN-LIST-STOP
-- ASN1STOP
```

UAC-BarringPerPLMN-List field descriptions

uac-ACBarringListType

Access control parameters for each access category valid only for a specific PLMN. UE behaviour upon absence of this field is specified in clause 5.3.14.2.

plmn-ldentityIndex

Index of the PLMN across the plmn-IdentityInfoList fields included in SIB1.

UE-TimersAndConstants

The IE UE-Timers And Constants contains timers and constants used by the UE in RRC CONNECTED, RRC INACTIVE and RRC IDLE.

UE-TimersAndConstants information element

```
-- ASN1START
-- TAG-UE-TIMERSANDCONSTANTS-START
UE-TimersAndConstants ::=
                                    SEOUENCE {
    t.300
                                        ENUMERATED {ms100, ms200, ms300, ms400, ms600, ms1500, ms1500, ms2000},
    t301
                                        ENUMERATED {ms100, ms200, ms300, ms400, ms600, ms1000, ms1500, ms2000},
                                        ENUMERATED {ms0, ms50, ms100, ms200, ms500, ms1000, ms2000},
    t310
                                        ENUMERATED {n1, n2, n3, n4, n6, n8, n10, n20},
   n310
    t311
                                        ENUMERATED {ms1000, ms3000, ms5000, ms10000, ms15000, ms20000, ms30000},
                                        ENUMERATED {n1, n2, n3, n4, n5, n6, n8, n10},
    n311
                                        ENUMERATED {ms100, ms200, ms300, ms400, ms600, ms1000, ms1500, ms2000},
    t319
-- TAG-UE-TIMERSANDCONSTANTS-STOP
-- ASN1STOP
```

UplinkConfigCommon

The IE *UplinkConfigCommon* provides common uplink parameters of a cell.

UplinkConfigCommon information element

```
-- ASN1START
-- TAG-UPLINKCONFIGCOMMON-START

UplinkConfigCommon ::= SEQUENCE {
    frequencyInfoUL FrequencyInfoUL OPTIONAL, -- Cond InterFreqHOAndServCellAdd initialUplinkBWP BWP-UplinkCommon OPTIONAL, -- Cond ServCellAdd dummy TimeAlignmentTimer
}

-- TAG-UPLINKCONFIGCOMMON-STOP -- ASN1STOP
```

UplinkConfigCommon field descriptions	
frequencyInfoUL	
Absolute uplink frequency configuration and subcarrier specific virtual carriers.	
initialUplinkBWP	
The initial uplink BWP configuration for a serving cell (see TS 38.213 [13], clause 12).	

Conditional Presence	Explanation
InterFreqHOAndServCellAdd	This field is mandatory present for inter-frequency handover and upon serving cell (PSCell/SCell) addition. Otherwise, the field is optionally
	present, Need M.
ServCellAdd	This field is mandatory present upon serving cell addition (for PSCell and SCell) and upon handover from E-UTRA to NR. It is optionally
	present, Need M otherwise.

UplinkConfigCommonSIB

The IE *UplinkConfigCommonSIB* provides common uplink parameters of a cell.

UplinkConfigCommonSIB information element

```
-- ASN1START
-- TAG-UPLINKCONFIGCOMMONSIB-START

UplinkConfigCommonSIB ::= SEQUENCE {
    frequencyInfoUL FrequencyInfoUL-SIB,
    initialUplinkBWP BWP-UplinkCommon,
    timeAlignmentTimerCommon TimeAlignmentTimer
}

-- TAG-UPLINKCONFIGCOMMONSIB-STOP
-- ASN1STOP
```

UplinkConfigCommonSIB field descriptions

frequencyInfoUL

Absolute uplink frequency configuration and subcarrier specific virtual carriers.

InitialUplinkBWP

The initial uplink BWP configuration for a PCell (see TS 38.213 [13], clause 12).

UplinkTxDirectCurrentList

The IE *UplinkTxDirectCurrentList* indicates the Tx Direct Current locations per serving cell for each configured UL BWP in the serving cell, based on the BWP numerology and the associated carrier bandwidth.

UplinkTxDirectCurrentList information element

```
-- ASN1START
-- TAG-UPLINKTXDIRECTCURRENTLIST-START
                                         SEQUENCE (SIZE (1..maxNrofServingCells)) OF UplinkTxDirectCurrentCell
UplinkTxDirectCurrentList ::=
UplinkTxDirectCurrentCell ::=
                                         SEQUENCE {
    servCellIndex
                                            ServCellIndex,
    uplinkDirectCurrentBWP
                                             SEQUENCE (SIZE (1..maxNrofBWPs)) OF UplinkTxDirectCurrentBWP,
    . . . ,
    [ [
    uplinkDirectCurrentBWP-SUL
                                             SEQUENCE (SIZE (1..maxNrofBWPs)) OF UplinkTxDirectCurrentBWP
                                                                                                                         OPTIONAL
    11
UplinkTxDirectCurrentBWP ::=
                                         SEOUENCE {
    bwp-Id
                                             BWP-Id,
    shift7dot5kHz
                                             BOOLEAN,
    txDirectCurrentLocation
                                             INTEGER (0..3301)
-- TAG-UPLINKTXDIRECTCURRENTLIST-STOP
-- ASN1STOP
```

UplinkTxDirectCurrentBWP field descriptions

bwp-ld

The BWP-Id of the corresponding uplink BWP.

shift7dot5kHz

Indicates whether there is 7.5 kHz shift or not. 7.5 kHz shift is applied if the field is set to true. Otherwise 7.5 kHz shift is not applied.

txDirectCurrentLocation

The uplink Tx Direct Current location for the carrier. Only values in the value range of this field between 0 and 3299, which indicate the subcarrier index within the carrier corresponding to the numerology of the corresponding uplink BWP and value 3300, which indicates "Outside the carrier" and value 3301, which indicates "Undetermined position within the carrier" are used in this version of the specification.

UplinkTxDirectCurrentCell field descriptions

servCellIndex

The serving cell ID of the serving cell corresponding to the uplinkDirectCurrentBWP.

uplinkDirectCurrentBWP

The Tx Direct Current locations for all the uplink BWPs configured at the corresponding serving cell.

uplinkDirectCurrentBWP-SUL

The Tx Direct Current locations for all the supplementary uplink BWPs configured at the corresponding serving cell.

ZP-CSI-RS-Resource

The IE *ZP-CSI-RS-Resource* is used to configure a Zero-Power (ZP) CSI-RS resource (see TS 38.214 [19], clause 5.1.4.2). Reconfiguration of a *ZP-CSI-RS-Resource* between periodic or semi-persistent and aperiodic is not supported.

ZP-CSI-RS-Resource information element

ZP-CSI-RS-Resource field descriptions

periodicityAndOffset

Periodicity and slot offset for periodic/semi-persistent ZP-CSI-RS (see TS 38.214 [19], clause 5.1.4.2). Network always configures the UE with a value for this field for periodic and semi-persistent ZP-CSI-RS resource (as indicated in PDSCH-Config).

resourceMapping

-- ASN1STOP

OFDM symbol and subcarrier occupancy of the ZP-CSI-RS resource within a slot.

zp-CSI-RS-Resourceld

ZP CSI-RS resource configuration ID (see TS 38.214 [19], clause 5.1.4.2).

Conditional Presence	Explanation
PeriodicOrSemiPersistent	The field is optionally present, Need M, for periodic and semi-persistent ZP-CSI-RS-Resources (as indicated in PDSCH-
	Config). The field is absent otherwise.

ZP-CSI-RS-ResourceSet

The IE ZP-CSI-RS-ResourceSet refers to a set of ZP-CSI-RS-Resources using their ZP-CSI-RS-ResourceIds.

ZP-CSI-RS-ResourceSet information element

```
-- ASN1START
-- TAG-ZP-CSI-RS-RESOURCESET-START

ZP-CSI-RS-ResourceSet ::= SEQUENCE {
```

ZP-CSI-RS-ResourceSet field descriptions

zp-CSI-RS-ResourceldList

The list of ZP-CSI-RS-Resourceld identifying the ZP-CSI-RS-Resource elements belonging to this set.

ZP-CSI-RS-ResourceSetId

The IE ZP-CSI-RS-ResourceSetId identifies a ZP-CSI-RS-ResourceSet.

ZP-CSI-RS-ResourceSetId information element

```
-- ASN1START
-- TAG-ZP-CSI-RS-RESOURCESETID-START

ZP-CSI-RS-ResourceSetId ::= INTEGER (0..maxNrofZP-CSI-RS-ResourceSets-1)
-- TAG-ZP-CSI-RS-RESOURCESETID-STOP
-- ASN1STOP
```

6.3.3 UE capability information elements

AccessStratumRelease

The IE AccessStratumRelease indicates the release supported by the UE.

AccessStratumRelease information element

BandCombinationList

The IE BandCombinationList contains a list of NR CA, NR non-CA and/or MR-DC band combinations (also including DL only or UL only band).

BandCombinationList information element

```
-- ASN1START
-- TAG-BANDCOMBINATIONLIST-START
BandCombinationList ::=
                                     SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination
BandCombinationList-v1540 ::=
                                     SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination-v1540
BandCombinationList-v1550 ::=
                                    SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination-v1550
BandCombinationList-v1560 ::=
                                    SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination-v1560
BandCombinationList-v1570 ::=
                                    SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination-v1570
BandCombinationList-v1580 ::=
                                     SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination-v1580
BandCombinationList-v1590 ::=
                                     SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination-v1590
BandCombinationList-v15g0 ::=
                                    SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination-v15q0
BandCombination ::=
                                     SEOUENCE {
    bandList
                                        SEQUENCE (SIZE (1..maxSimultaneousBands)) OF BandParameters,
                                        FeatureSetCombinationId,
    featureSetCombination
    ca-ParametersEUTRA
                                        CA-ParametersEUTRA
                                                                                      OPTIONAL.
    ca-ParametersNR
                                        CA-ParametersNR
                                                                                      OPTIONAL,
    mrdc-Parameters
                                        MRDC-Parameters
                                                                                      OPTIONAL,
    supportedBandwidthCombinationSet
                                        BIT STRING (SIZE (1..32))
                                                                                      OPTIONAL,
    powerClass-v1530
                                        ENUMERATED {pc2}
                                                                                      OPTIONAL
BandCombination-v1540::=
    bandList-v1540
                                        SEQUENCE (SIZE (1..maxSimultaneousBands)) OF BandParameters-v1540,
    ca-ParametersNR-v1540
                                        CA-ParametersNR-v1540
                                                                                      OPTIONAL
BandCombination-v1550 ::=
                                    SEQUENCE {
    ca-ParametersNR-v1550
                                        CA-ParametersNR-v1550
BandCombination-v1560::=
                                     SEQUENCE {
    ne-DC-BC
                                            ENUMERATED {supported}
                                                                                    OPTIONAL,
                                            CA-ParametersNRDC
    ca-ParametersNRDC
                                                                                    OPTIONAL,
    ca-ParametersEUTRA-v1560
                                            CA-ParametersEUTRA-v1560
                                                                                    OPTIONAL,
    ca-ParametersNR-v1560
                                            CA-ParametersNR-v1560
                                                                                    OPTIONAL
BandCombination-v1570 ::=
                                     SEQUENCE {
    ca-ParametersEUTRA-v1570
                                        CA-ParametersEUTRA-v1570
```

```
BandCombination-v1580 ::=
                                    SEOUENCE
    mrdc-Parameters-v1580
                                        MRDC-Parameters-v1580
BandCombination-v1590::=
                                     SEOUENCE {
    supportedBandwidthCombinationSetIntraENDC BIT STRING (SIZE (1..32))
                                                                                    OPTIONAL,
    mrdc-Parameters-v1590
                                                MRDC-Parameters-v1590
BandCombination-v15g0::=
                                     SEQUENCE {
    ca-ParametersNR-v15g0
                                        CA-ParametersNR-v15g0
                                                                                     OPTIONAL,
    ca-ParametersNRDC-v15q0
                                        CA-ParametersNRDC-v15q0
                                                                                     OPTIONAL,
    mrdc-Parameters-v15g0
                                        MRDC-Parameters-v15g0
                                                                                     OPTIONAL
BandParameters ::=
                                        CHOICE {
                                        SEOUENCE {
    eutra
        bandEUTRA
                                            FreqBandIndicatorEUTRA,
        ca-BandwidthClassDL-EUTRA
                                            CA-BandwidthClassEUTRA
                                                                                    OPTIONAL,
        ca-BandwidthClassUL-EUTRA
                                            CA-BandwidthClassEUTRA
                                                                                     OPTIONAL
    nr
                                        SEQUENCE {
        bandNR
                                            FreqBandIndicatorNR,
        ca-BandwidthClassDL-NR
                                            CA-BandwidthClassNR
                                                                                    OPTIONAL,
        ca-BandwidthClassUL-NR
                                            CA-BandwidthClassNR
                                                                                     OPTIONAL
BandParameters-v1540 ::=
                                    SEQUENCE {
    srs-CarrierSwitch
                                        CHOICE {
                                            SEQUENCE {
       nr
            srs-SwitchingTimesListNR
                                                 SEQUENCE (SIZE (1..maxSimultaneousBands)) OF SRS-SwitchingTimeNR
        },
        eutra
                                            SEOUENCE {
                                                 SEQUENCE (SIZE (1..maxSimultaneousBands)) OF SRS-SwitchingTimeEUTRA
            srs-SwitchingTimesListEUTRA
                                                                                    OPTIONAL,
    srs-TxSwitch
                                     SEOUENCE -
        supportedSRS-TxPortSwitch
                                        ENUMERATED {t1r2, t1r4, t2r4, t1r4-t2r4, t1r1, t2r2, t4r4, notSupported},
                                        INTEGER (1..32)
        txSwitchImpactToRx
                                                                                    OPTIONAL,
        txSwitchWithAnotherBand
                                        INTEGER (1..32)
                                                                                    OPTIONAL
                                                                                    OPTIONAL
-- TAG-BANDCOMBINATIONLIST-STOP
-- ASN1STOP
```

BandCombination field descriptions

BandCombinationList-v1540, BandCombinationList-v1550, BandCombinationList-v1560, BandCombinationList-v1570, BandCombinationList-v1580, BandCombinationList-v1590, BandCombinationList-v15q0

The UE shall include the same number of entries, and listed in the same order, as in *BandCombinationList* (without suffix). If the field is included in *supportedBandCombinationListNEDC-Only-v15a0*, the UE shall include the same number of entries, and listed in the same order, as in *BandCombinationList* (without suffix) of *supportedBandCombinationListNEDC-Only* (without suffix) field.

ca-ParametersNRDC

If the field is included for a band combination in the NR capability container, the field indicates support of NR-DC. Otherwise, the field is absent.

ne-DC-BC

If the field is included for a band combination in the MR-DC capability container, the field indicates support of NE-DC. Otherwise, the field is absent.

srs-SwitchingTimesListNR

Indicates, for a particular pair of NR bands, the RF retuning time when switching between a NR carrier corresponding to this band entry and another (PUSCH-less) NR carrier corresponding to the band entry in the order indicated below:

- For the first NR band, the UE shall include the same number of entries for NR bands as in bandList, i.e. first entry corresponds to first NR band in bandList and so on,
- For the second NR band, the UE shall include one entry less, i.e. first entry corresponds to the second NR band in bandList and so on
- And so on

srs-SwitchingTimesListEUTRA

Indicates, for a particular pair of E-UTRA bands, the RF retuning time when switching between an E-UTRA carrier corresponding to this band entry and another (PUSCH-less) E-UTRA carrier corresponding to the band entry in the order indicated below:

- For the first E-UTRA band, the UE shall include the same number of entries for E-UTRA bands as in *bandList*, i.e. first entry corresponds to first E-UTRA band in *bandList* and so on.
- For the second E-UTRA band, the UE shall include one entry less, i.e. first entry corresponds to the second E-UTRA band in bandList and so on
- And so on

srs-TxSwitch

Indicates supported SRS antenna switch capability for the associated band. If the UE indicates support of SRS-SwitchingTimeNR, the UE is allowed to set this field for a band with associated FeatureSetUplinkId set to 0 for SRS carrier switching.

CA-BandwidthClassEUTRA

The IE CA-BandwidthClassEUTRA indicates the E-UTRA CA bandwidth class as defined in TS 36.101 [22], table 5.6A-1.

CA-BandwidthClassEUTRA information element

```
-- ASN1START
-- TAG-CA-BANDWIDTHCLASSEUTRA-START

CA-BandwidthClassEUTRA ::= ENUMERATED {a, b, c, d, e, f, ...}

-- TAG-CA-BANDWIDTHCLASSEUTRA-STOP
-- ASN1STOP
```

CA-BandwidthClassNR

The IE CA-BandwidthClassNR indicates the NR CA bandwidth class as defined in TS 38.101-1 [15], table 5.3A.5-1 and TS 38.101-2 [39], table 5.3A.4-1.

CA-BandwidthClassNR information element

```
-- ASN1START
-- TAG-CA-BANDWIDTHCLASSNR-START

CA-BandwidthClassNR ::= ENUMERATED {a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, ...}

-- TAG-CA-BANDWIDTHCLASSNR-STOP
-- ASN1STOP
```

CA-ParametersEUTRA

The IE CA-ParametersEUTRA contains the E-UTRA part of band combination parameters for a given MR-DC band combination.

NOTE: If additional E-UTRA band combination parameters are defined in TS 36.331 [10], which are supported for MR-DC, they will be defined here as well.

CA-ParametersEUTRA information element

```
-- ASN1START
-- TAG-CA-PARAMETERSEUTRA-START
CA-ParametersEUTRA ::=
                                                SEQUENCE {
   multipleTimingAdvance
                                                    ENUMERATED {supported}
                                                                                                     OPTIONAL,
                                                    ENUMERATED {supported}
    simultaneousRx-Tx
                                                                                                     OPTIONAL,
    supportedNAICS-2CRS-AP
                                                    BIT STRING (SIZE (1..8))
                                                                                                     OPTIONAL,
                                                    ENUMERATED {supported}
    additionalRx-Tx-PerformanceReq
                                                                                                     OPTIONAL,
    ue-CA-PowerClass-N
                                                    ENUMERATED {class2}
                                                                                                     OPTIONAL,
    supportedBandwidthCombinationSetEUTRA-v1530
                                                    BIT STRING (SIZE (1..32))
                                                                                                     OPTIONAL,
CA-ParametersEUTRA-v1560 ::=
                                                SEQUENCE {
                                                    INTEGER (2..128)
    fd-MIMO-TotalWeightedLayers
                                                                                                     OPTIONAL
CA-ParametersEUTRA-v1570 ::=
                                                SEQUENCE {
    dl-1024QAM-TotalWeightedLayers
                                                    INTEGER (0..10)
                                                                                                     OPTIONAL
-- TAG-CA-PARAMETERSEUTRA-STOP
-- ASN1STOP
```

CA-ParametersNR

The IE CA-ParametersNR contains carrier aggregation related capabilities that are defined per band combination.

CA-ParametersNR information element

```
-- ASN1START
-- TAG-CA-PARAMETERSNR-START
CA-ParametersNR ::=
                                     SEOUENCE {
                                                   ENUMERATED {supported}
                                                                                OPTIONAL,
    dummy
    parallelTxSRS-PUCCH-PUSCH
                                                   ENUMERATED
                                                               {supported}
                                                                                OPTIONAL,
    parallelTxPRACH-SRS-PUCCH-PUSCH
                                                               {supported}
                                                                                OPTIONAL,
                                                   ENUMERATED
    simultaneousRxTxInterBandCA
                                                   ENUMERATED {supported}
                                                                                OPTIONAL,
    simultaneousRxTxSUL
                                                               {supported}
                                                                                OPTIONAL,
                                                   ENUMERATED
    diffNumerologyAcrossPUCCH-Group
                                                   ENUMERATED {supported}
                                                                                OPTIONAL,
    diffNumerologyWithinPUCCH-GroupSmallerSCS
                                                   ENUMERATED {supported}
                                                                                OPTIONAL,
                                                   ENUMERATED {n2, n3, n4}
    supportedNumberTAG
                                                                                OPTIONAL,
    . . .
CA-ParametersNR-v1540 ::=
                                     SEQUENCE {
    simultaneousSRS-AssocCSI-RS-AllCC
                                                             INTEGER (5..32)
                                                                                      OPTIONAL,
    csi-RS-IM-ReceptionForFeedbackPerBandComb
                                                             SEOUENCE {
        maxNumberSimultaneousNZP-CSI-RS-ActBWP-AllCC
                                                                 INTEGER (1..64)
                                                                                          OPTIONAL,
        totalNumberPortsSimultaneousNZP-CSI-RS-ActBWP-AllCC
                                                                 INTEGER (2..256)
                                                                                          OPTIONAL
                                                                                      OPTIONAL,
    simultaneousCSI-ReportsAllCC
                                                             INTEGER (5..32)
                                                                                      OPTIONAL,
    dualPA-Architecture
                                                             ENUMERATED {supported}
                                                                                      OPTIONAL
CA-ParametersNR-v1550 ::=
                                     SEOUENCE {
                                         ENUMERATED {supported}
                                                                     OPTIONAL
CA-ParametersNR-v1560 ::=
                                     SEQUENCE {
    diffNumerologyWithinPUCCH-GroupLargerSCS
                                                   ENUMERATED {supported}
                                                                                      OPTIONAL
CA-ParametersNR-v15g0 ::=
                                     SEOUENCE {
    simultaneousRxTxInterBandCAPerBandPair
                                                   SimultaneousRxTxPerBandPair
                                                                                      OPTIONAL,
    simultaneousRxTxSULPerBandPair
                                                   SimultaneousRxTxPerBandPair
                                                                                      OPTIONAL
-- TAG-CA-PARAMETERSNR-STOP
-- ASN1STOP
```

CA-ParametersNRDC

The IE CA-ParametersNRDC contains dual connectivity related capabilities that are defined per band combination.

CA-ParametersNRDC information element

```
-- ASN1START
```

⁻⁻ TAG-CA-PARAMETERS-NRDC-START

```
CA-ParametersNRDC ::=
                                             SEOUENCE {
                                                 CA-ParametersNR
                                                                                                  OPTIONAL.
    ca-ParametersNR-ForDC
    ca-ParametersNR-ForDC-v1540
                                               CA-ParametersNR-v1540
                                                                                              OPTIONAL,
    ca-ParametersNR-ForDC-v1550
                                               CA-ParametersNR-v1550
                                                                                              OPTIONAL.
    ca-ParametersNR-ForDC-v1560
                                               CA-ParametersNR-v1560
                                                                                              OPTIONAL,
    featureSetCombinationDC
                                                FeatureSetCombinationId
                                                                                               OPTIONAL
                                      SEOUENCE {
CA-ParametersNRDC-v15q0 ::=
    ca-ParametersNR-ForDC-v15g0
                                          CA-ParametersNR-v15g0
                                                                                 OPTIONAL
-- TAG-CA-PARAMETERS-NRDC-STOP
-- ASN1STOP
```

CA-ParametersNRDC field descriptions

ca-ParametersNR-forDC (with and without suffix)

If this field is present for a band combination, it reports the UE capabilities when NR-DC is configured with the band combination. If a version of this field (i.e., with or without suffix) is absent for a band combination, the corresponding *ca-ParametersNR* field version in *BandCombination* is applicable to the UE configured with NR-DC for the band combination. If a version of this field (i.e., with or without suffix) is present for a band combination but does not contain any parameters, the UE does not support the corresponding field version when configured with NR-DC for the band combination.

featureSetCombinationDC

If this field is present for a band combination, it reports the feature set combination supported for the band combination when NR-DC is configured. If this field is absent for a band combination, the *featureSetCombination* in *BandCombination* (without suffix) is applicable to the UE configured with NR-DC for the band combination.

CarrierAggregationVariant

The IE CarrierAggregationVariant informs the network about supported "placement" of the SpCell in an NR cell group.

CarrierAggregationVariant information element

```
-- ASN1START
-- TAG-CARRIERAGGREGATIONVARIANT-START
CarrierAggregationVariant ::=
                                        SEOUENCE {
    fr1fdd-FR1TDD-CA-SpCellOnFR1FDD
                                            ENUMERATED {supported}
                                                                                         OPTIONAL,
    fr1fdd-FR1TDD-CA-SpCellOnFR1TDD
                                            ENUMERATED {supported}
                                                                                         OPTIONAL,
    fr1fdd-FR2TDD-CA-SpCellOnFR1FDD
                                            ENUMERATED {supported}
                                                                                         OPTIONAL,
                                            ENUMERATED {supported}
    fr1fdd-FR2TDD-CA-SpCellOnFR2TDD
                                                                                         OPTIONAL,
    fr1tdd-FR2TDD-CA-SpCellOnFR1TDD
                                            ENUMERATED {supported}
                                                                                         OPTIONAL,
    fr1tdd-FR2TDD-CA-SpCellOnFR2TDD
                                            ENUMERATED {supported}
                                                                                         OPTIONAL,
    fr1fdd-FR1TDD-FR2TDD-CA-SpCellOnFR1FDD ENUMERATED {supported}
                                                                                         OPTIONAL,
    fr1fdd-FR1TDD-FR2TDD-CA-SpCellOnFR1TDD ENUMERATED {supported}
                                                                                         OPTIONAL,
    fr1fdd-FR1TDD-FR2TDD-CA-SpCellOnFR2TDD ENUMERATED {supported}
                                                                                         OPTIONAL
-- TAG-CARRIERAGGREGATIONVARIANT-STOP
```

-- ASN1STOP

CodebookParameters

The IE CodebookParameters is used to convey codebook related parameters.

CodebookParameters information element

```
-- ASN1START
-- TAG-CODEBOOKPARAMETERS-START
                                   SEQUENCE {
CodebookParameters ::=
    type1
                                           SEQUENCE {
        singlePanel
                                              SEQUENCE {
                                              SEQUENCE (SIZE (1.. maxNrofCSI-RS-Resources)) OF SupportedCSI-RS-Resource,
            supportedCSI-RS-ResourceList
                                                   ENUMERATED {mode1, mode1andMode2},
            maxNumberCSI-RS-PerResourceSet.
                                              INTEGER (1..8)
       multiPanel
                                              SEOUENCE {
            supportedCSI-RS-ResourceList
                                              SEQUENCE (SIZE (1.. maxNrofCSI-RS-Resources)) OF SupportedCSI-RS-Resource,
           modes
                                                   ENUMERATED {mode1, mode2, both},
                                                  ENUMERATED {n2, n4},
           nrofPanels
            maxNumberCSI-RS-PerResourceSet
                                              INTEGER (1..8)
                                                                                                                         OPTIONAL
    type2
                                           SEQUENCE {
                                          SEQUENCE (SIZE (1.. maxNrofCSI-RS-Resources)) OF SupportedCSI-RS-Resource,
        supportedCSI-RS-ResourceList
        parameterLx
                                              INTEGER (2..4),
        amplitudeScalingType
                                            ENUMERATED {wideband, widebandAndSubband},
        amplitudeSubsetRestriction
                                           ENUMERATED {supported}
                                                                                OPTIONAL
                                                                                                                         OPTIONAL,
    type2-PortSelection
                                        SEOUENCE {
       supportedCSI-RS-ResourceList
                                          SEQUENCE (SIZE (1.. maxNrofCSI-RS-Resources)) OF SupportedCSI-RS-Resource,
       parameterLx
                                                 INTEGER (2..4),
       amplitudeScalingType
                                               ENUMERATED {wideband, widebandAndSubband}
                                                                                                                         OPTIONAL
SupportedCSI-RS-Resource ::=
                                 SEQUENCE {
    maxNumberTxPortsPerResource
                                     ENUMERATED {p2, p4, p8, p12, p16, p24, p32},
                                     INTEGER (1..64),
    maxNumberResourcesPerBand
    totalNumberTxPortsPerBand
                                     INTEGER (2..256)
-- TAG-CODEBOOKPARAMETERS-STOP
-- ASN1STOP
```

FeatureSetCombination

The IE FeatureSetCombination is a two-dimensional matrix of FeatureSet entries.

Each FeatureSetsPerBand contains a list of feature sets applicable to the carrier(s) of one band entry of the associated band combination. Across the associated bands, the UE shall support the combination of FeatureSets at the same position in the FeatureSetsPerBand. All FeatureSetsPerBand in one FeatureSetCombination must have the same number of entries.

The number of FeatureSetsPerBand in the FeatureSetCombination must be equal to the number of band entries in an associated band combination. The first FeatureSetPerBand applies to the first band entry of the band combination, and so on.

Each FeatureSet contains either a pair of NR or E-UTRA feature set IDs for UL and DL.

In case of NR, the actual feature sets for UL and DL are defined in the *FeatureSets* IE and referred to from here by their ID, i.e., their position in the *featureSetsUplink* / *featureSetsDownlink* list in the FeatureSet IE.

In case of E-UTRA, the feature sets referred to from this list are defined in TS 36.331 [10] and conveyed as part of the UE-EUTRA-Capability container.

The FeatureSetUplink and FeatureSetDownlink referred to from the FeatureSet comprise, among other information, a set of FeatureSetUplinkPerCC-Ids and FeatureSetDownlinkPerCC-Ids. The number of these per-CC IDs determines the number of carriers that the UE is able to aggregate contiguously in frequency domain in the corresponding band. The number of carriers supported by the UE is also restricted by the bandwidth class indicated in the associated BandCombination, if present.

In feature set combinations the UE shall exclude entries with same or lower capabilities, since the network may anyway assume that the UE supports those.

- NOTE 1: The UE may advertise fallback band-combinations in which it supports additional functionality explicitly in two ways: Either by setting FeatureSet IDs to zero (inter-band and intra-band non-contiguous fallback) and by reducing the number of FeatureSet-PerCC Ids in a Feature Set (intra-band contiguous fallback). Or by separate *BandCombination* entries with associated *FeatureSetCombinations*.
- NOTE 2: The UE may advertise a *FeatureSetCombination* containing only fallback band combinations. That means, in a *FeatureSetCombination*, each group of *FeatureSets* across the bands may contain at least one pair of *FeatureSetUplinkId* and *FeatureSetDownlinkId* which is set to 0/0.
- NOTE 3: The Network configures serving cell(s) and BWP(s) configuration to comply with capabilities derived from the combination of FeatureSets at the same position in the FeatureSetsPerBand, regardless of activated/deactivated serving cell(s) and BWP(s).

FeatureSetCombination information element

```
nr SEQUENCE {
    downlinkSetNR FeatureSetDownlinkId,
    uplinkSetNR FeatureSetUplinkId
    }
}
-- TAG-FEATURESETCOMBINATION-STOP
-- ASN1STOP
```

FeatureSetCombinationId

The IE FeatureSetCombinationId identifies a FeatureSetCombination. The FeatureSetCombinationId of a FeatureSetCombination is the position of the FeatureSetCombination in the featureSetCombination list (in UE-NR-Capability or UE-MRDC-Capability). The FeatureSetCombinationId = 0 refers to the first entry in the featureSetCombinations list (in UE-NR-Capability).

NOTE: The FeatureSetCombinationId = 1024 is not used due to the maximum entry number of featureSetCombinations.

FeatureSetCombinationId information element

```
-- ASN1START
-- TAG-FEATURESETCOMBINATIONID-START

FeatureSetCombinationId ::= INTEGER (0.. maxFeatureSetCombinations)
-- TAG-FEATURESETCOMBINATIONID-STOP
-- ASN1STOP
```

FeatureSetDownlink

The IE FeatureSetDownlink indicates a set of features that the UE supports on the carriers corresponding to one band entry in a band combination.

FeatureSetDownlink information element

```
-- ASN1START
-- TAG-FEATURESETDOWNLINK-START
FeatureSetDownlink ::=
                                         SEOUENCE {
    featureSetListPerDownlinkCC
                                             SEQUENCE (SIZE (1..maxNrofServingCells)) OF FeatureSetDownlinkPerCC-Id,
    intraBandFreqSeparationDL
                                             FreqSeparationClass
                                                                                                                       OPTIONAL,
    scalingFactor
                                             ENUMERATED {f0p4, f0p75, f0p8}
                                                                                                                       OPTIONAL,
    dummy8
                                             ENUMERATED {supported}
                                                                                                                       OPTIONAL,
    scellWithoutSSB
                                             ENUMERATED {supported}
                                                                                                                       OPTIONAL,
    csi-RS-MeasSCellWithoutSSB
                                             ENUMERATED {supported}
                                                                                                                       OPTIONAL,
    dummy1
                                             ENUMERATED {supported}
                                                                                                                       OPTIONAL,
    type1-3-CSS
                                             ENUMERATED {supported}
                                                                                                                       OPTIONAL,
    pdcch-MonitoringAnyOccasions
                                             ENUMERATED {withoutDCI-Gap, withDCI-Gap}
                                                                                                                       OPTIONAL,
```

```
dummy2
                                             ENUMERATED
                                                        {supported}
                                                                                                                       OPTIONAL,
    ue-SpecificUL-DL-Assignment
                                             ENUMERATED
                                                        {supported}
                                                                                                                       OPTIONAL,
    searchSpaceSharingCA-DL
                                             ENUMERATED
                                                        {supported}
                                                                                                                       OPTIONAL.
    timeDurationForOCL
                                             SEOUENCE {
        scs-60kHz
                                             ENUMERATED {s7, s14, s28}
                                                                                                                           OPTIONAL.
        scs-120kHz
                                             ENUMERATED {s14, s28}
                                                                                                                           OPTIONAL
                                                                                                                       OPTIONAL,
    pdsch-ProcessingTypel-DifferentTB-PerSlot SEOUENCE {
        scs-15kHz
                                                 ENUMERATED
                                                            {upto2, upto4, upto7
                                                                                                                           OPTIONAL,
        scs-30kHz
                                                 ENUMERATED
                                                            {upto2, upto4, upto7
                                                                                                                           OPTIONAL.
        scs-60kHz
                                                 ENUMERATED {upto2, upto4, upto7
                                                                                                                           OPTIONAL,
        scs-120kHz
                                                 ENUMERATED {upto2, upto4, upto7}
                                                                                                                           OPTIONAL
                                                                                                                       OPTIONAL,
    dummy3
                                             DummyA
                                                                                                                       OPTIONAL.
    dummy4
                                             SEQUENCE (SIZE (1.. maxNrofCodebooks)) OF DummyB
                                                                                                                       OPTIONAL,
    dummy5
                                             SEQUENCE (SIZE (1.. maxNrofCodebooks)) OF DummyC
                                                                                                                       OPTIONAL,
    dummy6
                                             SEQUENCE (SIZE (1.. maxNrofCodebooks)) OF DummyD
                                                                                                                       OPTIONAL,
    dummy7
                                             SEQUENCE (SIZE (1.. maxNrofCodebooks)) OF DummyE
                                                                                                                       OPTIONAL
FeatureSetDownlink-v1540 ::= SEQUENCE {
    oneFL-DMRS-TwoAdditionalDMRS-DL
                                             ENUMERATED {supported}
                                                                                           OPTIONAL,
                                                        {supported}
    additional DMRS-DL-Alt
                                             ENUMERATED
                                                                                           OPTIONAL,
    twoFL-DMRS-TwoAdditionalDMRS-DL
                                             ENUMERATED
                                                        {supported}
                                                                                           OPTIONAL.
    oneFL-DMRS-ThreeAdditionalDMRS-DL
                                             ENUMERATED {supported}
                                                                                           OPTIONAL,
    pdcch-MonitoringAnyOccasionsWithSpanGap SEQUENCE {
        scs-15kHz
                                                 ENUMERATED {set1, set2, set3}
                                                                                               OPTIONAL,
        scs-30kHz
                                                 ENUMERATED {set1, set2, set3}
                                                                                               OPTIONAL,
        scs-60kHz
                                                 ENUMERATED {set1, set2, set3}
                                                                                               OPTIONAL,
        scs-120kHz
                                                 ENUMERATED {set1, set2, set3}
                                                                                               OPTIONAL
                                                                                           OPTIONAL.
    pdsch-SeparationWithGap
                                             ENUMERATED {supported}
                                                                                           OPTIONAL,
    pdsch-ProcessingType2
                                             SEQUENCE {
        scs-15kHz
                                                 ProcessingParameters
                                                                                               OPTIONAL,
        scs-30kHz
                                                 ProcessingParameters
                                                                                               OPTIONAL,
        scs-60kHz
                                                 ProcessingParameters
                                                                                               OPTIONAL
    } OPTIONAL,
    pdsch-ProcessingType2-Limited
                                             SEOUENCE {
        differentTB-PerSlot-SCS-30kHz
                                                 ENUMERATED {upto1, upto2, upto4, upto7}
    } OPTIONAL,
    dl-MCS-TableAlt-DynamicIndication
                                             ENUMERATED {supported}
                                                                                           OPTIONAL
FeatureSetDownlink-v15a0 ::= SEQUENCE {
    supportedSRS-Resources
                                         SRS-Resources
                                                                                           OPTIONAL
DummyA ::=
                SEQUENCE {
    maxNumberNZP-CSI-RS-PerCC
                                                 INTEGER (1..32),
    maxNumberPortsAcrossNZP-CSI-RS-PerCC
                                                 ENUMERATED {p2, p4, p8, p12, p16, p24, p32, p40, p48, p56, p64, p72, p80,
                                                             p88, p96, p104, p112, p120, p128, p136, p144, p152, p160, p168,
                                                             p176, p184, p192, p200, p208, p216, p224, p232, p240, p248, p256,
    maxNumberCS-IM-PerCC
                                                 ENUMERATED {n1, n2, n4, n8, n16, n32},
                                                 ENUMERATED {n5, n6, n7, n8, n9, n10, n12, n14, n16, n18, n20, n22, n24, n26,
    maxNumberSimultaneousCSI-RS-ActBWP-AllCC
```

n28, n30, n32, n34, n36, n38, n40, n42, n44, n46, n48, n50, n52,

```
n54, n56, n58, n60, n62, n64},
                                                                {p8, p12, p16, p24, p32, p40, p48, p56, p64, p72, p80,
    totalNumberPortsSimultaneousCSI-RS-ActBWP-AllCC ENUMERATED
                                                                p88, p96, p104, p112, p120, p128, p136, p144, p152, p160, p168,
                                                                p176, p184, p192, p200, p208, p216, p224, p232, p240, p248, p256}
DummvB ::=
                 SEOUENCE {
    maxNumberTxPortsPerResource
                                        ENUMERATED {p2, p4, p8, p12, p16, p24, p32},
    maxNumberResources
                                        INTEGER (1..64),
    totalNumberTxPorts
                                        INTEGER (2..256),
                                        ENUMERATED {mode1, mode1AndMode2},
    supportedCodebookMode
    maxNumberCSI-RS-PerResourceSet
                                        INTEGER (1..8)
DummyC ::=
                  SEOUENCE {
                                        ENUMERATED {p8, p16, p32},
    maxNumberTxPortsPerResource
    maxNumberResources
                                        INTEGER (1..64),
    totalNumberTxPorts
                                        INTEGER (2..256),
                                        ENUMERATED {mode1, mode2, both},
    supportedCodebookMode
    supportedNumberPanels
                                        ENUMERATED {n2, n4},
    maxNumberCSI-RS-PerResourceSet
                                        INTEGER (1..8)
DummyD ::=
                           SEQUENCE {
    maxNumberTxPortsPerResource
                                        ENUMERATED {p4, p8, p12, p16, p24, p32},
    maxNumberResources
                                        INTEGER (1..64),
    totalNumberTxPorts
                                        INTEGER (2..256),
    parameterLx
                                        INTEGER (2..4),
                                        ENUMERATED {wideband, widebandAndSubband},
    amplitudeScalingType
    amplitudeSubsetRestriction
                                        ENUMERATED {supported}
                                                                                         OPTIONAL,
    maxNumberCSI-RS-PerResourceSet
                                        INTEGER (1..8)
DummyE ::=
              SEOUENCE {
   maxNumberTxPortsPerResource
                                        ENUMERATED {p4, p8, p12, p16, p24, p32},
    maxNumberResources
                                        INTEGER (1..64),
                                        INTEGER (2..256),
    totalNumberTxPorts
    parameterLx
                                        INTEGER (2..4),
    amplitudeScalingType
                                        ENUMERATED {wideband, widebandAndSubband},
    maxNumberCSI-RS-PerResourceSet
                                        INTEGER (1..8)
-- TAG-FEATURESETDOWNLINK-STOP
-- ASN1STOP
```

FeatureSetDownlink field descriptions

featureSetListPerDownlinkCC

Indicates which features the UE supports on the individual DL carriers of the feature set (and hence of a band entry that refer to the feature set). The UE shall hence include at least as many FeatureSetDownlinkPerCC-Id in this list as the number of carriers it supports according to the ca-BandwidthClassDL, except if indicating additional functionality by reducing the number of FeatureSetDownlinkPerCC-Id in the feature set (see NOTE 1 in FeatureSetCombination IE description). The order of the elements in this list is not relevant, i.e., the network may configure any of the carriers in accordance with any of the FeatureSetDownlinkPerCC-Id in this list.

supportedSRS-Resources

Indicates supported SRS resources for SRS carrier switching to the band associated with this FeatureSetDownlink. The UE is only allowed to set this field for a band with associated FeatureSetUplinkId set to 0.

FeatureSetDownlinkId

The IE FeatureSetDownlinkId identifies a downlink feature set. The FeatureSetDownlinkId of a FeatureSetDownlink is the index position of the FeatureSetDownlink in the featureSetsDownlink list in the FeatureSets IE. The first element in that list is referred to by FeatureSetDownlinkId = 1. The FeatureSetDownlinkId=0 is not used by an actual FeatureSetDownlink but means that the UE does not support a carrier in this band of a band combination.

FeatureSetDownlinkId information element

```
-- ASN1START
-- TAG-FEATURESETDOWNLINKID-START

FeatureSetDownlinkId ::= INTEGER (0..maxDownlinkFeatureSets)
-- TAG-FEATURESETDOWNLINKID-STOP
-- ASN1STOP
```

FeatureSetDownlinkPerCC

The IE FeatureSetDownlinkPerCC indicates a set of features that the UE supports on the corresponding carrier of one band entry of a band combination.

FeatureSetDownlinkPerCC information element

```
-- ASN1START
-- TAG-FEATURESETDOWNLINKPERCC-START
FeatureSetDownlinkPerCC ::=
                                    SEQUENCE {
    supportedSubcarrierSpacingDL
                                        SubcarrierSpacing,
    supportedBandwidthDL
                                        SupportedBandwidth,
                                        ENUMERATED {supported}
    channelBW-90mhz
                                                                                                                 OPTIONAL,
    maxNumberMIMO-LayersPDSCH
                                        MIMO-LayersDL
                                                                                                                 OPTIONAL,
                                        ModulationOrder
    supportedModulationOrderDL
                                                                                                                 OPTIONAL
-- TAG-FEATURESETDOWNLINKPERCC-STOP
-- ASN1STOP
```

FeatureSetDownlinkPerCC-Id

The IE FeatureSetDownlinkPerCC-Id identifies a set of features applicable to one carrier of a feature set. The FeatureSetDownlinkPerCC-Id of a FeatureSetDownlinkPerCC is the index position of the FeatureSetDownlinkPerCC in the featureSetsDownlinkPerCC. The first element in the list is referred to by FeatureSetDownlinkPerCC-Id = 1, and so on.

FeatureSetDownlinkPerCC-Id information element

```
-- ASN1START
-- TAG-FEATURESETDOWNLINKPERCC-ID-START

FeatureSetDownlinkPerCC-Id ::= INTEGER (1..maxPerCC-FeatureSets)
-- TAG-FEATURESETDOWNLINKPERCC-ID-STOP
-- ASN1STOP
```

FeatureSetEUTRA-DownlinkId

The IE FeatureSetEUTRA-DownlinkId identifies a downlink feature set in E-UTRA list (see TS 36.331 [10]. The first element in that list is referred to by FeatureSetEUTRA-DownlinkId = 1. The FeatureSetEUTRA-DownlinkId=0 is used when the UE does not support a carrier in this band of a band combination.

FeatureSetEUTRA-DownlinkId information element

```
-- ASN1START
-- TAG-FEATURESETEUTRADOWNLINKID-START

FeatureSetEUTRA-DownlinkId ::= INTEGER (0..maxEUTRA-DL-FeatureSets)

-- TAG-FEATURESETEUTRADOWNLINKID-STOP
-- ASN1STOP
```

FeatureSetEUTRA-UplinkId

The IE FeatureSetEUTRA-UplinkId identifies an uplink feature set in E-UTRA list (see TS 36.331 [10]. The first element in that list is referred to by FeatureSetEUTRA-UplinkId = 1. The FeatureSetEUTRA-UplinkId = 0 is used when the UE does not support a carrier in this band of a band combination.

FeatureSetEUTRA-UplinkId information element

```
-- ASN1START
-- TAG-FEATURESETEUTRAUPLINKID-START

FeatureSetEUTRA-UplinkId ::= INTEGER (0..maxEUTRA-UL-FeatureSets)
```

```
-- TAG-FEATURESETEUTRAUPLINKID-STOP
-- ASN1STOP
```

FeatureSets

The IE *FeatureSets* is used to provide pools of downlink and uplink features sets. A *FeatureSetCombination* refers to the IDs of the feature set(s) that the UE supports in that *FeatureSetCombination*. The *BandCombination* entries in the *BandCombinationList* then indicate the ID of the *FeatureSetCombination* that the UE supports for that band combination.

The entries in the lists in this IE are identified by their index position. For example, the FeatureSetUplinkPerCC-Id = 4 identifies the 4^{th} element in the featureSetSUplinkPerCC list.

NOTE: When feature sets (per CC) IEs require extension in future versions of the specification, new versions of the FeatureSetDownlink, FeatureSetUplink, FeatureSets, FeatureSetDownlinkPerCC and/or FeatureSetUplinkPerCC will be created and instantiated in corresponding new lists in the FeatureSets IE. For example, if new capability bits are to be added to the FeatureSetDownlink, they will instead be defined in a new FeatureSetDownlink-rxy which will be instantiated in a new featureSetDownlinkList-rxy list. If a UE indicates in a FeatureSetCombination that it supports the FeatureSetDownlink with ID #5, it implies that it supports both the features in FeatureSetDownlink #5 and FeatureSetDownlink-rxy #5 (if present). The number of entries in the new list(s) shall be the same as in the original list(s).

FeatureSets information element

```
-- ASN1START
-- TAG-FEATURESETS-START
FeatureSets ::= SEOUENCE {
    featureSetsDownlink
                                        SEQUENCE (SIZE (1..maxDownlinkFeatureSets)) OF FeatureSetDownlink
                                                                                                                         OPTIONAL,
    featureSetsDownlinkPerCC
                                        SEQUENCE (SIZE (1..maxPerCC-FeatureSets)) OF FeatureSetDownlinkPerCC
                                                                                                                         OPTIONAL,
    featureSetsUplink
                                        SEQUENCE (SIZE (1..maxUplinkFeatureSets)) OF FeatureSetUplink
                                                                                                                         OPTIONAL,
    featureSetsUplinkPerCC
                                        SEQUENCE (SIZE (1..maxPerCC-FeatureSets)) OF FeatureSetUplinkPerCC
                                                                                                                         OPTIONAL.
    featureSetsDownlink-v1540
                                        SEQUENCE (SIZE (1..maxDownlinkFeatureSets)) OF FeatureSetDownlink-v1540
                                                                                                                         OPTIONAL.
    featureSetsUplink-v1540
                                        SEQUENCE (SIZE (1..maxUplinkFeatureSets)) OF FeatureSetUplink-v1540
                                                                                                                         OPTIONAL,
    featureSetsUplinkPerCC-v1540
                                        SEQUENCE (SIZE (1..maxPerCC-FeatureSets)) OF FeatureSetUplinkPerCC-v1540
                                                                                                                         OPTIONAL
    11.
    Π
    featureSetsDownlink-v15a0
                                        SEQUENCE (SIZE (1..maxDownlinkFeatureSets)) OF FeatureSetDownlink-v15a0
                                                                                                                         OPTIONAL
    ]]
-- TAG-FEATURESETS-STOP
-- ASN1STOP
```

- FeatureSetUplink

The IE FeatureSetUplink is used to indicate the features that the UE supports on the carriers corresponding to one band entry in a band combination.

FeatureSetUplink information element

```
-- ASN1START
-- TAG-FEATURESETUPLINK-START
FeatureSetUplink ::=
                                     SEOUENCE {
    featureSetListPerUplinkCC
                                         SEQUENCE (SIZE (1.. maxNrofServingCells)) OF FeatureSetUplinkPerCC-Id,
    scalingFactor
                                         ENUMERATED {f0p4, f0p75, f0p8}
                                                                                                                   OPTIONAL,
    dummv3
                                         ENUMERATED {supported}
                                                                                                                   OPTIONAL,
    intraBandFreqSeparationUL
                                         FreqSeparationClass
                                                                                                                   OPTIONAL,
                                         ENUMERATED {supported}
    searchSpaceSharingCA-UL
                                                                                                                   OPTIONAL,
    dummv1
                                         DummyI
                                                                                                                   OPTIONAL,
    supportedSRS-Resources
                                         SRS-Resources
                                                                                                                   OPTIONAL,
    twoPUCCH-Group
                                         ENUMERATED {supported}
                                                                                                                   OPTIONAL,
    dynamicSwitchSUL
                                         ENUMERATED
                                                    {supported}
                                                                                                                   OPTIONAL,
    simultaneousTxSUL-NonSUL
                                         ENUMERATED {supported}
                                                                                                                   OPTIONAL,
    pusch-ProcessingTypel-DifferentTB-PerSlot SEQUENCE {
        scs-15kHz
                                                   ENUMERATED {upto2, upto4, upto7}
                                                                                                                       OPTIONAL.
        scs-30kHz
                                                   ENUMERATED
                                                               {upto2, upto4, upto7}
                                                                                                                       OPTIONAL,
        scs-60kHz
                                                   ENUMERATED
                                                               {upto2, upto4, upto7}
                                                                                                                       OPTIONAL,
        scs-120kHz
                                                   ENUMERATED {upto2, upto4, upto7}
                                                                                                                       OPTIONAL
                                                                                                                   OPTIONAL,
    dummy2
                                          DummvF
                                                                                                                   OPTIONAL
FeatureSetUplink-v1540 ::=
                                      SEOUENCE {
    zeroSlotOffsetAperiodicSRS
                                          ENUMERATED {supported}
                                                                                      OPTIONAL,
    pa-PhaseDiscontinuityImpacts
                                          ENUMERATED {supported}
                                                                                      OPTIONAL,
                                                     {supported}
    pusch-SeparationWithGap
                                          ENUMERATED
                                                                                      OPTIONAL,
    pusch-ProcessingType2
                                          SEOUENCE {
        scs-15kHz
                                              ProcessingParameters
                                                                                          OPTIONAL,
        scs-30kHz
                                              ProcessingParameters
                                                                                          OPTIONAL,
        scs-60kHz
                                              ProcessingParameters
                                                                                          OPTIONAL
                                                                                      OPTIONAL,
    ul-MCS-TableAlt-DynamicIndication
                                          ENUMERATED {supported}
                                                                                      OPTIONAL
SRS-Resources ::=
                                             SEQUENCE {
                                                 ENUMERATED {n1, n2, n4, n8, n16},
    maxNumberAperiodicSRS-PerBWP
    maxNumberAperiodicSRS-PerBWP-PerSlot
                                                 INTEGER (1..6),
    maxNumberPeriodicSRS-PerBWP
                                                 ENUMERATED {n1, n2, n4, n8, n16},
    maxNumberPeriodicSRS-PerBWP-PerSlot
                                                 INTEGER (1..6),
    maxNumberSemiPersistentSRS-PerBWP
                                                 ENUMERATED {n1, n2, n4, n8, n16},
    maxNumberSemiPersistentSRS-PerBWP-PerSlot
                                                 INTEGER (1..6),
    maxNumberSRS-Ports-PerResource
                                                 ENUMERATED {n1, n2, n4}
                                             SEQUENCE {
    maxNumberPeriodicCSI-ReportPerBWP
                                                 INTEGER (1..4),
```

```
maxNumberAperiodicCSI-ReportPerBWP INTEGER (1..4),
maxNumberSemiPersistentCSI-ReportPerBWP iNTEGER (0..4),
simultaneousCSI-ReportsAllCC INTEGER (5..32)

-- TAG-FEATURESETUPLINK-STOP
-- ASN1STOP
```

FeatureSetUplink field descriptions

featureSetListPerUplinkCC

Indicates which features the UE supports on the individual UL carriers of the feature set (and hence of a band entry that refers to the feature set). The UE shall hence include at least as many FeatureSetUplinkPerCC-Id in this list as the number of carriers it supports according to the ca-BandwidthClassUL, except if indicating additional functionality by reducing the number of FeatureSetUplinkPerCC-Id in the feature set (see NOTE 1 in FeatureSetCombination). The order of the elements in this list is not relevant, i.e., the network may configure any of the carriers in accordance with any of the FeatureSetUplinkPerCC-Id in this list.

FeatureSetUplinkId

The IE FeatureSetUplinkId identifies an uplink feature set. The FeatureSetUplinkId of a FeatureSetUplink is the index position of the FeatureSetUplink in the featureSetSuplink list in the FeatureSet IE. The first element in the list is referred to by FeatureSetUplinkId = 1, and so on. The FeatureSetUplinkId = 0 is not used by an actual FeatureSetUplink but means that the UE does not support a carrier in this band of a band combination.

FeatureSetUplinkId information element

```
-- ASN1START
-- TAG-FEATURESETUPLINKID-START

FeatureSetUplinkId ::= INTEGER (0..maxUplinkFeatureSets)
-- TAG-FEATURESETUPLINKID-STOP
-- ASN1STOP
```

FeatureSetUplinkPerCC

The IE FeatureSetUplinkPerCC indicates a set of features that the UE supports on the corresponding carrier of one band entry of a band combination.

FeatureSetUplinkPerCC information element

```
-- ASN1START
-- TAG-FEATURESETUPLINKPERCC-START

FeatureSetUplinkPerCC ::= SEQUENCE {
    supportedSubcarrierSpacingUL SubcarrierSpacing,
    supportedBandwidthUL SupportedBandwidth,
    channelBW-90mhz ENUMERATED {supported} OPTIONAL,
    mimo-CB-PUSCH SEQUENCE {
```

```
maxNumberMIMO-LayersCB-PUSCH
                                               MIMO-LayersUL
                                                                                           OPTIONAL,
       maxNumberSRS-ResourcePerSet
                                               INTEGER (1..2)
                                                                                       OPTIONAL.
    maxNumberMIMO-LayersNonCB-PUSCH
                                           MIMO-LayersUL
                                                                                       OPTIONAL,
    supportedModulationOrderUL
                                           ModulationOrder
                                                                                       OPTIONAL
FeatureSetUplinkPerCC-v1540 ::=
                                     SEOUENCE {
    mimo-NonCB-PUSCH
                                         SEOUENCE {
       maxNumberSRS-ResourcePerSet
                                             INTEGER (1..4),
       maxNumberSimultaneousSRS-ResourceTx INTEGER (1..4)
    } OPTIONAL
-- TAG-FEATURESETUPLINKPERCC-STOP
-- ASN1STOP
```

FeatureSetUplinkPerCC-Id

The IE FeatureSetUplinkPerCC-Id identifies a set of features applicable to one carrier of a feature set. The FeatureSetUplinkPerCC-Id of a FeatureSetUplinkPerCC is the index position of the FeatureSetUplinkPerCC in the featureSetSuplinkPerCC. The first element in the list is referred to by FeatureSetUplinkPerCC-Id = 1, and so on.

FeatureSetUplinkPerCC-Id information element

```
-- ASN1START
-- TAG-FEATURESETUPLINKPERCC-ID-START

FeatureSetUplinkPerCC-Id ::= INTEGER (1..maxPerCC-FeatureSets)
-- TAG-FEATURESETUPLINKPERCC-ID-STOP
-- ASN1STOP
```

FreqBandIndicatorEUTRA

```
-- ASN1START
-- TAG-FREQBANDINDICATOREUTRA-START

FreqBandIndicatorEUTRA ::= INTEGER (1..maxBandsEUTRA)
-- TAG-FREQBANDINDICATOREUTRA-STOP
-- ASN1STOP
```

FreqBandList

The IE *FreqBandList* is used by the network to request NR CA, NR non-CA and/or MR-DC band combinations for specific NR and/or E-UTRA frequency bands and/or up to a specific number of carriers and/or up to specific aggregated bandwidth. This is also used to request feature sets (for NR) and feature set combinations (for NR and MR-DC).

FreqBandList information element

```
-- ASN1START
-- TAG-FREOBANDLIST-START
FreqBandList ::=
                                SEQUENCE (SIZE (1..maxBandsMRDC)) OF FreqBandInformation
FreqBandInformation ::=
                               CHOICE {
    bandInformationEUTRA
                                    FreqBandInformationEUTRA,
    bandInformationNR
                                    FregBandInformationNR
FreqBandInformationEUTRA ::=
                               SEOUENCE {
    bandEUTRA
                                    FregBandIndicatorEUTRA,
    ca-BandwidthClassDL-EUTRA
                                    CA-BandwidthClassEUTRA
                                                                            OPTIONAL, -- Need N
    ca-BandwidthClassUL-EUTRA
                                    CA-BandwidthClassEUTRA
                                                                            OPTIONAL
                                                                                       -- Need N
FreqBandInformationNR ::=
                                SEQUENCE {
    bandNR
                                    FreqBandIndicatorNR,
                                                                            OPTIONAL, -- Need N
    maxBandwidthRequestedDL
                                   AggregatedBandwidth
    maxBandwidthRequestedUL
                                    AggregatedBandwidth
                                                                            OPTIONAL, -- Need N
    maxCarriersRequestedDL
                                   INTEGER (1..maxNrofServingCells)
                                                                            OPTIONAL, -- Need N
    maxCarriersRequestedUL
                                    INTEGER (1..maxNrofServingCells)
                                                                            OPTIONAL
                                                                                       -- Need N
AggregatedBandwidth ::=
                                ENUMERATED {mhz50, mhz100, mhz150, mhz200, mhz250, mhz300, mhz350,
                                            mhz400, mhz450, mhz500, mhz550, mhz600, mhz650, mhz700, mhz750, mhz800}
-- TAG-FREQBANDLIST-STOP
-- ASN1STOP
```

FreqSeparationClass

The IE *FreqSeparationClass* is used for an intra-band non-contiguous CA band combination to indicate frequency separation between lower edge of lowest CC and upper edge of highest CC in a frequency band.

FreqSeparationClass information element

```
-- ASN1START
-- TAG-FREQSEPARATIONCLASS-START

FreqSeparationClass ::= ENUMERATED {c1, c2, c3, ...}

-- TAG-FREQSEPARATIONCLASS-STOP
-- ASN1STOP
```

IMS-Parameters

The IE IMS-Parameters is used to convery capabilities related to IMS.

IMS-Parameters information element

```
-- ASN1START
-- TAG-IMS-PARAMETERS-START
                    SEQUENCE {
IMS-Parameters ::=
   ims-ParametersCommon
                              IMS-ParametersCommon
                                                                    OPTIONAL,
   ims-ParametersFRX-Diff
                              IMS-ParametersFRX-Diff
                                                                    OPTIONAL,
IMS-ParametersCommon ::= SEQUENCE {
                              ENUMERATED {supported}
    voiceOverEUTRA-5GC
                                                                    OPTIONAL,
   ] ]
    voiceOverSCG-BearerEUTRA-5GC
                                      ENUMERATED {supported}
                                                                    OPTIONAL
    ]]
IMS-ParametersFRX-Diff ::= SEQUENCE {
    voiceOverNR
                              ENUMERATED {supported}
                                                                    OPTIONAL,
-- TAG-IMS-PARAMETERS-STOP
-- ASN1STOP
```

- InterRAT-Parameters

The IE InterRAT-Parameters is used convey UE capabilities related to the other RATs.

InterRAT-Parameters information element

```
-- ASN1START
-- TAG-INTERRAT-PARAMETERS-START
InterRAT-Parameters ::=
                                    SEOUENCE {
    eutra
                                        EUTRA-Parameters
                                                                        OPTIONAL,
EUTRA-Parameters ::=
                                    SEQUENCE {
                                    SEQUENCE (SIZE (1..maxBandsEUTRA)) OF FreqBandIndicatorEUTRA,
    supportedBandListEUTRA
    eutra-ParametersCommon
                                        EUTRA-ParametersCommon
                                                                                                     OPTIONAL,
    eutra-ParametersXDD-Diff
                                        EUTRA-ParametersXDD-Diff
                                                                                                     OPTIONAL,
```

```
EUTRA-ParametersCommon ::=
                                SEOUENCE {
    mfbi-EUTRA
                                         ENUMERATED {supported}
                                                                          OPTIONAL,
    modifiedMPR-BehaviorEUTRA
                                         BIT STRING (SIZE (32))
                                                                          OPTIONAL,
    multiNS-Pmax-EUTRA
                                         ENUMERATED {supported}
                                                                          OPTIONAL,
                                         ENUMERATED (supported)
    rs-SINR-MeasEUTRA
                                                                          OPTIONAL,
    ] ]
                                         ENUMERATED {supported}
    ne-DC
                                                                          OPTIONAL
    ]]
EUTRA-ParametersXDD-Diff ::=
                                     SEOUENCE {
    rsrqMeasWidebandEUTRA
                                         ENUMERATED {supported}
                                                                          OPTIONAL,
-- TAG-INTERRAT-PARAMETERS-STOP
-- ASN1STOP
```

MAC-Parameters

The IE MAC-Parameters is used to convey capabilities related to MAC.

MAC-Parameters information element

```
-- ASN1START
-- TAG-MAC-PARAMETERS-START
MAC-Parameters ::= SEQUENCE {
    mac-ParametersCommon
                                    MAC-ParametersCommon
                                                                 OPTIONAL,
    mac-ParametersXDD-Diff
                                    MAC-ParametersXDD-Diff
                                                                 OPTIONAL
MAC-ParametersCommon ::=
                            SEQUENCE {
    lcp-Restriction
                                    ENUMERATED {supported}
                                                                 OPTIONAL,
    dummy
                                    ENUMERATED {supported}
                                                                 OPTIONAL,
    lch-ToSCellRestriction
                                    ENUMERATED {supported}
                                                                 OPTIONAL,
    ] ]
    recommendedBitRate
                                     ENUMERATED {supported}
                                                                 OPTIONAL,
                                     ENUMERATED {supported}
    recommendedBitRateQuery
                                                                 OPTIONAL
    11
MAC-ParametersXDD-Diff ::= SEQUENCE {
    skipUplinkTxDynamic
                                     ENUMERATED {supported}
                                                                OPTIONAL,
    logicalChannelSR-DelayTimer
                                    ENUMERATED {supported}
                                                                OPTIONAL,
    longDRX-Cycle
                                    ENUMERATED {supported}
                                                                OPTIONAL,
```

```
shortDRX-Cycle ENUMERATED {supported} OPTIONAL, multipleSR-Configurations ENUMERATED {supported} OPTIONAL, multipleConfiguredGrants ENUMERATED {supported} OPTIONAL, ... }

-- TAG-MAC-PARAMETERS-STOP -- ASN1STOP
```

MeasAndMobParameters

The IE *MeasAndMobParameters* is used to convey UE capabilities related to measurements for radio resource management (RRM), radio link monitoring (RLM) and mobility (e.g. handover).

MeasAndMobParameters information element

```
-- ASN1START
-- TAG-MEASANDMOBPARAMETERS-START
MeasAndMobParameters ::=
                                             SEOUENCE {
    measAndMobParametersCommon
                                             MeasAndMobParametersCommon
                                                                                       OPTIONAL,
    measAndMobParametersXDD-Diff
                                                 MeasAndMobParametersXDD-Diff
                                                                                       OPTIONAL,
    measAndMobParametersFRX-Diff
                                                 MeasAndMobParametersFRX-Diff
                                                                                       OPTIONAL
MeasAndMobParametersCommon ::=
                                         SEQUENCE {
    supportedGapPattern
                                             BIT STRING (SIZE (22))
                                                                                       OPTIONAL,
    ssb-RLM
                                             ENUMERATED {supported}
                                                                                       OPTIONAL,
    ssb-AndCSI-RS-RLM
                                             ENUMERATED {supported}
                                                                                       OPTIONAL,
    ] ]
                                             ENUMERATED {supported}
    eventB-MeasAndReport
                                                                                       OPTIONAL,
    handoverFDD-TDD
                                                         {supported}
                                             ENUMERATED
                                                                                       OPTIONAL,
    eutra-CGI-Reporting
                                             ENUMERATED {supported}
                                                                                       OPTIONAL,
    nr-CGI-Reporting
                                             ENUMERATED {supported}
                                                                                       OPTIONAL
    11,
    ] ]
    independentGapConfig
                                             ENUMERATED {supported}
                                                                                       OPTIONAL,
                                             ENUMERATED {supported}
    periodicEUTRA-MeasAndReport
                                                                                       OPTIONAL,
    handoverFR1-FR2
                                             ENUMERATED {supported}
                                                                                       OPTIONAL,
    maxNumberCSI-RS-RRM-RS-SINR
                                             ENUMERATED {n4, n8, n16, n32, n64, n96} OPTIONAL
    ]],
    ] ]
    nr-CGI-Reporting-ENDC
                                             ENUMERATED {supported}
                                                                                       OPTIONAL
    ]],
    ] ]
    eutra-CGI-Reporting-NEDC
                                             ENUMERATED
                                                         {supported}
                                                                                       OPTIONAL.
    eutra-CGI-Reporting-NRDC
                                             ENUMERATED
                                                         {supported}
                                                                                       OPTIONAL,
    nr-CGI-Reporting-NEDC
                                             ENUMERATED {supported}
                                                                                       OPTIONAL,
    nr-CGI-Reporting-NRDC
                                             ENUMERATED {supported}
                                                                                       OPTIONAL
    ]]
```

```
MeasAndMobParametersXDD-Diff ::=
                                              SEOUENCE {
    intraAndInterF-MeasAndReport
                                          ENUMERATED {supported}
                                                                                        OPTIONAL,
    eventA-MeasAndReport
                                          ENUMERATED {supported}
                                                                                        OPTIONAL,
    . . . ,
    ] ]
    handoverInterF
                                          ENUMERATED {supported}
                                                                                        OPTIONAL.
    handoverLTE-EPC
                                          ENUMERATED
                                                     {supported}
                                                                                        OPTIONAL,
                                          ENUMERATED {supported}
    handoverLTE-5GC
                                                                                        OPTIONAL
    ]],
    ] ]
    sftd-MeasNR-Neigh
                                          ENUMERATED {supported}
                                                                                        OPTIONAL.
    sftd-MeasNR-Neigh-DRX
                                          ENUMERATED {supported}
                                                                                        OPTIONAL
    ]]
MeasAndMobParametersFRX-Diff ::=
                                              SEOUENCE {
                                                  ENUMERATED {supported}
    ss-SINR-Meas
                                                                                        OPTIONAL,
    csi-RSRP-AndRSRQ-MeasWithSSB
                                                  ENUMERATED
                                                              {supported}
                                                                                        OPTIONAL,
    csi-RSRP-AndRSRQ-MeasWithoutSSB
                                                  ENUMERATED
                                                              {supported}
                                                                                        OPTIONAL,
    csi-SINR-Meas
                                                  ENUMERATED
                                                              {supported}
                                                                                        OPTIONAL,
    csi-RS-RLM
                                                  ENUMERATED {supported}
                                                                                        OPTIONAL,
    . . . ,
    ] ]
    handoverInterF
                                                  ENUMERATED {supported}
                                                                                        OPTIONAL,
    handoverLTE-EPC
                                                  ENUMERATED
                                                              {supported}
                                                                                        OPTIONAL,
    handoverLTE-5GC
                                                  ENUMERATED {supported}
                                                                                        OPTIONAL
    ]],
    [ [
    maxNumberResource-CSI-RS-RLM
                                                  ENUMERATED {n2, n4, n6, n8}
                                                                                        OPTIONAL
    ]],
    ] ]
                                                  ENUMERATED {supported}
    simultaneousRxDataSSB-DiffNumerology
                                                                                        OPTIONAL
-- TAG-MEASANDMOBPARAMETERS-STOP
-- ASN1STOP
```

MeasAndMobParametersMRDC

The IE MeasAndMobParametersMRDC is used to convey capability parameters related to RRM measurements and RRC mobility.

Meas And Mob Parameters MRDC information element

```
measAndMobParametersMRDC-XDD-Diff
                                            MeasAndMobParametersMRDC-XDD-Diff
                                                                                             OPTIONAL,
    measAndMobParametersMRDC-FRX-Diff
                                            MeasAndMobParametersMRDC-FRX-Diff
                                                                                             OPTIONAL
MeasAndMobParametersMRDC-v1560 ::=
    measAndMobParametersMRDC-XDD-Diff-v1560
                                               MeasAndMobParametersMRDC-XDD-Diff-v1560
                                                                                            OPTIONAL
MeasAndMobParametersMRDC-Common ::=
                                        SEQUENCE {
                                            ENUMERATED {supported}
    independentGapConfig
                                                                                            OPTIONAL
MeasAndMobParametersMRDC-XDD-Diff ::= SEQUENCE {
    sftd-MeasPSCell
                                            ENUMERATED {supported}
                                                                                            OPTIONAL,
    sftd-MeasNR-Cell
                                            ENUMERATED {supported}
                                                                                            OPTIONAL
MeasAndMobParametersMRDC-XDD-Diff-v1560 ::=
                                               SEOUENCE
                                                   ENUMERATED {supported}
    sftd-MeasPSCell-NEDC
                                                                                            OPTIONAL
MeasAndMobParametersMRDC-FRX-Diff ::=
                                               SEQUENCE {
    simultaneousRxDataSSB-DiffNumerology
                                                   ENUMERATED {supported}
                                                                                            OPTIONAL
-- TAG-MEASANDMOBPARAMETERSMRDC-STOP
-- ASN1STOP
```

MIMO-Layers

The IE MIMO-Layers is used to convey the number of supported MIMO layers.

MIMO-Layers information element

```
-- ASN1START
-- TAG-MIMO-LAYERS-START

MIMO-LayersDL ::= ENUMERATED {twoLayers, fourLayers, eightLayers}

MIMO-LayersUL ::= ENUMERATED {oneLayer, twoLayers, fourLayers}

-- TAG-MIMO-LAYERS-STOP
-- ASN1STOP
```

MIMO-ParametersPerBand

The IE MIMO-Parameters PerBand is used to convey MIMO related parameters specific for a certain band (not per feature set or band combination).

MIMO-ParametersPerBand information element

```
-- ASN1START
-- TAG-MIMO-PARAMETERSPERBAND-START
MIMO-ParametersPerBand ::=
                                     SEOUENCE {
    tci-StatePDSCH
                                         SEQUENCE {
        maxNumberConfiguredTCIstatesPerCC ENUMERATED {n4, n8, n16, n32, n64, n128}
                                                                                                                          OPTIONAL.
        maxNumberActiveTCI-PerBWP
                                             ENUMERATED {n1, n2, n4, n8}
                                                                                                                          OPTIONAL
                                                                                                                      OPTIONAL,
    additionalActiveTCI-StatePDCCH
                                                 ENUMERATED {supported}
                                                                                                                      OPTIONAL,
    pusch-TransCoherence
                                                 ENUMERATED
                                                             {nonCoherent, partialCoherent, fullCoherent}
                                                                                                                      OPTIONAL,
    beamCorrespondenceWithoutUL-BeamSweeping
                                                            {supported}
                                                 ENUMERATED
                                                                                                                      OPTIONAL,
    periodicBeamReport
                                                 ENUMERATED
                                                            {supported}
                                                                                                                      OPTIONAL,
                                                            {supported}
    aperiodicBeamReport
                                                 ENUMERATED
                                                                                                                      OPTIONAL,
    sp-BeamReportPUCCH
                                                 ENUMERATED {supported}
                                                                                                                      OPTIONAL,
    sp-BeamReportPUSCH
                                                 ENUMERATED {supported}
                                                                                                                      OPTIONAL,
    dummy1
                                                 DummyG
                                                                                                                      OPTIONAL,
    maxNumberRxBeam
                                                 INTEGER (2..8)
                                                                                                                      OPTIONAL,
    maxNumberRxTxBeamSwitchDL
                                                 SEOUENCE {
        scs-15kHz
                                                     ENUMERATED {n4, n7, n14}
                                                                                                                          OPTIONAL,
        scs-30kHz
                                                     ENUMERATED {n4, n7, n14}
                                                                                                                          OPTIONAL,
        scs-60kHz
                                                     ENUMERATED {n4, n7, n14}
                                                                                                                          OPTIONAL,
        scs-120kHz
                                                     ENUMERATED {n4, n7, n14}
                                                                                                                          OPTIONAL,
                                                     ENUMERATED {n4, n7, n14}
        scs-240kHz
                                                                                                                          OPTIONAL
                                                                                                                      OPTIONAL,
    maxNumberNonGroupBeamReporting
                                                 ENUMERATED {n1, n2, n4}
                                                                                                                      OPTIONAL,
    groupBeamReporting
                                                 ENUMERATED {supported}
                                                                                                                      OPTIONAL,
    uplinkBeamManagement
                                                 SEQUENCE {
        maxNumberSRS-ResourcePerSet-BM
                                                     ENUMERATED {n2, n4, n8, n16},
        maxNumberSRS-ResourceSet
                                                     INTEGER (1..8)
                                                                                                                      OPTIONAL,
    maxNumberCSI-RS-BFD
                                         INTEGER (1..64)
                                                                                                                      OPTIONAL,
    maxNumberSSB-BFD
                                         INTEGER (1..64)
                                                                                                                      OPTIONAL,
    maxNumberCSI-RS-SSB-CBD
                                         INTEGER (1..256)
                                                                                                                      OPTIONAL,
    dummy2
                                         ENUMERATED {supported
                                                                                                                      OPTIONAL,
    twoPortsPTRS-UL
                                         ENUMERATED {supported}
                                                                                                                      OPTIONAL,
    dummy5
                                         SRS-Resources
                                                                                                                      OPTIONAL,
    dummy3
                                         INTEGER (1..4)
                                                                                                                      OPTIONAL,
    beamReportTiming
                                         SEQUENCE {
        scs-15kHz
                                             ENUMERATED {sym2, sym4, sym8}
                                                                                                                          OPTIONAL,
        scs-30kHz
                                             ENUMERATED {sym4, sym8, sym14, sym28}
                                                                                                                          OPTIONAL,
        scs-60kHz
                                             ENUMERATED {sym8, sym14, sym28}
                                                                                                                          OPTIONAL,
        scs-120kHz
                                             ENUMERATED {sym14, sym28, sym56}
                                                                                                                          OPTIONAL
                                                                                                                      OPTIONAL,
    ptrs-DensityRecommendationSetDL
                                         SEQUENCE {
        scs-15kHz
                                             PTRS-DensityRecommendationDL
                                                                                                                          OPTIONAL,
        scs-30kHz
                                             PTRS-DensityRecommendationDL
                                                                                                                          OPTIONAL,
        scs-60kHz
                                             PTRS-DensityRecommendationDL
                                                                                                                          OPTIONAL,
        scs-120kHz
                                             PTRS-DensityRecommendationDL
                                                                                                                          OPTIONAL
                                                                                                                      OPTIONAL,
    ptrs-DensityRecommendationSetUL
                                         SEOUENCE {
        scs-15kHz
                                             PTRS-DensityRecommendationUL
                                                                                                                          OPTIONAL,
        scs-30kHz
                                             PTRS-DensityRecommendationUL
                                                                                                                          OPTIONAL,
```

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```
scs-60kHz
                                            PTRS-DensityRecommendationUL
                                                                                                                         OPTIONAL,
        scs-120kHz
                                            PTRS-DensityRecommendationUL
                                                                                                                         OPTIONAL
                                                                                                                     OPTIONAL.
    dummy4
                                        DummyH
                                                                                                                     OPTIONAL,
    aperiodicTRS
                                         ENUMERATED {supported}
                                                                                                                     OPTIONAL,
    . . . ,
    [ [
    dummy6
                                         ENUMERATED {true}
                                                                                                                     OPTIONAL,
    beamManagementSSB-CSI-RS
                                        BeamManagementSSB-CSI-RS
                                                                                                                     OPTIONAL,
    beamSwitchTiming
                                        SEQUENCE {
        scs-60kHz
                                            ENUMERATED {sym14, sym28, sym48, sym224, sym336}
                                                                                                                         OPTIONAL,
        scs-120kHz
                                            ENUMERATED {sym14, sym28, sym48, sym224, sym336}
                                                                                                                         OPTIONAL
                                                                                                                     OPTIONAL,
    codebookParameters
                                        CodebookParameters
                                                                                                                     OPTIONAL.
    csi-RS-IM-ReceptionForFeedback
                                        CSI-RS-IM-ReceptionForFeedback
                                                                                                                     OPTIONAL,
    csi-RS-ProcFrameworkForSRS
                                        CSI-RS-ProcFrameworkForSRS
                                                                                                                     OPTIONAL,
                                        CSI-ReportFramework
    csi-ReportFramework
                                                                                                                     OPTIONAL,
    csi-RS-ForTracking
                                        CSI-RS-ForTracking
                                                                                                                     OPTIONAL,
    srs-AssocCSI-RS
                                        SEQUENCE (SIZE (1.. maxNrofCSI-RS-Resources)) OF SupportedCSI-RS-Resource
                                                                                                                     OPTIONAL,
    spatialRelations
                                        SpatialRelations
                                                                                                                     OPTIONAL
    11
DummyG ::=
                                     SEOUENCE
    maxNumberSSB-CSI-RS-ResourceOneTx
                                        ENUMERATED {n8, n16, n32, n64},
                                        ENUMERATED {n0, n4, n8, n16, n32, n64},
    maxNumberSSB-CSI-RS-ResourceTwoTx
                                         ENUMERATED {one, three, oneAndThree}
    supportedCSI-RS-Density
                                    SEOUENCE {
BeamManagementSSB-CSI-RS ::=
                                        ENUMERATED {n0, n8, n16, n32, n64},
    maxNumberSSB-CSI-RS-ResourceOneTx
    maxNumberCSI-RS-Resource
                                        ENUMERATED {n0, n4, n8, n16, n32, n64},
    maxNumberCSI-RS-ResourceTwoTx
                                        ENUMERATED {n0, n4, n8, n16, n32, n64},
                                        ENUMERATED {one, three, oneAndThree}
    supportedCSI-RS-Density
                                                                                                                     OPTIONAL,
    maxNumberAperiodicCSI-RS-Resource
                                        ENUMERATED {n0, n1, n4, n8, n16, n32, n64}
DummyH ::=
                                     SEOUENCE {
    burstLength
                                         INTEGER (1..2),
    maxSimultaneousResourceSetsPerCC
                                        INTEGER (1..8),
    maxConfiguredResourceSetsPerCC
                                        INTEGER (1..64),
    maxConfiguredResourceSetsAllCC
                                        INTEGER (1..128)
CSI-RS-ForTracking ::=
                                    SEOUENCE {
    maxBurstLength
                                        INTEGER (1..2),
    maxSimultaneousResourceSetsPerCC
                                        INTEGER (1..8),
    maxConfiguredResourceSetsPerCC
                                        INTEGER (1..64),
    maxConfiguredResourceSetsAllCC
                                        INTEGER (1..256)
CSI-RS-IM-ReceptionForFeedback ::=
                                                 SEQUENCE {
    maxConfigNumberNZP-CSI-RS-PerCC
                                                     INTEGER (1..64),
    maxConfigNumberPortsAcrossNZP-CSI-RS-PerCC
                                                     INTEGER (2..256),
```

```
ENUMERATED {n1, n2, n4, n8, n16, n32},
    maxConfigNumberCSI-IM-PerCC
    maxNumberSimultaneousNZP-CSI-RS-PerCC
                                                     INTEGER (1..64),
    totalNumberPortsSimultaneousNZP-CSI-RS-PerCC
                                                     INTEGER (2..256)
CSI-RS-ProcFrameworkForSRS ::=
                                                 SEOUENCE {
    maxNumberPeriodicSRS-AssocCSI-RS-PerBWP
                                                     INTEGER (1..4),
    maxNumberAperiodicSRS-AssocCSI-RS-PerBWP
                                                     INTEGER (1..4),
    maxNumberSP-SRS-AssocCSI-RS-PerBWP
                                                     INTEGER (0..4),
    simultaneousSRS-AssocCSI-RS-PerCC
                                                     INTEGER (1..8)
                                                 SEOUENCE {
CSI-ReportFramework ::=
    maxNumberPeriodicCSI-PerBWP-ForCSI-Report
                                                     INTEGER (1..4),
    maxNumberAperiodicCSI-PerBWP-ForCSI-Report
                                                     INTEGER (1..4),
    maxNumberSemiPersistentCSI-PerBWP-ForCSI-Report INTEGER (0..4),
    maxNumberPeriodicCSI-PerBWP-ForBeamReport
                                                     INTEGER (1..4),
    maxNumberAperiodicCSI-PerBWP-ForBeamReport
                                                     INTEGER (1..4),
    maxNumberAperiodicCSI-triggeringStatePerCC
                                                     ENUMERATED {n3, n7, n15, n31, n63, n128},
    maxNumberSemiPersistentCSI-PerBWP-ForBeamReport INTEGER (0..4),
    simultaneousCSI-ReportsPerCC
                                                     INTEGER (1..8)
PTRS-DensityRecommendationDL ::=
                                    SEOUENCE {
    frequencyDensity1
                                        INTEGER (1..276),
    frequencyDensity2
                                        INTEGER (1..276),
    timeDensity1
                                        INTEGER (0..29),
    timeDensity2
                                        INTEGER (0..29),
    timeDensity3
                                        INTEGER (0..29)
PTRS-DensityRecommendationUL ::=
                                    SEQUENCE {
    frequencyDensity1
                                         INTEGER (1..276),
    frequencyDensity2
                                        INTEGER (1..276),
    timeDensitv1
                                        INTEGER (0..29),
    timeDensity2
                                        INTEGER (0..29),
    timeDensity3
                                        INTEGER (0..29),
                                        INTEGER (1..276),
    sampleDensity1
    sampleDensity2
                                        INTEGER (1..276),
    sampleDensity3
                                        INTEGER (1..276),
    sampleDensity4
                                        INTEGER (1..276),
    sampleDensity5
                                        INTEGER (1..276)
SpatialRelations ::=
                                        SEOUENCE {
    maxNumberConfiguredSpatialRelations
                                             ENUMERATED {n4, n8, n16, n32, n64, n96},
    maxNumberActiveSpatialRelations
                                             ENUMERATED {n1, n2, n4, n8, n14},
    additionalActiveSpatialRelationPUCCH
                                             ENUMERATED {supported}
                                                                                                  OPTIONAL,
    maxNumberDL-RS-QCL-TypeD
                                             ENUMERATED {n1, n2, n4, n8, n14}
DummyI ::=
                         SEOUENCE {
    supportedSRS-TxPortSwitch
                                        ENUMERATED {t1r2, t1r4, t2r4, t1r4-t2r4, tr-equal},
    txSwitchImpactToRx
                                         ENUMERATED {true}
                                                                                                  OPTIONAL
```

```
}
-- TAG-MIMO-PARAMETERSPERBAND-STOP
-- ASN1STOP
```

MIMO-ParametersPerBand field descriptions

csi-RS-IM-ReceptionForFeedback/ csi-RS-ProcFrameworkForSRS/ csi-ReportFramework

CSI related capabilities which the UE supports on each of the carriers operated on this band. If the network configures the UE with serving cells on both FR1 and FR2 bands, these values may be further limited by the corresponding fields in fr1-fr2-Add-UE-NR-Capabilities.

ModulationOrder

The IE *ModulationOrder* is used to convey the maximum supported modulation order.

ModulationOrder information element

```
-- ASN1START
-- TAG-MODULATIONORDER-START

ModulationOrder ::= ENUMERATED {bpsk-halfpi, bpsk, qpsk, qam16, qam64, qam256}
-- TAG-MODULATIONORDER-STOP
-- ASN1STOP
```

MRDC-Parameters

The IE MRDC-Parameters contains the band combination parameters specific to MR-DC for a given MR-DC band combination.

MRDC-Parameters information element

```
-- ASN1START
-- TAG-MRDC-PARAMETERS-START
MRDC-Parameters ::= SEOUENCE {
    singleUL-Transmission
                                        ENUMERATED {supported}
                                                                             OPTIONAL,
    dynamicPowerSharingENDC
                                        ENUMERATED {supported}
                                                                             OPTIONAL,
    tdm-Pattern
                                        ENUMERATED {supported}
                                                                             OPTIONAL,
    ul-SharingEUTRA-NR
                                        ENUMERATED {tdm, fdm, both}
                                                                             OPTIONAL,
                                        ENUMERATED {type1, type2}
    ul-SwitchingTimeEUTRA-NR
                                                                             OPTIONAL,
                                        ENUMERATED {supported}
    simultaneousRxTxInterBandENDC
                                                                             OPTIONAL,
                                         ENUMERATED {supported}
    asyncIntraBandENDC
                                                                             OPTIONAL,
    . . . ,
    dualPA-Architecture
                                        ENUMERATED {supported}
                                                                             OPTIONAL,
    intraBandENDC-Support
                                         ENUMERATED {non-contiquous, both}
                                                                             OPTIONAL,
    ul-TimingAlignmentEUTRA-NR
                                        ENUMERATED {required}
                                                                             OPTIONAL
```

NRDC-Parameters

The IE NRDC-Parameters contains parameters specific to NR-DC, i.e., which are not applicable to NR SA.

NRDC-Parameters information element

```
-- ASN1START
-- TAG-NRDC-PARAMETERS-START
NRDC-Parameters ::=
                                     SEQUENCE {
                                                                                      OPTIONAL,
    measAndMobParametersNRDC
                                         MeasAndMobParametersMRDC
    generalParametersNRDC
                                         GeneralParametersMRDC-XDD-Diff
                                                                                      OPTIONAL,
    fdd-Add-UE-NRDC-Capabilities
                                         UE-MRDC-CapabilityAddXDD-Mode
                                                                                      OPTIONAL,
    tdd-Add-UE-NRDC-Capabilities
                                         UE-MRDC-CapabilityAddXDD-Mode
                                                                                      OPTIONAL,
    fr1-Add-UE-NRDC-Capabilities
                                         UE-MRDC-CapabilityAddFRX-Mode
                                                                                      OPTIONAL,
    fr2-Add-UE-NRDC-Capabilities
                                         UE-MRDC-CapabilityAddFRX-Mode
                                                                                      OPTIONAL,
    dummy2
                                         OCTET STRING
                                                                                      OPTIONAL,
    dummy
                                         SEQUENCE {}
                                                                                      OPTIONAL
NRDC-Parameters-v1570 ::=
                                     SEQUENCE {
    sfn-SyncNRDC
                                         ENUMERATED {supported}
                                                                                      OPTIONAL
NRDC-Parameters-v15c0 ::=
                                 SEQUENCE {
    pdcp-DuplicationSplitSRB
                                         ENUMERATED {supported}
                                                                                      OPTIONAL,
    pdcp-DuplicationSplitDRB
                                         ENUMERATED {supported}
                                                                                      OPTIONAL
-- TAG-NRDC-PARAMETERS-STOP
-- ASN1STOP
```

PDCP-Parameters

The IE *PDCP-Parameters* is used to convey capabilities related to PDCP.

PDCP-Parameters information element

```
-- ASN1START
-- TAG-PDCP-PARAMETERS-START
                            SEOUENCE {
PDCP-Parameters ::=
    supportedROHC-Profiles
                                SEOUENCE {
       profile0x0000
                                    BOOLEAN,
        profile0x0001
                                    BOOLEAN,
        profile0x0002
                                    BOOLEAN,
        profile0x0003
                                    BOOLEAN,
        profile0x0004
                                    BOOLEAN,
        profile0x0006
                                    BOOLEAN,
        profile0x0101
                                    BOOLEAN,
       profile0x0102
                                    BOOLEAN,
        profile0x0103
                                    BOOLEAN,
        profile0x0104
                                    BOOLEAN
    maxNumberROHC-ContextSessions
                                         ENUMERATED {cs2, cs4, cs8, cs12, cs16, cs24, cs32, cs48, cs64,
                                                 cs128, cs256, cs512, cs1024, cs16384, spare2, spare1},
    uplinkOnlyROHC-Profiles
                                         ENUMERATED {supported}
                                                                     OPTIONAL,
    continueROHC-Context
                                        ENUMERATED {supported}
                                                                     OPTIONAL,
    outOfOrderDelivery
                                         ENUMERATED
                                                    {supported}
                                                                     OPTIONAL,
                                        ENUMERATED {supported}
    shortSN
                                                                     OPTIONAL,
    pdcp-DuplicationSRB
                                         ENUMERATED {supported}
                                                                     OPTIONAL,
    pdcp-DuplicationMCG-OrSCG-DRB
                                        ENUMERATED {supported}
                                                                     OPTIONAL,
-- TAG-PDCP-PARAMETERS-STOP
-- ASN1STOP
```

PDCP-ParametersMRDC

The IE PDCP-ParametersMRDC is used to convey PDCP related capabilities for MR-DC.

PDCP-ParametersMRDC information element

```
-- ASN1START
-- TAG-PDCP-PARAMETERSMRDC-START

PDCP-ParametersMRDC ::= SEQUENCE {
   pdcp-DuplicationSplitSRB ENUMERATED {supported} OPTIONAL,
   pdcp-DuplicationSplitDRB ENUMERATED {supported} OPTIONAL
```

```
-- TAG-PDCP-PARAMETERSMRDC-STOP
-- ASN1STOP
```

- Phy-Parameters

The IE *Phy-Parameters* is used to convey the physical layer capabilities.

Phy-Parameters information element

```
-- ASN1START
-- TAG-PHY-PARAMETERS-START
Phy-Parameters ::=
                                     SEOUENCE {
                                         Phy-ParametersCommon
                                                                                       OPTIONAL,
    phy-ParametersCommon
                                         Phy-ParametersXDD-Diff
                                                                                       OPTIONAL,
    phy-ParametersXDD-Diff
    phy-ParametersFRX-Diff
                                         Phy-ParametersFRX-Diff
                                                                                       OPTIONAL,
    phy-ParametersFR1
                                         Phy-ParametersFR1
                                                                                       OPTIONAL,
    phy-ParametersFR2
                                         Phy-ParametersFR2
                                                                                       OPTIONAL
Phy-ParametersCommon ::=
                                     SEOUENCE {
    csi-RS-CFRA-ForHO
                                         ENUMERATED {supported}
                                                                                       OPTIONAL.
    dynamicPRB-BundlingDL
                                         ENUMERATED
                                                    {supported
                                                                                       OPTIONAL.
    sp-CSI-ReportPUCCH
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
                                         ENUMERATED
    sp-CSI-ReportPUSCH
                                                     {supported
                                                                                       OPTIONAL,
    nzp-CSI-RS-IntefMgmt
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
    type2-SP-CSI-Feedback-LongPUCCH
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
    precoderGranularityCORESET
                                         ENUMERATED
                                                     supported
                                                                                       OPTIONAL,
    dynamicHARQ-ACK-Codebook
                                         ENUMERATED
                                                     supported
                                                                                       OPTIONAL,
    semiStaticHARQ-ACK-Codebook
                                                     {supported
                                         ENUMERATED
                                                                                       OPTIONAL,
    spatialBundlingHARO-ACK
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
    dynamicBetaOffsetInd-HARQ-ACK-CSI
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
    pucch-Repetition-F1-3-4
                                         ENUMERATED
                                                     {supported}
                                                                                       OPTIONAL.
    ra-Type0-PUSCH
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
    dynamicSwitchRA-Type0-1-PDSCH
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
    dynamicSwitchRA-Type0-1-PUSCH
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
    pdsch-MappingTypeA
                                         ENUMERATED
                                                      supported
                                                                                       OPTIONAL,
    pdsch-MappingTypeB
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
    interleavingVRB-ToPRB-PDSCH
                                         ENUMERATED
                                                     supported
                                                                                       OPTIONAL,
    interSlotFreqHopping-PUSCH
                                         ENUMERATED
                                                      supported
                                                                                       OPTIONAL,
    type1-PUSCH-RepetitionMultiSlots
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
    type2-PUSCH-RepetitionMultiSlots
                                         ENUMERATED
                                                     supported
                                                                                       OPTIONAL,
    pusch-RepetitionMultiSlots
                                         ENUMERATED
                                                     supported
                                                                                       OPTIONAL,
    pdsch-RepetitionMultiSlots
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
    downlinkSPS
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
    configuredUL-GrantType1
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
    configuredUL-GrantType2
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
    pre-EmptIndication-DL
                                         ENUMERATED
                                                     {supported
                                                                                       OPTIONAL,
    cbg-TransIndication-DL
                                                     {supported
                                         ENUMERATED
                                                                                       OPTIONAL.
    cbg-TransIndication-UL
                                         ENUMERATED
                                                     {supported}
                                                                                       OPTIONAL,
    cbg-FlushIndication-DL
                                         ENUMERATED {supported}
                                                                                       OPTIONAL,
```

```
{supported}
    dynamicHARO-ACK-CodeB-CBG-Retx-DL
                                         ENUMERATED
                                                                                        OPTIONAL,
    rateMatchingResrcSetSemi-Static
                                          ENUMERATED
                                                     {supported}
                                                                                        OPTIONAL,
    rateMatchingResrcSetDynamic
                                         ENUMERATED
                                                     {supported}
                                                                                        OPTIONAL.
    bwp-SwitchingDelay
                                         ENUMERATED {type1, type2}
                                                                                        OPTIONAL,
    . . . ,
    ] ]
    dummy
                                          ENUMERATED {supported}
                                                                                        OPTIONAL
    11,
    11
    maxNumberSearchSpaces
                                          ENUMERATED {n10}
                                                                                        OPTIONAL.
    rateMatchingCtrlResrcSetDynamic
                                         ENUMERATED {supported}
                                                                                        OPTIONAL,
    maxLayersMIMO-Indication
                                         ENUMERATED {supported}
                                                                                        OPTIONAL
    11,
    П
    spCellPlacement
                                          CarrierAggregationVariant
                                                                                        OPTIONAL
    11
Phy-ParametersXDD-Diff ::=
                                      SEOUENCE
    dvnamicSFI
                                          ENUMERATED
                                                     {supported}
                                                                                        OPTIONAL,
    twoPUCCH-F0-2-ConsecSymbols
                                         ENUMERATED
                                                      supported
                                                                                        OPTIONAL.
    twoDifferentTPC-Loop-PUSCH
                                         ENUMERATED
                                                     {supported}
                                                                                        OPTIONAL,
    twoDifferentTPC-Loop-PUCCH
                                         ENUMERATED
                                                     {supported}
                                                                                        OPTIONAL,
    . . . ,
    [ [
    dl-SchedulingOffset-PDSCH-TypeA
                                          ENUMERATED
                                                     {supported}
                                                                                        OPTIONAL,
    dl-SchedulingOffset-PDSCH-TypeB
                                         ENUMERATED
                                                      {supported}
                                                                                        OPTIONAL,
    ul-SchedulingOffset
                                         ENUMERATED {supported}
                                                                                        OPTIONAL
    ]]
Phy-ParametersFRX-Diff ::=
                                              SEQUENCE {
    dvnamicSFI
                                                  ENUMERATED {supported}
                                                                                                OPTIONAL,
    dummy1
                                                  BIT STRING (SIZE (2))
                                                                                                OPTIONAL,
    twoFL-DMRS
                                                  BIT STRING (SIZE (2))
                                                                                                OPTIONAL,
    dummy2
                                                  BIT STRING (SIZE (2))
                                                                                                OPTIONAL,
    dummy3
                                                  BIT STRING (SIZE (2))
                                                                                                OPTIONAL,
                                                              {type1, type1And2}
    supportedDMRS-TypeDL
                                                  ENUMERATED
                                                                                                OPTIONAL,
    supportedDMRS-TypeUL
                                                              {type1, type1And2}
                                                  ENUMERATED
                                                                                                OPTIONAL,
    semiOpenLoopCSI
                                                  ENUMERATED
                                                              {supported}
                                                                                                OPTIONAL,
    csi-ReportWithoutPMI
                                                  ENUMERATED
                                                              {supported}
                                                                                                OPTIONAL,
    csi-ReportWithoutCOI
                                                  ENUMERATED
                                                              {supported}
                                                                                                OPTIONAL,
                                                  BIT STRING (SIZE (2))
    onePortsPTRS
                                                                                                OPTIONAL,
    twoPUCCH-F0-2-ConsecSymbols
                                                              {supported}
                                                  ENUMERATED
                                                                                                OPTIONAL,
                                                              supported 
    pucch-F2-WithFH
                                                  ENUMERATED
                                                                                                OPTIONAL,
    pucch-F3-WithFH
                                                  ENUMERATED
                                                              supported }
                                                                                                OPTIONAL,
    pucch-F4-WithFH
                                                  ENUMERATED
                                                              supported }
                                                                                                OPTIONAL,
    pucch-F0-2WithoutFH
                                                  ENUMERATED
                                                              {notSupported
                                                                                                OPTIONAL,
    pucch-F1-3-4WithoutFH
                                                  ENUMERATED
                                                              {notSupported
                                                                                                OPTIONAL,
                                                              supported}
    mux-SR-HARO-ACK-CSI-PUCCH-MultiPerSlot
                                                  ENUMERATED
                                                                                                OPTIONAL,
    uci-CodeBlockSegmentation
                                                  ENUMERATED
                                                              supported }
                                                                                                OPTIONAL,
    onePUCCH-LongAndShortFormat
                                                  ENUMERATED
                                                              supported }
                                                                                                OPTIONAL,
    twoPUCCH-AnyOthersInSlot
                                                  ENUMERATED
                                                              {supported}
                                                                                                OPTIONAL,
    intraSlotFreqHopping-PUSCH
                                                  ENUMERATED {supported}
                                                                                                OPTIONAL,
```

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```
ENUMERATED {supported}
    pusch-LBRM
                                                                                               OPTIONAL,
    pdcch-BlindDetectionCA
                                                  INTEGER (4..16)
                                                                                               OPTIONAL,
    tpc-PUSCH-RNTI
                                                  ENUMERATED {supported}
                                                                                               OPTIONAL.
    tpc-PUCCH-RNTI
                                                  ENUMERATED
                                                             {supported}
                                                                                               OPTIONAL,
    tpc-SRS-RNTI
                                                  ENUMERATED
                                                              {supported}
                                                                                               OPTIONAL,
                                                              {supported}
    absoluteTPC-Command
                                                  ENUMERATED
                                                                                               OPTIONAL,
    twoDifferentTPC-Loop-PUSCH
                                                              {supported}
                                                  ENUMERATED
                                                                                               OPTIONAL,
    twoDifferentTPC-Loop-PUCCH
                                                  ENUMERATED
                                                              {supported}
                                                                                               OPTIONAL,
    pusch-HalfPi-BPSK
                                                  ENUMERATED
                                                              {supported}
                                                                                               OPTIONAL,
    pucch-F3-4-HalfPi-BPSK
                                                  ENUMERATED
                                                              supported)
                                                                                               OPTIONAL,
                                                              {supported}
    almostContiguousCP-OFDM-UL
                                                  ENUMERATED
                                                                                               OPTIONAL,
    sp-CSI-RS
                                                  ENUMERATED
                                                              {supported}
                                                                                               OPTIONAL,
    sp-CSI-IM
                                                  ENUMERATED
                                                              {supported}
                                                                                               OPTIONAL,
    tdd-MultiDL-UL-SwitchPerSlot
                                                  ENUMERATED
                                                             {supported}
                                                                                               OPTIONAL,
                                                  ENUMERATED {supported}
    multipleCORESET
                                                                                                OPTIONAL,
    [ [
    csi-RS-IM-ReceptionForFeedback
                                                  CSI-RS-IM-ReceptionForFeedback
                                                                                               OPTIONAL,
    csi-RS-ProcFrameworkForSRS
                                                  CSI-RS-ProcFrameworkForSRS
                                                                                                OPTIONAL,
    csi-ReportFramework
                                                  CSI-ReportFramework
                                                                                               OPTIONAL,
    mux-SR-HARQ-ACK-CSI-PUCCH-OncePerSlot
                                                  SEQUENCE {
        sameSymbol
                                                      ENUMERATED {supported}
                                                                                                    OPTIONAL,
        diffSymbol
                                                      ENUMERATED {supported}
                                                                                                    OPTIONAL
                                                                                               OPTIONAL,
    mux-SR-HARO-ACK-PUCCH
                                                  ENUMERATED {supported}
                                                                                               OPTIONAL,
    mux-MultipleGroupCtrlCH-Overlap
                                                  ENUMERATED
                                                              {supported}
                                                                                               OPTIONAL,
    dl-SchedulingOffset-PDSCH-TypeA
                                                              {supported}
                                                  ENUMERATED
                                                                                               OPTIONAL,
    dl-SchedulingOffset-PDSCH-TypeB
                                                  ENUMERATED
                                                              {supported}
                                                                                               OPTIONAL,
    ul-SchedulingOffset
                                                  ENUMERATED
                                                              {supported}
                                                                                               OPTIONAL,
    dl-640AM-MCS-TableAlt
                                                  ENUMERATED
                                                              {supported}
                                                                                               OPTIONAL,
    ul-64QAM-MCS-TableAlt
                                                  ENUMERATED
                                                              supported 
                                                                                               OPTIONAL,
                                                              {supported}
    cgi-TableAlt
                                                  ENUMERATED
                                                                                               OPTIONAL,
    oneFL-DMRS-TwoAdditionalDMRS-UL
                                                  ENUMERATED
                                                              {supported}
                                                                                               OPTIONAL,
    twoFL-DMRS-TwoAdditionalDMRS-UL
                                                  ENUMERATED
                                                             {supported}
                                                                                               OPTIONAL,
    oneFL-DMRS-ThreeAdditionalDMRS-UL
                                                  ENUMERATED {supported}
                                                                                                OPTIONAL
    11,
    ] ]
    pdcch-BlindDetectionNRDC
                                              SEOUENCE {
        pdcch-BlindDetectionMCG-UE
                                                  INTEGER (1..15),
        pdcch-BlindDetectionSCG-UE
                                                  INTEGER (1..15)
                                                                                                OPTIONAL,
    mux-HARQ-ACK-PUSCH-DiffSymbol
                                                  ENUMERATED {supported}
                                                                                                OPTIONAL
    ]]
Phy-ParametersFR1 ::=
                                             SEOUENCE {
    pdcch-MonitoringSingleOccasion
                                                  ENUMERATED
                                                             {supported}
                                                                                                OPTIONAL.
    scs-60kHz
                                                  ENUMERATED
                                                              {supported}
                                                                                                OPTIONAL,
    pdsch-256QAM-FR1
                                                  ENUMERATED
                                                             {supported}
                                                                                               OPTIONAL,
    pdsch-RE-MappingFR1-PerSymbol
                                                  ENUMERATED {n10, n20}
                                                                                                OPTIONAL,
    pdsch-RE-MappingFR1-PerSlot
                                                  ENUMERATED {n16, n32, n48, n64, n80, n96, n112, n128,
                                                  n144, n160, n176, n192, n208, n224, n240, n256}
                                                                                                            OPTIONAL
```

```
]]
Phy-ParametersFR2 ::=
                                             SEOUENCE {
                                                 ENUMERATED {supported}
                                                                                                          OPTIONAL,
    pdsch-RE-MappingFR2-PerSymbol
                                                 ENUMERATED {n6, n20}
                                                                                                          OPTIONAL,
    pCell-FR2
                                                 ENUMERATED {supported}
                                                                                                          OPTIONAL,
    pdsch-RE-MappingFR2-PerSlot
                                                 ENUMERATED {n16, n32, n48, n64, n80, n96, n112, n128,
                                                     n144, n160, n176, n192, n208, n224, n240, n256}
                                                                                                          OPTIONAL
    ]]
-- TAG-PHY-PARAMETERS-STOP
-- ASN1STOP
```

Phy-ParametersFRX-Diff field descriptions

csi-RS-IM-ReceptionForFeedback/ csi-RS-ProcFrameworkForSRS/ csi-ReportFramework

These fields are optionally present in *fr1-fr2-Add-UE-NR-Capabilities* in *UE-NR-Capability*. They shall not be set in any other instance of the IE *Phy-ParametersFRX-Diff*. If the network configures the UE with serving cells on both FR1 and FR2 bands, these parameters, if present, limit the corresponding parameters in *MIMO-ParametersPerBand*.

Phy-ParametersMRDC

The IE *Phy-ParametersMRDC* is used to convey physical layer capabilities for MR-DC.

Phy-ParametersMRDC information element

```
-- ASN1START
-- TAG-PHY-PARAMETERSMRDC-START
Phy-ParametersMRDC ::=
                                    SEQUENCE {
    naics-Capability-List
                                        SEQUENCE (SIZE (1..maxNrofNAICS-Entries)) OF NAICS-Capability-Entry
                                                                                                                       OPTIONAL,
    . . . ,
    [ [
    spCellPlacement
                                        CarrierAggregationVariant
                                                                                      OPTIONAL
    11
NAICS-Capability-Entry ::=
                                     SEOUENCE {
    numberOfNAICS-CapableCC
                                        INTEGER(1..5),
    numberOfAggregatedPRB
                                        ENUMERATED {n50, n75, n100, n125, n150, n175, n200, n225,
                                                     n250, n275, n300, n350, n400, n450, n500, spare},
-- TAG-PHY-PARAMETERSMRDC-STOP
-- ASN1STOP
```

PHY-ParametersMRDC field descriptions

naics-Capability-List

Indicates that UE in MR-DC supports NAICS as defined in TS 36.331 [10].

ProcessingParameters

The IE Processing Parameters is used to indicate PDSCH/PUSCH processing capabilities supported by the UE.

ProcessingParameters information element

```
-- ASN1START
-- TAG-PROCESSINGPARAMETERS-START
ProcessingParameters ::=
                              SEQUENCE {
    fallback
                                   ENUMERATED {sc, cap1-only},
    differentTB-PerSlot
                                    SEQUENCE {
                                     NumberOfCarriers
       upto1
                                                                         OPTIONAL,
       upto2
                                      NumberOfCarriers
                                                                         OPTIONAL,
       upto4
                                      NumberOfCarriers
                                                                         OPTIONAL,
       upto7
                                      NumberOfCarriers
                                                                         OPTIONAL
    } OPTIONAL
NumberOfCarriers ::=
                      INTEGER (1..16)
-- TAG-PROCESSINGPARAMETERS-STOP
-- ASN1STOP
```

RAT-Type

The IE RAT-Type is used to indicate the radio access technology (RAT), including NR, of the requested/transferred UE capabilities.

RAT-Type information element

```
-- ASN1START
-- TAG-RAT-TYPE-START

RAT-Type ::= ENUMERATED {nr, eutra-nr, eutra, spare1, ...}

-- TAG-RAT-TYPE-STOP
-- ASN1STOP
```

RF-Parameters

The IE *RF-Parameters* is used to convey RF-related capabilities for NR operation.

RF-Parameters information element

```
-- ASN1START
-- TAG-RF-PARAMETERS-START
                                     SEOUENCE {
RF-Parameters ::=
                                         SEQUENCE (SIZE (1..maxBands)) OF BandNR,
    supportedBandListNR
    supportedBandCombinationList
                                         BandCombinationList
                                                                                      OPTIONAL,
    appliedFreqBandListFilter
                                         FreqBandList
                                                                                      OPTIONAL,
    11
    supportedBandCombinationList-v1540 BandCombinationList-v1540
                                                                                      OPTIONAL.
    srs-SwitchingTimeRequested
                                         ENUMERATED {true}
                                                                                      OPTIONAL
    ]],
    supportedBandCombinationList-v1550 BandCombinationList-v1550
                                                                                      OPTIONAL
    ]],
    [ [
    supportedBandCombinationList-v1560 BandCombinationList-v1560
                                                                                      OPTIONAL
    11
RF-Parameters-v15q0 ::=
                                    SEOUENCE {
    supportedBandCombinationList-v15q0 BandCombinationList-v15q0
                                                                                      OPTIONAL
BandNR ::=
                                     SEOUENCE {
    bandNR
                                         FreqBandIndicatorNR,
    modifiedMPR-Behaviour
                                         BIT STRING (SIZE (8))
                                                                                          OPTIONAL,
                                        MIMO-ParametersPerBand
    mimo-ParametersPerBand
                                                                                          OPTIONAL,
    extendedCP
                                        ENUMERATED {supported}
                                                                                          OPTIONAL,
    multipleTCI
                                         ENUMERATED {supported}
                                                                                          OPTIONAL,
    bwp-WithoutRestriction
                                        ENUMERATED {supported}
                                                                                          OPTIONAL,
    bwp-SameNumerology
                                        ENUMERATED {upto2, upto4}
                                                                                          OPTIONAL,
    bwp-DiffNumerology
                                        ENUMERATED {upto4}
                                                                                          OPTIONAL,
    crossCarrierScheduling-SameSCS
                                         ENUMERATED {supported}
                                                                                          OPTIONAL,
                                         ENUMERATED {supported}
    pdsch-256QAM-FR2
                                                                                          OPTIONAL,
    pusch-256QAM
                                         ENUMERATED {supported}
                                                                                          OPTIONAL,
    ue-PowerClass
                                         ENUMERATED {pc1, pc2, pc3, pc4}
                                                                                          OPTIONAL,
    rateMatchingLTE-CRS
                                         ENUMERATED {supported}
                                                                                          OPTIONAL,
    channelBWs-DL
                                        CHOICE {
        fr1
                                             SEQUENCE {
            scs-15kHz
                                                                                              OPTIONAL,
                                                 BIT STRING (SIZE (10))
            scs-30kHz
                                                 BIT STRING (SIZE (10))
                                                                                              OPTIONAL,
            scs-60kHz
                                                 BIT STRING (SIZE (10))
                                                                                              OPTIONAL
        fr2
                                             SEQUENCE {
            scs-60kHz
                                                 BIT STRING (SIZE (3))
                                                                                              OPTIONAL,
            scs-120kHz
                                                 BIT STRING (SIZE (3))
                                                                                              OPTIONAL
```

-- TAG-RF-PARAMETERS-STOP

```
OPTIONAL,
channelBWs-UL
                                    CHOICE {
   fr1
                                        SEOUENCE {
       scs-15kHz
                                            BIT STRING (SIZE (10))
                                                                                         OPTIONAL,
       scs-30kHz
                                            BIT STRING (SIZE (10))
                                                                                         OPTIONAL,
       scs-60kHz
                                            BIT STRING (SIZE (10))
                                                                                         OPTIONAL
   },
   fr2
                                        SEQUENCE {
                                            BIT STRING (SIZE (3))
       scs-60kHz
                                                                                         OPTIONAL,
       scs-120kHz
                                            BIT STRING (SIZE (3))
                                                                                         OPTIONAL
                                                                                     OPTIONAL,
] ]
maxUplinkDutyCycle-PC2-FR1
                                            ENUMERATED {n60, n70, n80, n90, n100}
                                                                                     OPTIONAL
]],
] ]
pucch-SpatialRelInfoMAC-CE
                                    ENUMERATED {supported}
                                                                                     OPTIONAL,
                                    ENUMERATED {supported}
powerBoosting-pi2BPSK
                                                                                     OPTIONAL
]],
maxUplinkDutyCycle-FR2
                                ENUMERATED {n15, n20, n25, n30, n40, n50, n60, n70, n80, n90, n100}
                                                                                                         OPTIONAL
]],
] ]
channelBWs-DL-v1590
                                    CHOICE {
   fr1
                                        SEOUENCE {
       scs-15kHz
                                            BIT STRING (SIZE (16))
                                                                                 OPTIONAL,
       scs-30kHz
                                            BIT STRING (SIZE (16))
                                                                                 OPTIONAL,
       scs-60kHz
                                            BIT STRING (SIZE (16))
                                                                                 OPTIONAL
   fr2
                                        SEQUENCE {
       scs-60kHz
                                            BIT STRING (SIZE (8))
                                                                                 OPTIONAL,
       scs-120kHz
                                            BIT STRING (SIZE (8))
                                                                                 OPTIONAL
                                                                                 OPTIONAL,
channelBWs-UL-v1590
                                    CHOICE {
   fr1
                                        SEOUENCE {
       scs-15kHz
                                            BIT STRING (SIZE (16))
                                                                                 OPTIONAL,
       scs-30kHz
                                            BIT STRING (SIZE (16))
                                                                                 OPTIONAL,
       scs-60kHz
                                            BIT STRING (SIZE (16))
                                                                                 OPTIONAL
                                        SEQUENCE {
       scs-60kHz
                                            BIT STRING (SIZE (8))
                                                                                 OPTIONAL,
       scs-120kHz
                                            BIT STRING (SIZE (8))
                                                                                 OPTIONAL
                                                                                 OPTIONAL
]],
asymmetricBandwidthCombinationSet
                                    BIT STRING (SIZE (1..32))
                                                                           OPTIONAL
```

-- ASN1STOP

RF-Parameters field descriptions

appliedFreqBandListFilter

In this field the UE mirrors the FreqBandList that the NW provided in the capability enquiry, if any. The UE filtered the band combinations in the supportedBandCombinationList in accordance with this appliedFreqBandListFilter. The UE does not include this field if the UE capability is requested by E-UTRAN and the network request includes the field eutra-nr-only [10].

supportedBandCombinationList

A list of band combinations that the UE supports for NR (and NR-DC, if requested). The *FeatureSetCombinationId*:s in this list refer to the *FeatureSetCombination* entries in the *featureSetCombinations* list in the *UE-NR-Capability* IE. The UE does not include this field if the UE capability is requested by E-UTRAN and the network request includes the field *eutra-nr-only* [10].

RF-ParametersMRDC

The IE RF-ParametersMRDC is used to convey RF related capabilities for MR-DC.

RF-ParametersMRDC information element

```
-- ASN1START
-- TAG-RF-PARAMETERSMRDC-START
RF-ParametersMRDC ::=
                                         SEOUENCE {
    supportedBandCombinationList
                                             BandCombinationList
                                                                                  OPTIONAL,
    appliedFreqBandListFilter
                                             FreqBandList
                                                                                  OPTIONAL,
    [ [
    srs-SwitchingTimeRequested
                                             ENUMERATED {true}
                                                                                  OPTIONAL,
    supportedBandCombinationList-v1540
                                             BandCombinationList-v1540
                                                                                  OPTIONAL
    ]],
    supportedBandCombinationList-v1550
                                             BandCombinationList-v1550
                                                                                  OPTIONAL
    11,
    11
    supportedBandCombinationList-v1560
                                             BandCombinationList-v1560
                                                                                  OPTIONAL.
    supportedBandCombinationListNEDC-Only
                                             BandCombinationList
                                                                                  OPTIONAL
    ]],
    supportedBandCombinationList-v1570
                                             BandCombinationList-v1570
                                                                                  OPTIONAL
    ]],
    supportedBandCombinationList-v1580
                                             BandCombinationList-v1580
                                                                                  OPTIONAL
    ]],
    1 1
    supportedBandCombinationList-v1590
                                             BandCombinationList-v1590
                                                                                  OPTIONAL
    ]],
    ] ]
    supportedBandCombinationListNEDC-Only-v15a0
                                                   SEQUENCE {
        supportedBandCombinationList-v1540
                                                 BandCombinationList-v1540
                                                                                  OPTIONAL,
```

```
supportedBandCombinationList-v1560
                                                BandCombinationList-v1560
                                                                                OPTIONAL,
        supportedBandCombinationList-v1570
                                                BandCombinationList-v1570
                                                                                OPTIONAL,
        supportedBandCombinationList-v1580
                                                BandCombinationList-v1580
                                                                                OPTIONAL.
        supportedBandCombinationList-v1590
                                                BandCombinationList-v1590
                                                                                OPTIONAL
                                                                                OPTIONAL
    j,
RF-ParametersMRDC-v15g0 ::=
                                               SEOUENCE {
    supportedBandCombinationList-v15g0
                                                   BandCombinationList-v15g0
                                                                                OPTIONAL,
    supportedBandCombinationListNEDC-Only-v15g0
                                                   BandCombinationList-v15g0
                                                                                OPTIONAL
-- TAG-RF-PARAMETERSMRDC-STOP
-- ASN1STOP
```

RF-ParametersMRDC field descriptions

appliedFreqBandListFilter

In this field the UE mirrors the FreqBandList that the NW provided in the capability enquiry, if any. The UE filtered the band combinations in the supportedBandCombinationList in accordance with this appliedFreqBandListFilter.

supportedBandCombinationList

A list of band combinations that the UE supports for (NG)EN-DC, or both (NG)EN-DC and NE-DC. The FeatureSetCombinationId:s in this list refer to the FeatureSetCombination entries in the featureSetCombinations list in the UE-MRDC-Capability IE.

supportedBandCombinationListNEDC-Only

A list of band combinations that the UE supports only for NE-DC. The FeatureSetCombinationId:s in this list refer to the FeatureSetCombination entries in the featureSetCombinations list in the UE-MRDC-Capability IE.

RLC-Parameters

The IE RLC-Parameters is used to convey capabilities related to RLC.

RLC-Parameters information element

SDAP-Parameters

The IE SDAP-Parameters is used to convey capabilities related to SDAP.

SDAP-Parameters information element

SimultaneousRxTxPerBandPair

The IE Simultaneous Rx/TxPerBandPair contains the simultaneous Rx/Tx UE capability for each band pair in a band combination.

SimultaneousRxTxPerBandPair information element

```
-- ASN1START
-- TAG-SIMULTANEOUSRXTXPERBANDPAIR-START

SimultaneousRxTxPerBandPair ::= BIT STRING (SIZE (3..496))

-- TAG-SIMULTANEOUSRXTXPERBANDPAIR-STOP
-- ASN1STOP
```

SRS-SwitchingTimeNR

The IE SRS-SwitchingTimeNR is used to indicate the SRS carrier switching time supported by the UE for one NR band pair.

SRS-SwitchingTimeNR information element

-- ASN1STOP

SRS-SwitchingTimeEUTRA

The IE SRS-SwitchingTimeEUTRA is used to indicate the SRS carrier switching time supported by the UE for one E-UTRA band pair.

SRS-SwitchingTimeEUTRA information element

SupportedBandwidth

The IE SupportedBandwidth is used to indicate the maximum channel bandwidth supported by the UE on one carrier of a band of a band combination.

SupportedBandwidth information element

UE-CapabilityRAT-ContainerList

The IE UE-CapabilityRAT-ContainerList contains a list of radio access technology specific capability containers.

UE-CapabilityRAT-ContainerList information element

-- ASN1START

```
-- TAG-UE-CAPABILITYRAT-CONTAINERLIST-START

UE-CapabilityRAT-ContainerList ::= SEQUENCE (SIZE (0..maxRAT-CapabilityContainers)) OF UE-CapabilityRAT-Container

UE-CapabilityRAT-Container ::= SEQUENCE {
    rat-Type RAT-Type,
    ue-CapabilityRAT-Container OCTET STRING
}

-- TAG-UE-CAPABILITYRAT-CONTAINERLIST-STOP
    ASN1STOP
```

UE-CapabilityRAT-ContainerList field descriptions

ue-CapabilityRAT-Container

Container for the UE capabilities of the indicated RAT. The encoding is defined in the specification of each RAT:

For rat-Type set to nr. the encoding of UE capabilities is defined in UE-NR-Capability.

For rat-Type set to eutra-nr. the encoding of UE capabilities is defined in UE-MRDC-Capability.

For rat-Type set to eutra: the encoding of UE capabilities is defined in UE-EUTRA-Capability specified in TS 36.331 [10].

UE-CapabilityRAT-RequestList

The IE UE-CapabilityRAT-RequestList is used to request UE capabilities for one or more RATs from the UE.

UE-CapabilityRAT-RequestList information element

```
-- ASN1START
-- TAG-UE-CAPABILITYRAT-REQUESTLIST-START

UE-CapabilityRAT-RequestList ::= SEQUENCE (SIZE (1..maxRAT-CapabilityContainers)) OF UE-CapabilityRAT-Request

UE-CapabilityRAT-Request ::= SEQUENCE {
    rat-Type RAT-Type,
    capabilityRequestFilter OCTET STRING OPTIONAL, -- Need N
    ...
}

-- TAG-UE-CAPABILITYRAT-REQUESTLIST-STOP
-- ASN1STOP
```

UE-CapabilityRAT-Request field descriptions

capabilityRequestFilter

Information by which the network requests the UE to filter the UE capabilities.

For rat-Type set to nr or eutra-nr. the encoding of the capabilityRequestFilter is defined in UE-CapabilityRequestFilterNR.

For rat-Type set to eutra: the encoding of the capability Request Filter is defined by UECapability Enquiry message defined in TS36.331 [10], in which RAT-Type in UECapability Request includes only 'eutra'.

rat-Type

The RAT type for which the NW requests UE capabilities.

UE-CapabilityRequestFilterCommon

The IE UE-CapabilityRequestFilterCommon is used to request filtered UE capabilities. The filter is common for all capability containers that are requested.

UE-CapabilityRequestFilterCommon information element

```
-- ASN1START
-- TAG-UE-CAPABILITYREOUESTFILTERCOMMON-START
UE-CapabilityRequestFilterCommon ::=
                                               SEOUENCE
    mrdc-Request
                                               SEOUENCE {
       omitEN-DC
                                                  ENUMERATED {true}
                                                                                         OPTIONAL,
                                                                                                      -- Need N
       includeNR-DC
                                                   ENUMERATED {true}
                                                                                         OPTIONAL,
                                                                                                      -- Need N
       includeNE-DC
                                                  ENUMERATED {true}
                                                                                         OPTIONAL
                                                                                                      -- Need N
                                                                                     OPTIONAL,
                                                                                                      -- Need N
-- TAG-UE-CAPABILITYREOUESTFILTERCOMMON-STOP
-- ASN1STOP
```

UE-CapabilityRequestFilterCommon field descriptions

includeNE-DC

Only if this field is present, the UE supporting NE-DC shall indicate support for NE-DC in band combinations and include feature set combinations which are applicable to NE-DC. Band combinations supporting both NE-DC and (NG)EN-DC shall be included in *supportedBandCombinationList*, band combinations supporting only NE-DC shall be included in *supportedBandCombinationListNEDC-Only*.

includeNR-DC

Only if this field is present, the UE supporting NR-DC shall indicate support for NR-DC in band combinations and include feature set combinations which are applicable to NR-DC.

omitEN-DC

Only if this field is present, the UE shall omit band combinations and feature set combinations which are only applicable to (NG)EN-DC.

UE-CapabilityRequestFilterNR

The IE *UE-CapabilityRequestFilterNR* is used to request filtered UE capabilities.

UE-CapabilityRequestFilterNR information element

```
-- ASN1START
-- TAG-UE-CAPABILITYREOUESTFILTERNR-START
UE-CapabilityRequestFilterNR ::=
                                             SEOUENCE {
    frequencyBandListFilter
                                                 FreqBandList
                                                                                        OPTIONAL,
                                                                                                    -- Need N
    nonCriticalExtension
                                                 UE-CapabilityRequestFilterNR-v1540
                                                                                        OPTIONAL
UE-CapabilityRequestFilterNR-v1540 ::=
                                            SEOUENCE {
    srs-SwitchingTimeRequest
                                                 ENUMERATED {true}
                                                                                        OPTIONAL, -- Need N
                                                 SEQUENCE {}
    nonCriticalExtension
                                                                                        OPTIONAL
-- TAG-UE-CAPABILITYREOUESTFILTERNR-STOP
-- ASN1STOP
```

UE-MRDC-Capability

The IE UE-MRDC-Capability is used to convey the UE Radio Access Capability Parameters for MR-DC, see TS 38.306 [26].

UE-MRDC-Capability information element

```
-- ASN1START
-- TAG-UE-MRDC-CAPABILITY-START
UE-MRDC-Capability ::=
                                     SEOUENCE {
    measAndMobParametersMRDC
                                        MeasAndMobParametersMRDC
                                                                                                                          OPTIONAL,
    phy-ParametersMRDC-v1530
                                        Phy-ParametersMRDC
                                                                                                                          OPTIONAL,
    rf-ParametersMRDC
                                        RF-ParametersMRDC,
    generalParametersMRDC
                                        GeneralParametersMRDC-XDD-Diff
                                                                                                                          OPTIONAL,
                                        UE-MRDC-CapabilityAddXDD-Mode
    fdd-Add-UE-MRDC-Capabilities
                                                                                                                          OPTIONAL,
                                        UE-MRDC-CapabilityAddXDD-Mode
    tdd-Add-UE-MRDC-Capabilities
                                                                                                                          OPTIONAL,
    fr1-Add-UE-MRDC-Capabilities
                                        UE-MRDC-CapabilityAddFRX-Mode
                                                                                                                          OPTIONAL,
    fr2-Add-UE-MRDC-Capabilities
                                        UE-MRDC-CapabilityAddFRX-Mode
                                                                                                                          OPTIONAL,
    featureSetCombinations
                                        SEQUENCE (SIZE (1..maxFeatureSetCombinations)) OF FeatureSetCombination
                                                                                                                          OPTIONAL,
    pdcp-ParametersMRDC-v1530
                                        PDCP-ParametersMRDC
                                                                                                                          OPTIONAL,
    lateNonCriticalExtension
                                        OCTET STRING (CONTAINING UE-MRDC-Capability-v15q0)
                                                                                                                          OPTIONAL,
    nonCriticalExtension
                                        UE-MRDC-Capability-v1560
                                                                                                                          OPTIONAL
-- Regular non-critical extensions:
UE-MRDC-Capability-v1560 ::=
                                    SEQUENCE {
    receivedFilters
                                        OCTET STRING (CONTAINING UECapabilityEnquiry-v1560-IEs)
                                                                                                                          OPTIONAL,
    measAndMobParametersMRDC-v1560
                                        MeasAndMobParametersMRDC-v1560
                                                                                                                          OPTIONAL,
    fdd-Add-UE-MRDC-Capabilities-v1560 UE-MRDC-CapabilityAddXDD-Mode-v1560
                                                                                                                          OPTIONAL,
    tdd-Add-UE-MRDC-Capabilities-v1560 UE-MRDC-CapabilityAddXDD-Mode-v1560
                                                                                                                          OPTIONAL,
    nonCriticalExtension
                                        SEOUENCE {}
                                                                                                                          OPTIONAL
```

```
-- Late non-critical extensions:
UE-MRDC-Capability-v15q0 ::=
                                    SEOUENCE {
   rf-ParametersMRDC-v15q0
                                        RF-ParametersMRDC-v15q0
                                                                                                                         OPTIONAL,
   nonCriticalExtension
                                        SEQUENCE {}
                                                                                                                         OPTIONAL
UE-MRDC-CapabilityAddXDD-Mode ::= SEQUENCE {
    measAndMobParametersMRDC-XDD-Diff
                                            MeasAndMobParametersMRDC-XDD-Diff
                                                                                                                         OPTIONAL.
    generalParametersMRDC-XDD-Diff
                                            General ParametersMRDC-XDD-Diff
                                                                                                                         OPTIONAL
UE-MRDC-CapabilityAddXDD-Mode-v1560 ::=
                                           SEQUENCE {
    measAndMobParametersMRDC-XDD-Diff-v1560
                                               MeasAndMobParametersMRDC-XDD-Diff-v1560
                                                                                                                         OPTIONAL
UE-MRDC-CapabilityAddFRX-Mode ::= SEOUENCE {
    measAndMobParametersMRDC-FRX-Diff
                                            MeasAndMobParametersMRDC-FRX-Diff
GeneralParametersMRDC-XDD-Diff ::= SEQUENCE {
    splitSRB-WithOneUL-Path
                                        ENUMERATED {supported}
                                                                                                                         OPTIONAL,
                                        ENUMERATED {supported}
    splitDRB-withUL-Both-MCG-SCG
                                                                                                                         OPTIONAL,
    srb3
                                        ENUMERATED {supported}
                                                                                                                         OPTIONAL.
                                        ENUMERATED {supported}
                                                                                                                         OPTIONAL,
    dummy
-- TAG-UE-MRDC-CAPABILITY-STOP
-- ASN1STOP
```

UE-MRDC-Capability field descriptions

featureSetCombinations

A list of FeatureSetCombination:s for supportedBandCombinationList and supportedBandCombinationListNEDC-Only in UE-MRDC-Capability. The FeatureSetDownlink:s and FeatureSetUplink:s referred to from these FeatureSetCombination:s are defined in the featureSets list in UE-NR-Capability.

UE-NR-Capability

The IE UE-NR-Capability is used to convey the NR UE Radio Access Capability Parameters, see TS 38.306 [26].

UE-NR-Capability information element

OPTIONAL,

```
mac-Parameters
                                    MAC-Parameters
                                                                                                                  OPTIONAL,
    phy-Parameters
                                     Phy-Parameters,
    rf-Parameters
                                    RF-Parameters.
    measAndMobParameters
                                    MeasAndMobParameters
                                                                                                                  OPTIONAL,
    fdd-Add-UE-NR-Capabilities
                                    UE-NR-CapabilityAddXDD-Mode
                                                                                                                  OPTIONAL,
                                    UE-NR-CapabilityAddXDD-Mode
    tdd-Add-UE-NR-Capabilities
                                                                                                                  OPTIONAL,
    fr1-Add-UE-NR-Capabilities
                                    UE-NR-CapabilityAddFRX-Mode
                                                                                                                  OPTIONAL,
    fr2-Add-UE-NR-Capabilities
                                    UE-NR-CapabilityAddFRX-Mode
                                                                                                                  OPTIONAL,
    featureSets
                                     FeatureSets
                                                                                                                  OPTIONAL,
    featureSetCombinations
                                     SEQUENCE (SIZE (1..maxFeatureSetCombinations)) OF FeatureSetCombination
                                                                                                                  OPTIONAL,
    lateNonCriticalExtension
                                     OCTET STRING (CONTAINING UE-NR-Capability-v15c0)
                                                                                                                  OPTIONAL,
    nonCriticalExtension
                                    UE-NR-Capability-v1530
                                                                                                                  OPTIONAL
-- Regular non-critical extensions:
UE-NR-Capability-v1530 ::=
                                         SEOUENCE {
    fdd-Add-UE-NR-Capabilities-v1530
                                              UE-NR-CapabilityAddXDD-Mode-v1530
                                                                                                                  OPTIONAL,
    tdd-Add-UE-NR-Capabilities-v1530
                                              UE-NR-CapabilityAddXDD-Mode-v1530
                                                                                                                  OPTIONAL,
                                              ENUMERATED {supported}
    dummy
                                                                                                                  OPTIONAL,
    interRAT-Parameters
                                              InterRAT-Parameters
                                                                                                                  OPTIONAL,
                                              ENUMERATED {supported}
    inactiveState
                                                                                                                  OPTIONAL,
                                              ENUMERATED {supported}
    delayBudgetReporting
                                                                                                                  OPTIONAL,
                                              UE-NR-Capability-v1540
    nonCriticalExtension
                                                                                                                  OPTIONAL
UE-NR-Capability-v1540 ::=
                                        SEOUENCE {
    sdap-Parameters
                                            SDAP-Parameters
                                                                                                                  OPTIONAL,
                                            ENUMERATED {supported}
    overheatingInd
                                                                                                                  OPTIONAL,
                                            IMS-Parameters
    ims-Parameters
                                                                                                                  OPTIONAL,
    fr1-Add-UE-NR-Capabilities-v1540
                                            UE-NR-CapabilityAddFRX-Mode-v1540
                                                                                                                  OPTIONAL,
    fr2-Add-UE-NR-Capabilities-v1540
                                            UE-NR-CapabilityAddFRX-Mode-v1540
                                                                                                                  OPTIONAL,
    fr1-fr2-Add-UE-NR-Capabilities
                                            UE-NR-CapabilityAddFRX-Mode
                                                                                                                  OPTIONAL,
    nonCriticalExtension
                                            UE-NR-Capability-v1550
                                                                                                                  OPTIONAL
UE-NR-Capability-v1550 ::=
                                         SEOUENCE {
                                              ENUMERATED {supported}
    reducedCP-Latency
                                                                                                                  OPTIONAL,
    nonCriticalExtension
                                              UE-NR-Capability-v1560
                                                                                                                  OPTIONAL
UE-NR-Capability-v1560 ::=
                                         SEOUENCE {
    nrdc-Parameters
                                            NRDC-Parameters
                                                                                                                  OPTIONAL,
    receivedFilters
                                            OCTET STRING (CONTAINING UECapabilityEnquiry-v1560-IEs)
                                                                                                                  OPTIONAL,
    nonCriticalExtension
                                                                                                                  OPTIONAL
                                            UE-NR-Capability-v1570
UE-NR-Capability-v1570 ::=
                                         SEOUENCE {
    nrdc-Parameters-v1570
                                            NRDC-Parameters-v1570
                                                                                                                  OPTIONAL.
    nonCriticalExtension
                                            SEOUENCE {}
                                                                                                                  OPTIONAL
-- Late non-critical extensions:
UE-NR-Capability-v15c0 ::=
                                         SEQUENCE {
```

```
nrdc-Parameters-v15c0
                                             NRDC-Parameters-v15c0
                                                                                                                 OPTIONAL,
    partialFR2-FallbackRX-Req
                                             ENUMERATED {true}
                                                                                                                 OPTIONAL,
                                             UE-NR-Capability-v15q0
    nonCriticalExtension
                                                                                                                 OPTIONAL
UE-NR-Capability-v15q0 ::=
                                         SEQUENCE {
    rf-Parameters-v15q0
                                             RF-Parameters-v15q0
                                                                                                                 OPTIONAL,
    nonCriticalExtension
                                             SEQUENCE {}
                                                                                                                 OPTIONAL
UE-NR-CapabilityAddXDD-Mode ::=
                                        SEQUENCE {
    phy-ParametersXDD-Diff
                                            Phy-ParametersXDD-Diff
                                                                                                                 OPTIONAL,
   mac-ParametersXDD-Diff
                                            MAC-ParametersXDD-Diff
                                                                                                                 OPTIONAL,
    measAndMobParametersXDD-Diff
                                            MeasAndMobParametersXDD-Diff
                                                                                                                 OPTIONAL
UE-NR-CapabilityAddXDD-Mode-v1530 ::=
                                         SEOUENCE {
    eutra-ParametersXDD-Diff
                                             EUTRA-ParametersXDD-Diff
UE-NR-CapabilityAddFRX-Mode ::= SEQUENCE {
    phy-ParametersFRX-Diff
                                        Phy-ParametersFRX-Diff
                                                                                                                 OPTIONAL,
    measAndMobParametersFRX-Diff
                                        MeasAndMobParametersFRX-Diff
                                                                                                                 OPTIONAL
UE-NR-CapabilityAddFRX-Mode-v1540 ::=
                                         SEOUENCE {
    ims-ParametersFRX-Diff
                                             IMS-ParametersFRX-Diff
                                                                                                                 OPTIONAL
-- TAG-UE-NR-CAPABILITY-STOP
```

UE-NR-Capability field descriptions

featureSetCombinations

-- ASN1STOP

A list of FeatureSetCombination:s for supportedBandCombinationList in UE-NR-Capability. The FeatureSetDownlink:s and FeatureSetUplink:s referred to from these FeatureSetCombination:s are defined in the featureSets list in UE-NR-Capability.

UE-NR-Capability-v1540 field descriptions

fr1-fr2-Add-UE-NR-Capabilities

This instance of UE-NR-CapabilityAddFRX-Mode does not include any other fields than csi-RS-IM-ReceptionForFeedback/ csi-RS-ProcFrameworkForSRS/ csi-ReportFramework.

6.3.4 Other information elements

FUTRA-AllowedMeasBandwidth

The IE *EUTRA-AllowedMeasBandwidth* is used to indicate the maximum allowed measurement bandwidth on a carrier frequency as defined by the parameter Transmission Bandwidth Configuration "N_{RB}" in TS 36.104 [33]. The values *mbw6*, *mbw15*, *mbw25*, *mbw50*, *mbw75*, *mbw100* indicate 6, 15, 25, 50, 75 and 100 resource blocks, respectively.

FUTRA-AllowedMeasBandwidth information element

```
-- ASN1START
-- TAG-EUTRA-ALLOWEDMEASBANDWIDTH-START

EUTRA-AllowedMeasBandwidth ::= ENUMERATED {mbw6, mbw15, mbw25, mbw50, mbw75, mbw100}

-- TAG-EUTRA-ALLOWEDMEASBANDWIDTH-STOP
-- ASN1STOP
```

EUTRA-MBSFN-SubframeConfigList

The IE EUTRA-MBSFN-SubframeConfigList is used to define an E-UTRA MBSFN subframe pattern (for the purpose of NR rate matching).

EUTRA-MBSFN-SubframeConfigList information element

```
-- ASN1START
-- TAG-EUTRA-MBSFN-SUBFRAMECONFIGLIST-START
EUTRA-MBSFN-SubframeConfigList ::= SEOUENCE (SIZE (1..maxMBSFN-Allocations)) OF EUTRA-MBSFN-SubframeConfig
EUTRA-MBSFN-SubframeConfig ::=
                                  SEQUENCE {
   radioframeAllocationPeriod
                                      ENUMERATED {n1, n2, n4, n8, n16, n32},
   radioframeAllocationOffset
                                      INTEGER (0..7),
   subframeAllocation1
                                      CHOICE {
                                          BIT STRING (SIZE(6)),
       oneFrame
       fourFrames
                                          BIT STRING (SIZE(24))
   subframeAllocation2
                                      CHOICE {
       oneFrame
                                          BIT STRING (SIZE(2)),
       fourFrames
                                          BIT STRING (SIZE(8))
                                                                                                         OPTIONAL, -- Need R
-- TAG-EUTRA-MBSFN-SUBFRAMECONFIGLIST-STOP
-- ASN1STOP
```

EUTRA-MBSFN-SubframeConfig field descriptions

radioframeAllocationOffset

Field as defined in MBSFN-SubframeConfig in TS 36.331 [10].

radioframeAllocationPeriod

Field as defined in MBSFN-SubframeConfig in TS 36.331 [10], where SFN refers to the SFN of the NR serving cell.

subframeAllocation1

Field as defined in MBSFN-SubframeConfig in TS 36.331 [10], where the UE assumes the duplex mode (FDD or TDD) of the NR cell for which the E-UTRA-MBSFN-SubframeConfig is provided.

subframeAllocation2

Field as defined in MBSFN-SubframeConfig-v1430 in TS 36.331 [10], where the UE assumes the duplex mode (FDD or TDD) of the NR cell for which the E-UTRA-MBSFN-SubframeConfig is provided.

EUTRA-MultiBandInfoList

The IE EUTRA-MultiBandInfoList indicates the list of frequency bands in addition to the band represented by CarrierFreq for which cell reselection parameters are common, and a list of additionalPmax and additionalSpectrumEmission.

EUTRA-MultiBandInfoList information element

```
-- ASN1START
-- TAG-EUTRA-MULTIBANDINFOLIST-START

EUTRA-MultiBandInfoList ::= SEQUENCE (SIZE (1..maxMultiBands)) OF EUTRA-MultiBandInfo

EUTRA-MultiBandInfo ::= SEQUENCE {
    eutra-FreqBandIndicator FreqBandIndicatorEUTRA,
    eutra-NS-PmaxList EUTRA-NS-PmaxList OPTIONAL -- Need R
}

-- TAG-EUTRA-MULTIBANDINFOLIST-STOP
-- ASN1STOP
```

EUTRA-NS-PmaxList

The IE EUTRA-NS-PmaxList concerns a list of additionalPmax and additionalSpectrumEmission, as defined in TS 36.101 [22], table 6.2.4-1 for UEs neither in CE nor BL UEs and TS 36.101 [22], table 6.2.4E-1 for UEs in CE or BL UEs, for a given frequency band.

EUTRA-NS-PmaxList information element

```
-- ASN1START
-- TAG-EUTRA-NS-PMAXLIST-START

EUTRA-NS-PmaxList ::= SEQUENCE (SIZE (1..maxEUTRA-NS-Pmax)) OF EUTRA-NS-PmaxValue

EUTRA-NS-PmaxValue ::= SEQUENCE {
```

```
additionalPmax INTEGER (-30..33) OPTIONAL, -- Need R additionalSpectrumEmission INTEGER (1..288) OPTIONAL -- Need R

-- TAG-EUTRA-NS-PMAXLIST-STOP
-- ASN1STOP
```

- EUTRA-PhysCellId

-- ASN1STOP

The IE EUTRA-PhysCellId is used to indicate the physical layer identity of the cell, as defined in TS 36.211 [31].

EUTRA-PhysCellId information element

```
-- ASN1START
-- TAG-EUTRA-PHYSCELLID-START

EUTRA-PhysCellid ::= INTEGER (0..503)

-- TAG-EUTRA-PHYSCELLID-STOP
-- ASN1STOP
```

EUTRA-PhysCellIdRange

The IE *EUTRA-PhysCellIdRange* is used to encode either a single or a range of physical cell identities. The range is encoded by using a *start* value and by indicating the number of consecutive physical cell identities (including *start*) in the range. For fields comprising multiple occurrences of *EUTRA-PhysCellIdRange*, NW may configure overlapping ranges of physical cell identities.

EUTRA-PhysCellIdRange information element

EUTRA-PresenceAntennaPort1

The IE *EUTRA-PresenceAntennaPort1* is used to indicate whether all the neighbouring cells use Antenna Port 1. When set to *true*, the UE may assume that at least two cell-specific antenna ports are used in all neighbouring cells.

EUTRA-PresenceAntennaPort1 information element

```
-- ASN1START
-- TAG-EUTRA-PRESENCEANTENNAPORT1-START

EUTRA-PresenceAntennaPort1 ::= BOOLEAN
-- TAG-EUTRA-PRESENCEANTENNAPORT1-STOP
-- ASN1STOP
```

EUTRA-Q-OffsetRange

The IE *EUTRA-Q-OffsetRange* is used to indicate a cell, or frequency specific offset to be applied when evaluating triggering conditions for measurement reporting. The value in dB. Value *dB-24* corresponds to -24 dB, value *dB-22* corresponds to -22 dB and so on.

EUTRA-Q-OffsetRange information element

- OtherConfig

The IE OtherConfig contains configuration related to miscellaneous other configurations.

OtherConfig information element

```
-- ASN1START
-- TAG-OTHERCONFIG-START

OtherConfig ::= SEQUENCE {
    delayBudgetReportingConfig CHOICE{
```

```
release
       setup
                               SEQUENCE {
           delayBudgetReportingProhibitTimer ENUMERATED {s0, s0dot4, s0dot8, s1dot6, s3, s6, s12, s30}
                                                                                                         OPTIONAL
                                                                                                                         -- Need M
OtherConfig-v1540 ::=
                               SEOUENCE {
    overheatingAssistanceConfig
                                   SetupRelease {OverheatingAssistanceConfig}
                                                                                                         OPTIONAL, -- Need M
OverheatingAssistanceConfig ::= SEQUENCE {
    overheatingIndicationProhibitTimer ENUMERATED {s0, s0dot5, s1, s2, s5, s10, s20, s30,
                                         s60, s90, s120, s300, s600, spare3, spare2, spare1}
-- TAG-OTHERCONFIG-STOP
-- ASN1STOP
```

OtherConfig field descriptions

delayBudgetReportingProhibitTimer

Prohibit timer for delay budget reporting. Value in seconds. Value s0 means prohibit timer is set to 0 seconds, value s0dot4 means prohibit timer is set to 0.4 seconds, and so on.

overheatingAssistanceConfig

Configuration for the UE to report assistance information to inform the gNB about UE detected internal overheating.

overheatingIndicationProhibitTimer

Prohibit timer for overheating assistance information reporting. Value in seconds. Value s0 means prohibit timer is set to 0 seconds, value s0dot5 means prohibit timer is set to 0.5 seconds, value s1 means prohibit timer is set to 1 second and so on.

RRC-TransactionIdentifier

The IE RRC-TransactionIdentifier is used, together with the message type, for the identification of an RRC procedure (transaction).

RRC-TransactionIdentifier information element

```
-- ASN1START
-- TAG-RRC-TRANSACTIONIDENTIFIER-START

RRC-TransactionIdentifier ::= INTEGER (0..3)
-- TAG-RRC-TRANSACTIONIDENTIFIER-STOP
-- ASN1STOP
```

6.4 RRC multiplicity and type constraint values

Multiplicity and type constraint definitions

```
-- ASN1START
-- TAG-MULTIPLICITY-AND-TYPE-CONSTRAINT-DEFINITIONS-START
maxBandComb
                                        INTEGER ::= 65536
                                                            -- Maximum number of DL band combinations
maxCellBlack
                                        INTEGER ::= 16
                                                            -- Maximum number of NR blacklisted cell ranges in SIB3, SIB4
maxCellInter
                                        INTEGER ::= 16
                                                            -- Maximum number of inter-Freq cells listed in SIB4
                                                            -- Maximum number of intra-Freq cells listed in SIB3
maxCellIntra
                                        INTEGER ::= 16
                                                            -- Maximum number of cells in E-UTRAN
maxCellMeasEUTRA
                                        INTEGER ::= 32
maxEARFCN
                                        INTEGER ::= 262143 -- Maximum value of E-UTRA carrier frequency
maxEUTRA-CellBlack
                                        INTEGER ::= 16
                                                            -- Maximum number of E-UTRA blacklisted physical cell identity ranges
                                                            -- in SIB5
maxEUTRA-NS-Pmax
                                        INTEGER ::= 8
                                                            -- Maximum number of NS and P-Max values per band
maxMultiBands
                                        INTEGER ::= 8
                                                            -- Maximum number of additional frequency bands that a cell belongs to
maxNARFCN
                                        INTEGER ::= 3279165 -- Maximum value of NR carrier frequency
maxNR-NS-Pmax
                                        INTEGER ::= 8
                                                            -- Maximum number of NS and P-Max values per band
                                                            -- Max number of serving cells (SpCells + SCells)
maxNrofServingCells
                                        INTEGER ::= 32
maxNrofServingCells-1
                                        INTEGER ::= 31
                                                            -- Max number of serving cells (SpCells + SCells) minus 1
maxNrofAggregatedCellsPerCellGroup
                                        INTEGER ::= 16
maxNrofSCells
                                        INTEGER ::= 31
                                                            -- Max number of secondary serving cells per cell group
maxNrofCellMeas
                                        INTEGER ::= 32
                                                            -- Maximum number of entries in each of the cell lists in a measurement
                                                            -- object
maxNrofSS-BlocksToAverage
                                        INTEGER ::= 16
                                                            -- Max number for the (max) number of SS blocks to average to determine cell
                                                            -- measurement
maxNrofCSI-RS-ResourcesToAverage
                                        INTEGER ::= 16
                                                            -- Max number for the (max) number of CSI-RS to average to determine cell
                                                            -- measurement
maxNrofDL-Allocations
                                                            -- Maximum number of PDSCH time domain resource allocations
                                        INTEGER ::= 16
maxNrofSR-ConfigPerCellGroup
                                        INTEGER ::= 8
                                                            -- Maximum number of SR configurations per cell group
                                                            -- Maximum value of LCG ID
maxLCG-ID
                                        INTEGER ::= 7
maxLC-ID
                                        INTEGER ::= 32
                                                            -- Maximum value of Logical Channel ID
maxNrofTAGs
                                        INTEGER ::= 4
                                                            -- Maximum number of Timing Advance Groups
                                                            -- Maximum number of Timing Advance Groups minus 1
maxNrofTAGs-1
                                        INTEGER ::= 3
                                                            -- Maximum number of BWPs per serving cell
maxNrofBWPs
                                        INTEGER ::= 4
                                                            -- Maximum number of reported MR-DC combinations for IDC
maxNrofCombIDC
                                        INTEGER ::= 128
maxNrofSymbols-1
                                        INTEGER ::= 13
                                                            -- Maximum index identifying a symbol within a slot (14 symbols, indexed
                                                            -- from 0..13)
maxNrofSlots
                                        INTEGER ::= 320
                                                            -- Maximum number of slots in a 10 ms period
maxNrofSlots-1
                                        INTEGER ::= 319
                                                            -- Maximum number of slots in a 10 ms period minus 1
maxNrofPhysicalResourceBlocks
                                        INTEGER ::= 275
                                                            -- Maximum number of PRBs
                                                            -- Maximum number of PRBs minus 1
maxNrofPhysicalResourceBlocks-1
                                        INTEGER ::= 274
                                                            -- Maximum number of PRBs plus 1
maxNrofPhysicalResourceBlocksPlus1
                                        INTEGER ::= 276
maxNrofControlResourceSets-1
                                        INTEGER ::= 11
                                                            -- Max number of CoReSets configurable on a serving cell minus 1
                                                            -- Max number of OFDM symbols in a control resource set
maxCoReSetDuration
                                        INTEGER ::= 3
maxNrofSearchSpaces-1
                                        INTEGER ::= 39
                                                            -- Max number of Search Spaces minus 1
                                                            -- Max number payload of a DCI scrambled with SFI-RNTI
maxSFI-DCI-PayloadSize
                                        INTEGER ::= 128
                                                            -- Max number payload of a DCI scrambled with SFI-RNTI minus 1
maxSFI-DCI-PayloadSize-1
                                        INTEGER ::= 127
maxINT-DCI-PavloadSize
                                        INTEGER ::= 126
                                                            -- Max number payload of a DCI scrambled with INT-RNTI
maxINT-DCI-PayloadSize-1
                                        INTEGER ::= 125
                                                            -- Max number payload of a DCI scrambled with INT-RNTI minus 1
maxNrofRateMatchPatterns
                                        INTEGER ::= 4
                                                            -- Max number of rate matching patterns that may be configured
```

```
maxNrofRateMatchPatterns-1
                                        INTEGER ::= 3
                                                           -- Max number of rate matching patterns that may be configured minus 1
maxNrofRateMatchPatternsPerGroup
                                       INTEGER ::= 8
                                                            -- Max number of rate matching patterns that may be configured in one group
                                                           -- Maximum number of report configurations
maxNrofCSI-ReportConfigurations
                                       INTEGER ::= 48
                                                           -- Maximum number of report configurations minus 1
maxNrofCSI-ReportConfigurations-1
                                       INTEGER ::= 47
maxNrofCSI-ResourceConfigurations
                                       INTEGER ::= 112
                                                           -- Maximum number of resource configurations
maxNrofCSI-ResourceConfigurations-1
                                       INTEGER ::= 111
                                                           -- Maximum number of resource configurations minus 1
maxNrofAP-CSI-RS-ResourcesPerSet
                                       INTEGER ::= 16
maxNrOfCSI-AperiodicTriggers
                                       INTEGER ::= 128
                                                           -- Maximum number of triggers for aperiodic CSI reporting
-- Maximum number of report configurations per trigger state for aperiodic
maxNrofNZP-CSI-RS-Resources
                                       INTEGER ::= 192
                                                           -- Maximum number of Non-Zero-Power (NZP) CSI-RS resources
maxNrofNZP-CSI-RS-Resources-1
                                       INTEGER ::= 191
                                                            -- Maximum number of Non-Zero-Power (NZP) CSI-RS resources minus 1
maxNrofNZP-CSI-RS-ResourcesPerSet
                                                            -- Maximum number of NZP CSI-RS resources per resource set
                                       INTEGER ::= 64
maxNrofNZP-CSI-RS-ResourceSets
                                       INTEGER ::= 64
                                                            -- Maximum number of NZP CSI-RS resource sets per cell
maxNrofNZP-CSI-RS-ResourceSets-1
                                       INTEGER ::= 63
                                                           -- Maximum number of NZP CSI-RS resource sets per cell minus 1
maxNrofNZP-CSI-RS-ResourceSetsPerConfig INTEGER ::= 16
                                                           -- Maximum number of resource sets per resource configuration
                                                           -- Maximum number of resources per resource configuration
                                       INTEGER ::= 128
maxNrofNZP-CSI-RS-ResourcesPerConfig
                                                           -- Maximum number of Zero-Power (ZP) CSI-RS resources
maxNrofZP-CSI-RS-Resources
                                       INTEGER ::= 32
                                                           -- Maximum number of Zero-Power (ZP) CSI-RS resources minus 1
maxNrofZP-CSI-RS-Resources-1
                                       INTEGER ::= 31
maxNrofZP-CSI-RS-ResourceSets-1
                                       INTEGER ::= 15
maxNrofZP-CSI-RS-ResourcesPerSet
                                       INTEGER ::= 16
maxNrofZP-CSI-RS-ResourceSets
                                       INTEGER ::= 16
                                                           -- Maximum number of CSI-IM resources
maxNrofCST-TM-Resources
                                       INTEGER ::= 32
                                       INTEGER ::= 31
                                                           -- Maximum number of CSI-IM resources minus 1
maxNrofCSI-IM-Resources-1
maxNrofCSI-IM-ResourcesPerSet
                                       INTEGER ::= 8
                                                           -- Maximum number of CSI-IM resources per set
maxNrofCSI-IM-ResourceSets
                                       INTEGER ::= 64
                                                           -- Maximum number of NZP CSI-IM resource sets per cell
                                       INTEGER ::= 63
                                                           -- Maximum number of NZP CSI-IM resource sets per cell minus 1
maxNrofCSI-IM-ResourceSets-1
                                       INTEGER ::= 16
maxNrofCSI-IM-ResourceSetsPerConfig
                                                           -- Maximum number of CSI IM resource sets per resource configuration
                                                           -- Maximum number of SSB resources in a resource set
maxNrofCSI-SSB-ResourcePerSet
                                       INTEGER ::= 64
                                                           -- Maximum number of CSI SSB resource sets per cell
maxNrofCSI-SSB-ResourceSets
                                       INTEGER ::= 64
maxNrofCSI-SSB-ResourceSets-1
                                       INTEGER ::= 63
                                                           -- Maximum number of CSI SSB resource sets per cell minus 1
maxNrofCSI-SSB-ResourceSetsPerConfig
                                       INTEGER ::= 1
                                                           -- Maximum number of CSI SSB resource sets per resource configuration
maxNrofFailureDetectionResources
                                       INTEGER ::= 10
                                                           -- Maximum number of failure detection resources
                                                           -- Maximum number of failure detection resources minus 1
maxNrofFailureDetectionResources-1
                                       INTEGER ::= 9
maxNrofObjectId
                                       INTEGER ::= 64
                                                           -- Maximum number of measurement objects
maxNrofPageRec
                                       INTEGER ::= 32
                                                           -- Maximum number of page records
                                                           -- Maximum number of PCI ranges
maxNrofPCI-Ranges
                                       INTEGER ::= 8
                                                           -- Maximum number of PLMNs broadcast and reported by UE at establishment
maxPLMN
                                       INTEGER ::= 12
maxNrofCSI-RS-ResourcesRRM
                                                           -- Maximum number of CSI-RS resources for an RRM measurement object
                                       INTEGER ::= 96
maxNrofCSI-RS-ResourcesRRM-1
                                       INTEGER ::= 95
                                                           -- Maximum number of CSI-RS resources for an RRM measurement object minus 1
                                                           -- Maximum number of configured measurements
maxNrofMeasId
                                       INTEGER ::= 64
                                                            -- Maximum number of quantity configurations
maxNrofOuantityConfig
                                       INTEGER ::= 2
maxNrofCSI-RS-CellsRRM
                                       INTEGER ::= 96
                                                           -- Maximum number of cells with CSI-RS resources for an RRM measurement
maxNrofSRS-ResourceSets
                                       INTEGER ::= 16
                                                           -- Maximum number of SRS resource sets in a BWP.
maxNrofSRS-ResourceSets-1
                                       INTEGER ::= 15
                                                           -- Maximum number of SRS resource sets in a BWP minus 1.
maxNrofSRS-Resources
                                       INTEGER ::= 64
                                                           -- Maximum number of SRS resources.
maxNrofSRS-Resources-1
                                       INTEGER ::= 63
                                                           -- Maximum number of SRS resources minus 1.
maxNrofSRS-ResourcesPerSet
                                       INTEGER ::= 16
                                                            -- Maximum number of SRS resources in an SRS resource set
                                                           -- Maximum number of SRS trigger states minus 1, i.e., the largest code
maxNrofSRS-TriggerStates-1
                                       INTEGER ::= 3
maxNrofSRS-TriggerStates-2
                                       INTEGER ::= 2
                                                           -- Maximum number of SRS trigger states minus 2.
maxRAT-CapabilityContainers
                                       INTEGER ::= 8
                                                           -- Maximum number of interworking RAT containers (incl NR and MRDC)
maxSimultaneousBands
                                                           -- Maximum number of simultaneously aggregated bands
                                       INTEGER ::= 32
```

```
maxNrofSlotFormatCombinationsPerSet
                                                            -- Maximum number of Slot Format Combinations in a SF-Set.
                                        INTEGER ::= 512
maxNrofSlotFormatCombinationsPerSet-1
                                        INTEGER ::= 511
                                                            -- Maximum number of Slot Format Combinations in a SF-Set minus 1.
maxNrofPUCCH-Resources
                                        INTEGER ::= 128
maxNrofPUCCH-Resources-1
                                        INTEGER ::= 127
maxNrofPUCCH-ResourceSets
                                        INTEGER ::= 4
                                                            -- Maximum number of PUCCH Resource Sets
                                                            -- Maximum number of PUCCH Resource Sets minus 1.
maxNrofPUCCH-ResourceSets-1
                                        INTEGER ::= 3
                                        INTEGER ::= 32
                                                            -- Maximum number of PUCCH Resources per PUCCH-ResourceSet
maxNrofPUCCH-ResourcesPerSet.
maxNrofPUCCH-P0-PerSet
                                        INTEGER ::= 8
                                                            -- Maximum number of P0-pucch present in a p0-pucch set
maxNrofPUCCH-PathlossReferenceRSs
                                        INTEGER ::= 4
                                                            -- Maximum number of RSs used as pathloss reference for PUCCH power control.
                                                            -- Maximum number of RSs used as pathloss reference for PUCCH power
maxNrofPUCCH-PathlossReferenceRSs-1
                                        INTEGER ::= 3
                                                            -- control minus 1.
maxNrofP0-PUSCH-AlphaSets
                                        INTEGER ::= 30
                                                            -- Maximum number of P0-pusch-alpha-sets (see TS 38.213 [13], clause 7.1)
                                                            -- Maximum number of PO-pusch-alpha-sets minus 1 (see TS 38.213 [13], clause 7.1)
maxNrofP0-PUSCH-AlphaSets-1
                                        INTEGER ::= 29
maxNrofPUSCH-PathlossReferenceRSs
                                        INTEGER ::= 4
                                                            -- Maximum number of RSs used as pathloss reference for PUSCH power control.
maxNrofPUSCH-PathlossReferenceRSs-1
                                        INTEGER ::= 3
                                                            -- Maximum number of RSs used as pathloss reference for PUSCH power
                                                            -- control minus 1.
                                                            -- Maximum number of supported NAICS capability set
maxNrofNAICS-Entries
                                        INTEGER ::= 8
maxBands
                                        INTEGER ::= 1024
                                                            -- Maximum number of supported bands in UE capability.
maxBandsMRDC
                                        INTEGER ::= 1280
maxBandsEUTRA
                                        INTEGER ::= 256
maxCellReport
                                        INTEGER ::= 8
maxDRB
                                        INTEGER ::= 29
                                                            -- Maximum number of DRBs (that can be added in DRB-ToAddModList).
maxFreq
                                        INTEGER ::= 8
                                                            -- Max number of frequencies.
                                        INTEGER ::= 32
maxFreqIDC-MRDC
                                                            -- Maximum number of candidate NR frequencies for MR-DC IDC indication
maxNrofCandidateBeams
                                        INTEGER ::= 16
                                                            -- Max number of PRACH-ResourceDedicatedBFR in BFR config.
maxNrofPCIsPerSMTC
                                        INTEGER ::= 64
                                                            -- Maximum number of PCIs per SMTC.
maxNrofOFIs
                                        INTEGER ::= 64
maxNrOfSemiPersistentPUSCH-Triggers
                                        INTEGER ::= 64
                                                            -- Maximum number of triggers for semi persistent reporting on PUSCH
                                                            -- Maximum number of SR resources per BWP in a cell.
maxNrofSR-Resources
                                        INTEGER ::= 8
maxNrofSlotFormatsPerCombination
                                        INTEGER ::= 256
maxNrofSpatialRelationInfos
                                        INTEGER ::= 8
maxNrofIndexesToReport
                                        INTEGER ::= 32
maxNrofIndexesToReport2
                                        INTEGER ::= 64
                                                            -- Maximum number of SSB resources in a resource set minus 1.
maxNrofSSBs-1
                                        INTEGER ::= 63
maxNrofS-NSSAI
                                        INTEGER ::= 8
                                                            -- Maximum number of S-NSSAI.
maxNrofTCI-StatesPDCCH
                                        INTEGER ::= 64
maxNrofTCI-States
                                        INTEGER ::= 128
                                                            -- Maximum number of TCI states.
                                                            -- Maximum number of TCI states minus 1.
maxNrofTCI-States-1
                                        INTEGER ::= 127
maxNrofUL-Allocations
                                                            -- Maximum number of PUSCH time domain resource allocations.
                                        INTEGER ::= 16
maxOFI
                                        INTEGER ::= 63
maxRA-CSIRS-Resources
                                        INTEGER ::= 96
                                        INTEGER ::= 64
maxRA-OccasionsPerCSIRS
                                                            -- Maximum number of RA occasions for one CSI-RS
maxRA-Occasions-1
                                                            -- Maximum number of RA occasions in the system
                                        INTEGER ::= 511
maxRA-SSB-Resources
                                        INTEGER ::= 64
maxSCSs
                                        INTEGER ::= 5
maxSecondaryCellGroups
                                        INTEGER ::= 3
maxNrofServingCellsEUTRA
                                        INTEGER ::= 32
maxMBSFN-Allocations
                                        INTEGER ::= 8
maxNrofMultiBands
                                        INTEGER ::= 8
maxCellSFTD
                                        INTEGER ::= 3
                                                            -- Maximum number of cells for SFTD reporting
maxReportConfiqId
                                        INTEGER ::= 64
maxNrofCodebooks
                                        INTEGER ::= 16
                                                            -- Maximum number of codebooks supported by the UE
maxNrofCSI-RS-Resources
                                                            -- Maximum number of codebook resources supported by the UE
                                        INTEGER ::= 7
maxNrofSRI-PUSCH-Mappings
                                        INTEGER ::= 16
```

```
maxNrofSRI-PUSCH-Mappings-1
                                      INTEGER ::= 15
maxSIB
                                      INTEGER::= 32
                                                          -- Maximum number of SIBs
maxSI-Message
                                      INTEGER::= 32
                                                          -- Maximum number of SI messages
maxPO-perPF
                                      INTEGER ::= 4 -- Maximum number of paging occasion per paging frame
maxAccessCat-1
                                      INTEGER ::= 63 -- Maximum number of Access Categories minus 1
                                      INTEGER ::= 8 -- Maximum number of access control parameter sets
maxBarringInfoSet
maxCellEUTRA
                                      INTEGER ::= 8
                                                         -- Maximum number of E-UTRA cells in SIB list
maxEUTRA-Carrier
                                      INTEGER ::= 8 -- Maximum number of E-UTRA carriers in SIB list
maxPLMNTdentities
                                      INTEGER ::= 8
                                                          -- Maximum number of PLMN identities in RAN area configurations
                                      INTEGER ::= 1024 -- (for NR DL) Total number of FeatureSets (size of the pool)
maxDownlinkFeatureSets
                                                        -- (for NR UL) Total number of FeatureSets (size of the pool)
maxUplinkFeatureSets
                                      INTEGER ::= 1024
                                                          -- (for E-UTRA) Total number of FeatureSets (size of the pool)
maxEUTRA-DL-FeatureSets
                                      INTEGER ::= 256
                                                          -- (for E-UTRA) Total number of FeatureSets (size of the pool)
maxEUTRA-UL-FeatureSets
                                      INTEGER ::= 256
maxFeatureSetsPerBand
                                      INTEGER ::= 128
                                                          -- (for NR) The number of feature sets associated with one band.
                                      INTEGER ::= 1024
                                                         -- (for NR) Total number of CC-specific FeatureSets (size of the pool)
maxPerCC-FeatureSets
maxFeatureSetCombinations
                                      INTEGER ::= 1024
                                                          -- (for MR-DC/NR)Total number of Feature set combinations (size of the
                                      INTEGER ::= 3
maxInterRAT-RSTD-Freq
```

End of NR-RRC-Definitions

-- ASN1START

END

-- ASN1STOP

6.5 Short Message

Short Messages can be transmitted on PDCCH using P-RNTI with or without associated *Paging* message using Short Message field in DCI format 1_0 (see TS 38.212 [17], clause 7.3.1.2.1).

Table 6.5-1 defines Short Messages. Bit 1 is the most significant bit.

⁻⁻ TAG-MULTIPLICITY-AND-TYPE-CONSTRAINT-DEFINITIONS-STOP

⁻⁻ ASN1STOP

Table 6.5-1: Short Messages

Bit	Short Message
1	systemInfoModification
	If set to 1: indication of a BCCH modification other than SIB6, SIB7 and SIB8.
2	etwsAndCmasIndication
	If set to 1: indication of an ETWS primary notification and/or an ETWS secondary notification and/or a CMAS notification.
3 – 8	Not used in this release of the specification, and shall be ignored by UE if received.

- 7 Variables and constants
- 7.1 Timers
- 7.1.1 Timers (Informative)

Timer	Start	Stop	At expiry
T300	Upon transmission of RRCSetupRequest.	Upon reception of RRCSetup or RRCReject message, cell reselection and upon abortion of connection establishment by upper layers.	Perform the actions as specified in 5.3.3.7.
T301	Upon transmission of RRCReestabilshmentRe quest	Upon reception of RRCReestablishment or RRCSetup message as well as when the selected cell becomes unsuitable	Go to RRC_IDLE
T302	Upon reception of RRCReject while performing RRC connection establishment or resume, upon reception of RRCRelease with waitTime.	Upon entering RRC_CONNECTED or RRC_IDLE, upon cell re- selection and upon reception of RRCReject message.	Inform upper layers about barring alleviation as specified in 5.3.14.4
T304	Upon reception of RRCReconfiguration message including reconfigurationWithSync	Upon successful completion of random access on the corresponding SpCell For T304 of SCG, upon SCG release	For T304 of MCG, in case of the handover from NR or intra-NR handover, initiate the RRC reestablishment procedure; In case of handover to NR, perform the actions defined in the specifications applicable for the source RAT.
			For T304 of SCG, inform network about the reconfiguration with sync failure by initiating the SCG failure information procedure as specified in 5.7.3.
T310	Upon detecting physical layer problems for the SpCell i.e. upon receiving N310 consecutive out-of-sync indications from lower layers.	Upon receiving N311 consecutive in-sync indications from lower layers for the SpCell, upon receiving RRCReconfiguration with reconfigurationWithSync for that cell group, upon reception of MobilityFromNRCommand, and upon initiating the connection reestablishment procedure. Upon SCG release, if the T310 is kept in SCG.	If the T310 is kept in MCG: If AS security is not activated: go to RRC_IDLE else: initiate the connection re-establishment procedure. If the T310 is kept in SCG, Inform E-UTRAN/NR about the SCG radio link failure by initiating the SCG failure information procedure as specified in 5.7.3.

Timer	Start	Stop	At expiry
T311	Upon initiating the RRC connection re-establishment procedure	Upon selection of a suitable NR cell or a cell using another RAT.	Enter RRC_IDLE
T319	Upon transmission of RRCResumeRequest or RRCResumeRequest1.	Upon reception of RRCResume, RRCSetup, RRCRelease, RRCRelease with suspendConfig or RRCReject message and upon cell re- selection.	Perform the actions as specified in 5.3.13.5.
T320	Upon reception of <i>t320</i> or upon cell (re)selection to NR from another RAT with validity time configured for dedicated priorities (in which case the remaining validity time is applied).	Upon entering RRC_CONNECTED, upon reception of RRCRelease, when PLMN selection is performed on request by NAS, when the UE enters RRC_IDLE from RRC_INACTIVE, or upon cell (re)selection to another RAT (in which case the timer is carried on to the other RAT).	Discard the cell reselection priority information provided by dedicated signalling.
T321	Upon receiving measConfig including a reportConfig with the purpose set to reportCGI	Upon acquiring the information needed to set all fields of <i>cgi-info</i> , upon receiving <i>measConfig</i> that includes removal of the <i>reportConfig</i> with the <i>purpose</i> set to <i>reportCGI</i> and upon detecting that a cell is not broadcasting SIB1.	Initiate the measurement reporting procedure, stop performing the related measurements.
T322	Upon receving measConfig including reportConfigNR with the purpose set to reportSFTD and drx-SFTD-NeighMeas is set to true.	Upon acquiring the SFTD measurement results, upon receiving measConfig that includes removal of the reportConfig with the purpose set to reportSFTD.	Initiate the measurement reporting procedure, stop performing the related measurements.
T325	Upon reception of RRCRelease message with deprioritisationTimer.		Stop deprioritisation of all frequencies or NR signalled by RRCRelease.
T342	Upon transmitting UEAssistanceInformation message with DelayBudgetReport.	Upon initiating the connection re-establishment/resume procedures, and upon receiving delayBudgetReportingConfig set to release.	No action.

Timer	Start	Stop	At expiry
T345	Upon transmitting UEAssistanceInformation message with overheatingAssistance	Upon initiating the connection re-establishment procedure, upon initiating the connection resumption procedure, and upon receiving overheatingAssistanceConfig set to release.	No action.
T380	Upon reception of t380 in RRCRelease.	Upon reception of RRCResume, RRCSetup or RRCRelease.	Perform the actions as specified in 5.3.13.
T390	When access attempt is barred at access barring check for an Access Category. The UE maintains one instance of this timer per Access Category.	Upon cell (re)selection, upon entering RRC_CONNECTED, upon reception of RRCReconfiguration including reconfigurationWithSync, upon change of PCell while in RRC_CONNECTED, upon reception of MobilityFromNRCommand, or upon reception of RRCRelease.	Perform the actions as specified in 5.3.14.4.

7.1.2 Timer handling

When the UE applies zero value for a timer, the timer shall be started and immediately expire unless explicitly stated otherwise.

7.2 Counters

Counter	Reset	Incremented	When reaching max value
N310	Upon reception of "insync" indication from lower layers; upon receiving RRCReconfiguration with reconfigurationWithSync for that cell group; upon initiating the connection reestablishment procedure.	Upon reception of "out-of-sync" from lower layer while the timer T310 is stopped.	Start timer T310
N311	Upon reception of "out- of-sync" indication from lower layers; upon receiving RRCReconfiguration with reconfigurationWithSync for that cell group; upon initiating the connection re- establishment procedure.	Upon reception of the "in-sync" from lower layer while the timer T310 is running.	Stop the timer T310.

7.3 Constants

Constant	Usage
N310	Maximum number of consecutive "out-of-sync" indications for the SpCell received from lower layers
N311	Maximum number of consecutive "in-sync" indications for the SpCell received from lower layers

7.4 UE variables

NOTE: To facilitate the specification of the UE behavioural requirements, UE variables are represented using ASN.1. Unless explicitly specified otherwise, it is however up to UE implementation how to store the variables. The optionality of the IEs in ASN.1 is used only to indicate that the values may not always be available.

NR-UE-Variables

This ASN.1 segment is the start of the NR UE variable definitions.

```
-- ASN1START
-- NR-UE-VARIABLES-START
NR-UE-Variables DEFINITIONS AUTOMATIC TAGS ::=
BEGIN
IMPORTS
    CellIdentity,
    EUTRA-PhysCellId,
    MeasId,
    MeasIdToAddModList,
    MeasObjectToAddModList,
    PhysCellId,
    RNTI-Value,
    ReportConfigToAddModList,
    RSRP-Range,
    QuantityConfig,
    maxNrofCellMeas,
    maxNrofMeasId
FROM NR-RRC-Definitions;
-- NR-UE-VARIABLES-STOP
-- ASN1STOP
```

VarPendingRNA-Update

The UE variable *VarPendingRNA-Update* indicates whether there is a pending RNA update procedure or not. The setting of this BOOLEAN variable to *true* means that there is a pending RNA Update procedure.

VarPendingRNA-Update UE variable

```
-- ASN1START
-- TAG-VARPENDINGRNA-UPDATE-START

VarPendingRNA-Update ::= SEQUENCE {
    pendingRNA-Update BOOLEAN OPTIONAL
}

-- TAG-VARPENDINGRNA-UPDATE-STOP
-- ASN1STOP
```

VarMeasConfig

The UE variable *VarMeasConfig* includes the accumulated configuration of the measurements to be performed by the UE, covering intra-frequency, inter-frequency and inter-RAT mobility related measurements.

VarMeasConfig UE variable

```
-- ASN1START
-- TAG-VARMEASCONFIG-START
                                    SEQUENCE {
VarMeasConfig ::=
    -- Measurement identities
   measIdList
                                        MeasIdToAddModList
                                                                             OPTIONAL,
    -- Measurement objects
   measObjectList
                                        MeasObjectToAddModList
                                                                             OPTIONAL,
    -- Reporting configurations
    reportConfigList
                                        ReportConfigToAddModList
                                                                             OPTIONAL,
    -- Other parameters
    quantityConfig
                                        QuantityConfig
                                                                             OPTIONAL,
    s-MeasureConfig
                                            CHOICE {
       ssb-RSRP
                                                RSRP-Range,
       csi-RSRP
                                                RSRP-Range
                                                                             OPTIONAL
-- TAG-VARMEASCONFIG-STOP
-- ASN1STOP
```

VarMeasReportList

The UE variable VarMeasReportList includes information about the measurements for which the triggering conditions have been met.

VarMeasReportList UE variable

```
-- ASN1START
-- TAG-VARMEASREPORTLIST-START
VarMeasReportList ::=
                                    SEQUENCE (SIZE (1..maxNrofMeasId)) OF VarMeasReport
VarMeasReport ::=
                                    SEQUENCE {
    -- List of measurement that have been triggered
    cellsTriggeredList
                                        CellsTriggeredList
                                                                        OPTIONAL,
    numberOfReportsSent
                                        INTEGER
CellsTriggeredList ::=
                                    SEQUENCE (SIZE (1..maxNrofCellMeas)) OF CHOICE {
    physCellId
                                        PhysCellId,
    physCellIdEUTRA
                                        EUTRA-PhysCellId
-- TAG-VARMEASREPORTLIST-STOP
-- ASN1STOP
```

VarResumeMAC-Input

The UE variable *VarResumeMAC-Input* specifies the input used to generate the *resumeMAC-I* during RRC Connection Resume procedure.

VarResumeMAC-Input variable

VarResumeMAC-Input field descriptions

targetCellIdentity

An input variable used to calculate the *resumeMAC-I*. Set to the *cellIdentity* of the first *PLMN-Identity* included in the *PLMN-IdentityInfoList* broadcasted in *SIB1* of the target cell i.e. the cell the UE is trying to resume.

source-c-RNTI

Set to C-RNTI that the UE had in the PCell it was connected to prior to suspension of the RRC connection.

sourcePhysCellId

Set to the physical cell identity of the PCell the UE was connected to prior to suspension of the RRC connection.

VarShortMAC-Input

The UE variable VarShortMAC-Input specifies the input used to generate the shortMAC-I during RRC Connection Reestablishment procedure.

VarShortMAC-Input variable

```
-- ASN1START
-- TAG-VARSHORTMAC-INPUT-START

VarShortMAC-Input ::= SEQUENCE {
    sourcePhysCellId PhysCellId,
    targetCellIdentity CellIdentity,
    source-c-RNTI RNTI-Value
}

-- TAG-VARSHORTMAC-INPUT-STOP
```

-- ASN1STOP

VarShortMAC-Input field descriptions

targetCellIdentity

An input variable used to calculate the *shortMAC-I*. Set to the *cellIdentity* of the first *PLMN-Identity* in the *PLMN-IdentityInfoList* broadcasted in *SIB1* of the target cell i.e. the cell the UE is trying to reestablish the connection.

source-c-RNTI

Set to C-RNTI that the UE had in the PCell it was connected to prior to the reestablishment.

sourcePhysCellId

Set to the physical cell identity of the PCell the UE was connected to prior to the reestablishment.

- End of NR-UE-Variables

-- ASN1START

END

-- ASN1STOP

8 Protocol data unit abstract syntax

8.1 General

The RRC PDU contents in clause 6 and clause 10 are described using abstract syntax notation one (ASN.1) as specified in ITU-T Rec. X.680 [6] and X.681 [7]. Transfer syntax for RRC PDUs is derived from their ASN.1 definitions by use of Packed Encoding Rules, unaligned as specified in ITU-T Rec. X.691 [8].

The following encoding rules apply in addition to what has been specified in X.691:

- When a bit string value is placed in a bit-field as specified in 15.6 to 15.11 in X.691, the leading bit of the bit string value shall be placed in the leading bit of the bit-field, and the trailing bit of the bit string value shall be placed in the trailing bit of the bit-field;

NOTE: The terms 'leading bit' and 'trailing bit' are defined in ITU-T Rec. X.680. When using the 'bstring' notation, the leading bit of the bit string value is on the left, and the trailing bit of the bit string value is on the right.

- When decoding types constrained with the ASN.1 Contents Constraint ("CONTAINING"), automatic decoding of the contained type should not be performed because errors in the decoding of the contained type should not cause the decoding of the entire RRC message PDU to fail. It is recommended that the decoder first decodes the outer PDU type that contains the OCTET STRING or BIT STRING with the Contents Constraint, and then decodes the contained type that is nested within the OCTET STRING or BIT STRING as a separate step;
- When decoding a) RRC message PDUs, b) BIT STRING constrained with a Contents Constraint, or c) OCTET STRING constrained with a Contents Constraint, PER decoders are required to never report an error if there are extraneous zero or non-zero bits at the end of the encoded RRC message PDU, BIT STRING or OCTET STRING.

8.2 Structure of encoded RRC messages

An RRC PDU, which is the bit string that is exchanged between peer entities/across the radio interface contains the basic production as defined in X.691.

RRC PDUs shall be mapped to and from PDCP SDUs (in case of DCCH) or RLC SDUs (in case of PCCH, BCCH or CCCH) upon transmission and reception as follows:

- when delivering an RRC PDU as an PDCP SDU to the PDCP layer for transmission, the first bit of the RRC PDU shall be represented as the first bit in the PDCP SDU and onwards; and
- when delivering an RRC PDU as an RLC SDU to the RLC layer for transmission, the first bit of the RRC PDU shall be represented as the first bit in the RLC SDU and onwards; and
- upon reception of an PDCP SDU from the PDCP layer, the first bit of the PDCP SDU shall represent the first bit of the RRC PDU and onwards; and
- upon reception of an RLC SDU from the RLC layer, the first bit of the RLC SDU shall represent the first bit of the RRC PDU and onwards.

8.3 Basic production

The 'basic production' is obtained by applying UNALIGNED PER to the abstract syntax value (the ASN.1 description) as specified in X.691. It always contains a multiple of 8 bits.

8.4 Extension

The following rules apply with respect to the use of protocol extensions:

- A transmitter compliant with this version of the specification shall, unless explicitly indicated otherwise on a PDU type basis, set the extension part empty. Transmitters compliant with a later version may send non-empty extensions;

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- A transmitter compliant with this version of the specification shall set spare bits to zero.

8.5 Padding

If the encoded RRC message does not fill a transport block, the RRC layer shall add padding bits. This applies to PCCH and BCCH.

Padding bits shall be set to 0 and the number of padding bits is a multiple of 8.

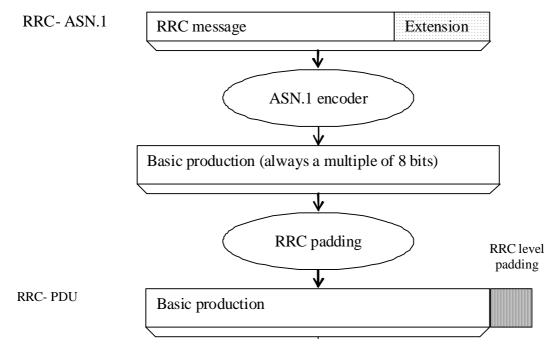


Figure 8.5-1: RRC level padding

9 Specified and default radio configurations

Specified and default configurations are configurations of which the details are specified in the standard. Specified configurations are fixed while default configurations can be modified using dedicated signalling. The default value for the parameters not listed in following clauses shall be set such as the corresponding features are not configured, i.e. *release* or *false* unless explicitly stated otherwise.

NOTE: The UE applies the default values specified in the field description of ASN.1 parameters only when the parent IE is present. Hence, the UE does not apply all default values in field descriptions when it applies the "default radio configuration" in accordance with this clause.

9.1 Specified configurations

9.1.1 Logical channel configurations

9.1.1.1 BCCH configuration

Parameters

Name	Value	Semantics description	Ver
SDAP configuration	Not used		
PDCP configuration	Not used		
RLC configuration	TM		
Logical channel configuration	Not used		

NOTE: RRC will perform padding, if required due to the granularity of the TF signalling, as defined in 8.5.

9.1.1.2 CCCH configuration

Parameters

Name	Value	Semantics description	Ver
SDAP configuration	Not used		
PDCP configuration	Not used		
RLC configuration	TM		
Logical channel configuration			
>priority	1	Highest priority	
>prioritisedBitRate	infinity		
>bucketSizeDuration	ms1000		
>logicalChannelGroup	0		

9.1.1.3 PCCH configuration

Parameters

Name	Value	Semantics description	Ver
SDAP configuration	Not used		
PDCP configuration	Not used		
RLC configuration	TM		
Logical channel configuration	Not used		

NOTE: RRC will perform padding, if required due to the granularity of the TF signalling, as defined in 8.5.

9.1.2 Void

9.2 Default radio configurations

The following clauses only list default values for REL-15 parameters included in protocol version v15.3.0. For all fields introduced in a later protocol version, the default value is "released" or "false" unless explicitly specified otherwise. If the UE is to apply default configuration while it is configured with some critically extended fields, the UE shall apply the original version of those fields with only default values.

NOTE 1: In general, the signalling should preferably support a "release" option for fields introduced after v15.3.0. The "value not applicable" should be used restrictively, mainly limited to for fields which value is relevant only if another field is set to a value other than its default.

NOTE 2: For parameters in ServingCellConfig, the default values are specified in the corresponding specification.

9.2.1 Default SRB configurations

Parameters

Name	Value		Semantics description	Ver	
	SRB1	SRB2	SRB3		
PDCP-Config					
>t-Reordering	infinity				
RLC-Config CHOICE	Am				
ul-AM-RLC >sn-FieldLength >t-PollRetransmit >pollPDU >pollByte >maxRetxThreshold dl-AM-RLC >sn-FieldLength >t-Reassembly	size12 ms45 infinity infinity t8 size12 ms35				
>t-StatusProhibit logicalChannelIdentity	ms0	2	3		
LogicalChannelConfig	I	4	J		
>priority	1	3	1		
>prioritisedBitRate	infinity			·	
>logicalChannelGroup	0				

9.2.2 Default MAC Cell Group configuration

Parameters

Name	Value	Semantics description	Ver
MAC Cell Group configuration			
bsr-Config			
>periodicBSR-Timer	sf10		
>retxBSR-Timer	sf80		
phr-Config			
>phr-PeriodicTimer	sf10		
>phr-ProhibitTimer	sf10		
>phr-Tx-PowerFactorChange	dB1		

9.2.3 Default values timers and constants

Parameters

Name	Value	Semantics description	Ver
t310	ms1000		
n310	n1		
t311	ms30000		
n311	n1		

10 Generic error handling

10.1 General

The generic error handling defined in the subsequent clauses applies unless explicitly specified otherwise e.g. within the procedure specific error handling.

The UE shall consider a value as not comprehended when it is set:

- to an extended value that is not defined in the version of the transfer syntax supported by the UE;

- to a spare or reserved value unless the specification defines specific behaviour that the UE shall apply upon receiving the concerned spare/reserved value.

The UE shall consider a field as not comprehended when it is defined:

- as spare or reserved unless the specification defines specific behaviour that the UE shall apply upon receiving the concerned spare/reserved field.

10.2 ASN.1 violation or encoding error

The UE shall:

- 1> when receiving an RRC message on the BCCH, CCCH or PCCH for which the abstract syntax is invalid [6]:
 - 2> ignore the message.

NOTE: This clause applies in case one or more fields is set to a value, other than a spare, reserved or extended value, not defined in this version of the transfer syntax. E.g. in the case the UE receives value 12 for a field defined as INTEGER (1..11). In cases like this, it may not be possible to reliably detect which field is in the error hence the error handling is at the message level.

10.3 Field set to a not comprehended value

The UE shall, when receiving an RRC message on any logical channel:

- 1> if the message includes a field that has a value that the UE does not comprehend:
 - 2> if a default value is defined for this field:
 - 3> treat the message while using the default value defined for this field;
 - 2> else if the concerned field is optional:
 - 3> treat the message as if the field were absent and in accordance with the need code for absence of the concerned field;
 - 2> else:
 - 3> treat the message as if the field were absent and in accordance with clause 10.4.

10.4 Mandatory field missing

The UE shall:

- 1> if the message includes a field that is mandatory to include in the message (e.g. because conditions for mandatory presence are fulfilled) and that field is absent or treated as absent:
 - 2> if the RRC message was not received on DCCH or CCCH:
 - 3> if the field concerns a (sub-field of) an entry of a list (i.e. a SEQUENCE OF):
 - 4> treat the list as if the entry including the missing or not comprehended field was absent;
 - 3> else if the field concerns a sub-field of another field, referred to as the 'parent' field i.e. the field that is one nesting level up compared to the erroneous field:
 - 4> consider the 'parent' field to be set to a not comprehended value;
 - 4> apply the generic error handling to the subsequent 'parent' field(s), until reaching the top nesting level i.e. the message level;
 - 3> else (field at message level):

- 4> ignore the message.
- NOTE 1: The error handling defined in these clauses implies that the UE ignores a message with the message type or version set to a not comprehended value.
- NOTE 2: The nested error handling for messages received on logical channels other than DCCH and CCCH applies for errors in extensions also, even for errors that can be regarded as invalid network operation e.g. the network not observing conditional presence.
- NOTE 3: UE behaviour on receipt of an RRC message on DCCH or CCCH that does not include a field that is mandatory (e.g. because conditions for mandatory presence are fulfilled) is unspecified.

The following ASN.1 further clarifies the levels applicable in case of nested error handling for errors in extension fields.

```
-- /example/ ASN1START
-- Example with extension addition group
ItemInfoList ::=
                              SEQUENCE (SIZE (1..max)) OFItemInfo
ItemInfo ::=
                              SEQUENCE {
                              INTEGER (1..max),
   itemIdentity
                                  Field1,
Field2
   field1
   field2
                                                      OPTIONAL, -- Need N
   [ [
                          Field3-r9 OPTIONAL,
Field4-r9 OPTIONAL
   field3-r9
                                                                        -- Cond Cond1
   field4-r9
                                                                         -- Need N
   ]]
-- Example with traditional non-critical extension (empty sequence)
BroadcastInfoBlock1 ::= SEQUENCE {
                              INTEGER (1..max),
   itemIdentity
                                  Field1,
   field1
                                                       OPTIONAL,
   field2
                                  Field2
                                                                           - Need N
   nonCriticalExtension
                                  BroadcastInfoBlock1-v940-IES OPTIONAL
BroadcastInfoBlock1-v940-IEs::= SEQUENCE {
             Field3-r9
Field4-r9
                                                    OPTIONAL,
OPTIONAL,
OPTIONAL
                                                                        -- Cond Condl
-- Need N
  field3-r9
   field4-r9
                                  Field4-r9
SEQUENCE {}
                                                                        -- Need S
   nonCriticalExtension
-- ASN1STOP
```

The UE shall, apply the following principles regarding the levels applicable in case of nested error handling:

- an extension addition group is not regarded as a level on its own. E.g. in the ASN.1 extract in the previous, a error regarding the conditionality of *field3* would result in the entire itemInfo entry to be ignored (rather than just the extension addition group containing *field3* and *field4*);
- a traditional *nonCriticalExtension* is not regarded as a level on its own. E.g. in the ASN.1 extract in the previous, an error regarding the conditionality of *field3* would result in the entire *BroadcastInfoBlock1* to be ignored (rather than just the non-critical extension containing *field3* and *field4*).

10.5 Not comprehended field

The UE shall, when receiving an RRC message on any logical channel:

- 1> if the message includes a field that the UE does not comprehend:
 - 2> treat the rest of the message as if the field was absent.

NOTE: This clause does not apply to the case of an extension to the value range of a field. Such cases are addressed instead by the requirements in clause 10.3.

11 Radio information related interactions between network nodes

11.1 General

This clause specifies RRC messages that are transferred between network nodes. These RRC messages may be transferred to or from the UE via another Radio Access Technology. Consequently, these messages have similar characteristics as the RRC messages that are transferred across the NR radio interface, i.e. the same transfer syntax and protocol extension mechanisms apply.

11.2 Inter-node RRC messages

11.2.1 General

This clause specifies RRC messages that are sent either across the X2-, Xn- or the NG-interface, either to or from the gNB, i.e. a single 'logical channel' is used for all RRC messages transferred across network nodes. The information could originate from or be destined for another RAT.

```
-- ASN1START
-- TAG-NR-INTER-NODE-DEFINITIONS-START
NR-InterNodeDefinitions DEFINITIONS AUTOMATIC TAGS ::=
BEGIN
IMPORTS
    ARFCN-ValueNR,
   ARFCN-ValueEUTRA,
   CellIdentity,
    CGI-InfoEUTRA,
    CGI-InfoNR,
    CSI-RS-Index,
    DRX-Config,
    EUTRA-PhysCellId,
    FregBandIndicatorNR,
    GapConfig,
    maxBandComb,
    maxBands,
    maxCellSFTD,
    maxFeatureSetsPerBand,
    maxFreqIDC-MRDC,
    maxNrofCombIDC,
    maxNrofSCells,
    maxNrofServingCells,
    maxNrofServingCells-1,
    maxNrofServingCellsEUTRA,
    maxNrofIndexesToReport,
```

```
maxSimultaneousBands,
    MeasQuantityResults,
    MeasResultCellListSFTD-EUTRA,
    MeasResultCellListSFTD-NR,
    MeasResultList2NR,
    MeasResultSCG-Failure,
    MeasResultServFreqListEUTRA-SCG,
    P-Max,
    PhysCellId,
    RadioBearerConfig,
    RAN-NotificationAreaInfo,
    RRCReconfiguration,
    ServCellIndex,
    SetupRelease,
    SSB-Index,
    SSB-MTC,
    SSB-ToMeasure,
    SS-RSSI-Measurement,
    ShortMAC-I,
    SubcarrierSpacing,
    UEAssistanceInformation,
    UE-CapabilityRAT-ContainerList
FROM NR-RRC-Definitions;
-- TAG-NR-INTER-NODE-DEFINITIONS-STOP
-- ASN1STOP
```

11.2.2 Message definitions

HandoverCommand

This message is used to transfer the handover command as generated by the target gNB.

Direction: target gNB to source gNB/source RAN.

HandoverCommand message

```
HandoverCommand-IEs ::= SEQUENCE {
    handoverCommandMessage nonCriticalExtension SEQUENCE {}

- TAG-HANDOVER-COMMAND-STOP
- ASN1STOP
```

HandoverCommand field descriptions

handoverCommandMessage

Contains the RRCReconfiguration message used to perform handover within NR or handover to NR, as generated (entirely) by the target gNB.

HandoverPreparationInformation

This message is used to transfer the NR RRC information used by the target gNB during handover preparation or UE context retrieval, e.g. in case of resume or reestablishment, including UE capability information. This message is also used for transferring the information between the CU and DU.

Direction: source gNB/source RAN to target gNB or CU to DU.

HandoverPreparationInformation message

```
-- ASN1START
-- TAG-HANDOVER-PREPARATION-INFORMATION-START
                                        SEOUENCE {
HandoverPreparationInformation ::=
    criticalExtensions
                                            CHOICE {
                                                CHOICE {
           handoverPreparationInformation
                                                    HandoverPreparationInformation-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        criticalExtensionsFuture
                                            SEOUENCE {}
HandoverPreparationInformation-IEs ::= SEQUENCE {
    ue-CapabilityRAT-List
                                            UE-CapabilityRAT-ContainerList,
    sourceConfig
                                            AS-Config
                                                                                             OPTIONAL, -- Cond HO
   rrm-Config
                                            RRM-Config
                                                                                             OPTIONAL,
    as-Context
                                            AS-Context
                                                                                             OPTIONAL,
    nonCriticalExtension
                                            SEQUENCE {}
                                                                                             OPTIONAL
AS-Config ::=
                                        SEQUENCE {
    rrcReconfiguration
                                            OCTET STRING (CONTAINING RRCReconfiguration),
    11
    sourceRB-SN-Config
                                            OCTET STRING (CONTAINING RadioBearerConfig)
                                                                                             OPTIONAL
    sourceSCG-NR-Config
                                            OCTET STRING (CONTAINING RRCReconfiguration)
                                                                                             OPTIONAL,
```

-- TAG-HANDOVER-PREPARATION-INFORMATION-STOP

```
sourceSCG-EUTRA-Config
                                            OCTET STRING
                                                                                             OPTIONAL
    ]],
    ГΓ
    sourceSCG-Configured
                                            ENUMERATED {true}
                                                                                             OPTIONAL
AS-Context ::=
                                        SEQUENCE {
    reestablishmentInfo
                                            ReestablishmentInfo
                                                                                             OPTIONAL,
    configRestrictInfo
                                            ConfigRestrictInfoSCG
                                                                                             OPTIONAL,
    [ ran-NotificationAreaInfo
                                            RAN-NotificationAreaInfo
                                                                                             OPTIONAL
    11.
    [[ ueAssistanceInformation
                                            OCTET STRING (CONTAINING UEAssistanceInformation) OPTIONAL -- Cond HO2
    11.
    ] ]
    selectedBandCombinationSN
                                            BandCombinationInfoSN
                                                                                             OPTIONAL
    ]]
                                    SEQUENCE {
ReestablishmentInfo ::=
    sourcePhysCellId
                                            PhysCellId,
    targetCellShortMAC-I
                                            ShortMAC-I,
    additionalReestabInfoList
                                            ReestabNCellInfoList
                                                                                             OPTIONAL
ReestabNCellInfoList ::=
                                SEQUENCE ( SIZE (1..maxCellPrep) ) OF ReestabNCellInfo
ReestabNCellInfo::= SEQUENCE{
    cellIdentity
                                            CellIdentity,
    key-gNodeB-Star
                                            BIT STRING (SIZE (256)),
    shortMAC-I
                                            ShortMAC-I
RRM-Config ::=
                            SEQUENCE {
    ue-InactiveTime
                                ENUMERATED {
                                    s1, s2, s3, s5, s7, s10, s15, s20,
                                    s25, s30, s40, s50, min1, min1s20, min1s40,
                                    min2, min2s30, min3, min3s30, min4, min5, min6,
                                    min7, min8, min9, min10, min12, min14, min17, min20,
                                    min24, min28, min33, min38, min44, min50, hr1,
                                    hrlmin30, hr2, hr2min30, hr3, hr3min30, hr4, hr5, hr6,
                                    hr8, hr10, hr13, hr16, hr20, day1, day1hr12, day2,
                                    day2hr12, day3, day4, day5, day7, day10, day14, day19,
                                    day24, day30, dayMoreThan30}
                                                                                             OPTIONAL,
    candidateCellInfoList
                                MeasResultList2NR
                                                                                             OPTIONAL,
    . . . ,
    11
    candidateCellInfoListSN-EUTRA
                                       MeasResultServFreqListEUTRA-SCG
                                                                                             OPTIONAL
```

-- ASN1STOP

HandoverPreparationInformation field descriptions

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as-Context

Local RAN context required by the target gNB or DU.

rrm-Config

Local RAN context used mainly for RRM purposes.

sourceConfig

The radio resource configuration as used in the source cell.

ue-CapabilityRAT-List

The UE radio access related capabilities concerning RATs supported by the UE. A gNB that retrieves MRDC related capability containers ensures that the set of included MRDC containers is consistent w.r.t. the feature set related information.

ue-InactiveTime

Duration while UE has not received or transmitted any user data. Thus the timer is still running in case e.g., UE measures the neighbour cells for the HO purpose. Value s1 corresponds to 1 second, s2 corresponds to 2 seconds and so on. Value min1 corresponds to 1 minute, value min1s20 corresponds to 1 minute and 20 seconds, value min1s40 corresponds to 1 minute and 40 seconds and so on. Value hr1 corresponds to 1 hour, hr1min30 corresponds to 1 hour and 30 minutes and so on.

AS-Config field descriptions

rrcReconfiguration

Contains the RRCReconfiguration configuration as generated entirely by the MN.

sourceRB-SN-Config

Contains the IE RadioBearerConfig as generated entirely by the SN. This field is only used when the UE is configured with SN terminated RB(s).

sourceSCG-Configured

Value *true* indicates that the UE is configured with NR or EUTRA SCG in source configuration. The field is only used in NR-DC and NE-DC and is included only if the fields *sourceSCG-NR-Config* and *sourceSCG-EUTRA-Config* are absent.

sourceSCG-EUTRA-Config

Contains the current dedicated SCG configuration in *RRCConnectionReconfiguration* message as specified in TS 36.331 [10] and generated entirely by the SN. In this version of the specification, the E-UTRA *RRCConnectionReconfiguration* message can only include the field *scg-Configuration*. This field is only used in NE-DC.

sourceSCG-NR-Config

Contains the current dedicated SCG configuration in *RRCReconfiguration* message as generated entirely by the SN. In this version of the specification, the *RRCReconfiguration* message can only include fields *secondaryCellGroup* and *measConfig.* This field is only used in NR-DC.

AS-Context field descriptions

selectedBandCombinationSN

Indicates the band combination selected by SN in (NG)EN-DC, NE-DC, and NR-DC.

ueAssistanceInformation

Includes for each UE assistance feature the information last reported by the UE, if any.

RRM-Config field descriptions

candidateCellInfoList

A list of the best cells on each frequency for which measurement information was available

candidateCellInfoListSN-EUTRA

A list of EUTRA cells including serving cells and best neighbour cells on each serving frequency, for which measurement results were available. This field is only used in NEDC.

Conditional Presence	Explanation	
НО	The field is mandatory present in case of handover within NR or UE context retrieval, e.g. in case of resume or re-	
	establishment. The field is optionally present in case of handover from E-UTRA/5GC. Otherwise the field is absent.	
HO2	The field is optionally present in case of handover within NR; otherwise the field is absent.	

NOTE 1: The following table indicates per source RAT whether RAT capabilities are included or not.

Source RAT	NR capabilites	E-UTRA capabilities	MR-DC capabilities
NR	Included	May be included	May be included
E-UTRAN	Included	May be included	May be included

NOTE 2: The following table indicates, in case of inter-RAT handover from E-UTRA, which additional IEs are included or not:

Source system	sourceConfig	rrm-Config	as-Context
E-UTRA/EPC	Not included	May be included	Not included
E-UTRA/5GC	May be included, but only radioBearerConfig is included in the RRCReconfiguration.	May be included	Not included

CG-Config

This message is used to transfer the SCG radio configuration as generated by the SgNB or SeNB. It can also be used by a CU to request a DU to perform certain actions, e.g. to request the DU to perform a new lower layer configuration.

Direction: Secondary gNB or eNB to master gNB or eNB, alternatively CU to DU.

CG-Config message

```
criticalExtensionsFuture
                                            SEOUENCE {}
CG-Config-IEs ::=
                                     SEOUENCE {
    scq-CellGroupConfiq
                                        OCTET STRING (CONTAINING RRCReconfiguration)
                                                                                          OPTIONAL,
    scq-RB-Confiq
                                        OCTET STRING (CONTAINING RadioBearerConfig)
                                                                                          OPTIONAL,
    configRestrictModReg
                                        ConfigRestrictModRegSCG
                                                                                          OPTIONAL,
    drx-InfoSCG
                                                                                          OPTIONAL,
                                        DRX-Info
    candidateCellInfoListSN
                                        OCTET STRING (CONTAINING MeasResultList2NR)
                                                                                          OPTIONAL,
    measConfigSN
                                        MeasConfigSN
                                                                                          OPTIONAL,
    selectedBandCombination
                                        BandCombinationInfoSN
                                                                                          OPTIONAL,
    fr-InfoListSCG
                                        FR-InfoList
                                                                                          OPTIONAL,
    candidateServingFregListNR
                                        CandidateServingFregListNR
                                                                                          OPTIONAL,
    nonCriticalExtension
                                        CG-Config-v1540-IEs
                                                                                          OPTIONAL
CG-Config-v1540-IEs ::=
                                     SEOUENCE {
    pSCellFrequency
                                        ARFCN-ValueNR
                                                                                          OPTIONAL,
    reportCGI-RequestNR
                                        SEQUENCE {
        requestedCellInfo
                                            SEQUENCE {
                                                 ARFCN-ValueNR,
            ssbFrequency
            cellForWhichToReportCGI
                                                 PhysCellId
                                                                                          OPTIONAL
                                                                                          OPTIONAL,
    ph-InfoSCG
                                                                                          OPTIONAL,
                                        PH-TypeListSCG
    nonCriticalExtension
                                        CG-Config-v1560-IEs
                                                                                          OPTIONAL
CG-Config-v1560-IEs ::=
                                     SEOUENCE {
    pSCellFrequencyEUTRA
                                        ARFCN-ValueEUTRA
                                                                                          OPTIONAL,
    scg-CellGroupConfigEUTRA
                                        OCTET STRING
                                                                                          OPTIONAL,
    candidateCellInfoListSN-EUTRA
                                        OCTET STRING
                                                                                          OPTIONAL,
    candidateServingFregListEUTRA
                                        CandidateServingFreqListEUTRA
                                                                                          OPTIONAL,
                                        ENUMERATED {true}
    needForGaps
                                                                                          OPTIONAL,
    drx-ConfigSCG
                                        DRX-Config
                                                                                          OPTIONAL,
    reportCGI-RequestEUTRA
                                        SEOUENCE
        requestedCellInfoEUTRA
                                        SEOUENCE
            eutraFrequency
                                                        ARFCN-ValueEUTRA,
            cellForWhichToReportCGI-EUTRA
                                                        EUTRA-PhysCellId
                                                                                          OPTIONAL
                                                                                          OPTIONAL,
    nonCriticalExtension
                                        CG-Config-v1590-IEs
                                                                                          OPTIONAL
CG-Config-v1590-IEs ::=
                                     SEOUENCE {
    scellFrequenciesSN-NR
                                        SEQUENCE (SIZE (1.. maxNrofServingCells-1)) OF ARFCN-ValueNR
                                                                                                             OPTIONAL,
    scellFrequenciesSN-EUTRA
                                        SEQUENCE (SIZE (1.. maxNrofServingCells-1)) OF ARFCN-ValueEUTRA
                                                                                                             OPTIONAL,
    nonCriticalExtension
                                        SEOUENCE {}
                                                                                                             OPTIONAL
PH-TypeListSCG ::=
                                    SEQUENCE (SIZE (1..maxNrofServingCells)) OF PH-InfoSCG
```

```
PH-InfoSCG ::=
                                     SEOUENCE {
    servCellIndex
                                        ServCellIndex,
                                        PH-UplinkCarrierSCG,
    ph-Uplink
    ph-SupplementaryUplink
                                        PH-UplinkCarrierSCG
                                                                                          OPTIONAL,
PH-UplinkCarrierSCG ::=
                                     SEOUENCE {
    ph-Typelor3
                                         ENUMERATED {type1, type3},
    . . .
MeasConfigSN ::=
                                     SEQUENCE {
    measuredFrequenciesSN
                                        SEQUENCE (SIZE (1..maxMeasFreqsSN)) OF NR-FreqInfo OPTIONAL,
NR-FregInfo ::=
                                     SEOUENCE {
    measuredFrequency
                                        ARFCN-ValueNR
                                                                                              OPTIONAL,
    . . .
ConfigRestrictModRegSCG ::=
                                    SEQUENCE {
    requestedBC-MRDC
                                         BandCombinationInfoSN
                                                                                              OPTIONAL,
    requestedP-MaxFR1
                                        P-Max
                                                                                              OPTIONAL,
    . . . ,
    ] ]
    requestedPDCCH-BlindDetectionSCG
                                        INTEGER (1..15)
                                                                                              OPTIONAL,
    requestedP-MaxEUTRA
                                        P-Max
                                                                                              OPTIONAL
    ]]
BandCombinationIndex ::= INTEGER (1..maxBandComb)
BandCombinationInfoSN ::=
                                     SEOUENCE {
    bandCombinationIndex
                                        BandCombinationIndex,
    requestedFeatureSets
                                        FeatureSetEntryIndex
FR-InfoList ::= SEQUENCE (SIZE (1..maxNrofServingCells-1)) OF FR-Info
FR-Info ::= SEQUENCE {
    servCellIndex
                        ServCellIndex,
    fr-Type
                        ENUMERATED {fr1, fr2}
CandidateServingFreqListNR ::= SEQUENCE (SIZE (1.. maxFreqIDC-MRDC)) OF ARFCN-ValueNR
CandidateServingFreqListEUTRA ::= SEQUENCE (SIZE (1.. maxFreqIDC-MRDC)) OF ARFCN-ValueEUTRA
-- TAG-CG-CONFIG-STOP
-- ASN1STOP
```

CG-Config field descriptions

candidateCellInfoListSN

Contains information regarding cells that the source secondary node suggests the target secondary gNB to consider configuring.

candidateCellInfoListSN-EUTRA

Includes the MeasResultList3EUTRA as specified in TS 36.331 [10]. Contains information regarding cells that the source secondary node suggests the target secondary eNB to consider configuring. This field is only used in NE-DC.

candidateServingFreqListNR, candidateServingFreqListEUTRA

Indicates frequencies of candidate serving cells for In-Device Co-existence Indication (see TS 36.331 [10]).

configRestrictModReg

Used by SN to request changes to SCG configuration restrictions previously set by MN to ensure UE capabilities are respected. E.g. can be used to request configuring an NR band combination whose use MN has previously forbidden. SN only includes this field in SN-initiated procedures.

drx-ConfigSCG

This field contains the complete DRX configuration of the SCG. This field is only used in NR-DC.

drx-InfoSCG

This field contains the DRX long and short cycle configuration of the SCG. This field is used in (NG)EN-DC and NE-DC.

fr-InfoListSCG

Contains information of FR information of serving cells that include PScell and SCells configured in SCG.

measuredFrequenciesSN

Used by SN to indicate a list of frequencies measured by the UE.

needForGaps

In NE-DC, indicates wheter the SN requests gNB to configure measurements gaps.

ph-InfoSCG

Power headroom information in SCG that is needed in the reception of PHR MAC CE of MCG

ph-SupplementaryUplink

Power headroom information for supplementary uplink. In the case of (NG)EN-DC and NR-DC, this field is only present when two UL carriers are configued for a serving cell and one UL carrier reports type 1 PH while the other reports type 3 PH.

ph-Type1or3

Type of power headroom for a certain serving cell in SCG (PSCell and activated SCells). Value *type1* refers to type 1 power headroom, value *type3* refers to type 3 power headroom. (See TS 38.321 [3]).

ph-Uplink

Power headroom information for uplink.

pSCellFrequency, pSCellFrequencyEUTRA

Indicates the frequency of PSCell in NR (i.e., pSCellFrequency) or E-UTRA (i.e., pSCellFrequencyEUTRA). In this version of the specification, pSCellFrequency is not used in NE-DC whereas pSCellFrequencyEUTRA is only used in NE-DC.

$report CGI-Request NR, \ report CGI-Request EUTRA$

Used by SN to indicate to MN about configuring reportCGI procedure. The request may optionally contain information about the cell for which SN intends to configure reportCGI procedure. In this version of the specification, the reportCGI-RequestNR is used in (NG)EN-DC and NR-DC whereas reportCGI-RequestEUTRA is used only for NE-DC.

requestedBC-MRDC

Used to request configuring a band combination and corresponding feature sets which are forbidden to use by MN (i.e. outside of the *allowedBC-ListMRDC*) to allow renegotiation of the UE capabilities for SCG configuration.

requestedPDCCH-BlindDetectionSCG

Requested value of the reference number of cells for PDCCH blind detection allowed to be configured for the SCG.

requestedP-MaxEUTRA

Requested value for the maximum power for the serving cells the UE can use in E-UTRA SCG. This field is only used in NE-DC.

requestedP-MaxFR1

Requested value for the maximum power for the serving cells on frequency range 1 (FR1) in this secondary cell group (see TS 38.104 [12]) the UE can use in NR SCG.

scellFrequenciesSN-EUTRA, scellFrequenciesSN-NR

Indicates the frequency of all SCells configured in SCG. The field scellFrequenciesSN-EUTRA is used in NE-DC; the field scellFrequenciesSN-NR is used in (NG)EN-DC and NR-DC. In (NG)EN-DC, the field is optionally provided to the MN.

scg-CellGroupConfig

Contains the RRCReconfiguration message (containing only secondaryCellGroup and/or measConfig):

- to be sent to the UE, used upon SCG establishment or modification (only when the SCG is not released by the SN), as generated (entirely) by the (target) SgNB. In this case, the SN sets the *RRCReconfiguration* message in accordance with clause 6 e.g. regarding the "Need" or "Cond" statements.

or

- including the current SCG configuration of the UE, when provided in response to a query from MN, or in SN triggered SN change in order to enable delta signaling by the target SN. In this case, the SN sets the RRCReconfiguration message in accordance with clause 11.2.3.

The field is absent if neither SCG (re)configuration nor SCG configuration query nor SN triggered SN change is performed, e.g. at inter-node capability/configuration coordination which does not result in SCG (re)configuration towards the UE. The field is also absent upon an SCG release triggered by the SN. This field is not applicable in NE-DC.

scg-CellGroupConfigEUTRA

Includes the E-UTRA RRCConnectionReconfiguration message as specified in TS 36.331 [10]. In this version of the specification, the E-UTRA RRC message can only include the field scq-Configuration:

- to be sent to the UE, used to (re-)configure the SCG configuration upon SCG establishment or modification (only when the SCG is not released by the SN), as generated (entirely) by the (target) SeNB. In this case, the SN sets the *scg-Configuration* within the EUTRA *RRCConnectionReconfiguration* message in accordance with clause 6 in TS 36.331 [10] e.g. regarding the "Need" or "Cond" statements.

or

- including the current SCG configuration of the UE, when provided in response to a query from MN, or in SN triggered SN change in order to enable delta signalling by the target SN.

The field is absent if neither SCG (re)configuration nor SCG configuration query nor SN triggered SN change is performed, e.g. at inter-node capability/configuration coordination which does not result in SCG (re)configuration towards the UE. The field is also absent upon an SCG release triggered by the SN. This field is only used in NE-DC.

sca-RB-Confia

Contains the IE RadioBearerConfig.

- to be sent to the UE, used to (re-)configure the SCG RB configuration upon SCG establishment or modification, as generated (entirely) by the (target) SgNB or SeNB. In this case, the SN sets the *RadioBearerConfig* in accordance with clause 6, e.g. regarding the "Need" or "Cond" statements.

or

- including the current SCG RB configuration of the UE, when provided in response to a query from MN or in SN triggered SN change or in SN triggered SN release or bearer type change between SN terminated bearer to MN terminated bearer in order to enable delta signaling by the MN or target SN. In this case, the SN sets the RadioBearerConfig in accordance with clause 11.2.3.

The field is absent if neither SCG (re)configuration nor SCG configuration query nor SN triggered SN change nor SN triggered SN release is performed, e.g. at inter-node capability/configuration coordination which does not result in SCG RB (re)configuration.

selectedBandCombination

Indicates the band combination selected by SN in (NG)EN-DC, NE-DC, and NR-DC. The SN should inform the MN with this field whenever the band combination and/or feature set it selected for the SCG changes (i.e. even if the new selection concerns a band combination and/or feature set that is allowed by the *allowedBC-ListMRDC*)

BandCombinationInfoSN field descriptions

bandCombinationIndex

In case of (NG)EN-DC and NR-DC, this field indicates the position of a band combination in the *supportedBandCombinationList*. In case of NE-DC, this field indicates the position of a band combination in the *supportedBandCombinationList* and/or *supportedBandCombinationListNEDC-Only*. Band combination entries in *supportedBandCombinationList* are referred by an index which corresponds to the position of a band combination in the *supportedBandCombinationListNEDC-Only* are referred by an index which corresponds to the position of a band combination in the *supportedBandCombinationListNEDC-Only* increased by the number of entries in *supportedBandCombinationList*.

requestedFeatureSets

The position in the FeatureSetCombination which identifies one FeatureSetUplink/Downlink for each band entry in the associated band combination

CG-ConfigInfo

This message is used by master eNB or gNB to request the SgNB or SeNB to perform certain actions e.g. to establish, modify or release an SCG. The message may include additional information e.g. to assist the SgNB or SeNB to set the SCG configuration. It can also be used by a CU to request a DU to perform certain actions, e.g. to establish, or modify an MCG or SCG.

Direction: Master eNB or gNB to secondary gNB or eNB, alternatively CU to DU.

CG-ConfigInfo message

```
-- ASN1START
-- TAG-CG-CONFIG-INFO-START
CG-ConfigInfo ::=
                               SEQUENCE {
    criticalExtensions CHOICE {
                                       CHOICE {
           cg-ConfigInfo
                                       CG-ConfigInfo-IEs,
           spare3 NULL, spare2 NULL, spare1 NULL
       criticalExtensionsFuture
                                 SEQUENCE {}
CG-ConfigInfo-IEs ::=
                               SEOUENCE {
   conriginto-ies ::= SEQU
ue-CapabilityInfo
candidateCellInfoListMN
                                   OCTET STRING (CONTAINING UE-CapabilityRAT-ContainerList)
                                                                                                    OPTIONAL, -- Cond SN-AddMod
                                   MeasResultList2NR
                                                                                                    OPTIONAL,
    candidateCellInfoListSN
                                OCTET STRING (CONTAINING MeasResultList2NR)
                                                                                                    OPTIONAL,
    measResultCellListSFTD-NR
                                   MeasResultCellListSFTD-NR
                                                                                                    OPTIONAL,
    scgFailureInfo
                                   SEQUENCE {
        failureType
                                       ENUMERATED { t310-Expiry, randomAccessProblem,
                                                    rlc-MaxNumRetx, synchReconfigFailure-SCG,
                                                    scg-reconfigFailure,
                                                    srb3-IntegrityFailure},
```

```
measResultSCG
                                        OCTET STRING (CONTAINING MeasResultSCG-Failure)
                                                                                                        OPTIONAL,
    configRestrictInfo
                                     ConfigRestrictInfoSCG
                                                                                                        OPTIONAL.
    drx-InfoMCG
                                     DRX-Info
                                                                                                        OPTIONAL,
    measConfiqMN
                                    MeasConfiqMN
                                                                                                        OPTIONAL,
    sourceConfiqSCG
                                    OCTET STRING (CONTAINING RRCReconfiguration)
                                                                                                        OPTIONAL,
    scq-RB-Config
                                    OCTET STRING (CONTAINING RadioBearerConfig)
                                                                                                        OPTIONAL,
    mcg-RB-Config
                                    OCTET STRING (CONTAINING RadioBearerConfig)
                                                                                                        OPTIONAL,
    mrdc-AssistanceInfo
                                    MRDC-AssistanceInfo
                                                                                                        OPTIONAL,
    nonCriticalExtension
                                    CG-ConfigInfo-v1540-IEs
                                                                                                        OPTIONAL
CG-ConfigInfo-v1540-IEs ::=
                                SEOUENCE {
    ph-InfoMCG
                                     PH-TypeListMCG
                                                                                                        OPTIONAL,
    measResultReportCGI
                                     SEOUENCE {
        ssbFrequency
                                        ARFCN-ValueNR,
        cellForWhichToReportCGI
                                         PhysCellId,
        cqi-Info
                                        CGI-InfoNR
                                                                                                        OPTIONAL,
    nonCriticalExtension
                                     CG-ConfigInfo-v1560-IEs
                                                                                                        OPTIONAL
CG-ConfigInfo-v1560-IEs ::=
                                     SEQUENCE {
    candidateCellInfoListMN-EUTRA
                                        OCTET STRING
                                                                                                    OPTIONAL,
    candidateCellInfoListSN-EUTRA
                                                                                                    OPTIONAL,
                                        OCTET STRING
    sourceConfigSCG-EUTRA
                                        OCTET STRING
                                                                                                    OPTIONAL,
                                         SEQUENCE {
    scqFailureInfoEUTRA
        failureTypeEUTRA
                                             ENUMERATED { t313-Expiry, randomAccessProblem,
                                                     rlc-MaxNumRetx, scq-ChangeFailure},
        measResultSCG-EUTRA
                                             OCTET STRING
                                                                                                    OPTIONAL,
    drx-ConfigMCG
                                         DRX-Config
                                                                                                    OPTIONAL,
    measResultReportCGI-EUTRA
                                             SEOUENCE {
                                             ARFCN-ValueEUTRA,
        eutraFrequency
        cellForWhichToReportCGI-EUTRA
                                                 EUTRA-PhysCellId,
        cgi-InfoEUTRA
                                                 CGI-InfoEUTRA
                                                                                                    OPTIONAL,
    measResultCellListSFTD-EUTRA
                                         MeasResultCellListSFTD-EUTRA
                                                                                                    OPTIONAL,
    fr-InfoListMCG
                                         FR-InfoList
                                                                                                    OPTIONAL,
    nonCriticalExtension
                                         CG-ConfigInfo-v1570-IEs
                                                                                                    OPTIONAL
CG-ConfigInfo-v1570-IEs ::= SEQUENCE {
    sftdFrequencyList-NR
                                         SFTD-FrequencyList-NR
                                                                                                    OPTIONAL,
    sftdFrequencyList-EUTRA
                                         SFTD-FrequencyList-EUTRA
                                                                                                    OPTIONAL.
    nonCriticalExtension
                                        CG-ConfigInfo-v1590-IEs
                                                                                                    OPTIONAL
CG-ConfigInfo-v1590-IEs ::= SEQUENCE {
    servFrequenciesMN-NR
                                     SEQUENCE (SIZE (1.. maxNrofServingCells-1)) OF ARFCN-ValueNR
                                                                                                        OPTIONAL,
    nonCriticalExtension
                                     SEQUENCE {}
                                                                                                        OPTIONAL
SFTD-FrequencyList-NR ::=
                                         SEQUENCE (SIZE (1..maxCellSFTD)) OF ARFCN-ValueNR
```

```
SFTD-FrequencyList-EUTRA ::=
                                         SEQUENCE (SIZE (1..maxCellSFTD)) OF ARFCN-ValueEUTRA
ConfigRestrictInfoSCG ::=
                                SEOUENCE {
    allowedBC-ListMRDC
                                     BandCombinationInfoList
                                                                                                    OPTIONAL,
    powerCoordination-FR1
                                        SEOUENCE {
        p-maxNR-FR1
                                        P-Max
                                                                                                    OPTIONAL,
        p-maxEUTRA
                                        P-Max
                                                                                                    OPTIONAL,
        p-maxUE-FR1
                                        P-Max
                                                                                                    OPTIONAL
                                                                                                    OPTIONAL,
    servCellIndexRangeSCG
                                     SEQUENCE {
        lowBound
                                         ServCellIndex,
                                        ServCellIndex
        upBound
                                                                                                                 -- Cond SN-AddMod
                                                                                                    OPTIONAL,
    maxMeasFreqsSCG
                                        INTEGER(1..maxMeasFreqsMN)
                                                                                                    OPTIONAL,
    dummy
                                         INTEGER(1..maxMeasIdentitiesMN)
                                                                                                    OPTIONAL,
    . . . ,
    [ [
    selectedBandEntriesMNList
                                      SEQUENCE (SIZE (1..maxBandComb)) OF SelectedBandEntriesMN
                                                                                                    OPTIONAL,
    pdcch-BlindDetectionSCG
                                      INTEGER (1..15)
                                                                                                    OPTIONAL,
    maxNumberROHC-ContextSessionsSN
                                     INTEGER(0.. 16384)
                                                                                                    OPTIONAL
    ]],
    ] ]
    maxIntraFreqMeasIdentitiesSCG
                                       INTEGER(1..maxMeasIdentitiesMN)
                                                                                                    OPTIONAL.
                                       INTEGER(1..maxMeasIdentitiesMN)
    maxInterFreqMeasIdentitiesSCG
                                                                                                    OPTIONAL
    ]]
SelectedBandEntriesMN ::=
                                SEQUENCE (SIZE (1..maxSimultaneousBands)) OF BandEntryIndex
BandEntryIndex ::=
                                INTEGER (0.. maxNrofServingCells)
PH-TypeListMCG ::=
                                SEQUENCE (SIZE (1..maxNrofServingCells)) OF PH-InfoMCG
PH-InfoMCG ::=
                                SEOUENCE {
                                        ServCellIndex,
    servCellIndex
    ph-Uplink
                                        PH-UplinkCarrierMCG,
    ph-SupplementaryUplink
                                        PH-UplinkCarrierMCG
                                                                                                    OPTIONAL,
PH-UplinkCarrierMCG ::=
                                SEOUENCE {
                                         ENUMERATED {type1, type3},
    ph-Typelor3
BandCombinationInfoList ::=
                                SEQUENCE (SIZE (1..maxBandComb)) OF BandCombinationInfo
BandCombinationInfo ::=
                                SEQUENCE {
    bandCombinationIndex
                                     BandCombinationIndex,
    allowedFeatureSetsList
                                     SEQUENCE (SIZE (1..maxFeatureSetsPerBand)) OF FeatureSetEntryIndex
FeatureSetEntryIndex ::=
                                INTEGER (1.. maxFeatureSetsPerBand)
```

```
DRX-Info ::=
                                SEQUENCE {
    drx-LongCycleStartOffset
                                    CHOICE {
        ms10
                                        INTEGER(0..9),
        ms20
                                        INTEGER(0..19),
        ms32
                                        INTEGER(0..31),
        ms40
                                        INTEGER(0..39),
        ms60
                                        INTEGER(0..59),
        ms64
                                        INTEGER(0..63),
        ms70
                                        INTEGER(0..69),
        ms80
                                        INTEGER(0..79),
        ms128
                                        INTEGER(0..127),
        ms160
                                        INTEGER(0..159),
        ms256
                                        INTEGER(0..255),
        ms320
                                        INTEGER(0..319),
        ms512
                                        INTEGER(0..511),
        ms640
                                        INTEGER(0..639),
        ms1024
                                        INTEGER(0..1023),
        ms1280
                                        INTEGER (0..1279),
        ms2048
                                        INTEGER(0..2047),
        ms2560
                                        INTEGER(0..2559),
        ms5120
                                        INTEGER(0..5119),
        ms10240
                                        INTEGER(0..10239)
    shortDRX
                                        SEQUENCE {
        drx-ShortCycle
                                            ENUMERATED
                                                 ms2, ms3, ms4, ms5, ms6, ms7, ms8, ms10, ms14, ms16, ms20, ms30, ms32,
                                                 ms35, ms40, ms64, ms80, ms128, ms160, ms256, ms320, ms512, ms640, spare9,
                                                 spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 },
        drx-ShortCycleTimer
                                            INTEGER (1..16)
                                                                                                    OPTIONAL
MeasConfigMN ::= SEQUENCE {
    measuredFrequenciesMN
                                        SEQUENCE (SIZE (1..maxMeasFregsMN)) OF NR-FregInfo
                                                                                                    OPTIONAL,
    measGapConfig
                                        SetupRelease { GapConfig
                                                                                                    OPTIONAL,
    gapPurpose
                                        ENUMERATED {perUE, perFR1}
                                                                                                    OPTIONAL,
    [[ measGapConfigFR2
                                        SetupRelease { GapConfig }
                                                                                                    OPTIONAL
    ]]
MRDC-AssistanceInfo ::= SEQUENCE {
    affectedCarrierFreqCombInfoListMRDC
                                            SEQUENCE (SIZE (1..maxNrofCombIDC)) OF AffectedCarrierFreqCombInfoMRDC,
AffectedCarrierFreqCombInfoMRDC ::= SEQUENCE {
    victimSystemType
    interferenceDirectionMRDC
                                        ENUMERATED {eutra-nr, nr, other, utra-nr-other, nr-other, spare3, spare2, spare1},
    affectedCarrierFreqCombMRDC
                                        SEOUENCE
        affectedCarrierFreqCombEUTRA
                                            AffectedCarrierFreqCombEUTRA
                                                                                                OPTIONAL,
                                            AffectedCarrierFreqCombNR
        affectedCarrierFreqCombNR
```

```
OPTIONAL
VictimSystemType ::= SEQUENCE {
                                    ENUMERATED {true}
                                                                         OPTIONAL,
                             ENUMERATED {true}
ENUMERATED {true}
ENUMERATED {true}
ENUMERATED {true}
ENUMERATED {true}
    glonass
                                                                         OPTIONAL,
    bds
                                                                         OPTIONAL,
    galileo
                                                                         OPTIONAL,
    wlan
                                                                         OPTIONAL,
    bluetooth
                                    ENUMERATED {true}
                                                                         OPTIONAL
AffectedCarrierFreqCombEUTRA ::= SEQUENCE (SIZE (1..maxNrofServingCellsEUTRA)) OF ARFCN-ValueEUTRA
AffectedCarrierFreqCombNR ::= SEQUENCE (SIZE (1..maxNrofServingCells)) OF ARFCN-ValueNR
-- TAG-CG-CONFIG-INFO-STOP
-- ASN1STOP
```

CG-ConfigInfo field descriptions

allowedBC-ListMRDC

A list of indices referring to band combinations in MR-DC capabilities from which SN is allowed to select the SCG band combination. Each entry refers to:

- a band combination numbered according to *supportedBandCombinationList* in the *UE-MRDC-Capability* (in case of (NG)EN-DC), or according to *supportedBandCombinationListNEDC-Only* in the *UE-MRDC-Capability* (in case of NE-DC), or according to *supportedBandCombinationList* in the UE-NR-Capability (in case of NR-DC).
- and the Feature Sets allowed for each band entry. All MR-DC band combinations indicated by this field comprise the MCG band combination, which is a superset of the MCG band(s) selected by MN.

candidateCellInfoListMN. candidateCellInfoListSN

Contains information regarding cells that the master node or the source node suggests the target gNB or DU to consider configuring.

For (NG)EN-DC, including CSI-RS measurement results in *candidateCellInfoListMN* is not supported in this version of the specification. For NR-DC, including SSB and/or CSI-RS measurement results in *candidateCellInfoListMN* is supported.

candidateCellInfoListMN-EUTRA, candidateCellInfoListSN-EUTRA

Includes the MeasResultList3EUTRA as specified in TS 36.331 [10]. Contains information regarding cells that the master node or the source node suggests the target secondary eNB to consider configuring. These fields are only used in NE-DC.

configRestrictInfo

Includes fields for which SgNB is explictly indicated to observe a configuration restriction.

drx-ConfigMCG

This field contains the complete DRX configuration of the MCG. This field is only used in NR-DC.

drx-InfoMCG

This field contains the DRX long and short cycle configuration of the MCG. This field is used in (NG)EN-DC and NE-DC.

fr-Infol istMCG

Contains information of FR information of serving cells that include PCell and SCell(s) configured in MCG.

maxMeasFreqsSCG

Indicates the maximum number of NR inter-frequency carriers the SN is allowed to configure with PSCell for measurements.

dummv

This field is not used in the specification and SN ignores the received value.

maxInterFreqMeasIdentitiesSCG

Indicates the maximum number of allowed measurement identities that the SCG is allowed to configure for inter-frequency measurement. The maximum value for this field is 10. If the field is absent, the SCG is allowed to configure inter-frequency measurements up to the maximum value. This field is only used in NR-DC.

maxIntraFreqMeasIdentitiesSCG

Indicates the maximum number of allowed measurement identities that the SCG is allowed to configure for intra-frequency measurement on each serving frequency. The maximum value for this field is 9 (in case of (NG)EN-DC or NR-DC) or 10 (in case of NE-DC). If the field is absent, the SCG is allowed to configure intra-frequency measurements up to the maximum value on each serving frequency.

maxNumberROHC-ContextSessionsSN

Indicates the maximum number of context sessions allowed to SN terminated bearer, excluding context sessions that leave all headers uncompressed.

measuredFrequenciesMN

Used by MN to indicate a list of frequencies measured by the UE.

measGapConfig

Indicates the FR1 and perUE measurement gap configuration configured by MN.

measGapConfigFR2

Indicates the FR2 measurement gap configuration configured by MN.

mca-RB-Confia

Contains all of the fields in the IE *RadioBearerConfig* used in MN, used by the SN to support delta configuration to UE (i.e. when MN does not use full configuration option), for bearer type change between MN terminated bearer with NR PDCP to SN terminated bearer. It is also used to indicate the PDCP duplication related information for MN terminated split bearer (whether duplication is configured and if so, whether it is initially activated) in SN Addition/Modification procedure. Otherwise, this field is absent.

measResultReportCGI, measResultReportCGI-EUTRA

Used by MN to provide SN with CGI-Info for the cell as per SN's request. In this version of the specification, the *measResultReportCGI* is used for (NG)EN-DC and NR-DC and the *measResultReportCGI-EUTRA* is used only for NE-DC.

measResultSCG-EUTRA

This field includes the MeasResultSCG-FailureMRDC IE as specified in TS 36.331 [10]. This field is only used in NE-DC.

measResultSFTD-EUTRA

SFTD measurement results between the PCell and the E-UTRA PScell in NE-DC. This field is only used in NE-DC.

mrdc-AssistanceInfo

Contains the IDC assistance information for MR-DC reported by the UE (see TS 36.331 [10]).

p-maxEUTRA

Indicates the maximum total transmit power to be used by the UE in the E-UTRA cell group (see TS 36.104 [33]). This field is used in (NG)EN-DC and NE-DC.

p-maxNR-FR1

Indicates the maximum total transmit power to be used by the UE in the NR cell group across all serving cells in frequency range 1 (FR1) (see TS 38.104 [12]). The field is used in (NG)EN-DC and NE-DC.

p-maxUE-FR1

Indicates the maximum total transmit power to be used by the UE across all serving cells in frequency range 1 (FR1).

pdcch-BlindDetectionSCG

Indicates the maximum value of the reference number of cells for PDCCH blind detection allowed to be configured for the SCG.

ph-InfoMCG

Power headroom information in MCG that is needed in the reception of PHR MAC CE in SCG.

ph-SupplementaryUplink

Power headroom information for supplementary uplink. For UE in (NG)EN-DC, this field is absent.

ph-Type1or3

Type of power headroom for a serving cell in MCG (PCell and activated SCells). *type1* refers to type 1 power headroom, *type3* refers to type 3 power headroom. (See TS 38.321 [3]).

ph-Uplink

Power headroom information for uplink.

powerCoordination-FR1

Indicates the maximum power that the UE can use in FR1.

scgFailureInfo

Contains SCG failure type and measurement results. In case the sender has no measurement results available, the sender may include one empty entry (i.e. without any optional fields present) in *measResultPerMOList*. This field is used in (NG)EN-DC and NR-DC.

scaFailureInfoEUTRA

Contains SCG failure type and measurement results of the EUTRA secondary cell group. This field is only used in NE-DC.

scg-RB-Config

Contains all of the fields in the IE RadioBearerConfig used in SN, used to allow the target SN to use delta configuration to the UE, e.g. during SN change. The field is signalled upon change of SN unless MN uses full configuration option. Otherwise, the field is absent.

selectedBandEntriesMNList

A list of indices referring to the position of a band entry selected by the MN, in each band combination entry in *allowedBC-ListMRDC* IE. *BandEntryIndex* 0 identifies the first band in the *bandList* of the *BandCombination*, *BandEntryIndex* 1 identifies the second band in the *bandList* of the *BandCombination*, and so on. This *selectedBandEntriesMNList* includes the same number of entries, and listed in the same order as in *allowedBC-ListMRDC*. The SN uses this information to determine which bands out of the NR band combinations in *allowedBC-ListMRDC* it can configure in SCG in NR-DC. The SN can use this information to determine for which band pair(s) it should check *SimultaneousRxTxPerBandPair*.

servCellIndexRangeSCG

Range of serving cell indices that SN is allowed to configure for SCG serving cells.

servFrequenciesMN-NR

Indicates the frequency of all serving cells that include PCell and SCell(s) configured in MCG. This field is only used in NR-DC.

sftdFrequencyList-NR

Includes a list of SSB frequencies. Each entry identifies the SSB frequency of a PSCell, which corresponds to one MeasResultCellSFTD-NR entry in the MeasResultCellListSFTD-NR.

sftdFrequencyList-EUTRA

Includes a list of E-UTRA frequencies. Each entry identifies the carrier frequency of a PSCell, which corresponds to one *MeasResultSFTD-EUTRA* entry in the *MeasResultCellListSFTD-EUTRA*.

sourceConfigSCG

Includes all of the current SCG configurations used by the target SN to build delta configuration to be sent to UE, e.g. during SN change. The field contains the *RRCReconfiguration* message, i.e. including *secondaryCellGroup* and *measConfig.* The field is signalled upon change of SN, unless MN uses full configuration option. Otherwise, the field is absent.

sourceConfigSCG-EUTRA

Includes the E-UTRA RRCConnectionReconfiguration message as specified in TS 36.331 [10]. In this version of the specification, the E-UTRA RRC message can only include the field scg-Configuration. In this version of the specification, this field is absent when master gNB uses full configuration option. This field is only used in NE-DC.

ue-CapabilityInfo

Contains the IE *UE-CapabilityRAT-ContainerList* supported by the UE (see NOTE 3). A gNB that retrieves MRDC related capability containers ensures that the set of included MRDC containers is consistent w.r.t. the feature set related information.

BandCombinationInfo field descriptions

allowedFeatureSetsList

Defines a subset of the entries in a FeatureSetCombination. Each index identifies a position in the FeatureSetCombination, which corresponds to one FeatureSetUplink/Downlink for each band entry in the associated band combination.

bandCombinationIndex

In case of (NG)EN-DC and NR-DC, this field indicates the position of a band combination in the *supportedBandCombinationList*. In case of NE-DC, this field indicates the position of a band combination in the *supportedBandCombinationList* and/or *supportedBandCombinationListNEDC-Only*. Band combination entries in *supportedBandCombinationList* are referred by an index which corresponds to the position of a band combination in the *supportedBandCombinationListNEDC-Only* are referred by an index which corresponds to the position of a band combination in the *supportedBandCombinationListNEDC-Only* increased by the number of entries in *supportedBandCombinationList*.

Conditional Presence	Explanation
SN-AddMod	The field is mandatory present upon SN addition and SN change. It is optionally present upon SN modification and inter-MN handover
	without SN change. Otherwise, the field is absent.

NOTE 3: The following table indicates per MN RAT and SN RAT whether RAT capabilities are included or not in *ue-CapabilityInfo*.

MN RAT	SN RAT	NR capabilities	E-UTRA capabilities	MR-DC capabilities
E-UTRA	NR	Included	Not included	Included
NR	E-UTRA	Not included	Included	Included
NR	NR	Included	Not included	Not included

MeasurementTimingConfiguration

The MeasurementTimingConfiguration message is used to convey assistance information for measurement timing.

Direction: en-gNB to eNB, eNB to en-gNB, gNB to gNB, ng-eNB to gNB, gNB to ng-eNB, ng-eNB to ng-eNB, gNB DU to gNB CU, and gNB CU to gNB DU.

MeasurementTimingConfiguration message

```
-- ASN1START
-- TAG-MEASUREMENT-TIMING-CONFIGURATION-START
MeasurementTimingConfiguration ::=
                                       SEQUENCE
    criticalExtensions
                                           CHOICE
       c1
                                               CHOICE {
           measTimingConf
                                                    MeasurementTimingConfiguration-IEs,
           spare3 NULL, spare2 NULL, spare1 NULL
       criticalExtensionsFuture
                                       SEOUENCE {}
MeasurementTimingConfiguration-IEs ::= SEQUENCE {
    measTiming
                                                                                        OPTIONAL,
                                           MeasurementTimingConfiguration-v1550-IEs
    nonCriticalExtension
                                                                                       OPTIONAL
MeasurementTimingConfiguration-v1550-IEs ::= SEQUENCE {
    campOnFirstSSB
                                                BOOLEAN,
    psCellOnlyOnFirstSSB
                                                BOOLEAN,
    nonCriticalExtension
                                                SEQUENCE {}
                                                                                       OPTIONAL
MeasTimingList ::= SEOUENCE (SIZE (1..maxMeasFreqsMN)) OF MeasTiming
MeasTiming ::= SEQUENCE {
    frequencyAndTiming
                                           SEQUENCE {
       carrierFreq
                                               ARFCN-ValueNR,
       ssbSubcarrierSpacing
                                               SubcarrierSpacing,
       ssb-MeasurementTimingConfiguration
                                               SSB-MTC,
       ss-RSSI-Measurement
                                               SS-RSSI-Measurement
                                                                                           OPTIONAL
                                                                                       OPTIONAL,
    ssb-ToMeasure
                                           SSB-ToMeasure
                                                                                       OPTIONAL,
    physCellId
                                           PhysCellId
                                                                                       OPTIONAL
-- TAG-MEASUREMENT-TIMING-CONFIGURATION-STOP
-- ASN1STOP
```

MeasTiming field descriptions

carrierFreq, ssbSubcarrierSpacing

Indicates the frequency and subcarrier spacing of the SS block of the cell for which this message is included, or of other SS blocks within the same carrier.

ssb-MeasurementTimingConfiguration

Indicates the SMTC which can be used to search for SSB of the cell for which the message is included. When the message is included in "Served NR Cell Information" (see TS 36.423 [37]), "Served Cell Information NR" (see TS 38.423 [35]), or "Served Cell Information" (see TS 38.473 [36]), the timing is based on the cell for which the message is included. When the message is included in "NR Neighbour Information" (see TS 36.423 [37]), or "Served Cell Information" (see TS 38.423 [35]), the timing is based on the cell indicated in the "Served NR Cell Information" or "Served Cell Information NR" with which the "NR Neighbour Information" or "Neighbour Information NR" is provided. When the message is included in "CU to DU RRC Information", the timing is based on the cell indicated by SpCell ID with which the message is included.

ss-RSSI-Measurement

Provides the configuration which can be used for RSSI measurements of the cell for which the message is included.

MeasurementTimingConfiguration field descriptions

campOnFirstSSB

Value *true* indicates that the SSB indicated in the first instance of *MeasTiming* in the *measTiming* list can be used for camping and for a PCell configuration (i.e. in *spCellConfigCommon* of the *masterCellGroup*).

measTiming

A list of SMTC information, SSB RSSI measurement information and associated NR frequency exchanged via EN-DC X2 Setup, EN-DC Configuration Update, Xn Setup and NG-RAN Node Configuration Update procedures, or F1 messages between qNB DU and qNB CU.

physCellId

Physical Cell Identity of the SSB on the ARFCN indicated by carrierFreq.

psCellOnlyOnFirstSSB

Value true indicates that only the SSB indicated in the first instance of MeasTiming in the measTiming list can be used for a PSCell configuration (i.e. in spCellConfigCommon of the secondaryCellGroup).

ssb-ToMeasure

The set of SS blocks to be measured within the SMTC measurement duration (see TS 38.215 [9]).

UERadioPagingInformation

This message is used to transfer radio paging information, covering both upload to and download from the 5GC, and between gNBs.

Direction: gNB to/ from 5GC and gNB to/from gNB

UERadioPagingInformation message

```
criticalExtensionsFuture
                                           SEOUENCE {}
UERadioPagingInformation-IEs ::=
                                   SEOUENCE {
    supportedBandListNRForPaging
                                       SEQUENCE (SIZE (1..maxBands)) OF FreqBandIndicatorNR
                                                                                               OPTIONAL.
    nonCriticalExtension
                                       UERadioPagingInformation-v15e0-IEs
                                                                                               OPTIONAL
UERadioPagingInformation-v15e0-IEs ::= SEQUENCE {
    dl-SchedulingOffset-PDSCH-TypeA-FDD-FR1
                                               ENUMERATED {supported}
                                                                               OPTIONAL.
    dl-SchedulingOffset-PDSCH-TypeA-TDD-FR1
                                               ENUMERATED {supported}
                                                                               OPTIONAL,
    dl-SchedulingOffset-PDSCH-TypeA-TDD-FR2
                                               ENUMERATED {supported}
                                                                               OPTIONAL.
    dl-SchedulingOffset-PDSCH-TypeB-FDD-FR1
                                               ENUMERATED {supported}
                                                                               OPTIONAL,
    dl-SchedulingOffset-PDSCH-TypeB-TDD-FR1 ENUMERATED {supported}
                                                                               OPTIONAL,
    dl-SchedulingOffset-PDSCH-TypeB-TDD-FR2
                                               ENUMERATED {supported}
                                                                               OPTIONAL,
    nonCriticalExtension
                                      SEOUENCE {}
                                                                               OPTIONAL
-- TAG-UE-RADIO-PAGING-INFORMATION-STOP
-- ASN1STOP
```

UERadioPagingInformation field descriptions

supportedBandListNRForPaging

Indicates the UE supported NR frequency bands which are derived by the gNB from UE-NR-Capability.

dl-SchedulingOffset-PDSCH-TypeA-FDD-FR1

Indicates whether the UE supports DL scheduling slot offset (K0) greater than 0 for PDSCH mapping type A in FDD FR1.

dl-SchedulingOffset-PDSCH-TypeA-TDD-FR1

Indicates whether the UE supports DL scheduling slot offset (K0) greater than 0 for PDSCH mapping type A in TDD FR1.

dl-SchedulingOffset-PDSCH-TypeA-TDD-FR2

Indicates whether the UE supports DL scheduling slot offset (K0) greater than 0 for PDSCH mapping type A in TDD FR2.

dl-SchedulingOffset-PDSCH-TypeB-FDD-FR1

Indicates whether the UE supports DL scheduling slot offset (K0) greater than 0 for PDSCH mapping type B in FDD FR1.

dl-SchedulinaOffset-PDSCH-TypeB-TDD-FR1

Indicates whether the UE supports DL scheduling slot offset (K0) greater than 0 for PDSCH mapping type B in TDD FR1.

dl-SchedulingOffset-PDSCH-TypeB-TDD-FR2

Indicates whether the UE supports DL scheduling slot offset (K0) greater than 0 for PDSCH mapping type B in TDD FR2.

UERadioAccessCapabilityInformation

This message is used to transfer UE radio access capability information, covering both upload to and download from the 5GC.

Direction: ng-eNB or gNB to/ from 5GC

UERadioAccessCapabilityInformation message

```
-- ASN1START
-- TAG-UE-RADIO-ACCESS-CAPABILITY-INFORMATION-START
UERadioAccessCapabilityInformation ::= SEQUENCE {
    criticalExtensions
                                          CHOICE {
       c1
                                              CHOICE {
           ueRadioAccessCapabilityInformation
                                                 UERadioAccessCapabilityInformation-IEs,
           spare7 NULL.
           spare6 NULL, spare5 NULL, spare4 NULL,
           spare3 NULL, spare2 NULL, spare1 NULL
       criticalExtensionsFuture
                                        SEQUENCE {}
UERadioAccessCapabilityInformation-IEs ::= SEQUENCE {
    ue-RadioAccessCapabilityInfo
                                  OCTET STRING (CONTAINING UE-CapabilityRAT-ContainerList),
    nonCriticalExtension
                                              SEOUENCE {}
                                                                                                           OPTIONAL
-- TAG-UE-RADIO-ACCESS-CAPABILITY-INFORMATION-STOP
-- ASN1STOP
```

UERadioAccessCapabilityInformation-IEs field descriptions

ue-RadioAccessCapabilityInfo

Including NR, MR-DC, E-UTRA radio access capabilities. A gNB that retrieves MRDC related capability containers ensures that the set of included MRDC containers is consistent w.r.t. the feature set related information.

11.2.3 Mandatory information in inter-node RRC messages

For the AS-Config transferred within the HandoverPreparationInformation:

- The source node shall include all fields necessary to reflect the current AS configuration of the UE, except for the fields *sourceSCG-NR-Config*, *sourceSCG-EUTRA-Config* and *sourceRB-SN-Config*, which can be omitted in case the source MN did not receive the latest configuration from the source SN. For *RRCReconfiguration* included in the field *rrcReconfiguration*, *ReconfigurationWithSync* is included with only the mandatory subfields (e.g. *newUE-Identity* and *t304*) and *ServingCellConfigCommon*;
- Need codes or conditions specified for subfields according to IEs defined in clause 6 do not apply. I.e. some fields shall be included regardless of the "Need" or "Cond" e.g. *discardTimer*;
- Based on the received AS configuration, the target node can indicate the delta (difference) to the current AS configuration (as included in *HandoverCommand*) to the UE. The fields *newUE-Identity* and *t304* included in *ReconfigurationWithSync* are not used for delta configuration purpose.

The candidateCellInfoListSN(-EUTRA) in CG-Config and the candidateCellInfoListMN(-EUTRA)/candidateCellInfoListSN(-EUTRA) in CG-ConfigInfo need not be included in procedures that do not involve a change of node.

For fields scg-CellGroupConfig, scg-CellGroupConfigEUTRA and scg-RB-Config in CG-Config (sent upon SN initiated SN change or other conditions as specified in field descriptions) and fields mcg-RB-Config, scg-RB-Config and sourceConfigSCG in CG-ConfigInfo (sent upon change of SN):

- The source node shall include all fields necessary to reflect the current AS configuration of the UE, unless stated otherwise in the field description. For *RRCReconfiguration* included in the field *scg-CellGroupConfig* in *CG-Config*, *ReconfigurationWithSync* is included with only the mandatory subfields (e.g. *newUE-Identity* and *t304*) and *ServingCellConfigCommon*;
- Need codes or conditions specified for subfields according to IEs defined in clause 6 do not apply;
- Based on the received AS configuration, the target node can indicate the delta (difference) as compared to the current AS configuration to the UE. The fields *newUE-Identity* and *t304* in *ReconfigurationWithSync* are always included by the target node, i.e. they are not used for delta configuration purpose to UE.

For fields in *CG-Config* and *CG-ConfigInfo* listed below, absence of the field means that the receiver maintains the values informed via the previous message. Note that every time there is a change in the configuration covered by a listed field, the MN or SN shall include the field and it shall provide the full configuration provided by that field unless stated otherwise, if there is no change, the field can be omitted:

- configRestrictInfo;
- gapPurpose;
- *measGapConfig* (for which delta signaling applies);
- *measGapConfigFR2* (for which delta signaling applies);
- measResultCellListSFTD;
- measResultSFTD-EUTRA:
- sftdFrequencyList-EUTRA;
- sftdFrequencyList-NR;
- ue-CapabilityInfo;
- servFrequenciesMN-NR.

For other fields in *CG-Config and CG-ConfigInfo*, the sender shall always signal the appropriate value even if same as indicated in the previous inter-node message, unless explicitly stated otherwise.

11.3 Inter-node RRC information element definitions

-

11.4 Inter-node RRC multiplicity and type constraint values

Multiplicity and type constraints definitions

```
-- ASN1START
```

-- TAG-NR-MULTIPLICITY-AND-CONSTRAINTS-START

```
maxMeasFreqsMNINTEGER :: 32-- Maximum number of MN-configured measurement frequenciesmaxMeasFreqsSNINTEGER :: 32-- Maximum number of SN-configured measurement frequenciesmaxMeasIdentitiesMNINTEGER :: 62-- Maximum number of measurement identities that a UE can be configured withmaxCellPrepINTEGER :: 32-- Maximum number of cells prepared for handover
```

-- TAG-NR-MULTIPLICITY-AND-CONSTRAINTS-STOP

-- ASN1STOP

End of NR-InterNodeDefinitions

```
-- ASN1START
```

-- TAG-NR-INTER-NODE-DEFINITIONS-END-START

END

- -- TAG-NR-INTER-NODE-DEFINITIONS-END-STOP
- -- ASN1STOP

12 Processing delay requirements for RRC procedures

The UE performance requirements for RRC procedures are specified in the following tables. The performance requirement is expressed as the time in [ms] from the end of reception of the network -> UE message on the UE physical layer up to when the UE shall be ready for the reception of uplink grant for the UE -> network response message with no access delay other than the TTI-alignment (e.g. excluding delays caused by scheduling, the random access procedure or physical layer synchronisation). In case the RRC procedure triggers BWP switching, the RRC procedure delay is the value defined in the following table plus the BWP switching delay defined in TS 38.133 [14], clause 8.6.3.

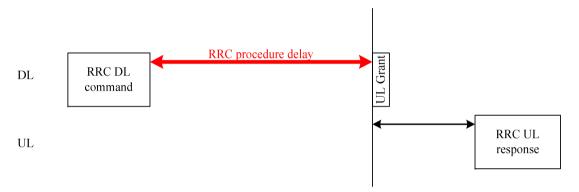


Figure 12.1-1: Illustration of RRC procedure delay

Table 12.1-1: UE performance requirements for RRC procedures for UEs

Procedure title:	Network -> UE	UE -> Network	Value [ms]	Notes
RRC Connection Control Procedure	s	•		
RRC reconfiguration	RRCReconfiguration	RRCReconfigurationComplete	10	
RRC reconfiguration (scell addition/release)	RRCReconfiguration	RRCReconfigurationComplete	16	
RRC reconfiguration (LTE/NR SCG establishment/ modification/ release)	RRCReconfiguration	RRCReconfigurationComplete	16	
RRC reconfiguration (Intra-NR mobility with LTE/NR SCG establishment/ modification/ release)	RRCReconfiguration	RRCReconfigurationComplete	16	
RRC setup	RRCSetup	RRCSetupComplete	10	
RRC Release	RRCRelease		NA	
RRC re-establishment	RRCReestablishment	RRCReestablishmentComplete	10	

Procedure title:	Network -> UE	UE -> Network	Value [ms]	Notes
RRC resume	RRCResume	RRCResumeComplete	6 or 10	Value=6 applies for a UE supporting reduced CP latency for the case of RRCResume message only including MAC and PHY configuration, reestablishPDCP and reestablishRLC for SRB2 and DRB(s), and no DRX, SPS, configured grant, CA or MIMO re- configuration will be triggered by this message. Further, the UL grant for transmission of RRCResumeComplet e and the data is transmitted over common search space with DCI format 0_0. In this scenario, the RRC procedure delay [ms] can extend beyond the reception of the UL grant, up to 7 ms. For other cases, Value = 10 applies.
RRC resume (scell addition)	RRCResume	RRCResumeComplete	16	
Initial AS security activation	SecurityModeCommand	SecurityModeComplete/Security ModeFailure	5	
Inter RAT mobility				
Handover to NR	RRCReconfiguration (sent by other RAT)	RRCReconfigurationComplete	NA	The performance of this procedure is specified in TS 36.133 [40] clauses 5.3.4.2 and 5.3.5.2 in case of handover from E-UTRA to NR.

Procedure title:	Network -> UE	UE -> Network	Value [ms]	Notes
Handover from NR MobilityFromNRComma nd			NA	The performance of this procedure is specified in TS 38.133 [14], clauses 6.1.2.1.2 and 6.1.2.2.2.
Other procedures				
UE assistance information		UEAssistanceInformation	NA	
UE capability transfer	UECapabilityEnquiry	UECapabilityInformation	80	
Counter check	CounterCheck	CounterCheckResponse	5	

Annex A (informative): Guidelines, mainly on use of ASN.1

A.1 Introduction

The following clauses contain guidelines for the specification of RRC protocol data units (PDUs) with ASN.1.

A.2 Procedural specification

A.2.1 General principles

The procedural specification provides an overall high level description regarding the UE behaviour in a particular scenario.

It should be noted that most of the UE behaviour associated with the reception of a particular field is covered by the applicable parts of the PDU specification. The procedural specification may also include specific details of the UE behaviour upon reception of a field, but typically this should be done only for cases that are not easy to capture in the PDU clause e.g. general actions, more complicated actions depending on the value of multiple fields.

Likewise, the procedural specification need not specify the UE requirements regarding the setting of fields within the messages that are sent to the network i.e. this may also be covered by the PDU specification.

A.2.2 More detailed aspects

The following more detailed conventions should be used:

- Bullets:
 - Capitals should be used in the same manner as in other parts of the procedural text i.e. in most cases no capital applies since the bullets are part of the sentence starting with 'The UE shall:'
 - All bullets, including the last one in a clause, should end with a semi-colon i.e. an ';.
- Conditions:
 - Whenever multiple conditions apply, a semi-colon should be used at the end of each conditions with the exception of the last one, i.e. as in 'if cond1, or cond2.

A.3 PDU specification

A.3.1 General principles

A.3.1.1 ASN.1 sections

The RRC PDU contents are formally and completely described using abstract syntax notation (ASN.1), see X.680 [6], X.681 [7].

The complete ASN.1 code is divided into a number of ASN.1 sections in the specifications. In order to facilitate the extraction of the complete ASN.1 code from the specification, each ASN.1 section begins with the following:

- a first text paragraph consisting entirely of an ASN.1 start tag, which consists of a double hyphen followed by a single space and the text string "ASN1START" (in all upper case letters);
- a second text paragraph consisting entirely of a *block start tag* is included, which consists of a double hyphen followed by a single space and the text string "TAG-NAME-START" (in all upper case letters), where the "NAME" refers to the main name of the paragraph (in all upper-case letters).

Similarly, each ASN.1 section ends with the following:

- a first text paragraph consisting entirely of a *blockstop tag*, which consists of a double hyphen followed by a single space and the text string "TAG-NAME-STOP" (in all upper-case letters), where the "NAME" refers to the main name of the paragraph (in all upper-case letters);
- a second text paragraph consisting entirely of an ASN.1 stop tag, which consists of a double hyphen followed by a singlespace and the text "ASN1STOP" (in all upper case letters).

This results in the following tags:

- -- ASN1START
- -- TAG-NAME-START
- -- TAG-NAME-STOP
- -- ASN1STOP

The text paragraphs containing either of the start and stop tags should not contain any ASN.1 code significant for the complete description of the RRC PDU contents. The complete ASN.1 code may be extracted by copying all the text paragraphs between an ASN.1 start tag and the following ASN.1 stop tag in the order they appear, throughout the specification.

NOTE: A typical procedure for extraction of the complete ASN.1 code consists of a first step where the entire RRC PDU contents description (ultimately the entire specification) is saved into a plain text (ASCII) file format, followed by a second step where the actual extraction takes place, based on the occurrence of the ASN.1 start and stop tags.

A.3.1.2 ASN.1 identifier naming conventions

The naming of identifiers (i.e., the ASN.1 field and type identifiers) should be based on the following guidelines:

- Message (PDU) identifiers should be ordinary mixed case without hyphenation. These identifiers, *e.g.*, the *RRCConnectionModificationCommand*, should be used for reference in the procedure text. Abbreviations should be avoided in these identifiers and abbreviated forms of these identifiers should not be used.
- Type identifiers other than PDU identifiers should be ordinary mixed case, with hyphenation used to set off acronyms only where an adjacent letter is a capital, e.g., EstablishmentCause, SelectedPLMN (not Selected-PLMN, since the "d" in "Selected" is lowercase), InitialUE-Identity and MeasSFN-SFN-TimeDifference.
- Field identifiers shall start with a lowercase letter and use mixed case thereafter, *e.g.*, *establishmentCause*. If a field identifier begins with an acronym (which would normally be in upper case), the entire acronym is lowercase (*plmn-Identity*, not *pLMN-Identity*). The acronym is set off with a hyphen (*ue-Identity*, not *ueIdentity*), in order to facilitate a consistent search pattern with corresponding type identifiers.
- Identifiers should convey the meaning of the identifier and should avoid adding unnecessary postfixes (e.g. abstractions like 'Info') for the name.
- Identifiers that are likely to be keywords of some language, especially widely used languages, such as C++ or Java, should be avoided to the extent possible.
- Identifiers, other than PDU identifiers, longer than 25 characters should be avoided where possible. It is recommended to use abbreviations, which should be done in a consistent manner i.e. use 'Meas' instead of 'Measurement' for all occurrences. Examples of typical abbreviations are given in table A.3.1.2.1-1 below.
- For future extension: When an extension is introduced a suffix is added to the identifier of the concerned ASN.1 field and/or type. A suffix of the form "-rX" is used, with X indicating the release, for ASN.1 fields or types introduced in a later release (i.e. a release later than the original/first release of the protocol) as well as for ASN.1 fields or types for which a revision is introduced in a later release replacing a previous version, e.g., Foo-r9 for the Rel-9 version of the ASN.1 type Foo. A suffix of the form "-rXb" is used for the first revision of a field that it appears in the same release (X) as the original version of the field, "-rXc" for a second intra-release revision and so on. A suffix of the form "-vXYZ" is used for ASN.1 fields or types that only are an extension of a corresponding earlier field or type (see clause A.4), e.g., AnElement-v10b0 for the extension of the ASN.1 type AnElement introduced in version 10.11.0 of the specification. A number 0...9, 10, 11, etc. is used to represent the first part of the version number, indicating the release of the protocol. Lower case letters a, b, c, etc. are used to represent the second (and third) part of the version number if they are greater than 9. In the procedural specification, in field descriptions as well as in headings suffices are not used, unless there is a clear need to distinguish the extension from the original field.
- More generally, in case there is a need to distinguish different variants of an ASN.1 field or IE, a suffix should be added at the end of the identifiers e.g. MeasObjectUTRA, ConfigCommon. When there is no particular need to distinguish the fields (e.g. because the field is included in different IEs), a common field identifier name may be used. This may be attractive e.g. in case the procedural specification is the same for the different variants.
- It should be avoided to use field identifiers with the same name within the elements of a CHOICE, including using a CHOICE inside a SEQUENCE (to avoid certain compiler errors).

Table A.3.1.2-1: Examples of typical abbreviations used in ASN.1 identifiers

Abbreviation	Abbreviated word
Config	Configuration
DL	Downlink
Ext	Extension
Freq	Frequency
ld	Identity
Ind	Indication
Meas	Measurement
MIB	MasterInformationBlock
Neigh	Neighbour(ing)
Param(s)	Parameter(s)
Phys	Physical
PCI	Physical Cell Id
Proc	Process
Reconfig	Reconfiguration
Reest	Re-establishment
Req	Request
Rx	Reception
Sched	Scheduling
SIB	SystemInformationBlock
Sync	Synchronisation
Thr	Threshold
Tx	Transmission
UL	Uplink

NOTE: The table A.3.1.2.1-1 is not exhaustive. Additional abbreviations may be used in ASN.1 identifiers when needed.

A.3.1.3 Text references using ASN.1 identifiers

A text reference into the RRC PDU contents description from other parts of the specification is made using the ASN.1 field identifier of the referenced type. The ASN.1 field and type identifiers used in text references should be in the *italic font style*. The "do not check spelling and grammar" attribute in Word should be set. Quotation marks (i.e., "") should not be used around the ASN.1 field or type identifier.

A reference to an RRC PDU should be made using the corresponding ASN.1 field identifier followed by the word "message", e.g., a reference to the RRCRelease message.

A reference to a specific part of an RRC PDU, or to a specific part of any other ASN.1 type, should be made using the corresponding ASN.1 field identifier followed by the word "field", e.g., a reference to the *prioritisedBitRate* field in the example below.

```
-- /example/ ASN1START

LogicalChannelConfig ::= SEQUENCE {
   ul-SpecificParameters SEQUENCE {
      priority Priority,
```

NOTE: All the ASN.1 start tags in the ASN.1 sections, used as examples in this annex to the specification, are deliberately distorted, in order not to include them when the ASN.1 description of the RRC PDU contents is extracted from the specification.

A reference to a specific type of information element should be made using the corresponding ASN.1 type identifier preceded by the acronym "IE", e.g., a reference to the IE *LogicalChannelConfig* in the example above.

References to a specific type of information element should only be used when those are generic, i.e., without regard to the particular context wherein the specific type of information element is used. If the reference is related to a particular context, e.g., an RRC PDU type (message) wherein the information element is used, the corresponding field identifier in that context should be used in the text reference.

A reference to a specific value of an ASN.1 field should be made using the corresponding ASN.1 value without using quotation marks around the ASN.1 value, e.g., 'if the *status* field is set to value *true*'.

A.3.2 High-level message structure

Within each logical channel type, the associated RRC PDU (message) types are alternatives within a CHOICE, as shown in the example below.

```
-- /example/ ASN1START
DL-DCCH-Message ::= SEQUENCE {
   message
                          DL-DCCH-MessageType
DL-DCCH-MessageType ::= CHOICE {
       dlInformationTransfer
                                             DLInformationTransfer,
       handoverFromEUTRAPreparationRequest
                                             HandoverFromEUTRAPreparationRequest,
       mobilityFromEUTRACommand
                                             MobilityFromEUTRACommand,
       rrcConnectionReconfiguration
                                             RRCConnectionReconfiguration,
       rrcConnectionRelease
                                             RRCConnectionRelease,
       securityModeCommand
                                             SecurityModeCommand,
       ueCapabilityEnquiry
                                             UECapabilityEnquiry,
       spare1 NULL
   -- ASN1STOP
```

A nested two-level CHOICE structure is used, where the alternative PDU types are alternatives within the inner level c1 CHOICE.

Spare alternatives (i.e., *spare1* in this case) may be included within the *c1* CHOICE to facilitate future extension. The number of such spare alternatives should not extend the total number of alternatives beyond an integer-power-of-two number of alternatives (i.e., eight in this case).

Further extension of the number of alternative PDU types is facilitated using the messageClassExtension alternative in the outer level CHOICE.

A.3.3 Message definition

Each PDU (message) type is specified in an ASN.1 section similar to the one shown in the example below.

```
-- /example/ ASN1START
RRCConnectionReconfiguration ::= SEOUENCE {
    rrc-TransactionIdentifier
                                        RRC-TransactionIdentifier,
    criticalExtensions
                                        CHOICE {
                                            CHOICE {
       c1
           rrcConnectionReconfiguration-r8
                                                RRCConnectionReconfiguration-r8-IEs,
           spare3 NULL, spare2 NULL, spare1 NULL
       criticalExtensionsFuture
                                           SEOUENCE {}
RRCConnectionReconfiguration-r8-IEs ::= SEOUENCE {
    -- Enter the IEs here.
-- ASN1STOP
```

Hooks for critical and non-critical extension should normally be included in the PDU type specification. How these hooks are used is further described in clause A.4.

Critical extensions are characterised by a redefinition of the PDU contents and need to be governed by a mechanism for protocol version agreement between the encoder and the decoder of the PDU, such that the encoder is prevented from sending a critically extended version of the PDU type, which is not comprehended by the decoder.

Critical extension of a PDU type is facilitated by a two-level CHOICE structure, where the alternative PDU contents are alternatives within the inner level *c1* CHOICE. Spare alternatives (i.e., *spare3* down to *spare1* in this case) may be included within the *c1* CHOICE. The number of spare alternatives to be included in the original PDU specification should be decided case by case, based on the expected rate of critical extension in the future releases of the protocol.

Further critical extension, when the spare alternatives from the original specifications are used up, is facilitated using the criticalExtensionsFuture in the outer level CHOICE.

In PDU types where critical extension is not expected in the future releases of the protocol, the inner level c1 CHOICE and the spare alternatives may be excluded, as shown in the example below.

```
-- /example/ ASN1START
```

Non-critical extensions are characterised by the addition of new information to the original specification of the PDU type. If not comprehended, a non-critical extension may be skipped by the decoder, whilst the decoder is still able to complete the decoding of the comprehended parts of the PDU contents.

Non-critical extensions at locations other than the end of the message or other than at the end of a field contained in a BIT or OCTET STRING are facilitated by use of the ASN.1 extension marker "...". The original specification of a PDU type should normally include the extension marker at the end of the sequence of information elements contained.

Non-critical extensions at the end of the message or at the end of a field that is contained in a BIT or OCTET STRING may be facilitated by use of an empty sequence that is marked OPTIONAL e.g. as shown in the following example:

```
-- /example/ ASN1START

RRCMessage-r8-IEs ::= SEQUENCE {
    field1 InformationElement1,
    field2 InformationElement2,

    nonCriticalExtension SEQUENCE {}

-- ASN1STOP
```

The ASN.1 section specifying the contents of a PDU type may be followed by a *field description* table where a further description of, e.g., the semantic properties of the fields may be included. The general format of this table is shown in the example below. The field description table is absent in case there are no fields for which further description needs to be provided e.g. because the PDU does not include any fields, or because an IE is defined for each field while there is nothing specific regarding the use of this IE that needs to be specified.

```
%PDU-TypeIdentifier% field descriptions
%field identifier%
Field description.
%field identifier%
Field description.
```

The field description table has one column. The header row shall contain the ASN.1 type identifier of the PDU type.

The following rows are used to provide field descriptions. Each row shall include a first paragraph with a *field identifier* (in *bold and italic* font style) referring to the part of the PDU to which it applies. The following paragraphs at the same row may include (in regular font style), e.g., semantic description, references to other specifications and/or specification of value units, which are relevant for the particular part of the PDU.

The parts of the PDU contents that do not require a field description shall be omitted from the field description table.

A.3.4 Information elements

Each IE (information element) type is specified in an ASN.1 section similar to the one shown in the example below.

```
-- /example/ ASN1START
PRACH-ConfigSIB ::=
                                  INTEGER (0..1023),
   rootSequenceIndex
   prach-ConfigInfo
                                      PRACH-ConfigInfo
PRACH-Config ::=
                                  SEOUENCE {
    rootSequenceIndex
                                      INTEGER (0..1023),
                                      PRACH-ConfigInfo
   prach-ConfigInfo
                                                                         OPTIONAL -- Need N
PRACH-ConfigInfo ::=
                                     ENUMERATED {ffs},
    prach-ConfigIndex
   highSpeedFlag
                                      ENUMERATED {ffs}.
   zeroCorrelationZoneConfig
                                     ENUMERATED {ffs}
-- ASN1STOP
```

IEs should be introduced whenever there are multiple fields for which the same set of values apply. IEs may also be defined for other reasons e.g. to break down a ASN.1 definition in to smaller pieces.

A group of closely related IE type definitions, like the IEs *PRACH-ConfigSIB* and *PRACH-Config* in this example, are preferably placed together in a common ASN.1 section. The IE type identifiers should in this case have a common base, defined as the *generic type identifier*. It may be complemented by a suffix to distinguish the different variants. The "*PRACH-Config*" is the generic type identifier in this example, and the "*SIB*" suffix is added to distinguish the variant. The clause heading and generic references to a group of closely related IEs defined in this way should use the generic type identifier.

The same principle should apply if a new version, or an extension version, of an existing IE is created for *critical* or *non-critical* extension of the protocol (see clause A.4). The new version, or the extension version, of the IE is included in the same ASN.1 section defining the original. A suffix is added to the type identifier, using the naming conventions defined in clause A.3.1.2, indicating the release or version of the where the new version, or extension version, was introduced.

Local IE type definitions, like the IE *PRACH-ConfigInfo* in the example above, may be included in the ASN.1 section and be referenced in the other IE types defined in the same ASN.1 section. The use of locally defined IE types should be encouraged, as a tool to break up large and complex IE type definitions. It can improve the readability of the

code. There may also be a benefit for the software implementation of the protocol end-points, as these IE types are typically provided by the ASN.1 compiler as independent data elements, to be used in the software implementation.

An IE type defined in a local context, like the IE *PRACH-ConfigInfo*, should not be referenced directly from other ASN.1 sections in the RRC specification. An IE type which is referenced in more than one ASN.1 section should be defined in a separate clause, with a separate heading and a separate ASN.1 section (possibly as one in a set of closely related IE types, like the IEs *PRACH-ConfigSIB* and *PRACH-Config* in the example above). Such IE types are also referred to as 'global IEs'.

NOTE: Referring to an IE type, that is defined as a local IE type in the context of another ASN.1 section, does not generate an ASN.1 compilation error. Nevertheless, using a locally defined IE type in that way makes the IE type definition difficult to find, as it would not be visible at an outline level of the specification. It should be avoided.

The ASN.1 section specifying the contents of one or more IE types, like in the example above, may be followed by a *field description* table, where a further description of, e.g., the semantic properties of the fields of the information elements may be included. This table may be absent, similar as indicated in clause A.3.3 for the specification of the PDU type. The general format of the *field description* table is the same as shown in clause A.3.3 for the specification of the PDU type.

A.3.5 Fields with optional presence

A field with optional presence may be declared with the keyword DEFAULT. It identifies a default value to be assumed, if the sender does not include a value for that field in the encoding:

```
-- /example/ ASN1START

PreambleInfo ::= SEQUENCE {
    numberOfRA-Preambles INTEGER (1..64) DEFAULT 1,
    ...
}

-- ASN1STOP
```

Alternatively, a field with optional presence may be declared with the keyword OPTIONAL. It identifies a field for which a value can be omitted. The omission carries semantics, which is different from any normal value of the field:

```
-- /example/ ASN1START

PRACH-Config ::= SEQUENCE {
   rootSequenceIndex INTEGER (0..1023),
   prach-ConfigInfo PRACH-ConfigInfo OPTIONAL -- Need N
}

-- ASN1STOP
```

The semantics of an optionally present field, in the case it is omitted, should be indicated at the end of the paragraph including the keyword OPTIONAL, using a short comment text with a need code. The need code includes the keyword "Need", followed by one of the predefined semantics tags (S, M, N or R) defined in clause 6.1. If the semantics tag S is used, the semantics of the absent field are further specified either in the field description table following the ASN.1 section, or in procedure text.

The addition of OPTIONAL keywords for capability groups is based on the following guideline. If there is more than one field in the lower level IE, then OPTIONAL keyword is added at the group level. If there is only one field in the lower level IE, OPTIONAL keyword is not added at the group level.

A.3.6 Fields with conditional presence

A field with conditional presence is declared with the keyword OPTIONAL. In addition, a short comment text shall be included at the end of the paragraph including the keyword OPTIONAL. The comment text includes the keyword "Cond", followed by a condition tag associated with the field ("UL" in this example):

```
-- /example/ ASN1START

LogicalChannelConfig ::= SEQUENCE {
   ul-SpecificParameters SEQUENCE {
      priority INTEGER (0),
      ...
   } OPTIONAL -- Cond UL

-- ASN1STOP
```

When conditionally present fields are included in an ASN.1 section, the field description table after the ASN.1 section shall be followed by a *conditional presence* table. The conditional presence table specifies the conditions for including the fields with conditional presence in the particular ASN.1 section.

Conditional pro	esence	Explanation
UL		Specification of the conditions for including the field associated with the condition tag = "UL". Semantics in case of optional presence under certain
		conditions may also be specified.

The conditional presence table has two columns. The first column (heading: "Conditional presence") contains the condition tag (in *italic* font style), which links the fields with a condition tag in the ASN.1 section to an entry in the table. The second column (heading: "Explanation") contains a text specification of the conditions and requirements for the presence of the field. The second column may also include semantics, in case of an optional presence of the field, under certain conditions i.e. using the same predefined tags as defined for optional fields in A.3.5.

Conditional presence should primarily be used when presence of a field depends on the presence and/or value of other fields within the same message. If the presence of a field depends on whether another feature/function has been configured, while this function can be configured independently e.g. by another message and/or at another point in time, the relation is best reflected by means of a statement in the field description table.

If the ASN.1 section does not include any fields with conditional presence, the conditional presence table shall not be included.

Whenever a field is only applicable in specific cases e.g. TDD, use of conditional presence should be considered.

A.3.7 Guidelines on use of lists with elements of SEQUENCE type

Where an information element has the form of a list (the SEQUENCE OF construct in ASN.1) with the type of the list elements being a SEQUENCE data type, an information element shall be defined for the list elements even if it would not otherwise be needed.

For example, a list of PLMN identities with reservation flags is defined as in the following example:

rather than as in the following (bad) example, which may cause generated code to contain types with unpredictable names:

```
-- /bad example/ ASN1START

PLMN-IdentityList ::= SEQUENCE (SIZE (1..6)) OF SEQUENCE {
   plmn-Identity PLMN-Identity,
   cellReservedForOperatorUse ENUMERATED {reserved, notReserved}
}

-- ASN1STOP
```

A.3.8 Guidelines on use of parameterised SetupRelease type

The usage of the parameterised *SetupRelease* type is like a function call in programming languages where the element type parameter is passed as a parameter. The parameterised type only implies a textual change in abstract syntax where all references to the parameterised type are replaced by the compiler with the release/setup choice. Two examples of the usage are shown below:

```
-- /example/ ASN1START
RRCMessage-rX-IEs ::= SEQUENCE {
   field-rX SetupRelease { IE-rX }
                                                     OPTIONAL,
                                                                 -- Need M
RRCMessage-rX-IEs ::= SEQUENCE {
   field-rX SetupRelease { Element-rX }
                                                        OPTIONAL,
                                                                -- Need M
Element-rX ::= SEQUENCE {
   field1-rX
                         IE1-rX,
                                                        OPTIONAL -- Need N
   field2-rX
                       IE2-rX
                                                           OPTIONAL, -- Need M
-- /example/ ASN1STOP
```

The SetupRelease is always be used with only named IEs, i.e. the example below is not allowed:

If a field defined using the parameterized SetupRelease type requires procedural text, the field is referred to using the values defined for the type itself, namely, "setup" and "release". For example, procedural text for field-rX above could be as follows:

```
1> if field-rX is set to "setup":
2> do something;
1> else (field-rX is set to "release"):
2> release field-rX (if appropriate).
```

A.3.9 Guidelines on use of ToAddModList and ToReleaseList

In order to benefit from delta signalling when modifying lists with many and/or large elements, so-called add/mod- and release- lists should be used. Instead of a single list containing all elements of the list, the ASN.1 provides two lists. One list is used to convey the actual elements that are to be added to the list or modified in the list. The second list conveys only the identities (IDs) of the list elements that are to be released from the list. In other words, the ASN.1 defines only means to signal modifications to a list maintained in the receiver (typically the UE). An example is provided below:

```
-- /example/ ASN1START

AnExampleIE ::= SEQUENCE {
    elementsToAddModList SEQUENCE (SIZE (1.maxNrofElements)) OF Element
    elementsToReleaseList SEQUENCE (SIZE (1.maxNrofElements)) OF ElementId
    ...
}

Element ::= SEQUENCE {
    elementId ElementId,
    aField INTEG ER (0..16777215),
    anotherField OCTET STRING,
    ...
}
```

```
ElementId ::= INTEGER (0..maxNrofElements-1)

maxNrofElements INTEGER ::= 50
maxNrofElements-1 INTEGER ::= 49

-- /example/ ASN1STOP
```

As can be seen, the elements of the list must contain an identity (INTEGER) that identifies the elements unambiguously upon addition, modification and removal. It is recommended to define an IE for that identifier (here ElementId) so that it can be used both for a field inside the element as well as in the *elementsToReleaseList*.

Both lists should be made OPTIONAL and flagged as "Need N". The need code reflects that the UE does not maintain the received lists as such but rather updates its configuration using the information therein. In other words, it is not possible to provide via delta signalling an update to a previously signalled *elementsToAddModList* or elementsToReleaseList (which Need M would imply). The update is always in relation to the UE's internal configuration.

Note that the release of a field (a list element as well as any other field) releases all its sub-fields (sub-fields configured by elementsToAddModList and any other sub-field).

If no procedural text is provided for a set of ToAddModList and ToReleaseList, the following generic procedure applies:

The UE shall:

- 1> for each *ElementId* in the *elementsToReleaseList*,:
 - 2> if the current UE configuration includes an *Element* with the given *ElementId*:
 - 3> release the *Element* from the current UE configuration;
- 1> for each *Element* in the *elementsToAddModList*:
 - 2> if the current UE configuration includes an *Element* with the given *ElementId*:
 - 3> modify the configured *Element* in accordance with the received *Element*;
 - 2> else:
 - 3> add received *Element* to the UE configuration.

A.3.10 Guidelines on use of of lists (without ToAddModList and ToReleaseList)

As per clause 6.1.3, when using lists without the ToAddModList and ToReleaseList structure, the contents of the lists are always replaced. To illustrate this, an example is provided below:

```
-- /example/ ASN1START
-- TAG_EXAMPLE_LISTS_START

AnexampleIE ::= SEQUENCE {
```

```
elementList
                         SEQUENCE (SIZE (1..maxNrofElements)) OF Element
                                                                                                      OPTIONAL, -- Need M
   elementListExt-v2030
                         SEQUENCE (SIZE (1..maxNrofElementsExt)) OF Element
                                                                                                      OPTIONAL, -- Need M
   11
Element ::= SEOUENCE {
   useFeatureX BOOLEAN, aField INTEGER
   aField INTEGER (0..127) anotherField INTEGER (0..127)
                                                                                                      OPTIONAL, -- Need M
                                                                                                      OPTIONAL, -- Need R
maxNrofElements-1 INTEGER ::= 7
maxNrofElementsExt
                     INTEGER ::= 8
maxNrofElementsExt-1 INTEGER ::= 7
-- TAG EXAMPLE LISTS STOP
-- /example/ ASN1STOP
```

As can be seen, the *elementList* list itself uses Need M, but each list entry *Element* contains mandatory, Need M and Need R fields. If the list is first signalled to UE with 3 entries, and subsequently again with 2 entries, UE shall retain only the latter list, i.e. the list with 2 elements will completely replace the list with 3 elements. That also means that the field *aField* will be treated as if it was newly created, i.e. network must include it if it wishes UE to utilize the field even if it was previously signalled. This also implies that the Need M field (*aField*) will be treated in the same way as the Need R field (*anotherField*), i.e. delta signalling is not applied and the network has to signal the field to ensure UE does not release the value (which is why Need M should not normally be used in the entries of these lists).

A.4 Extension of the PDU specifications

A.4.1 General principles to ensure compatibility

It is essential that extension of the protocol does not affect interoperability i.e. it is essential that implementations based on different versions of the RRC protocol are able to interoperate. In particular, this requirement applies for the following kind of protocol extensions:

- Introduction of new PDU types (i.e. these should not cause unexpected behaviour or damage).
- Introduction of additional fields in an extensible PDUs (i.e. it should be possible to ignore uncomprehended extensions without affecting the handling of the other parts of the message).
- Introduction of additional values of an extensible field of PDUs. If used, the behaviour upon reception of an uncomprehended value should be defined.

It should be noted that the PDU extension mechanism may depend on the logical channel used to transfer the message e.g. for some PDUs an implementation may be aware of the protocol version of the peer in which case selective ignoring of extensions may not be required.

The non-critical extension mechanism is the primary mechanism for introducing protocol extensions i.e. the critical extension mechanism is used merely when there is a need to introduce a 'clean' message version. Such a need appears when the last message version includes a large number of non-critical extensions, which results in issues like readability, overhead associated with the extension markers. The critical extension mechanism may also be considered when it is complicated to accommodate the extensions by means of non-critical extension mechanisms.

A.4.2 Critical extension of messages and fields

The mechanisms to critically extend a message are defined in A.3.3. There are both "outer branch" and "inner branch" mechanisms available. The "outer branch" consists of a CHOICE having the name *criticalExtensions*, with two values, *c1* and *criticalExtensionsFuture*. The *criticalExtensionsFuture* branch consists of an empty SEQUENCE, while the c1 branch contains the "inner branch" mechanism.

The "inner branch" structure is a CHOICE with values of the form "MessageName-rX-IEs" (e.g., "RRCConnectionReconfiguration-r8-IEs") or "spareX", with the spare values having type NULL. The "-rX-IEs" structures contain the complete structure of the message IEs for the appropriate release; i.e., the critical extension branch for the Rel-10 version of a message includes all Rel-8 and Rel-9 fields (that are not obviated in the later version), rather than containing only the additional Rel-10 fields.

The following guidelines may be used when deciding which mechanism to introduce for a particular message, i.e. only an 'outer branch', or an 'outer branch' in combination with an 'inner branch' including a certain number of spares:

- For certain messages, e.g. initial uplink messages, messages transmitted on a broadcast channel, critical extension may not be applicable.
- An outer branch may be sufficient for messages not including any fields.
- The number of spares within inner branch should reflect the likelihood that the message will be critically extended in future releases (since each release with a critical extension for the message consumes one of the spare values). The estimation of the critical extension likelihood may be based on the number, size and changeability of the fields included in the message.
- In messages where an inner branch extension mechanism is available, all spare values of the inner branch should be used before any critical extensions are added using the outer branch.

The following example illustrates the use of the critical extension mechanism by showing the ASN.1 of the original and of a later release

```
-- /example/ ASN1START
                                         -- Later release
RRCMessage ::=
                                        SEOUENCE {
   rrc-TransactionIdentifier
                                            RRC-TransactionIdentifier,
    criticalExtensions
                                                CHOICE {
                                                     CHOICE {
           rrcMessage-r8
                                                         RRCMessage-r8-IEs,
           rrcMessage-r10
                                                         RRCMessage-r10-IEs,
           rrcMessage-r11
                                                        RRCMessage-r11-IEs,
           rrcMessage-r14
                                                        RRCMessage-r14-IEs
       later
                                                   CHOICE {
            c2
                                                        CHOICE {
                rrcMessage-r16
                                                            RRCMessage-r16-IEs,
                spare7 NULL, spare6 NULL, spare5 NULL, spare4 NULL,
                spare3 NULL, spare2 NULL, spare1 NULL
            criticalExtensionsFuture
                                                    SEOUENCE {}
-- ASN1STOP
```

It is important to note that critical extensions may also be used at the level of individual fields i.e. a field may be replaced by a critically extended version. When sending the extended version, the original version may also be included (e.g. original field is mandatory, E-UTRAN is unaware if UE supports the extended version). In such cases, a UE supporting both versions may be required to ignore the original field. The following example illustrates the use of the critical extension mechanism by showing the ASN.1 of the original and of a later release.

```
-- /example/ ASN1START
                                       -- Original release
RRCMessage ::=
                                       SEOUENCE {
    rrc-TransactionIdentifier
                                           RRC-TransactionIdentifier,
    criticalExtensions
                                           CHOICE {
                                               CHOICE {
           rrcMessage-r8
                                                   RRCMessage-r8-IEs,
           spare3 NULL, spare2 NULL, spare1 NULL
       criticalExtensionsFuture
                                           SEQUENCE {}
RRCMessage-rN-IEs ::= SEQUENCE {
    field1-rN
                                       ENUMERATED {
                                           value1, value2, value3, value4}
                                                                               OPTIONAL,
                                                                                          -- Need N
    field2-rN
                                       InformationElement2-rN
                                                                               OPTIONAL,
                                                                                          -- Need N
    nonCriticalExtension
                                       RRCConnectionReconfiguration-vMxy-IEs
                                                                              OPTIONAL
RRCConnectionReconfiguration-vMxy-IEs ::= SEQUENCE {
    field2-rM
                                             InformationElement2-rM
                                                                               OPTIONAL, -- Cond NoField2rN
    nonCriticalExtension
                                             SEQUENCE {}
                                                                               OPTIONAL
```

-- ASN1STOP

Conditional presence	Explanation
NoField2rN	The field is optionally present, need N, if field2-rN is absent. Otherwise the field is absent

Finally, it is noted that a critical extension may be introduced in the same release as the one in which the original field was introduced e.g. to correct an essential ASN.1 error. In such cases a UE capability may be introduced, to assist the network in deciding whether or not to use the critical extension.

A.4.3 Non-critical extension of messages

A.4.3.1 General principles

The mechanisms to extend a message in a non-critical manner are defined in A.3.3. W.r.t. the use of extension markers, the following additional guidelines apply:

- When further non-critical extensions are added to a message that has been critically extended, the inclusion of these non-critical extensions in earlier critical branches of the message should be avoided when possible.
- The extension marker ("...") is the primary non-critical extension mechanism that is used but empty sequences may be used if length determinant is not required. Examples of cases where a length determinant is not required:
 - at the end of a message;
 - at the end of a structure contained in a BIT STRING or OCTET STRING.
- When an extension marker is available, non-critical extensions are preferably placed at the location (e.g. the IE) where the concerned parameter belongs from a logical/functional perspective (referred to as the 'default extension location').
- It is desirable to aggregate extensions of the same release or version of the specification into a group, which should be placed at the lowest possible level.
- In specific cases it may be preferable to place extensions elsewhere (referred to as the 'actual extension location') e.g. when it is possible to aggregate several extensions in a group. In such a case, the group should be placed at the lowest suitable level in the message.
- In case placement at the default extension location affects earlier critical branches of the message, locating the extension at a following higher level in the message should be considered.
- In case an extension is not placed at the default extension location, an IE should be defined. The IE's ASN.1 definition should be placed in the same ASN.1 section as the default extension location. In case there are intermediate levels in-between the actual and the default extension location, an IE may be defined for each level. Intermediate levels are primarily introduced for readability and overview. Hence intermediate levels need not always be introduced e.g. they may not be needed when the default and the actual extension location are within the same ASN.1 section.

A.4.3.2 Further guidelines

Further to the general principles defined in the previous section, the following additional guidelines apply regarding the use of extension markers:

- Extension markers within SEQUENCE:
 - Extension markers are primarily, but not exclusively, introduced at the higher nesting levels.
 - Extension markers are introduced for a SEQUENCE comprising several fields as well as for information elements whose extension would result in complex structures without it (e.g. re-introducing another list).
 - Extension markers are introduced to make it possible to maintain important information structures e.g. parameters relevant for one particular RAT.
 - Extension markers are also used for size critical messages (i.e. messages on BCCH, BR-BCCH, PCCH and CCCH), although introduced somewhat more carefully.
 - The extension fields introduced (or frozen) in a specific version of the specification are grouped together using double brackets.
- Extension markers within ENUMERATED:
 - Spare values may be used until the number of values reaches the next power of 2, while the extension marker caters for extension beyond that limit, given that the use of spare values in a later Release is possible without any error cases.
 - A suffix of the form "vXYZ" is used for the identifier of each new value, e.g. "value-vXYZ".
- Extension markers within CHOICE:
 - Extension markers are introduced when extension is foreseen and when comprehension is not required by the receiver i.e. behaviour is defined for the case where the receiver cannot comprehend the extended value (e.g. ignoring an optional CHOICE field). It should be noted that defining the behaviour of a receiver upon receiving a not comprehended choice value is not required if the sender is aware whether or not the receiver supports the extended value.
 - A suffix of the form "vXYZ" is used for the identifier of each new choice value, e.g. "choice-vXYZ".

Non-critical extensions at the end of a message/ of a field contained in an OCTET or BIT STRING:

- When a nonCriticalExtension is actually used, a "Need" code should not be provided for the field, which always is a group including at least one extension and a field facilitating further possible extensions. For simplicity, it is recommended not to provide a "Need" code when the field is not actually used either.

Further, more general, guidelines:

- In case a need code is not provided for a group, a "Need" code is provided for all individual extension fields within the group i.e. including for fields that are not marked as OPTIONAL. The latter is to clarify the action upon absence of the whole group.

A.4.3.3 Typical example of evolution of IE with local extensions

The following example illustrates the use of the extension marker for a number of elementary cases (sequence, enumerated, choice). The example also illustrates how the IE may be revised in case the critical extension mechanism is used.

NOTE In case there is a need to support further extensions of release n while the ASN.1 of release (n+1) has been frozen, without requiring the release n receiver to support decoding of release (n+1) extensions, more advanced mechanisms are needed e.g. including multiple extension markers.

```
-- /example/ ASN1START
InformationElement1 ::=
                                   SEQUENCE {
    field1
                                       ENUMERATED {
                                          value1, value2, value3, value4-v880,
                                          ..., value5-v960 },
    field2
                                      CHOICE {
       field2a
                                          BOOLEAN,
       field2b
                                          InformationElement2b,
       field2c-v960
                                          InformationElement2c-r9
   11
   field3-r9
                                      InformationElement3-r9
                                                                  OPTIONAL
                                                                                 -- Need R
   ]],
   field3-v9a0
                                      InformationElement3-v9a0
                                                                                 -- Need R
                                                                  OPTIONAL,
   field4-r9
                                      InformationElement4
                                                                  OPTIONAL
                                                                                  -- Need R
    ]]
InformationElement1-r10 ::=
                                  SEQUENCE {
    field1
                                          value1, value2, value3, value4-v880,
                                          value5-v960, value6-v1170, spare2, spare1, ... },
    field2
                                      CHOICE {
       field2a
                                          BOOLEAN,
       field2b
                                          InformationElement2b,
       field2c-v960
                                          InformationElement2c-r9,
       field2d-v12b0
                                          INTEGER (0..63)
   field3-r9
                                      InformationElement3-r10
                                                                      OPTIONAL, -- Need R
   field4-r9
                                      InformationElement4
                                                                   OPTIONAL, -- Need R
   field5-r10
                                      BOOLEAN,
   field6-r10
                                      InformationElement6-r10
                                                                      OPTIONAL, -- Need R
    field3-v1170
                                      InformationElement3-v1170
                                                                      OPTIONAL
                                                                                 -- Need R
    ]]
-- ASN1STOP
```

Some remarks regarding the extensions of *InformationElement1* as shown in the above example:

- The *InformationElement1* is initially extended with a number of non-critical extensions. In release 10 however, a critical extension is introduced for the message using this IE. Consequently, a new version of the IE *InformationElement1* (i.e. *InformationElement1-r10*) is defined in which the earlier non-critical extensions are incorporated by means of a revision of the original field.
- The *value4-v880* is replacing a spare value defined in the original protocol version for *field1*. Likewise *value6-v1170* replaces *spare3* that was originally defined in the r10 version of *field1*.
- Within the critically extended release 10 version of *InformationElement1*, the names of the original fields/IEs are not changed, unless there is a real need to distinguish them from other fields/IEs. E.g. the *field1* and *InformationElement4* were defined in the original protocol version (release 8) and hence not tagged. Moreover, the *field3-r9* is introduced in release 9 and not re-tagged; although, the *InformationElement3* is also critically extended and therefore tagged *InformationElement3-r10* in the release 10 version of InformationElement1.

A.4.3.4 Typical examples of non critical extension at the end of a message

The following example illustrates the use of non-critical extensions at the end of the message or at the end of a field that is contained in a BIT or OCTET STRING i.e. when an empty sequence is used.

```
-- /example/ ASN1START
RRCMessage-r8-IEs ::=
                              SEOUENCE {
    field1
                                  InformationElement1,
    field2
                                  InformationElement2,
    field3
                                  InformationElement3
                                                                    OPTIONAL, -- Need N
    nonCriticalExtension
                                  RRCMessage-v860-IEs
                                                                     OPTIONAL
RRCMessage-v860-IEs ::= SEQUENCE {
    field4-v860
                             InformationElement4
                                                                     OPTIONAL, -- Need S
                                                                    OPTIONAL, -- Cond C54
    field5-v860
                                  BOOLEAN
    nonCriticalExtension
                                  RRCMessage-v940-IEs
                                                                     OPTIONAL
RRCMessage-v940-IEs ::=
                              SEOUENCE {
    field6-v940
                                  InformationElement6-r9
                                                                     OPTIONAL,
                                                                                -- Need R
                                  SEQUENCE {}
    nonCriticalExtensions
                                                                     OPTIONAL
  ASN1STOP
```

Some remarks regarding the extensions shown in the above example:

- The *InformationElement4* is introduced in the original version of the protocol (release 8) and hence no suffix is used.

A.4.3.5 Examples of non-critical extensions not placed at the default extension location

The following example illustrates the use of non-critical extensions in case an extension is not placed at the default extension location.

ParentIE-WithEM

The IE *ParentIE-WithEM* is an example of a high level IE including the extension marker (EM). The root encoding of this IE includes two lower level IEs *ChildIE1-WithoutEM* and *ChildIE2-WithoutEM* which not include the extension marker. Consequently, non-critical extensions of the Child-IEs have to be included at the level of the Parent-IE.

The example illustrates how the two extension IEs *ChildIE1-WithoutEM-vNx0* and *ChildIE2-WithoutEM-vNx0* (both in release N) are used to connect non-critical extensions with a default extension location in the lower level IEs to the actual extension location in this IE.

ParentlE-WithEM information element

```
-- /example/ ASN1START
                                   SEOUENCE {
ParentIE-WithEM ::=
    -- Root encoding, including:
                                                                                  -- Need N
    childIE1-WithoutEM
                                       ChildIE1-WithoutEM
                                                                       OPTIONAL,
    childIE2-WithoutEM
                                       ChildIE2-WithoutEM
                                                                       OPTIONAL.
                                                                                      -- Need N
    [[
    childIE1-WithoutEM-vNx0
                                       ChildIE1-WithoutEM-vNx0
                                                                   OPTIONAL,
                                                                                   -- Need N
    childIE2-WithoutEM-vNx0
                                       ChildIE2-WithoutEM-vNx0
                                                                   OPTIONAL
                                                                                   -- Need N
-- ASN1STOP
```

Some remarks regarding the extensions shown in the above example:

- The fields *childIEx-WithoutEM-vNx0* may not really need to be optional (depends on what is defined at the next lower level).
- In general, especially when there are several nesting levels, fields should be marked as optional only when there is a clear reason.

ChildIE1-WithoutEM

The IE *ChildIE1-WithoutEM* is an example of a lower level IE, used to control certain radio configurations including a configurable feature which can be setup or released using the local IE *ChIE1-ConfigurableFeature*. The example illustrates how the new field *chIE1-NewField* is added in release N to the configuration of the configurable feature. The example is based on the following assumptions:

- When initially configuring as well as when modifying the new field, the original fields of the configurable feature have to be provided also i.e. as if the extended ones were present within the setup branch of this feature.
- When the configurable feature is released, the new field should be released also.

- When omitting the original fields of the configurable feature the UE continues using the existing values (which is used to optimise the signalling for features that typically continue unchanged upon handover).
- When omitting the new field of the configurable feature the UE releases the existing values and discontinues the associated functionality (which may be used to support release of unsupported functionality upon handover to an eNB supporting an earlier protocol version).

The above assumptions, which affect the use of conditions and need codes, may not always apply. Hence, the example should not be re-used blindly.

ChildIE1-WithoutEM information element

```
-- /example/ ASN1START
ChildIE1-WithoutEM ::=
                                   SEOUENCE {
   -- Root encoding, including:
   chIE1-ConfigurableFeature
                                       ChIE1-ConfigurableFeature
                                                                      OPTIONAL
                                                                                      -- Need N
ChildIE1-WithoutEM-vNx0 ::= SEOUENCE {
                                       ChIEl-ConfigurableFeature-vNx0 OPTIONAL -- Cond ConfigF
    chIE1-ConfigurableFeature-vNx0
ChIE1-ConfigurableFeature ::=
                                   CHOICE {
   release
                                       NULL,
                                       SEOUENCE {
       -- Root encoding
ChIE1-ConfigurableFeature-vNx0 ::= SEQUENCE {
   chIE1-NewField-rN
                                      INTEGER (0..31)
-- ASN1STOP
```

Conditional presence	Explanation
ConfigF	The field is optional present, need R, in case of chlE1-ConfigurableFeature is included and set to "setup"; otherwise the field is absent and the UE
	shall delete any existing value for this field.

ChildIE2-WithoutEM

The IE *ChildIE2-WithoutEM* is an example of a lower level IE, typically used to control certain radio configurations. The example illustrates how the new field *chIE1-NewField* is added in release N to the configuration of the configurable feature.

ChildIE2-WithoutEM information element

```
-- /example/ ASN1START
```

Conditional presence	Explanation
ConfigF	The field is optional present, need R, in case of chIE2-ConfigurableFeature is included and set to "setup"; otherwise the field is absent and the UE
	shall delete any existing value for this field.

A.5 Guidelines regarding inclusion of transaction identifiers in RRC messages

The following rules provide guidance on which messages should include a Transaction identifier

- 1: DL messages on CCCH that move UE to RRC-Idle should not include the RRC transaction identifier.
- 2: All network initiated DL messages by default should include the RRC transaction identifier.
- 3: All UL messages that are direct response to a DL message with an RRC Transaction identifier should include the RRC Transaction identifier.
- 4: All UL messages that require a direct DL response message should include an RRC transaction identifier.
- 5: All UL messages that are not in response to a DL message nor require a corresponding response from the network should not include the RRC Transaction identifier.

A.6 Guidelines regarding use of need codes

The following rule provides guidance for determining need codes for optional downlink fields:

- if the field needs to be stored by the UE (i.e. maintained) when absent:
 - use Need M (=Maintain);
- else, if the field needs to be released by the UE when absent:
 - use Need R (=Release);

- else, if UE shall take no action when the field is absent (i.e. UE does not even need to maintain any existing value of the field):
 - use Need N (=None);
- else (UE behaviour upon absence does not fit any of the above conditions):
 - use Need S (=Specified);
 - specify the UE behaviour upon absence of the field in the procedural text or in the field description table.

A.7 Guidelines regarding use of conditions

Conditions are primarily used to specify network restrictions, for which the following types can be distinguished:

- Message Contents related constraints e.g. that a field B is mandatory present if the same message includes field A and when it is set value X.
- Configuration Constraints e.g. that a field D can only be signalled if field C is configured and set to value Y. (i.e. regardless of whether field C is present in the same message or previously configured).

The use of these conditions is illustrated by an example.

```
-- /example/ ASN1START
RRCMessage-IEs ::= SEQUENCE {
    fieldA
                                   FieldA
                                                          OPTIONAL, -- Need M
    fieldB
                                   FieldB
                                                          OPTIONAL, -- Cond FieldAsetToX
    fieldC
                                                          OPTIONAL, -- Need M
                                   FieldC
                                                                     -- Cond FieldCsetToY
    fieldD
                                   FieldD
                                                          OPTIONAL,
                                   SEQUENCE {}
   nonCriticalExtension
  /example/ ASN1STOP
```

Conditional presence	Explanation
FieldAsetToX	The field is mandatory present if fieldA is included and set to valueX. Otherwise the field
	is optionally present, need R.
FieldCsetToY	The field is optionally present, need M, if fieldC is configured and set to valueY. Otherwise
	the field is absent and the UE does not maintain the value

A.8 Miscellaneous

The following miscellaneous convention should be used:

- UE capabilities: TS 38.306 [26] specifies that the network should in general respect the UE's capabilities. Hence there is no need to include statement clarifying that the network, when setting the value of a certain configuration field, shall respect the related UE capabilities unless there is a particular need e.g. particularly complicated cases.

Annex B (informative): RRC Information

B.1 Protection of RRC messages

The following list provides information which messages can be sent (unprotected) prior to AS security activation and which messages can be sent unprotected after AS security activation. Those messages indicated "-" in "P" column should never be sent unprotected by gNB or UE. Further requirements are defined in the procedural text.

- P...Messages that can be sent (unprotected) prior to AS security activation
- A I...Messages that can be sent without integrity protection after AS security activation
- A C...Messages that can be sent unciphered after AS security activation
- NA... Message can never be sent after AS security activation

Message	Р	A-I	A-C	Comment
CounterCheck	-	-	-	
CounterCheckResponse	-	-	-	
DLInformationTransfer	+	-	-	
FailureInformation	-	-	-	
LocationMeasurementIndication	-	-	-	
MIB	+	+	+	
MeasurementReport	-	-	-	Measurement configuration may be sent prior to AS security activation. But: In order to protect privacy of UEs, MeasurementReport is only sent from the UE after successful AS security activation.
MobilityFromNRCommand	-	-	-	
Paging	+	+	+	
RRCReconfiguration	+	-	-	The message shall not be sent unprotected before AS security activation if it is used to perform handover or to establish SRB2 and DRBs.
RRCReconfigurationComplete	+	-	-	Unprotected, if sent as response to RRCReconfiguration which was sent before AS security activation.
RRCReestablishment	-	-	+	Integrity protection applied, but no ciphering.
RRCReestablishmentComplete	-	-	-	
RRCReestablishmentRequest	-	-	+	This message is not protected by PDCP operation. However, a shortMAC-I is included.
RRCReject	+	+	+	Justification for A-I and A-C: the message can be sent in SRB0 in RRC_INACTIVE state, after the AS security is activated.
RRCRelease	+	-	-	Justification for P: If the RRC connection only for signalling not requiring DRBs or ciphered messages, or the signalling connection has to be released prematurely, this message is sent as unprotected. RRCRelease message sent before AS security activation cannot include deprioritisationReg, suspendConfig, redirectedCarrierInfo, cellReselectionPriorities information fields.
RRCResume	-	-	-	<u></u>
RRCResumeComplete	-	-	-	
RRCResumeRequest	-	-	+	This message is not protected by PDCP operation. However, a resumeMAC-I is included.
RRCResumeRequest1	-	-	+	This message is not protected by PDCP operation. However, a <i>resumeMAC-I</i> is included.
RRCSetup	+	+	+	Justification for A-I and A-C: the message can be sent in SRB0 in RRC_INACTIVE or RRC_CONNECTED states, after the AS security is activated.
RRCSetupComplete	+	NA	NA	·
RRCSetupReguest	+	NA	NA	
RRCSystemInfoRequest	+	+	+	Justification for A-I and A-C: the message can be sent in SRB0 in RRC_INACTIVE state, after the AS security is activated.
SIB1	+	+	+	
SCGFailureInformation	-	-	-	
SCGFailureInformationEUTRA	-	-	-	
SecurityModeCommand	+	NA	NA	Integrity protection applied, but no ciphering (integrity verification done after the message received by RRC).
SecurityModeComplete	-	-	+	The message is sent after AS security activation. Integrity protection applied, but no ciphering. Ciphering is applied after completing the procedure.
SecurityModeFailure	+	NA	NA	Neither integrity protection nor ciphering applied.
SystemInformation	+	+	+	
UEAssistanceInformation	-	-	-	
UECapabilityEnquiry	+	-	-	The network should retrieve UE capabilities only after AS security activation.
UECapabilityInformation	+	-	-	

Message	Р	A-I	A-C	Comment
ULInformationTransfer	+	-	-	
ULInformationTransferMRDC	-	-	-	

B.2 Description of BWP configuration options

There are two possible ways to configure BWP#0 (i.e. the initial BWP) for a UE:

- 1) Configure BWP-DownlinkCommon and BWP-UplinkCommon in ServingCellConfigCommon, but do not configure dedicated configurations in BWP-DownlinkDedicated or BWP-UplinkDedicated in ServingCellConfig.
- 2) Configure both *BWP-DownlinkCommon* and *BWP-UplinkCommon* in *ServingCellConfigCommon* and configure dedicated configurations in at least one of *BWP-DownlinkDedicated* or *BWP-UplinkDedicated* in *ServingCellConfig*.

The same way of configuration is used for UL BWP#0 and DL BWP#0 if both are configured.

With the first option (illustrated by figure B2-1 below), the BWP#0 is not considered to be an RRC-configured BWP, i.e. UE only supporting one BWP can still be configured with BWP#1 in addition to BWP#0 when using this configuration. The BWP#0 can still be used even if it does not have the dedicated configuration, albeit in a more limited manner since only the SIB1-defined configurations are available. For example, only DCI format 1_0 can be used with BWP#0 without dedicated configuration, so changing to another BWP requires RRCReconfiguration since DCI format 1_0 doesn't support DCI-based switching.

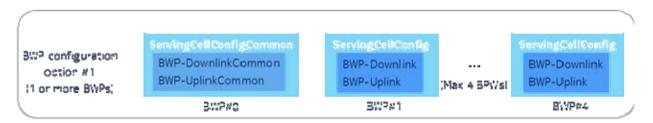


Figure B2-1: BWP#0 configuration without dedicated configuration

With the second option (illustrated by figure B2-2 below), the BWP#0 is considered to be an RRC-configured BWP, i.e. UE only supporting one BWP cannot be configured with BWP#1 in addition to BWP#0 when using this configuration. However, UE supporting more than one BWP can still switch to and from BWP#0 e.g. via DCI normally, and there are no explicit limitations to using the BWP#0 (compared to the first option).



Figure B2-2: BWP#0 configuration with dedicated configuration

For BWP#0, the BWP-DownlinkCommon and BWP-UplinkCommon in ServingCellConfigCommon should match the parameters configured by MIB and SIB1 (if provided) in the corresponding serving cell.

Annex C (informative): Change history

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	Change history								
Date	Meeti ng	TDoc	CR	R ev	C at	Subject/Comment	New versio n		
04/2017	RAN2 #97bis	R2-1703395					0.0.1		
04/2017		R2-1703922					0.0.2		
05/2017		R2-1705815					0.0.3		
06/2017		R2-1707187					0.0.4		
08/2017		R2-1708468					0.0.5		
09/2017		R2-1710557					0.1.0		
11/2017		R2-1713629					0.2.0		
11/2017		R2-1714126					0.3.0		
12/2017		R2-1714259					0.4.0		
12/2017		RP-172570				Submitted for Approval in RAN#78	1.0.0		
12/2017	RP#78					Upgraded to Rel-15 (MCC)	15.0.0		
03/2018		RP-180479	8000	1	F	Corrections for EN-DC (Note: the clause numbering between 15.0.0 and 15.1.0 has changed in some cases).	15.1.0		
06/2018	RP-80	RP-181326	0042	7	F	Miscellaneous EN-DC corrections	15.2.0		
	RP-80					Correction: Duplicate Foreword clause removed & ASN.1 clauses touched up	15.2.1		
09/2018	RP-81	RP-181942	0100	4	F	Introduction of SA	15.3.0		
12/2018		RP-182656	0179	3	F	Handling of Resume Failure	15.4.0		
		RP-182651	0187	1	F	Clarification on the presence of ra-ResponseWindow	15.4.0		
		RP-182656	0188	3	F	Addition of RAN specific Access Category	15.4.0		
	RP-82	RP-182653	0199	2	F	CR for TS38.331 on MIB	15.4.0		
	RP-82	RP-182653	0200	1	F	CR for TS38.331 on PDCCH-ConfigSIB	15.4.0		
	RP-82	RP-182661	0202	2	F	Handling Cell Reselection during SI Request	15.4.0		
	RP-82	RP-182649	0213	2	F	Corrections on security field descriptions	15.4.0		
	RP-82	RP-182649	0216	2	F	Remain issue for T302	15.4.0		
	RP-82	RP-182649	0219	1	F	[C204] Handling of timer T380	15.4.0		
		RP-182655	0229	2	F	Clarification on configured grant timer in 38.331	15.4.0		
		RP-182663	0232	2	F	CR for ServingCellConfigCommon in 38.331	15.4.0		
		RP-182659	0234	3	F	Introduction of cell level rate matching parameters in ServingCellConfig	15.4.0		
		RP-182650	0235	2	F	CR for introducing PSCell frequency in CG-Config	15.4.0		
	RP-82	RP-182650	0236	2	F	CR for security handling for eLTE in 38.331	15.4.0		
		RP-182650	0237	1	F	Handling on simultaneously triggered NAS&AS events (I770)	15.4.0		
	RP-82	RP-182650	0238	2	F	Handling on security keys for resume procedure (I774)	15.4.0		
		RP-182664	0239	5	F	RIL I556, I557, I558 on RB handling when resuming	15.4.0		
		RP-182650	0242	2	F	Security for RRC connection release	15.4.0		
	RP-82	RP-182650	0243	4	F	Corrections on reestablishment and security procedures	15.4.0		

RP-82	RP-182650	0244	1	F	RIL I118 on release case to upper layers for CN paging for a UE in	15.4.0
					RRC_INACTIVE	
	RP-182650	0246	2	F	CR on SI request procedure in TS38.331	15.4.0
	RP-182650	0248	2	F	CR to 38331 on ul-DataSplitThreshold for SRB	15.4.0
	RP-182652	0249	2	F	Clarification of guami-Type	15.4.0
	RP-182652	0252	1	F	CR to 38.331 on Protection of RRC messages Table	15.4.0
	RP-182663	0254	2	F	Access barring check after handover	15.4.0
	RP-182663	0259	3	F	Stop of T390 and related UE actions	15.4.0
	RP-182657	0260	4	F	Corrections for handover between NR and E-UTRA	15.4.0
	RP-182738	0267	3	F	CR on ssb-ToMeasure in MeasurementTimingConfiguration	15.4.0
	RP-182659	0269	3	F	Clarification of the applicability of 38.331 to EN-DC	15.4.0
RP-82	RP-182654	0270	3	F	Clarification on the smtc signalled for intra-NR handover, PSCell change or SCell addition	15.4.0
RP-82	RP-182654	0273	3	F	CR on fallback to the setup procedure	15.4.0
RP-82	RP-182654	0275	1	F	Correction on cell sorting for periodical measurement reporting	15.4.0
	RP-182660	0277	2	F	Measurement related actions upon re-establishment	15.4.0
RP-82	RP-182654	0278	1	F	CR on threshold description for cell quality derivation	15.4.0
RP-82	RP-182654	0282	1	F	CR to avoid unnecessary L3 filtered beam measurements	15.4.0
RP-82	RP-182660	0283	2	F	CR on CGI reporting	15.4.0
RP-82	RP-182660	0291	3	F	Additional UE capabilities for NR standalone	15.4.0
RP-82	RP-182667	0294	4	F	NR RRC Processing Time	15.4.0
RP-82	RP-182812	0295	5	F	Update of L1/RF capabilities	15.4.0
RP-82	RP-182651	0296	2	F	UE configuration on re-establishment procedure	15.4.0
RP-82	RP-182651	0298	2	F	SIB size limitation [M201]	15.4.0
RP-82	RP-182651	0299	2	F	Correction on SRS-TPC-CommandConfig	15.4.0
RP-82	RP-182651	0302	2	F	Clarification on counter check procedure	15.4.0
RP-82	RP-182666	0307	4	F	CR on the Clarification for the Support of the Delay Budget Report in NR	15.4.0
	RP-182666	0320	3	F	ssb-PositionsInBurst correction	15.4.0
RP-82	RP-182666	0325	3	F	Barring behaviour when SIB1 reception fails	15.4.0
RP-82	RP-182666	0329	5	F	System Information Storing and Validity Clarifications and Corrections	15.4.0
RP-82	RP-182666	0330	3	F	SIBs required before initiating connection	15.4.0
RP-82	RP-182652	0333	1	F	On contens of measObjectEUTRA	15.4.0
RP-82	RP-182654	0335	2	F	A3 and A5 corrections – neighbouring cell definition	15.4.0
RP-82	RP-182650	0339	2	F	SI reception in RRC Connected mode (RIL#II611)	15.4.0
	RP-182650	0340	2	F	Miscellaneous corrections on SI procedures	15.4.0
	RP-182652	0342	1	F	On RRM measurements related procedual text corrections	15.4.0
	RP-182651	0344	1	F	Clarification for absense of nr-NS-PmaxList IE	15.4.0
	RP-182652	0345	2	F	Clarification on paging in connected mode	15.4.0
	RP-182651	0350	2	F	ASN.1 correction to fr-InfoListSCG in CG-Config	15.4.0
	RP-182661	0355	2	F	Update of L2 capability parameters	15.4.0
	RP-182651	0364	1	F	Procedures for full config at RRCResume	15.4.0
	RP-182651	0365	2	F	Clarification of PDCP-Config field descriptions	15.4.0
	RP-182653	0368	2	F	UE Context handling during handover to NR	15.4.0
RP-82	RP-182652	0371	2	F	[E255] CR to 38.331 on corrections related to CGI reporting timer T321	15.4.0
	RP-182655	0375	3	F	R2-1817981 CR to 38.331 on pendingRnaUpdate setting	15.4.0
	RP-182653	0376	2	F	Introducing procedure for reporting RLC failures	15.4.0
	RP-182654	0379	2	F	Correction of frequency band indication in MeasObjectNR	15.4.0
	RP-182654	0382	2	F	RRC connection release triggered by upper layers	15.4.0
	RP-182660	0384	3	F	Correction to configuration of measurement object	15.4.0

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RP-82 RP-182665 0388 3 F Correction to 38331 in SRS-Config	15.4.0 15.4.0
RP-82 RP-182668 0395 4 F Inter-band EN-DC Configured Output Power requirements RP-82 RP-182655 0396 2 F E573 Configuration of SRB1 during Resume	15.4.0
RP-82 RP-182655 0396 2 F E573 Configuration of SRB1 during Resume	
	15.4.0
RP-82 RP-182655 0402 1 F Triggers for abortion of RRC establishment	15.4.0
The or its rorood to tor it it images to aboution of the colabilities.	15.4.0
RP-82 RP-182656 0406 2 F Correction on CN type indication for Redirection from NR to E-U	JTRA 15.4.0
RP-82 RP-182664 0409 4 F Miscellaneous minor corrections	15.4.0
RP-82 RP-182654 0410 1 F Invalidation of L1 parameter nrofCQIsPerReport	15.4.0
RP-82 RP-182654 0411 1 F Clarifications on RNA update and CN registration (N023)	15.4.0
RP-82 RP-182666 0412 3 F Missing optionality bit in CG-ConfigInfo	15.4.0
RP-82 RP-182662 0414 2 F Clarification for the implementation of UE feature list item 6-1 (B	
RP-82 RP-182654 0417 1 F Clarification on ssb-PositionsInBurst	15.4.0
RP-82 RP-182667 0418 3 F Correction to commonControlResourceSet	15.4.0
RP-82 RP-182667 0420 2 F Correction to TDD configuration in SIB1	15.4.0
RP-82 RP-182668 0421 5 F Clarification on handling of default parameters	15.4.0
RP-82 RP-182663 0429 2 F SRB3 integrity protection failure handling	15.4.0
RP-82 RP-182653 0431 2 F Corrections to the field decriptions of System Information	15.4.0
RP-82 RP-182653 0434 1 F Correction to SI provision in connected mode	15.4.0
RP-82 RP-182661 0436 3 F PDCCH Monitoring Occasions in SI Window	15.4.0
RP-82 RP-182655 0438 3 F CR on SI Message Acquisition	15.4.0
RP-82 RP-182652 0439 1 F Update of nas-SecurityParamFromNR according to LS from SA3	
RP-82 RP-182652 0445 2 F Correction to Default MAC Cell Group configuration	15.4.0
RP-82 RP-102032 0443 2 F Correction to Default MAC Cell Gloup Configuration RP-82 RP-182652 0447 1 F Correction to missing field descriptions of PLMN Identity	
	15.4.0
	15.4.0
RP-82 RP-182657 0449 2 F Correction to PDCP statusReportRequired	15.4.0
RP-82 RP-182664 0454 3 F CR to 38.331 on the ambiguity of targetCellIdentity in	15.4.0
RP-82 RP-182655 0457 1 F Corrections on P-Max description	15.4.0
RP-82 RP-182656 0469 2 F Correction on conditional presence of PCellOnly	15.4.0
RP-82 RP-182657 0474 4 F Introduction of power boosting indicator for pi2BPSK waveform	15.4.0
RP-82 RP-182655 0475 1 F Correction on the allowedBC-ListMRDC	15.4.0
RP-82 RP-182649 0476 2 F Removal of restriction on RB removal and addition	15.4.0
RP-82 RP-182649 0482 2 F Correction to full configuration	15.4.0
RP-82 RP-182661 0492 3 F CR on MeasurementTimingConfiguration	15.4.0
RP-82 RP-182654 0502 1 F Bandwidth configuration for initial BWP	15.4.0
RP-82 RP-182664 0503 4 F CORESET#0 configuration when SIB1 is not broadcast	15.4.0
RP-82 RP-182663 0506 1 F Correction on the behaviors with cell reselection while T302 is ru	
RP-82 RP-182661 0509 2 F Correction on SDAP reconfiguration handling	15.4.0
RP-82 RP-182663 0510 1 F Clarification for the UE behaviour in camped normally and camp cell states	ped on any 15.4.0
RP-82 RP-182663 0514 2 F Correction to description of parameter Ns nAndPagingFrameOff	
RP-82 RP-182649 0515 - F Correction to description of parameter Ns	15.4.0
RP-82 RP-182661 0516 1 F CR on UE behaviour after SI Acquisition Failure	15.4.0
RP-82 RP-182662 0518 1 F CR on PUCCH-ConfigCommon	15.4.0
RP-82 RP-182662 0520 1 F Clarifications on receiving RRCReject without wait timer	15.4.0
RP-82 RP-182665 0522 1 F CR on powerControlOffset	15.4.0
RP-82 RP-182664 0524 2 F Correction to configuration of firstPDCCH-MonitoringOccasionO	
	15.4.0

	RP-82	RP-182649	0541	-	F	Clarification to no barring configuration for Implicit UAC	15.4.0
	RP-82	RP-182649	0542	-	F	Correction to Access Category and barring config determination for implicit	15.4.0
						access barring	
	RP-82	RP-182664	0543	2	F	Per serving cell MIMO layer configuration	15.4.0
	RP-82	RP-182661	0545	1	F	Correction to reconfiguration with sync	15.4.0
	RP-82	RP-182659	0552	1	F	Correction for SSB power	15.4.0
		RP-182659	0554	1	F	Corrections on SearchSpace configuration	15.4.0
	RP-82	RP-182665	0558	1	F	Correction for TCI state in ControlResourceSet	15.4.0
	RP-82	RP-182663	0560	1	F	CR for the optional configuration of subbandSize	15.4.0
	RP-82	RP-182650	0562	-	F	Correction on ShortMAC-I description in 38.331	15.4.0
	RP-82	RP-182661	0567	1	F	CR to the field descriptions of System Information	15.4.0
	RP-82	RP-182650	0569	-	F	Clarification on SRB3 release	15.4.0
	RP-82	RP-182650	0570	-	F	Avoiding security risk for RLC UM bearers during termination point change	15.4.0
	RP-82	RP-182660	0571	1	F	MO configuration with SSB SCS for a given SSB frequency	15.4.0
	RP-82	RP-182663	0572	1	F	Barring alleviation for emergency service	15.4.0
	RP-82	RP-182664	0575	1	F	Corrections for security configurations during setup of SRB1	15.4.0
	RP-82	RP-182660	0577	1	F	Clarification of UE behaviour when frequencyBandList is absent in SIB4	15.4.0
		RP-182661	0578	2	F	Handling of missing fields in SIB1	15.4.0
	RP-82	RP-182659	0580	1	F	Correction to ControlResourceSetZero	15.4.0
	RP-82	RP-182667	0582	2	F	Full configuration for inter-RAT handover	15.4.0
	RP-82	RP-182664	0587	1	F	Corrections on number of RadioLinkMonitoringRS condifuration	15.4.0
	RP-82	RP-182659	0591	1	F	Clarification on phr-Type2OtherCell	15.4.0
		RP-182667	0594	2	F	Addition of PCI in MeasTiming	15.4.0
	RP-82	RP-182667	0600	5	F	Clarifications to SIBs requiring request procedure	15.4.0
		RP-182659	0601	1	F	Correction for support of initial downlink BWP	15.4.0
	RP-82	RP-182657	0602	1	F	Miscellaneous corrections related to idle mode SIBs	15.4.0
		RP-182657	0603	1	F	Correction for missing fields in SIB2 and SIB4	15.4.0
		RP-182657	0604	2	F	Correction to Q-QualMin value range	15.4.0
	RP-82	RP-182663	0616	1	F	Clarification of cell reselection during resume procedure	15.4.0
		RP-182663	0617	1	F	Determination of Access Identities for RRC-triggered Access Attempts	15.4.0
		RP-182663	0618	1	F	CR to 38.331 on stopping of timer T390 upon reception of RRCRelease	15.4.0
	RP-82	RP-182840	0620	3	F	CR on MN/SN coordination for report CGI procedure	15.4.0
	RP-82	RP-182666	0624	2	F	CR to 38.331 on aligning I-RNTI terminology in paging and SuspendConfig	15.4.0
	DD 00	DD 400005	0007	0	F	(Alt.2) CR to 38.331 on IRAT Cell reselection in RRC_INACTIVE	15.4.0
		RP-182665	0627	2	F	CR for pendingRnaUpdate set	
		RP-182662	0638	1	-		15.4.0
		RP-182665	0640	2	F	Corrections on BWP ID	15.4.0
		RP-182664	0643	1	F	Inter-frequency handover capability	15.4.0
		RP-182659	0646	1	F	Search space configuration for DCI format 2_0 monitoring	15.4.0
		RP-182739	0647	3	F	Correction on power headroom configuration exchange	15.4.0
		RP-182665	0649	2	F	UE capability on PA architecture	15.4.0
	RP-82	RP-182662	0654	1	F	CR on pdsch-TimeDomainAllocationList and pusch- TimeDomainAllocationList	15.4.0
	RP-82	RP-182664	0655	1	F	Correction on the SSB based RACH configuration	15.4.0
		RP-182659	0656	1	F	CR on starting bit of Format 2-3	15.4.0
		RP-182663	0660	1	С	CR on wait timer in RRC release	15.4.0
		RP-182662	0664	1	F	SCell release at RRC Reestablishment	15.4.0
-		RP-182663	0665	1	F	Clean up of SRB1 terminology	15.4.0
		RP-182662	0670	1	F	Correction on the size of PUCCH resource ID	15.4.0
		RP-182667	0673	3	F	CR to 38.331 on Integrity Check failure at RRC Reestablishment	15.4.0

	DD 02	RP-182661	0680	1	F	Correction on SI message acquisition timing	15.4.0
		RP-182653	0682	+-	F	Add t-ReselectionNR-SF in SIB2	15.4.0
		RP-182654	0683	Ι-	F	freqBandIndicatorNR correction in MultiFrequencyBandListNR-SIB	15.4.0
		RP-182658	0684	2	F	Corrections to CellSelectionInfo in SIB1 and SIB4	15.4.0
		RP-182654	0686		F	Correction on the field description of DRX timers	15.4.0
		RP-182661	0687	1	F	Correction on DC subcarrier usage in SetupComplete message	
		RP-182665	0688	3	F	Various carrier frequency definition corrections	15.4.0 15.4.0
		RP-182661	0689	1	F	CR on signaling contiguous and non-contiguous EN-DC capability	15.4.0
		RP-182654	0692	<u>'</u>	F	Update of the usage of QCL type-C	15.4.0
		RP-182659	0694	1	F	Cleanup of references to L1 specifications	15.4.0
		RP-182660	0695	1	F	Correction of MeasResultEUTRA	15.4.0
		RP-182660	0696	1	F	Missing need code for refFreqCSI-RS	15.4.0
		RP-182661	0697	2	F	Missing procedure text in RRC Reconfiguration	15.4.0
		RP-182781	0700	3	F	Correction to UE capability procedures in 38.331	15.4.0
		RP-182667	0700	1	F	Correction to de capability procedures in 38.331 Correction to aperiodicTriggeringOffset	15.4.0
		RP-182664	0701	1	F	CR to 38.331 on including serving cell measurements	15.4.0
		RP-182660	0709	1	F	CR to 38.331 on associatedSSB	15.4.0
		RP-182662	0711	1	F	CR on 38.331 for RRCResumeRequest and RRCResumeRequest1 and	15.4.0
	KP-02	KP-162002	07 14	'	Г	protection of RRCResumeRequest1	15.4.0
	DD 92	RP-182667	0715	2	F	Correction for reporting of NR serving cell measurements when rsType is	15.4.0
	IXF-02	KF-102001	07 13	-		missing	13.4.0
	RP-82	RP-182656	0719	1	F	Clarification of the values for RangeToBestCell	15.4.0
		RP-182668	0721	2	F	CR on handling of timer T380	15.4.0
		RP-182662	0723	2	F	CR on supporting signalling only connection	15.4.0
		RP-182838	0725	3	F	Signalling introduction of SRS switching capability	15.4.0
		RP-182667	0729	3	В	CR on signalling introduction of UE overheating support in NR SA scenario	15.4.0
		RP-182856	0730	4	F	CR on SRS antenna switching	15.4.0
		RP-182660	0731	1	F	Correction to offsetToPointA	15.4.0
		RP-182655	0732	 -	F	Correction to cell selection parameters	15.4.0
		RP-182665	0746	2	F	CR to 38.331 on stopping T302 and UE related actions	15.4.0
		RP-182666	0750	2	F	Correction on indication for user plane resource release	15.4.0
		RP-182662	0767	1	F	Correction on the terminology scg-ChangeFailure	15.4.0
		RP-182661	0768	1	F	Correction on default configuration	15.4.0
		RP-182660	0772	1	F	Clarification of measurement object for beam reporting for NR cells	15.4.0
		RP-182667	0773	3	F	CR to 38.331 on UE AS Context definition – Include suspendConfig	15.4.0
		RP-182661	0778	1	F	CR to 38.331 on HO support in Setup Procedure	15.4.0
		RP-182656	0781	1-	F	CR on description of k0	15.4.0
		RP-182666	0783	2	F	CR to 38.331 on removing FFS of locationInfo	15.4.0
		RP-182661	0787	1-	F	Clarification on MIB Acquisition	15.4.0
		RP-182662	0788	-	F	CR to 38331 on release after completion of inter-RAT HO	15.4.0
		RP-182662	0789	-	F	CR to 38.331 on rbg-Size in PDSCH-Config, PUSCH-Config and	15.4.0
						ConfiguredGrantConfig	
	RP-82	RP-182657	0790	 -	F	Advanced processing time configuration for PDSCH and PUSCH	15.4.0
	RP-82	RP-182896	0791	2	F	UE specific channel bandwidth signaling	15.4.0
03/2019	RP-83	RP-190541	0416	4	F	Clarification on hopping parameters for PUSCH	15.5.0
	RP-83	RP-190541	0593	2	F	Removal of creation of MCG MAC entity	15.5.0
	RP-83	RP-190633	0792	1	F	Capability for aperiodic CSI-RS triggering with different numerology between PDCCH and CSI-RS	15.5.0
	RP-83	RP-190541	0796	2	F	Correction on Mapping between SSBs and PDCCH Monitoring Occasions in SI Window	15.5.0

RP-83 RP-		0797		F	Correction to SI Request Procedure	15.5.0
RP-83 RP-		0798		F	CR to 38.331 on clarification of reportCGI	15.5.0
RP-83 RP-				F	Describing mandatory/optional information in inter-node RRC messages	15.5.0
RP-83 RP-		0800	1	F	Search space configuration for cross carrier scheduling	15.5.0
RP-83 RP-	190542	0803	1	F	Clarification on FeatureSetCombinationId zero value	15.5.0
RP-83 RP-		0805	2	F	Clarification on UE Capability Request Filtering	15.5.0
RP-83 RP-		0807		F	Miscellaneous non-controversial corrections	15.5.0
RP-83 RP-	190541	8080	2	F	CR to 38.331 on MAC configuration	15.5.0
RP-83 RP-	190543	0810	2	F	Correction to SCG failiure	15.5.0
RP-83 RP-	190540	0811	1	F	Clarifying handling of parent and child IE need nodes	15.5.0
RP-83 RP-	190544	0812	2	F	Clarification to channel bandwidth signalling	15.5.0
RP-83 RP-		0813	1	F	Clarifications to BWP configuration options	15.5.0
RP-83 RP-	190543	0822	2	F	Correction to EUTRA-MBSFN-SubframeConfig	15.5.0
RP-83 RP-	190545	0823	2	F	Clarification on dedicated serving cell configuration in Re-establishment	15.5.0
RP-83 RP-	190541	0828	2	F	Clarification on the BWP id configuration	15.5.0
RP-83 RP-	190541	0836	1	F	Upon entering a new PLMN which is in the list of EPLMNs in RRC INACTIVE state	15.5.0
RP-83 RP-	190546	0843	1	F	EUTRA UE capability filtering in NR UE capability enquiry	15.5.0
RP-83 RP-	190543	0847	2	F	Correction to SIB1 transmission during handover	15.5.0
RP-83 RP-	190545	0850	2	F	Clarification to monitoring occasion of PWS notification	15.5.0
RP-83 RP-	190541	0853		F	HandoverPreparationInformation for CU/DU	15.5.0
RP-83 RP-	190542	0855	1	F	CR to introduce simultaneousRxDataSSB-DiffNumerology for NR SA	15.5.0
RP-83 RP-	190550	0858	-	F	Condition on integrity protection for DRB	15.5.0
RP-83 RP-			2	F	Handling on UE Inactive AS context upon resume	15.5.0
RP-83 RP-		0861	1	F	Miscellaneous Corrections for INACTIVE	15.5.0
RP-83 RP-		0864	1	F	Correction on RRC processing delay	15.5.0
RP-83 RP-		0865	-	F	Dummify the ue-BeamLockFunction IE	15.5.0
RP-83 RP-			2	F	Further update of Need codes	15.5.0
RP-83 RP-		0867	1	F	Corrections to reestablishment procedure	15.5.0
RP-83 RP-		0868	2	F	CR on use of positioning measurement gaps for subframe and slot timing detection towards E-UTRA	15.5.0
RP-83 RP-	190542	0876	2	F	Barring alleviation when T302 or T390 is stopped	15.5.0
RP-83 RP-		0877	2	F	Correction on smtc configuration in NR SCell addition procedure	15.5.0
RP-83 RP-		0884	2	F	Correction on the configuration for transform preceding of PUSCH	15.5.0
RP-83 RP-		0896	2	F	Correction to Need Codes in system information	15.5.0
RP-83 RP-		0897	1	F	Corrections on drb-ContinueROHC	15.5.0
RP-83 RP-		0898	1	F	Correction on outOfOrderDelivery	15.5.0
RP-83 RP-		0902	1	F	Corrections on radio link failure related actions	15.5.0
RP-83 RP-		0904	1	F	Clarification for SIB validity	15.5.0
RP-83 RP-		0905	<u>:</u>	F	Corrections to MFBI	15.5.0
RP-83 RP-		0903	1	F	CR on clarification on the description of NIA0	15.5.0
RP-83 RP-		0913	1	F	CR on the number of bits of downlink NAS COUNT value	15.5.0
RP-83 RP-		0920		F	CR to 38.331 for not supporting different quantities for thresholds in Event	15.5.0
					A5 and B2	
RP-83 RP-		0922		F	CR on SSB type indication	15.5.0
RP-83 RP-		0923	_	F	Correction for measurements of serving cells without SSB or without CSI-RS	15.5.0
RP-83 RP-		0930	-	F	CR on introduction of UE assistance information in inter-node message	15.5.0
RP-83 RP-		0931	-	F	CR on description of SRS carrier switching	15.5.0
RP-83 RP-	190542	0932	1	F	Clarification on the relation between CA configuration and supported featureset combination_Option1	15.5.0

	RP-83	RP-190545	0935	2	F	Unification of EN-DC terminology	15.5.0
		RP-190550	0938	-	F	PDCP re-establishment during SRB modification for EUTRA/5GC	15.5.0
		RP-190541	0939	1	F	The support of drb-ContinueROHC	15.5.0
		RP-190541	0948	1	F	Correction on PTRS port index	15.5.0
		RP-190541	0956	1	F	CR on the supplementaryUplink and uplinkConfig	15.5.0
		RP-190545	0963	2	F	Correction on MIB acquisition upon Reconfiguration with Sync	15.5.0
		RP-190543	0967	2	F	Qoffset for inter-RAT cell reselection	15.5.0
		RP-190541	0975	1	F	Correction on SI scheduling	15.5.0
		RP-190543	0976	2	F	Correction of uac-AccessCategory1-SelectionAssistanceInfo field description	15.5.0
		RP-190546	0978	3	F	Correction on going to RRC_IDLE upon inter-RAT cell reselection in	15.5.0
						RRC_INACTIVE	
	RP-83	RP-190543	0981	2	F	Clarification on nrofSS-BlocksToAverage and absThreshSS-BlocksConsolidation	15.5.0
	RP-83	RP-190543	0984	3	F	Correction on compilation of featureSets for NR container	15.5.0
	RP-83	RP-190540	0985	-	F	Enable and disable of security at DRB setup	15.5.0
	RP-83	RP-190545	0986	2	F	Clarification on TCI state ID	15.5.0
	RP-83	RP-190544	0987	-	F	Clarification for random access on SUL	15.5.0
	RP-83	RP-190545	0988	1	F	Correction on supportedBandwidthCombinationSetEUTRA-v1530 usage	15.5.0
		RP-190544	0989	-	F	CR on Processing delay requirements for RRC Resume procedures in TS 38.331	15.5.0
04/2019	RP-83					MCC: Formatting error correction (missing carriage return) in the end of clause 5.3.5.11.	15.5.1
06/2019	PD-84	RP-191379	0906	5	F	Reconfig with sync terminology	15.6.0
00/2019		RP-191378	0906	5	В	Introduction of late drop NGEN-DC, NE-DC and NR-DC	15.6.0
		RP-191374	0996	2	F	Correction to the need code of some fields in SIB2	15.6.0
		RP-191377	1003	3	F	Clarification for handling of suspendConfig	15.6.0
		RP-191377	1005	3	F	Reporting of serving cell and best neighbour cell and sorting of beam	15.6.0
		RP-191377	1011	1	F	On T321 timer related informative text correction	15.6.0
		RP-191377	1011	1	С	CR to direct current report for UL and SUL	15.6.0
		RP-191377	1013	1	F	Correction on storing UE AS Inactive Context	15.6.0
	DD 04	RP-191373	1014	<u>'</u>	F	Correction on ReconfigurationWithSync	15.6.0
		RP-191373	1015	2	F	Correction on Handover from NR to EUTRAN	15.6.0
		RP-191360	1018		F	Introduction of additional UE capability on HARQ-ACK multiplexing on	15.6.0
				_		PUSCH	15.6.0
	RP-84	RP-191378	1019	1	F	Correction on bar indication of emergency service (access category 2)	15.6.0
	RP-84	RP-191373	1020	-	F	Correction on UE configuration for RRC Resume procedure	15.6.0
	RP-84	RP-191373	1021	-	F	RRC release with suspend configuration and inter-RAT redirection	15.6.0
		RP-191373	1022	-	F	RRC Reconfiguration via SRB3 in EN-DC	15.6.0
	RP-84	RP-191373	1023	-	F	Corrections on RLC bearer setup	15.6.0
	RP-84	RP-191373	1024	-	F	Clarification to Permitted MaxCID for ROHC and Uplink-Only ROHC	15.6.0
	RP-84	RP-191373	1025	-	F	Coordination of ROHC capability for MR-DC	15.6.0
	RP-84	RP-191373	1026	-	F	Correction on the rlmInSyncOutOfSyncThreshold	15.6.0
	RP-84	RP-191373	1027	-	F	Correction on description of tci-PresentInDCI	15.6.0
	RP-84	RP-191374	1031	-	F	RRC processing delay for UE capability transfer	15.6.0
	RP-84	RP-191377	1032	1	F	Handling of SMTC configuration	15.6.0
	RP-84	RP-191378	1033	1	F	Clarification on filters used to generate FeatureSets (38.331)	15.6.0
	RP-84	RP-191374	1034	-	F	Correction of behavior for eutra-nr-only	15.6.0
	RP-84	RP-191377	1038	1	F	Clarification on CSI-RS resource configuration in MO	15.6.0
	RP-84	RP-191378	1039	2	F	Update on usage of Need codes	15.6.0
		RP-191377	1040	1	F	Ignore additional fields in RRC Release message before security activation	15.6.0

	DD Ω4	RP-191374	1041	T_	F	Correction on use of Null algorithm for DRBs during emergency calls in LSM	15.6.0
		RP-191374	1041	2	F	NR changes for FullConfig for Inter-RAT intra-system HO	15.6.0
		RP-191376	1042	2	F	Monitoring of short messages with multi-beams	15.6.0
<u> </u>		RP-191377	1045	1	F	Clarification of commonControlResourceSet frequency reference point	15.6.0
		RP-191379	1045	2	F	CR on capability of maxUplinkDutyCycle for FR2	15.6.0
		RP-191374	1049		F	CR to subcarrierSpacing in RateMatchPattern and SCS-SpecificCarrier	15.6.0
		RP-191374	1049	1	F	CR on transferring common configuration during handover and SN change	15.6.0
-		RP-191377	1054	2	F	Correction to barring alleviation	15.6.0
-		RP-191381	1054	3	F	UE behaviour on the cell without TAC	15.6.0
-		RP-191379	1058	2	F	Correction to RRC resume	15.6.0
		RP-191379	1061	1	F	Corrections to inter-node messages	15.6.0
-		RP-191378	1063	1	F	Clarification on mandatory information in inter node RRC messages	15.6.0
-		RP-191376	1065	-	F	Correction to PWS reception	15.6.0
		RP-191374	1068	1	F	Serving cell measurement handling with different rsType configuration	15.6.0
						scenarios	
		RP-191374	1069	-	F	On CGI reporting contents	15.6.0
	RP-84	RP-191374	1071	-	F	CR for 38.331 on security related corrections to UE and Network initiated RRC procedures to increase user's security and privacy	15.6.0
	RP-84	RP-191379	1072	3	F	Correction on the issue with NCP and ECP for RateMatchPattern	15.6.0
		RP-191377	1075	1	F	Security protection of RRC messages	15.6.0
		RP-191381	1076	1	F	Introduction of a new NR band for LTE/NR spectrum sharing in Band 41/n41	15.6.0
		RP-191375	1077	<u> </u>	F	Stop of T302 and T390 at reception of RRCRelease with waitTime	15.6.0
		RP-191375	1078	-	F	Restriction of piggybacking of NAS PDUs	15.6.0
		RP-191379	1079	3	F	Correction on intra-band fallback behavior with FeatureSetsPerCC	15.6.0
		RP-191375	1081	-	F	Removal of spurious requirement on consistency of feature set combination IDs	15.6.0
	RP-84	RP-191381	1082	3	F	Miscellaneous non-controversial corrections Set II	15.6.0
	RP-84	RP-191377	1083	1	F	Correction to configuration of security in RadioBearerConfig	15.6.0
	RP-84	RP-191379	1086	2	F	CR to 38.331 on MeasurementTimingConfiguration	15.6.0
	RP-84	RP-191375	1088	-	F	Correction to the description of subcarrierspacing usage in ServingCellConfigCommon	15.6.0
	RP-84	RP-191375	1089	-	F	38.331 Clarfication on multiple TA capabilities	15.6.0
		RP-191375	1091	t	F	Set beamCorrespondenceCA dummy	15.6.0
		RP-191377	1092	1	F	Correction on Measurement Report Triggering for Periodical Report	15.6.0
		RP-191375	1094	<u> </u>	F	Correction on PDCP duplication configuration	15.6.0
		RP-191375	1095	-	F	Correction on BWP configuration	15.6.0
		RP-191377	1097	1	F	Correction on configuration of pucch-ResourceCommon	15.6.0
		RP-191376	1098	1	F	Clarification of PUCCH reconfiguration on NR UL and SUL	15.6.0
		RP-191375	1100	1	F	Correction on initial BWP configuration in DownlinkConfigCommon and UplinkConfigCommon	15.6.0
	RP-84	RP-191377	1101	1	F	Correction on PUCCH cell	15.6.0
-		RP-191377	1103	1	F	Correction on the pdcp-Config	15.6.0
-		RP-191377	1103	2	F	Correction on pathlossReferenceLinking	15.6.0
		RP-191381	1106	2	F	Clarification of dedicated priority handling from RRC_INACTIVE to RRC_IDLE	15.6.0
	DD 04	RP-191375	1110	1-	F	Clarification on sending condition for mcg-RB-Config	15.6.0
	1RP-84						
				1-	F	Clarification of timing reference for CSI-RS resources	15.6.0
	RP-84	RP-191375 RP-191376	1111	-	F F	Clarification of timing reference for CSI-RS resources Setting of resumeCause for NAS triggered event	15.6.0 15.6.0

	RP-84	RP-191376	1115	-	F	Modified UE capability on different numerologies within the same PUCCH group	15.6.0
	RP-84	RP-191478	1116	2	F	Clarification to commonSearchSpaceList in PDCCH-ConfigCommon	15.6.0
	_	RP-191589	1117	1	F	Removal of "Capability for aperiodic CSI-RS triggering with different numerology between PDCCH and CSI-RS"	15.6.0
09/2019	RP-85	RP-192196	1120	1	С	Additional capability signalling for 1024QAM support	15.7.0
		RP-192191	1121	1	F	Correction on TDD-UL-DL-Config	15.7.0
		RP-192191	1122	1	F	Correction of the secondHopPRB Parameter	15.7.0
	RP-85	RP-192190	1123	1-	F	RSRP reporting of SFTD measurement in NR-DC	15.7.0
	RP-85	RP-192191	1124	1	F	Small Corrections for System Information	15.7.0
	RP-85	RP-192194	1125	-	F	Corrections for Inter-node Messages	15.7.0
	RP-85	RP-192191	1126	1	F	Clarification of Layer 3 Filtering for E-UTRA	15.7.0
	RP-85	RP-192190	1127	-	F	Clarification on FailureInformation report for NE-DC	15.7.0
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	RP-85	RP-192191	1138	1	F	Clarification for enabling of configured PUSCH frequency hopping	15.7.0
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		RP-192192	1144	1	F	Corrections to 38.331 on SI-schedulingInfo	15.7.0
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	RP-85	RP-192193	1174	2	F	Clarifying handling of information elements on the F1 interface	15.7.0
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History

	Document history							
V15.2.1	June 2018	Publication						
V15.3.0	October 2018	Publication						
V15.4.0	April 2019	Publication						
V15.5.1	May 2019	Publication						
V15.6.0	July 2019	Publication						
V15.7.0	October 2019	Publication						
V15.8.0	January 2020	Publication						
V15.9.0	April 2020	Publication						
V15.10.0	July 2020	Publication						
V15.11.0	November 2020	Publication						
V15.12.0	January 2021	Publication						
V15.13.0	April 2021	Publication						
V15.14.0	September 2021	Publication						
V15.15.0	October 2021	Publication						
V15.16.0	January 2022	Publication						
V15.17.0	May 2022	Publication						
V15.18.0	August 2022	Publication						