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Foreword

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1 Scope

This document provides a high level description of the mobility procedures applicable to Home NodeB support in the current Release. Where appropriate, the reasons behind the agreements are provided. Throughout this document, unless otherwise stated, the UE is assumed to be a current Release UE that supports the Closed Subscriber Group (CSG) feature, whether it is actually a member of a CSG or not. A UE that does not support the CSG feature is not required to support any of the procedures stated in this document.

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 25.304: "UE procedures in idle mode and procedures for cell reselection in connected mode".
- [3] 3GPP TS 25.331: "Radio Resource Control (RRC) protocol specification".
- [4] 3GPP TS 23.011: "Service accessibility".
- [5] 3GPP TS 22.220: "Service Requirements for Home NodeBs and Home eNodeBs".
- [6] 3GPP TS 25.467: "UTRAN architecture for 3G Home Node B (HNB)".
- [7] 3GPP TS 25.214: "Physical layer procedures (FDD)".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

Acceptable Cell: A cell that satisfies certain conditions as specified [2]. A UE can always attempt emergency calls on an acceptable cell.

CSG whitelist: A list provided by NAS containing all the CSG Identities of the CSGs to which the subscriber belongs.

NOTE: This list is known as Allowed CSG List in Rel-8 Access Stratum specifications.

Available PLMN: A PLMN for which the UE has found at least one cell and read its PLMN identity.

Barred Cell: A cell a UE is not allowed to camp on.

Camped on a cell: UE has completed the cell selection/reselection process and has chosen a cell. The UE monitors system information and (in most cases) paging information.

Camped on any cell: UE is in idle mode and has completed the cell selection/reselection process and has chosen a cell irrespective of PLMN identity.

Closed Subscriber Group (CSG): A Closed Subscriber Group identifies subscribers of an operator who are permitted to access one or more cells of the PLMN but which have restricted access (CSG cells).

CSG Cell: A cell, part of the PLMN, broadcasting a CSG Indicator that is set to TRUE and a specific CSG identity. A CSG cell is accessible by the members of the closed subscriber group for that CSG identity.

CSG Identity (CSG ID): An identifier broadcast by a CSG/Hybrid cell or cells and used by the UE to facilitate access for authorised members of the associated Closed Subscriber Group.

CSG member cell: A cell broadcasting the identity of the selected PLMN, registered PLMN or equivalent PLMN and for which the CSG whitelist of the UE includes an entry comprising cell's CSG ID and the respective PLMN identity.

DRX cycle: Individual time interval between monitoring Paging Occasion for a specific UE.

Equivalent PLMN list: List of PLMNs considered as equivalent by the UE for cell selection, cell reselection, MBSFN Cluster selection MBSFN Cluster reselection and handover according to the information provided by the NAS.

Home NodeB (HNB): A HNB is a customer-premises equipment that connects a 3GPP UE over UTRAN wireless air interface to a mobile operator's network using broadband IP backhaul.

HNB Name: The Home NodeB Name is a broadcast string in free text format that provides a human readable name for the Home NodeB CSG identity.

Home PLMN: A PLMN where the Mobile Country Code (MCC) and Mobile Network Code (MNC) of the PLMN identity are the same as the MCC and MNC of the IMSI.

Hybrid cell: A cell broadcasting a CSG identity which is accessible as a CSG cell by UEs which are members of the CSG and as a normal cell by all other UEs.

Non-CSG Cell: A cell that is not a CSG cell, e.g. a macro cell.

Process: A local action in the UE invoked by a RRC procedure or an Idle Mode procedure.

Radio Access Mode: Radio access mode of the cell, FDD or TDD.

Radio Access Technology: Type of technology used for radio access, for instance UTRA or GSM.

Registered PLMN: This is the PLMN on which certain Location Registration outcomes have occurred.

Registration Area: (NAS) registration area is an area in which the UE may roam without a need to perform location registration, which is a NAS procedure.

Reserved Cell: A cell on which camping is not allowed, except for particular UEs, if so indicated in the system information.

Restricted Cell: A cell on which camping is allowed, but access attempts are disallowed for UEs whose access classes are indicated as barred.

Selected PLMN: This is the PLMN that has been selected by the NAS, either manually or automatically.

Serving cell: The cell on which the UE is camped.

Strongest cell: The cell on a particular carrier that is considered strongest according to the layer 1 cell search procedure [7]. As the details of the layer 1 cell search are implementation dependent, the precise definition of 'strongest cell' is also implementation dependent.

Suitable Cell: This is a cell on which an UE may camp.

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].

AS Access Stratum

BCCH	Broadcast Control Channel
CM	Connection Management
CN	Core Network
CSG	Closed Subscriber Group
DRX	Discontinuous Reception
E-UTRA	Evolved UMTS Terrestrial Radio Access
FDD	Frequency Division Duplex
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
HCS	Hierarchical Cell Structure
HNB	Home NodeB
IMSI	International Mobile Subscriber Identity
MCC	Mobile Country Code
MM	Mobility Management
MNC	Mobile Network Code
NAS	Non-Access Stratum
PCH	Paging Channel
PI	Page Indicator
PICH	Page Indication Channel
PLMN	Public Land Mobile Network
RAT	Radio Access Technology
RRC	Radio Resource Control
SAP	Service Access Point
TDD	Time Division Duplex
TMGI	Temporary Mobile Group Identity
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

4 Overview

A Home NodeB may provide restricted access to only UEs belonging to a Closed Subscriber Group (CSG). One or more of such cells providing restricted access, known as CSG cells, are identified by a unique numeric identifier called CSG Identity. To facilitate access control, a UE with CSG subscription would have an CSG whitelist, which contains one or more CSG Identities associated with the CSG cells on which the UE is allowed access. The UE uses the CSG whitelist along with the CSG Identity and associated PLMN ID broadcast by the CSG Cells in CSG cell selection and reselection.

A HNB can also be operated as a hybrid cell. A hybrid cell is accessed as a CSG cell by a UE whose CSG whitelist contains the cell's CSG ID and associated PLMN ID and as a normal cell by all other UEs. Members of the CSG are expected to receive preferential access according to [5].

NOTE: Although pre-Rel-9 UEs are able to camp on hybrid cells (which would be regarded as normal cells for access) there is no possibility for these UEs to identify a hybrid cell as a CSG cell even though the cell's CSG identity and associated PLMN ID are in the UE's CSG whitelist.

In addition, manual selection of CSG Identity is introduced, which enables the human user to manually select a CSG Identity for UE to camp on.

This document provides high level descriptions and procedures of the mobility features to support CSG deployment in the current Release. The following areas will be covered in the subsequent chapters:

- Identifiers associated with the CSG framework
- Manual selection of CSG Identity
- Measurement rules for CSG Cells
- Cell reselection to a CSG cell, from a CSG cell, and between CSG cells
- Handover to a CSG cell, from a CSG cell, and between CSG cells, where applicable

- Measurement rules, (re)selection and handover procedures for hybrid cells.

5 CSG Identification

One or more Closed Subscriber Group (CSG) cells are identified by a unique numeric identifier called CSG Identity or CSG ID. A UE belonging to a CSG has the corresponding CSG ID and associated PLMN ID in its CSG whitelist. The CSG whitelist is maintained and provided by NAS. The CSG ID is broadcast in system information by the CSG cell or hybrid cell, and used by the UE for cell (re)selection and handover purposes.

A cell may optionally broadcast the CSG Indicator, whose presence and value of TRUE indicates the cell is a CSG cell. The absence of the CSG indicator in a cell which broadcasts a CSG identity indicates that it is a hybrid cell.

A CSG cell or hybrid cell may broadcast the HNB Name, a textual identifier, in system information. The HNB Name can be used to aid the human user in manual selection of a CSG ID.

At the physical layer, a CSG cell is identified by its carrier frequency (UARFCN) and Primary Scrambling Code (PSC). A set of PSCs could be reserved for CSG deployment and this reserved PSC range may be signalled in system information. The PSC of a CSG cell belongs to the reserved PSC range if broadcast.

On the mixed carrier frequency shared by both non-CSG cells (UMTS macro cells) and CSG cells, CSG cells broadcast in system information the PSC range reserved by the network for CSG cells. The non-CSG cells may also broadcast the reserved PSC range. The reserved PSC range is only applicable to the UARFCN within the PLMN where the UE received this information. The UE considers the last received reserved PSC range to be valid within the entire PLMN for the duration of 24 hours. The UE may use the reserved PSC information for CSG cell search and (re)selection purposes, according to UE's implementation.

NOTE: In shared network scenario, aligned PSC ranges are beneficial in the shared carrier frequency across the involved PLMNs. Furthermore, in deployments where cells broadcast different primary PLMN (with or without multiple PLMN IDs), it is beneficial that CSG and non-CSG cells will broadcast same PSC ranges. Moreover, it is beneficial if a CSG cell, if listed in system information and associated with a PLMN, is associated with the primary PLMN of the serving cell.

Non-CSG cells and CSG cells may broadcast indications of one or more carrier frequencies used for dedicated CSG deployment. This information may be used by a UE to avoid unnecessary measurements on that frequency even when cell measurement rules would require measurements of this carrier frequency. Indications of which carrier frequencies are dedicated to CSG-only deployment may be signalled in system information and are applicable only in the cell where this information is broadcast.

6 CSG Selection

6.1 Manual CSG ID Selection

Manual CSG ID selection enables a human user to select a CSG ID. In manual CSG ID selection the UE may scan all frequencies in the supported frequency bands and display a list of found CSG IDs or the corresponding HNB Names if broadcast by the CSG cells or hybrid cells, and indications as to whether the found CSG IDs and associated PLMN IDs are contained in the UE's CSG whitelist. When the user selects an entry in the list, the UE selects any CSG cell or hybrid cell among the ones with same CSG ID and PLMN ID. The UE may normally camp on the chosen cell if it is a CSG member cell or a hybrid cell.

During manual CSG ID selection a UE is allowed to perform Location Registration procedure on a CSG cell that is not a CSG member cell.

Based on the outcome of a Location Registration procedure initiated on a CSG cell, the UE's CSG whitelist is updated.

The UE is allowed to *not* support manual CSG ID selection in connected mode.

7 CSG Cell Reselection

7.1 Measurement Rules for CSG Cells

To measure CSG member cell(s), a UE applies an autonomous search function, per UE implementation, regardless of which RAT the UE is camping on. The autonomous search function determines when and where to search for the CSG member cells.

Autonomous search procedure is disabled by the search function if UE's CSG whitelist does not exist or is empty.

On a mixed carrier, a UE may avoid measurements of any CSG cells that are known by the UE not to be CSG member cells.

A UE may avoid measurements of any CSG cells that are known by the UE not to be CSG member cells on the carrier frequency dedicated to CSG deployment.

7.2 Reselection to CSG Cell

The cell reselection criteria described in this section is applicable when the UE is in the following call states: Idle Mode, Cell_PCH, URA_PCH and Cell_FACH states, unless otherwise stated.

Inter-RAT and inter-frequency reselection in CELL_FACH state only needs to be performed when second DRX is used.

7.2.1 Criteria for Intra-frequency Cell Reselection

For intra-frequency reselection from a non-CSG cell to a CSG member cell, the UE follows the same cell ranking rules as those defined for the UTRA case in [2]. The UE may ignore not allowed CSG cells in the ranking. The UE applies reselection parameters broadcast by the serving cell. A UE may normally camp on a CSG member cell.

7.2.2 Criteria for Inter-frequency Cell Reselection

For inter-frequency cell reselection, the UE considers the frequency where its CSG member cell is on to have the highest priority value, irrespective of network configured frequency priorities, as long as the CSG member cell remains best ranked on that frequency.

7.2.3 Criteria for Inter-RAT Cell Reselection

Inter-RAT reselection to a CSG member cell is supported when the UE is camped on another RAT. The UE requirements are defined in the specifications of the concerned RAT.

7.3 Reselection from CSG Cell

7.3.1 Criteria for Intra-frequency Cell Reselection

For intra-frequency reselection from a CSG member cell to a non-CSG cell, the UE follows the same cell ranking rules as those defined for the UTRA case defined in [2].

7.3.2 Criteria for Inter-frequency Cell Reselection

For inter-frequency reselection from a CSG member cell to a non-CSG cell, the UE follows the same cell ranking rules as those defined for the UTRA case defined in [2].

7.3.3 Criteria for Inter-RAT Cell Reselection

For reselection from a CSG cell to a GSM or E-UTRA cell, the UE follows the respective procedures defined in [2].

7.4 Reselection from CSG Cell to CSG Cell

For reselection between CSG member cells, the UE follows the same cell ranking rules as those defined for the UTRA case in [2].

7.5 Parameters for CSG Cell Reselection

No new parameters are defined for CSG cell ranking. The same cell reselection parameters defined for the UTRA case in [2] are used for CSG cell ranking purposes, if configured. The operator may configure the cell reselection parameters, such as Q_{offset} and Q_{hyst} , to bias the reselection of CSG cells.

8 CSG and Hybrid Cell Handover

8.1 Handover to CSG/Hybrid Cell

Handover to a HNB/HeNB follows the framework as specified in [3], [6]. Handover to a HNB/HeNB is different from the normal handover procedure in four aspects:

1. **Proximity Estimation:** in case the UE is able to determine, based on UE implementation, that it is near a CSG member cell, the UE may provide to the SRNC an indication of proximity. The CSG proximity indication may be used as follows:
 - a. If a measurement configuration is not present for the concerned frequency/RAT, the SRNC may configure the UE to perform measurements and reporting for the concerned frequency/RAT.
 - b. The SRNC may determine whether to perform other actions related to handover to HNB/HeNBs based on having received a proximity indication (for example, the SRNC may not configure compressed mode gaps for the UE to detect the HNB/HeNB on a different frequency/RAT unless it has received a proximity indication).
2. **PSC/PCI Confusion:** due to the typical cell size of HNB/HeNBs being much smaller than macro cells, there can be multiple HNBs/HeNBs within the coverage of the SRNC that have the same PSC/PCI. This leads to a condition referred to as PSC/PCI confusion, wherein the SRNC is unable to determine the correct target cell for handover from the PSC/PCI included in the measurement reports from the UE. PSC/PCI confusion is solved by the UE reporting the cell identity of the target HNB/HeNB.
3. **Access Control:** If the target cell is a hybrid cell, prioritization of allocated resources may be performed based on the UE's membership status. Access control is done by a two step process, where first the UE reports whether the target cell is a CSG member cell based on the UE's CSG whitelist, and then the network verifies the reported status.
4. **PLMN Report:** If the target cell is a shared CSG/hybrid cell, the UE reports the subset of the broadcasted PLMN identities that fulfil the CSG member cell definition.

Mobility from SRNC to a CSG/hybrid cell from network perspective is described in [6]. The following two sections describe the radio aspects. The SRNC in the call flows of these sections can be an RNC or a HNB.

8.1.1 CSG/Hybrid Cell Intra-frequency Measurement Procedure

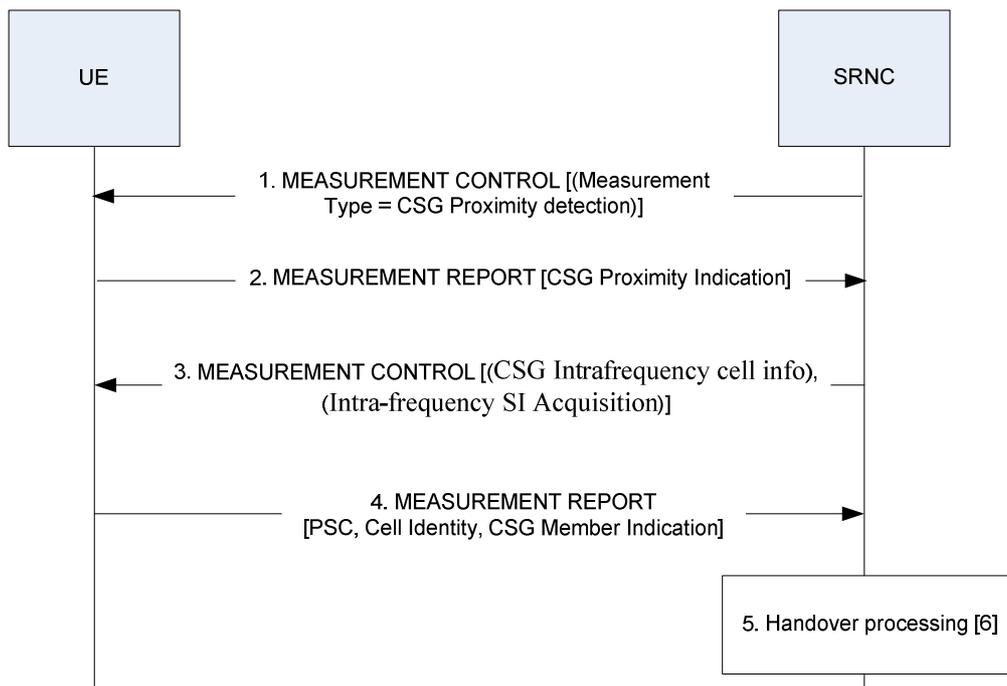


Figure 8.1.1-1: Intra-frequency Measurement Procedure of CSG and Hybrid cells

- 1) The SRNC configures the UE with a measurement having "CSG Proximity detection" as measurement type.
- 2) The UE sends an "entering" CSG proximity indication when it determines it may be near a CSG member cell (based on UE implementation).
- 3) If a measurement configuration for CSG/hybrid cells is not present, the SRNC configures the UE with relevant measurement configuration which includes the PSCs that the UE must measure and the PSCs for which SI acquisition should be performed. The network may use the CSG proximity indication for intra-frequency case to minimize the time during which measurements for CSG/hybrid cells are configured.
- 4) The UE sends a measurement report including the measured PSC, Cell Identity, CSG ID and CSG membership indication of the target HNB to the SRNC (e.g., due to a triggered intra-frequency event 1d). The UE can acquire MIB and SIB3/SIB4 of intra-frequency target HNB cells in parallel with reception of the serving cell transmissions in CELL_DCH. No measurement gaps are required for reading MIB and SIB3/SIB4. If the target cell is a shared CSG/hybrid cell, the UE reports the subset of the broadcasted PLMN identities that fulfil the CSG member cell definition.
- 5) SRNC can then proceed with the handover processing as described in [6].

After sending an "entering" CSG proximity indication (step 2), if the UE determines that it is no longer near any CSG member cell (on the reported proximate RAT and frequency), the UE sends a "leaving" CSG proximity indication to the SRNC. Upon reception of this indication, the SRNC may reconfigure the UE to stop measurements configured.

The PSC confusion is resolved by steps 3 and 4. The SRNC can request SI acquisition and reporting for any PSC, not limited to PSCs of CSG or hybrid cells.

8.1.2 CSG/Hybrid Cell Inter-frequency/Inter-RAT Measurement Procedure

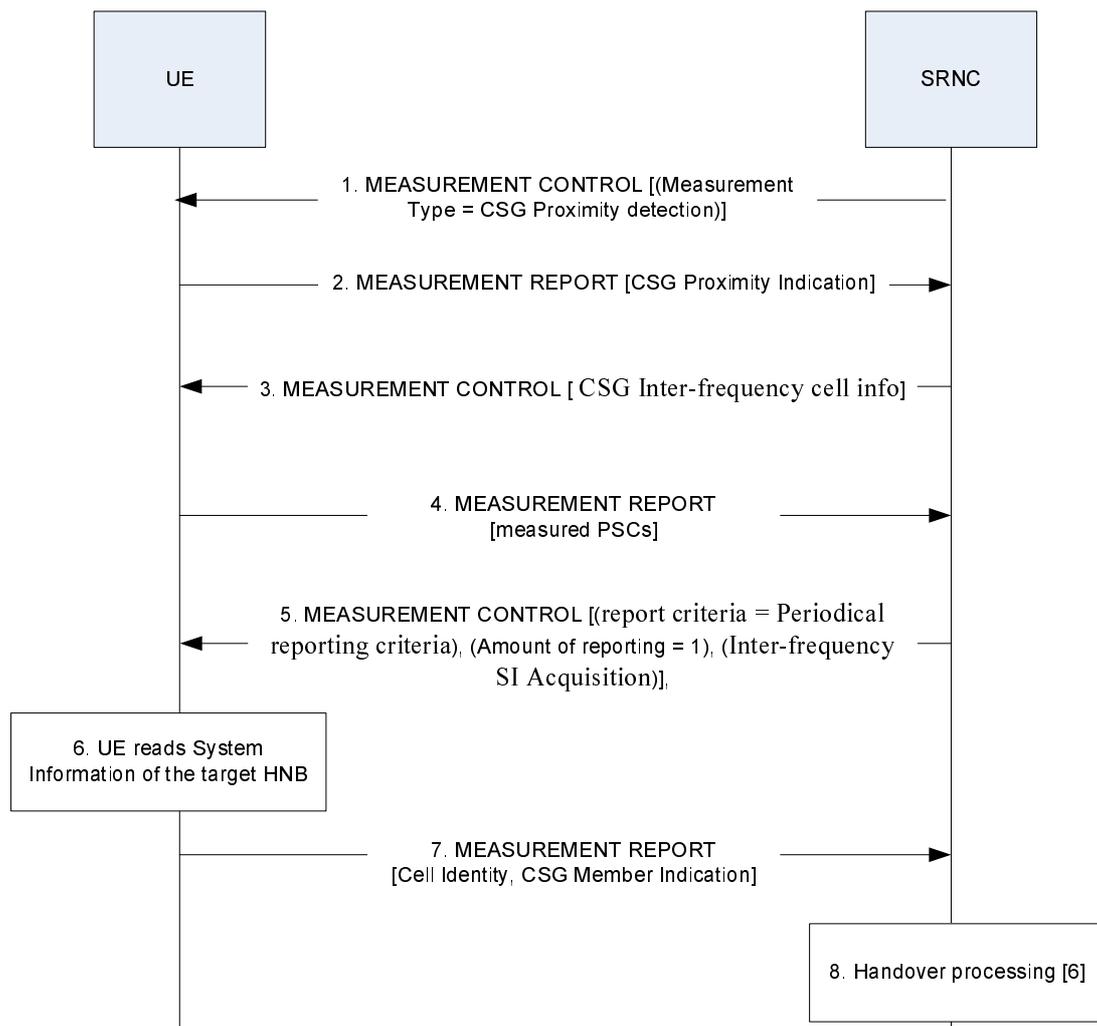


Figure 8.1.2-1: Inter-frequency Measurement Procedure of CSG and Hybrid cells.

- 1) The SRNC configures the UE with a measurement having "CSG Proximity detection" as measurement type.
- 2) The UE sends an "entering" CSG proximity indication when it determines it may be near a CSG member cell (based on UE implementation). The CSG proximity indication includes the RAT and frequency of the cell.
- 3) The SRNC configures a measurement on the concerned frequency/RAT to measure CSG/hybrid cells. Compressed mode gaps, if required by the UE, are also activated to allow UE to perform measurements on the reported RAT and frequency. The network may also use the proximity indication to minimize the requesting of handover preparation information of CSG/hybrid cells by avoiding requesting such information when the UE is not in the geographical area where its CSG member cells are located.
- 4) The UE sends a measurement report including the measured PSCs/PCIs.
- 5) The SRNC configures the UE to perform SI acquisition and reporting of a particular PSC/PCI.
- 6) The UE performs SI acquisition using autonomous gaps, i.e., the UE may suspend reception and transmission with the SRNC to acquire the relevant system information from the target HNB/HeNB.
- 7) The UE sends a measurement report including Cell Identity, CSG ID and CSG membership indication. If the target cell is a shared CSG/hybrid cell, the UE reports the subset of the broadcasted PLMN identities that fulfil the CSG member cell definition.
- 8) SRNC can then proceed with the handover processing. The handover processing for inter-frequency handover to a CSG/Hybrid cell is described in [6].

NOTE: The above steps also apply to inter-RAT mobility from UMTS cell to HeNB.

After sending an "entering" CSG proximity indication (step 2), if the UE determines that it is no longer near any CSG member cell (on the reported proximate RAT and frequency), the UE sends a "leaving" CSG proximity indication to the SRNC. Upon reception of this indication, the SRNC may reconfigure the UE to stop measurements on the reported RAT and frequency.

In the above procedure, step 2 may not be performed in case the UE has not previously visited the HNB, e.g., when the UE first visits a CSG/hybrid cell.

The PSC/PCI confusion is resolved by steps 5, 6 and 7. The SRNC can request SI acquisition and reporting for any PSC/PCI, not limited to PSCs/PCIs of CSG or hybrid cells.

8.2 Handover from CSG Cell

In Cell_DCH state, the handover procedure from a CSG member cell to a non-CSG cell is expected to be the same as the procedure specified in [3].

8.3 Handover from CSG Cell to CSG Cell

In Cell_DCH state, handover between CSG member cells with the same CSG ID is expected to be the same as the procedure specified in Section 8.1.

In Cell_DCH state, handover between CSG member cells with different CSG IDs is expected to be the same as the procedure specified in Section 8.1.

9 Support of Hybrid Cells

9.1 Measurement Rules

To measure for hybrid cells with a CSG Identity and its associated PLMN ID belonging to an entry in the UE's CSG whitelist, measurement rules of Chapter 7.1 apply. Otherwise, normal measurement rules apply.

NOTE: The autonomous search for hybrid cells does not imply that UE need to constantly check the CSG ID of all cells it sees.

9.2 Reselection

In case the UE has CSG ID and its associated PLMN ID of the hybrid cell in its CSG whitelist, cell reselection procedures will be the same as for a CSG cell as described in Chapter 7.2.

For all other UEs, cell reselection procedures will utilise normal cell reselection rules.

Annex B (informative):
Void

Annex C (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Cat	Subject/Comment	New version
2008-11-17	RAN2#64					Proposal for 25.367 TS structure and Text Proposals	0.0.0
2008-11-20	RAN2#64					Revision based on discussion for email agreement.	0.0.1
2008-11-21	RAN2#64					Final text proposals for email agreement.	0.0.2
2008-11-25	RAN2#64					Revision based on email agreement.	1.0.0
2008-12	RP-42	RP-080873	-	-		v1.0.0 was approved at RAN #42 as v8.0.0 and put under CR control	8.0.0
2009-03	RP-43	RP-090135	0001	1		Corrections to manual CSG search	8.1.0
	RP-43	RP-090135	0002	1		Alignment to latest stage 3 agreements	8.1.0
2009-06	RP-44	RP-090524	0003	-		Idle mode requirements to support hybrid cells for HNB	9.0.0
2009-09	RP-45	RP-090930	0005	4		CR capturing HNB inbound mobility agreements	9.1.0
	RP-45	RP-090911	0008	-		Correction to manual CSG ID selection_25.367CR(R9)	9.1.0
2009-12	RP-46	RP-091343	0010	1		CR on Add Hybrid cell into the manual CSG ID selection in 25.367	9.2.0
	RP-46	RP-091343	0011	2		Draft CR capturing HNB inbound mobility agreements	9.2.0
	RP-46	RP-091343	0012	-		Removal of description related to small repetition of SIB3/4	9.2.0
	RP-46	RP-091343	0014	1		Renaming Allowed CSG List (25.367 Rel-9)	9.2.0
	RP-46	RP-091330	0015	-		Correction to definition of CSG cell.	9.2.0
2010-03	RP-47	RP-100306	0017	-		CR capturing HNB inbound mobility agreements	9.3.0
2010-06	RP-48	RP-100551	0018	-		Some corrections to 25.367	9.4.0
2010-12	RP-50	RP-101206	0019	-		Correction to the limitation of SI acquisition	9.5.0
2011-03	RP-51	-	-	-		Upgrade to the Release 10 - no technical change	10.0.0
2012-06	RP-56	RP-120880	0026	-		PSC range note on RAN sharing	11.0.0
2013-03	RP-59	RP-130247	0028	1		Corrections on mobility to CSG and hybrid cells for UMTS	11.1.0
2013-12	RP-62	RP-131998	0030	1		Introduction of inbound mobility to shared CSG/hybrid cell	12.0.0
	RP-62	RP-131998	0031	-		Introduction of CSG CELL_FACH mobility	12.0.0
2015-12	RP-70					Upgrade to the Release 13 - no technical change	13.0.0
2017-03	RP-75					Upgrade to Release 14 - no technical change	14.0.0
2018-06	SA-80	-	-	-	-	Update to Rel-15 version (MCC)	15.0.0
2020-07	RP-88e	-	-	-	-	Upgrade to Rel-16 version without technical change	16.0.0
2022-03	RP-95e	-	-	-	-	Upgrade to Rel-17 version without technical change	17.0.0

History

Document history		
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