

# ETSI TS 136 214 V13.2.0 (2016-08)



**LTE;  
Evolved Universal Terrestrial Radio Access (E-UTRA);  
Physical layer;  
Measurements  
(3GPP TS 36.214 version 13.2.0 Release 13)**



---

Reference

RTS/TSGR-0136214vd20

---

Keywords

LTE

**ETSI**

650 Route des Lucioles  
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C  
Association à but non lucratif enregistrée à la  
Sous-Préfecture de Grasse (06) N° 7803/88

---

**Important notice**

The present document can be downloaded from:  
<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at  
<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:  
<https://portal.etsi.org/People/CommiteeSupportStaff.aspx>

---

**Copyright Notification**

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.  
The copyright and the foregoing restriction extend to reproduction in all media.

© European Telecommunications Standards Institute 2016.  
All rights reserved.

**DECT™**, **PLUGTESTS™**, **UMTS™** and the ETSI logo are Trade Marks of ETSI registered for the benefit of its Members.  
**3GPP™** and **LTE™** are Trade Marks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.  
**GSM®** and the GSM logo are Trade Marks registered and owned by the GSM Association.

---

## Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org>).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

---

## Foreword

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

The present document may refer to technical specifications or reports using their 3GPP identities, UMTS identities or GSM identities. These should be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between GSM, UMTS, 3GPP and ETSI identities can be found under <http://webapp.etsi.org/key/queryform.asp>.

---

## Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

# Contents

Intellectual Property Rights .....	2
Foreword.....	2
Modal verbs terminology.....	2
Foreword.....	5
1 Scope .....	6
2 References .....	6
3 Definitions, symbols and abbreviations .....	7
3.1 Definitions .....	7
3.2 Symbols.....	7
3.3 Abbreviations .....	7
4 Control of UE/E-UTRAN measurements.....	7
5 Measurement capabilities for E-UTRA.....	8
5.1 UE measurement capabilities .....	8
5.1.1 Reference Signal Received Power (RSRP).....	9
5.1.2 Void .....	9
5.1.3 Reference Signal Received Quality (RSRQ) .....	10
5.1.4 UTRA FDD CPICH RSCP .....	10
5.1.5 UTRA FDD carrier RSSI.....	10
5.1.6 UTRA FDD CPICH Ec/No.....	11
5.1.7 GSM carrier RSSI.....	11
5.1.8 Void .....	11
5.1.9 UTRA TDD P-CCPCH RSCP .....	11
5.1.10 CDMA2000 1x RTT Pilot Strength.....	11
5.1.11 CDMA2000 HRPD Pilot Strength.....	11
5.1.12 Reference signal time difference (RSTD).....	12
5.1.13 UE GNSS Timing of Cell Frames for UE positioning.....	12
5.1.14 UE GNSS code measurements.....	12
5.1.15 UE Rx – Tx time difference.....	12
5.1.16 IEEE 802.11 WLAN RSSI .....	12
5.1.17 MBSFN Reference Signal Received Power (MBSFN RSRP).....	13
5.1.18 MBSFN Reference Signal Received Quality (MBSFN RSRQ) .....	13
5.1.19 Multicast Channel Block Error Rate (MCH BLER) .....	14
5.1.20 CSI Reference Signal Received Power (CSI-RSRP).....	14
5.1.21 Sidelink Reference Signal Received Power (S-RSRP).....	14
5.1.22 Sidelink Discovery Reference Signal Received Power (SD-RSRP).....	15
5.1.23 Reference signal-signal to noise and interference ratio (RS-SINR).....	15
5.1.24 Received Signal Strength Indicator (RSSI) .....	16
5.1.25 SFN and subframe timing difference (SSTD).....	16
5.1.26 Narrowband Reference Signal Received Power (NRSRP).....	16
5.1.27 Narrowband Reference Signal Received Quality (NRSRQ).....	17
5.2 E-UTRAN measurement abilities.....	17
5.2.1 DL RS TX power.....	17
5.2.2 Received Interference Power .....	18
5.2.3 Thermal noise power .....	18
5.2.4 Timing advance (T <sub>ADV</sub> ).....	18
5.2.5 eNB Rx – Tx time difference.....	18
5.2.6 E-UTRAN GNSS Timing of Cell Frames for UE positioning.....	19
5.2.7 Angle of Arrival (AoA) .....	19
5.2.8 UL Relative Time of Arrival (T <sub>UL-RTOA</sub> ) .....	19
<b>Annex A (informative): Change history .....</b>	<b>20</b>
History .....	21

---

# Foreword

This Technical Specification has been produced by the 3<sup>rd</sup> 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 contains the description and definition of the measurements done at the UE and network in order to support operation in idle mode and connected mode.

---

# 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 36.201: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer – General Description".
- [3] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation".
- [4] 3GPP TS 36.212: "Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding".
- [5] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".
- [6] 3GPP TS 36.321: "Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification".
- [7] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".
- [8] 3GPP2 CS.0005-D v1.0 "Upper Layer (Layer 3) Signaling Standard for CDMA2000 Spread Spectrum Systems Release D".
- [9] 3GPP2 CS.0024-A v3.0 "cdma2000 High Rate Packet Data Air Interface Specification"
- [10] 3GPP TS 36.104: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception".
- [11] 3GPP TS 36.355: "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP)"
- [12] 3GPP TS 36.455: "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol A (LPPa)"
- [13] 3GPP TS 36.459: "Evolved Universal Terrestrial Radio Access (E-UTRA); SLm Application Protocol (SLmAP)"
- [14] 3GPP TS 36.111: "Evolved Universal Terrestrial Radio Access (E-UTRA); Location Measurement Unit (LMU) performance specification; Network Based Positioning Systems in E-UTRAN"
- [15] IEEE 802.11, Part 11: "Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications, IEEE Std."

- [16] 3GPP TS 36.304: “Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode “.

---

## 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].

### 3.2 Symbols

For the purposes of the present document, the following symbols apply:

$E_c/N_0$  Received energy per chip divided by the power density in the band

### 3.3 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].

1x RTT	CDMA2000 1x Radio Transmission Technology
CPICH	Common Pilot Channel
E-SMLC	Enhanced Serving Mobile Location Centre
E-UTRA	Evolved UTRA
E-UTRAN	Evolved UTRAN
FDD	Frequency Division Duplex
GNSS	Global Navigation Satellite System
GSM	Global System for Mobile communication
HRPD	CDMA2000 High Rate Packet Data
LMU	Location Measurement Unit
P-CCPCH	Primary Common Control Physical Channel
RSCP	Received Signal Code Power
RSRP	Reference Signal Received Power
RSRQ	Reference Signal Received Quality
RSSI	Received Signal Strength Indicator
RSTD	Reference Signal Time Difference
SRS	Sounding Reference Signal
TDD	Time Division Duplex
UTRA	Universal Terrestrial Radio Access
UTRAN	Universal Terrestrial Radio Access Network

---

## 4 Control of UE/E-UTRAN measurements

In this chapter the general measurement control concept of the higher layers is briefly described to provide an understanding on how L1 measurements are initiated and controlled by higher layers.

With the measurement specifications L1 provides measurement capabilities for the UE and E-UTRAN. These measurements can be classified in different reported measurement types: intra-frequency, inter-frequency, inter-system, traffic volume, quality and UE internal measurements (see the RRC Protocol [7]).

In the L1 measurement definitions, see chapter 5, the measurements are categorised as measurements in the UE (the messages for these will be described in the MAC Protocol [6] or RRC Protocol [7] or LPP Protocol [11]) or measurements in the E-UTRAN (the messages for these will be described in the Frame Protocol or LPPa Protocol [12]).

To initiate a specific measurement, the E-UTRAN transmits a 'RRC connection reconfiguration message' to the UE including a measurement ID and type, a command (setup, modify, release), the measurement objects, the measurement quantity, the reporting quantities and the reporting criteria (periodical/event-triggered), see [7] or E-SMLC transmits an 'LPP Request Location Information message' to UE, see [11].

When the reporting criteria are fulfilled the UE shall answer with a 'measurement report message' to the E-UTRAN including the measurement ID and the results or an 'LPP Provide Location Information message' to the E-SMLC, see [11].

For idle mode, the measurement information elements are broadcast in the System Information.

---

## 5 Measurement capabilities for E-UTRA

In this chapter the physical layer measurements reported to higher layers are defined.

### 5.1 UE measurement capabilities

The structure of the table defining a UE measurement quantity is shown below.

Column field	Comment
<b>Definition</b>	Contains the definition of the measurement.
<b>Applicable for</b>	States in which state(s) it shall be possible to perform this measurement. The following terms are used in the tables: RRC_IDLE; RRC_CONNECTED;  Intra-frequency appended to the RRC state: Shall be possible to perform in the corresponding RRC state on an intra-frequency cell; Inter-frequency appended to the RRC state: Shall be possible to perform in the corresponding RRC state on an inter-frequency cell Inter-RAT appended to the RRC state: Shall be possible to perform in the corresponding RRC state on an inter-RAT cell.



### 5.1.1 Reference Signal Received Power (RSRP)

<b>Definition</b>	<p>Reference signal received power (RSRP), is defined as the linear average over the power contributions (in [W]) of the resource elements that carry cell-specific reference signals within the considered measurement frequency bandwidth.</p> <p>For RSRP determination the cell-specific reference signals <math>R_0</math> according to TS 36.211 [3] shall be used. If the UE can reliably detect that <math>R_1</math> is available it may use <math>R_1</math> in addition to <math>R_0</math> to determine RSRP.</p> <p>If higher layers indicate measurements based on discovery signals, the UE shall measure RSRP in the subframes in the configured discovery signal occasions. If the UE can reliably detect that cell-specific reference signals are present in other subframes, the UE may use those subframes in addition to determine RSRP.</p>
-------------------	---

<p>The reference point for the RSRP shall be the antenna connector of the UE.</p> <p>If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding RSRP of any of the individual diversity branches.</p>	<p><b>Applicable for</b></p> <p>RRC_IDLE intra-frequency,  RRC_IDLE inter-frequency,  RRC_CONNECTED intra-frequency,  RRC_CONNECTED inter-frequency</p>
--	---

NOTE 1: The number of resource elements within the considered measurement frequency bandwidth and within the measurement period that are used by the UE to determine RSRP is left up to the UE implementation with the limitation that corresponding measurement accuracy requirements have to be fulfilled.

NOTE 2: The power per resource element is determined from the energy received during the useful part of the symbol, excluding the CP.

### 5.1.2 Void

### 5.1.3 Reference Signal Received Quality (RSRQ)

<b>Definition</b>	<p>Reference Signal Received Quality (RSRQ) is defined as the ratio <math>N \times \text{RSSI} / (\text{E-UTRA carrier RSSI})</math>, where <math>N</math> is the number of RB's of the E-UTRA carrier RSSI measurement bandwidth. The measurements in the numerator and denominator shall be made over the same set of resource blocks.</p> <p>E-UTRA Carrier Received Signal Strength Indicator (RSSI), comprises the linear average of the total received power (in [W]) observed only in certain OFDM symbols of measurement subframes, in the measurement bandwidth, over <math>N</math> number of resource blocks by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc.</p> <p>Unless indicated otherwise by higher layers, RSSI is measured only from OFDM symbols containing reference symbols for antenna port 0 of measurement subframes. If higher layers indicate all OFDM symbols for performing RSRQ measurements, then RSSI is measured from all OFDM symbols of the DL part of measurement subframes. If higher-layers indicate certain subframes for performing RSRQ measurements, then RSSI is measured from all OFDM symbols of the DL part of the indicated subframes.</p> <p>If higher layers indicate measurements based on discovery signals, RSSI is measured from all OFDM symbols of the DL part of the subframes in the configured discovery signal occasions.</p>
-------------------	---

<p>The reference point for the RSRQ shall be the antenna connector of the UE.</p> <p>If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding RSRQ of any of the individual diversity branches.</p>	
<b>Applicable for</b>	RRC_IDLE intra-frequency, RRC_IDLE inter-frequency, RRC_CONNECTED intra-frequency, RRC_CONNECTED inter-frequency

### 5.1.4 UTRA FDD CPICH RSCP

<b>Definition</b>	<p>Received Signal Code Power, the received power on one code measured on the Primary CPICH. The reference point for the RSCP shall be the antenna connector of the UE. If Tx diversity is applied on the Primary CPICH the received code power from each antenna shall be separately measured and summed together in [W] to a total received code power on the Primary CPICH. If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding CPICH RSCP of any of the individual receive antenna branches.</p>
<b>Applicable for</b>	RRC_IDLE inter-RAT, RRC_CONNECTED inter-RAT

### 5.1.5 UTRA FDD carrier RSSI

<b>Definition</b>	<p>The received wide band power, including thermal noise and noise generated in the receiver, within the bandwidth defined by the receiver pulse shaping filter. The reference point for the measurement shall be the antenna connector of the UE. If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding UTRA carrier RSSI of any of the individual receive antenna branches.</p>
<b>Applicable for</b>	RRC_IDLE inter-RAT, RRC_CONNECTED inter-RAT

NOTE: This definition does not correspond to a reported measurement. This definition is just an intermediate definition used in the definition of UTRA FDD CPICH  $E_c/N_0$ .

### 5.1.6 UTRA FDD CPICH Ec/No

<b>Definition</b>	The received energy per chip divided by the power density in the band. If receiver diversity is not in use by the UE, the CPICH Ec/No is identical to CPICH RSCP/UTRA Carrier RSSI. Measurement shall be performed on the Primary CPICH. The reference point for the CPICH Ec/No shall be the antenna connector of the UE. If Tx diversity is applied on the Primary CPICH the received energy per chip (Ec) from each antenna shall be separately measured and summed together in [Ws] to a total received chip energy per chip on the Primary CPICH, before calculating the Ec/No. If receiver diversity is in use by the UE, the measured CPICH Ec/No value shall not be lower than the corresponding CPICH RSCP/UTRA Carrier RSSI <sub>i</sub> of receive antenna branch <i>i</i> .
<b>Applicable for</b>	RRC_IDLE inter-RAT, RRC_CONNECTED inter-RAT

### 5.1.7 GSM carrier RSSI

<b>Definition</b>	Received Signal Strength Indicator, the wide-band received power within the relevant channel bandwidth. Measurement shall be performed on a GSM BCCH carrier. The reference point for the RSSI shall be the antenna connector of the UE.
<b>Applicable for</b>	RRC_IDLE inter-RAT, RRC_CONNECTED inter-RAT

### 5.1.8 Void

### 5.1.9 UTRA TDD P-CCPCH RSCP

<b>Definition</b>	Received Signal Code Power, the received power on P-CCPCH of a neighbour UTRA TDD cell. The reference point for the RSCP shall be the antenna connector of the UE.
<b>Applicable for</b>	RRC_IDLE inter-RAT, RRC_CONNECTED inter-RAT

### 5.1.10 CDMA2000 1x RTT Pilot Strength

<b>Definition</b>	CDMA2000 1x RTT Pilot Strength measurement is defined in section 2.6.6.2.2 of [8]
<b>Applicable for</b>	RRC_IDLE inter-RAT, RRC_CONNECTED inter-RAT

### 5.1.11 CDMA2000 HRPD Pilot Strength

<b>Definition</b>	CDMA2000 HRPD Pilot Strength Measurement is defined in section 8.7.6.1.2.3 of [9]
<b>Applicable for</b>	RRC_IDLE inter-RAT, RRC_CONNECTED inter-RAT

### 5.1.12 Reference signal time difference (RSTD)

<b>Definition</b>	The relative timing difference between the neighbour cell $j$ and the reference cell $i$ , defined as $T_{\text{SubframeRxj}} - T_{\text{SubframeRxi}}$ , where: $T_{\text{SubframeRxj}}$ is the time when the UE receives the start of one subframe from cell $j$ $T_{\text{SubframeRxi}}$ is the time when the UE receives the corresponding start of one subframe from cell $i$ that is closest in time to the subframe received from cell $j$ . The reference point for the observed subframe time difference shall be the antenna connector of the UE.
<b>Applicable for</b>	RRC_CONNECTED intra-frequency RRC_CONNECTED inter-frequency

### 5.1.13 UE GNSS Timing of Cell Frames for UE positioning

<b>Definition</b>	The timing between cell $j$ and a GNSS-specific reference time for a given GNSS (e.g., GPS/Galileo/Glonass system time). $T_{\text{UE-GNSS}}$ is defined as the time of occurrence of a specified E-UTRAN event according to GNSS time for a given GNSS Id. The specified E-UTRAN event is the beginning of a particular frame (identified through its SFN) in the first detected path (in time) of the cell-specific reference signals of the cell $j$ , where cell $j$ is a cell chosen by the UE. The reference point for $T_{\text{UE-GNSSj}}$ shall be the antenna connector of the UE.
<b>Applicable for</b>	RRC_CONNECTED intra-frequency

### 5.1.14 UE GNSS code measurements

<b>Definition</b>	The GNSS code phase (integer and fractional parts) of the spreading code of the $i^{\text{th}}$ GNSS satellite signal. The reference point for the GNSS code phase shall be the antenna connector of the UE.
<b>Applicable for</b>	Void (this measurement is not related to E-UTRAN/UTRAN/GSM signals; its applicability is therefore independent of the UE RRC state)

### 5.1.15 UE Rx – Tx time difference

<b>Definition</b>	The UE Rx – Tx time difference is defined as $T_{\text{UE-RX}} - T_{\text{UE-TX}}$  Where: $T_{\text{UE-RX}}$ is the UE received timing of downlink radio frame $\#i$ from the serving cell, defined by the first detected path in time. $T_{\text{UE-TX}}$ is the UE transmit timing of uplink radio frame $\#i$ .  The reference point for the UE Rx – Tx time difference measurement shall be the UE antenna connector.
<b>Applicable for</b>	RRC_CONNECTED intra-frequency

### 5.1.16 IEEE 802.11 WLAN RSSI

<b>Definition</b>	The IEEE 802.11 WLAN RSSI is defined in [15].
<b>Applicable for</b>	RRC_CONNECTED inter-RAT, RRC_IDLE inter-RAT

### 5.1.17 MBSFN Reference Signal Received Power (MBSFN RSRP)

<b>Definition</b>	<p>MBSFN Reference signal received power (MBSFN RSRP), is defined as the linear average over the power contributions (in [W]) of the resource elements that carry MBSFN reference signals within the considered measurement frequency bandwidth.</p> <p>For MBSFN RSRP determination the MBSFN reference signals <math>R_4</math> according to TS 36.211 [3] shall be used.</p> <p>The reference point for the MBSFN RSRP shall be the antenna connector of the UE.</p> <p>If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding MBSFN RSRP of any of the individual diversity branches.</p>
<b>Applicable for</b>	RRC_IDLE intra-frequency, RRC_IDLE inter-frequency, RRC_CONNECTED intra-frequency, RRC_CONNECTED inter-frequency

NOTE 1: The number of resource elements within the considered measurement frequency bandwidth and within the measurement period that are used by the UE to determine MBSFN RSRP is left up to the UE implementation with the limitation that corresponding measurement accuracy requirements have to be fulfilled.

NOTE 2: The power per resource element is determined from the energy received during the useful part of the symbol, excluding the CP.

NOTE 3: The measurement is made only in subframes and on carriers where the UE is decoding PMCH.

### 5.1.18 MBSFN Reference Signal Received Quality (MBSFN RSRQ)

<b>Definition</b>	<p>MBSFN Reference Signal Received Quality (RSRQ) is defined as the ratio <math>N \times \text{MBSFN RSRP} / (\text{MBSFN carrier RSSI})</math>, where N is the number of RBs of the MBSFN carrier RSSI measurement bandwidth. The measurements in the numerator and denominator shall be made over the same set of resource blocks.</p> <p>MBSFN Carrier Received Signal Strength Indicator (MBSFN carrier RSSI), comprises the linear average of the total received power (in [W]) observed only in OFDM symbols containing reference symbols for antenna port 4, in the measurement bandwidth, over N number of resource blocks by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc.</p> <p>The reference point for the MBSFN RSRQ shall be the antenna connector of the UE.</p> <p>If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding MBSFN RSRQ of any of the individual diversity branches.</p>
<b>Applicable for</b>	RRC_IDLE intra-frequency, RRC_IDLE inter-frequency, RRC_CONNECTED intra-frequency, RRC_CONNECTED inter-frequency

NOTE 1: The measurement is made only in subframes and on carriers where the UE is decoding PMCH.

### 5.1.19 Multicast Channel Block Error Rate (MCH BLER)

<b>Definition</b>	Multicast channel block error rate (MCH BLER) estimation shall be based on evaluating the CRC of MCH transport blocks. The BLER shall be computed over the measurement period as the ratio between the number of received MCH transport blocks resulting in a CRC error and the total number of received MCH transport blocks of an MCH. The MCH BLER estimation shall only consider MCH transport blocks using the same MCS.
<b>Applicable for</b>	RRC_IDLE intra-frequency, RRC_IDLE inter-frequency, RRC_CONNECTED intra-frequency, RRC_CONNECTED inter-frequency

NOTE 1: The measurement is made only in subframes and on carriers where the UE is decoding PMCH.

### 5.1.20 CSI Reference Signal Received Power (CSI-RSRP)

<b>Definition</b>	CSI reference signal received power (CSI-RSRP), is defined as the linear average over the power contributions (in [W]) of the resource elements that carry CSI reference signals configured for discovery signal measurements within the considered measurement frequency bandwidth in the subframes in the configured discovery signal occasions. For CSI-RSRP determination CSI reference signals R <sub>15</sub> according to TS 36.211 [3] shall be used.  The reference point for the CSI-RSRP shall be the antenna connector of the UE.  If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding CSI-RSRP of any of the individual diversity branches.
<b>Applicable for</b>	RRC_CONNECTED intra-frequency, RRC_CONNECTED inter-frequency

NOTE 1: The number of resource elements within the considered measurement frequency bandwidth and within the measurement period that are used by the UE to determine CSI-RSRP is left up to the UE implementation with the limitation that corresponding measurement accuracy requirements have to be fulfilled.

NOTE 2: The power per resource element is determined from the energy received during the useful part of the symbol, excluding the CP.

### 5.1.21 Sidelink Reference Signal Received Power (S-RSRP)

<b>Definition</b>	Sidelink Reference Signal Received Power (S-RSRP) is defined as the linear average over the power contributions (in [W]) of the resource elements that carry demodulation reference signals associated with PSBCH, within the central 6 PRBs of the applicable subframes.  The reference point for the S-RSRP shall be the antenna connector of the UE.  If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding S-RSRP of any of the individual diversity branches.
<b>Applicable for</b>	RRC_IDLE intra-frequency, RRC_IDLE inter-frequency, RRC_CONNECTED inter-frequency

NOTE 1: The number of resource elements within the considered measurement frequency bandwidth and within the measurement period that are used by the UE to determine S-RSRP is left up to the UE implementation with the limitation that corresponding measurement accuracy requirements have to be fulfilled.

NOTE 2: The power per resource element is determined from the energy received during the useful part of the symbol, excluding the CP.

NOTE 3: For RRC\_IDLE intra-frequency, S-RSRP is only applicable to the Any Cell Selection state[16].

### 5.1.22 Sidelink Discovery Reference Signal Received Power (SD-RSRP)

<b>Definition</b>	<p>Sidelink Discovery Reference Signal Received Power (SD-RSRP) is defined as the linear average over the power contributions (in [W]) of the resource elements that carry demodulation reference signals associated with PSDCH for which CRC has been validated.</p> <p>The reference point for the SD-RSRP shall be the antenna connector of the UE.</p> <p>If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding SD-RSRP of any of the individual diversity branches.</p>
<b>Applicable for</b>	<p>RRC_IDLE intra-frequency,  RRC_IDLE inter-frequency,  RRC_CONNECTED intra-frequency  RRC_CONNECTED inter-frequency</p>

NOTE 1: The number of resource elements within the considered measurement frequency bandwidth and within the measurement period that are used by the UE to determine SD-RSRP is left up to the UE implementation with the limitation that corresponding measurement accuracy requirements have to be fulfilled.

NOTE 2: The power per resource element is determined from the energy received during the useful part of the symbol, excluding the CP.

### 5.1.23 Reference signal-signal to noise and interference ratio (RS-SINR)

<b>Definition</b>	<p>Reference signal-signal to noise and interference ratio (RS-SINR), is defined as the linear average over the power contribution (in [W]) of the resource elements carrying cell-specific reference signals divided by the linear average of the noise and interference power contribution (in [W]) over the resource elements carrying cell-specific reference signals within the same frequency bandwidth.</p> <p>For RS-SINR determination, the cell-specific reference signals <math>R_0</math> according TS 36.211 [3] shall be used.</p> <p>The reference point for the RS-SINR shall be the antenna connector of the UE.</p> <p>If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding RS-SINR of any of the individual diversity branches.</p> <p>If higher-layer signalling indicates certain subframes for performing RS-SINR measurements, then RS-SINR is measured in the indicated subframes.</p>
<b>Applicable for</b>	<p>RRC_CONNECTED intra-frequency,  RRC_CONNECTED inter-frequency</p>

### 5.1.24 Received Signal Strength Indicator (RSSI)

<b>Definition</b>	<p>E-UTRA Received Signal Strength Indicator (RSSI), comprises the linear average of the total received power (in [W]) observed only in the configured OFDM symbol and in the measurement bandwidth over <math>N</math> number of resource blocks, by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc.</p> <p>Higher layers indicate the measurement duration and which OFDM symbol(s) should be measured by the UE.</p> <p>The reference point for the RSSI shall be the antenna connector of the UE.</p> <p>If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding RSSI of any of the individual diversity branches</p>
<b>Applicable for</b>	RRC_CONNECTED intra-frequency, RRC_CONNECTED inter-frequency

### 5.1.25 SFN and subframe timing difference (SSTD)

<b>Definition</b>	<p>The observed SFN and subframe timing difference (SSTD) between a PCell and a PSCell is defined as consisting of the following three components;</p> <ul style="list-style-type: none"> <li>- SFN offset = <math>(\text{SFN}_{\text{PCell}} - \text{SFN}_{\text{PSCell}}) \bmod 1024</math>, where <math>\text{SFN}_{\text{PCell}}</math> is the SFN of a PCell radio frame and <math>\text{SFN}_{\text{PSCell}}</math> is the SFN of the PSCell radio frame of which the UE receives the start closest in time to the time when it receives the start of the PCell radio frame.</li> <li>- Frame boundary offset = <math>\lfloor T_{\text{FrameBoundaryPCell}} - T_{\text{FrameBoundaryPSCell}} \rfloor / 1000</math>, where <math>T_{\text{FrameBoundaryPCell}}</math> is the time when the UE receives the start of a radio frame from the PCell and <math>T_{\text{FrameBoundaryPSCell}}</math> is the time when the UE receives the start of the radio frame of PSCell that is closest in time to the radio frame received from the PCell. The unit of <math>(T_{\text{FrameBoundaryPCell}} - T_{\text{FrameBoundaryPSCell}})</math> is [<math>\mu\text{s}</math>].</li> <li>- Subframe boundary offset = <math>T_{\text{SubframePCell}} - T_{\text{SubframePSCell}}</math>, where <math>T_{\text{SubframePCell}}</math> is the time when the UE receives the start of a subframe from the PCell and <math>T_{\text{SubframePSCell}}</math> is the time when the UE receives the start of the subframe from the PSCell that is closest in time to the subframe received from the PCell.</li> </ul> <p>The reference point for the observed SFN and subframe time difference shall be the antenna connector of the UE.</p>
<b>Applicable for</b>	RRC_CONNECTED intra-frequency

### 5.1.26 Narrowband Reference Signal Received Power (NRSRP)

<b>Definition</b>	<p>Narrowband Reference signal received power (NRSRP), is defined as the linear average over the power contributions (in [W]) of the resource elements that carry narrowband specific reference signals within the considered measurement frequency bandwidth.</p> <p>For NRS based NRSRP determination the narrowband reference signals for the first antenna port (<math>R_0</math> or <math>R_{1000}</math>) according to TS 36.211 [3] shall be used. If the UE can reliably detect that a second antenna port (<math>R_1</math> or <math>R_{1001}</math>) is available it may use the second antenna port in addition to the first antenna port to determine NRSRP.</p> <p>The reference point for the NRSRP shall be the antenna connector of the UE.</p>
<b>Applicable for</b>	RRC_IDLE intra-frequency, RRC_IDLE inter-frequency, RRC_CONNECTED intra-frequency,



## 5.1.27 Narrowband Reference Signal Received Quality (NRSRQ)

<b>Definition</b>	<p>Narrowband Reference Signal Received Quality (NRSRQ) is defined as the ratio NRSRP/NRSSI. The measurements in the numerator and denominator shall be made over the same set of resource blocks.</p> <p>Narrowband Received Signal Strength Indicator (NRSSI), comprises the linear average of the total received power (in [W]) observed OFDM symbols of measurement subframes, in the measurement bandwidth by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc.</p> <p>NRSSI is measured from all OFDM symbols of measurement subframes.</p> <p>The reference point for the NRSRQ shall be the antenna connector of the UE.</p>
<b>Applicable for</b>	RRC_IDLE intra-frequency,

## 5.2 E-UTRAN measurement abilities

The structure of the table defining a E-UTRAN measurement quantity is shown below.

Column field	Comment
<b>Definition</b>	Contains the definition of the measurement.

The term "antenna connector" used in this sub-clause to define the reference point for the E-UTRAN measurements refers to the "BS antenna connector" test port A and test port B as described in [10]. The term "antenna connector" refers to Rx or Tx antenna connector as described in the respective measurement definitions.

### 5.2.1 DL RS TX power

<b>Definition</b>	<p>Downlink reference signal transmit power is determined for a considered cell as the linear average over the power contributions (in [W]) of the resource elements that carry cell-specific reference signals which are transmitted by the eNode B within its operating system bandwidth. For DL RS TX power determination the cell-specific reference signals <math>R_0</math> and if available <math>R_1</math> according TS 36.211 [3] can be used.</p> <p>The reference point for the DL RS TX power measurement shall be the TX antenna connector.</p>
-------------------	---

## 5.2.2 Received Interference Power

<b>Definition</b>	The uplink received interference power, including thermal noise, within one physical resource block's bandwidth of $N_{sc}^{RB}$ resource elements as defined in TS 36.211 [3]. The reported value shall contain a set of Received Interference Powers of physical resource blocks $n_{PRB} = 0, \dots, N_{RB}^{UL} - 1$ as defined in TS 36.211 [3]. The reference point for the measurement shall be the RX antenna connector. In case of receiver diversity, the reported value shall be linear average of the power in the diversity branches.
-------------------	--

## 5.2.3 Thermal noise power

<b>Definition</b>	The uplink thermal noise power within the UL system bandwidth consisting of $N_{RB}^{UL}$ resource blocks as defined in [3]. It is defined as $(N_0 \times W)$ , where $N_0$ denotes the white noise power spectral density on the uplink carrier frequency and $W = N_{RB}^{UL} \cdot N_{sc}^{RB} \cdot \Delta f$ denotes the UL system bandwidth. The measurement is optionally reported together with the Received Interference Power measurement, it shall be determined over the same time period as the Received Interference Power measurement, The reference point for the measurement shall be the RX antenna connector. In case of receiver diversity, the reported value shall be linear average of the power in the diversity branches.
-------------------	---

## 5.2.4 Timing advance ( $T_{ADV}$ )

<b>Definition</b>	<p><u>Type1:</u> Timing advance (<math>T_{ADV}</math>) type 1 is defined as the time difference</p> $T_{ADV} = (\text{eNB Rx} - \text{Tx time difference}) + (\text{UE Rx} - \text{Tx time difference}),$ <p>where the eNB Rx – Tx time difference corresponds to the same UE that reports the UE Rx – Tx time difference.</p> <p><u>Type2:</u> Timing advance (<math>T_{ADV}</math>) type 2 is defined as the time difference</p> $T_{ADV} = (\text{eNB Rx} - \text{Tx time difference}),$ <p>where the eNB Rx – Tx time difference corresponds to a received uplink radio frame containing PRACH from the respective UE.</p>
-------------------	--

## 5.2.5 eNB Rx – Tx time difference

<b>Definition</b>	The eNB Rx – Tx time difference is defined as $T_{\text{eNB-RX}} - T_{\text{eNB-TX}}$
	Where:
	$T_{\text{eNB-RX}}$ is the eNB received timing of uplink radio frame #i, defined by the first detected path in time.
	The reference point for $T_{\text{eNB-RX}}$ shall be the Rx antenna connector.
	$T_{\text{eNB-TX}}$ is the eNB transmit timing of downlink radio frame #i.
	The reference point for $T_{\text{eNB-TX}}$ shall be the Tx antenna connector.

## 5.2.6 E-UTRAN GNSS Timing of Cell Frames for UE positioning

<b>Definition</b>	$T_{E-UTRAN-GNSS}$ is defined as the time of the occurrence of a specified LTE event according to a GNSS-specific reference time for a given GNSS (e.g., GPS/Galileo/Glonass system time). The specified LTE event is the beginning of the transmission of a particular frame (identified through its SFN) in the cell. The reference point for $T_{E-UTRAN-GNSS}$ shall be the Tx antenna connector.
-------------------	---

## 5.2.7 Angle of Arrival (AoA)

<b>Definition</b>	AoA defines the estimated angle of a user with respect to a reference direction. The reference direction for this measurement shall be the geographical North, positive in a counter-clockwise direction. The AoA is determined at the eNB antenna for an UL channel corresponding to this UE.
-------------------	---

## 5.2.8 UL Relative Time of Arrival ( $T_{UL-RTOA}$ )

<b>Definition</b>	The UL Relative Time of Arrival ( $T_{UL-RTOA}$ ) is the beginning of subframe $i$ containing SRS received in LMU $j$ , relative to the configurable reference time [13], [14]. The reference point [14] for the UL relative time of arrival shall be the RX antenna connector of the LMU node when LMU has a separate RX antenna or shares RX antenna with eNB and the eNB antenna connector when LMU is integrated in eNB.
-------------------	--

## Annex A (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
02/10/06	-	-	-		Draft version created	-	0.0.0
11/10/06	-	-	-		Minor editorial updates for RAN1#46bis	0.0.0	0.0.1
13/10/06	-	-	-		Endorsed skeleton	0.0.1	0.1.0
27/02/07	-	-	-		Update after 3GPP TSG RAN WG1 #48	0.1.0	0.1.1
05/03/07	-	-	-		RAN1 endorsed version	0.1.1	0.2.0
03/05/07	-	-	-		Update after 3GPP TSG RAN WG1#48bis	0.2.0	0.2.1
08/03/07	-	-	-		RAN WG1#49 endorsed version	0.2.1	0.3.0
31/05/07	RAN#36	RP-070490	-		Presented for information at RAN#36	0.3.0	1.0.0
21/06/07	-	-	-		Update after 3GPP TSG RAN #36	1.0.0	1.0.1
25/06/07	-	-	-		3GPP TSG RAN WG1#49bis endorsed version	1.0.1	1.1.0
17/08/07	-	-	-		Update after 3GPP TSG RAN WG1#48bis	1.1.0	1.1.1
20/08/07	-	-	-		3GPP TSG RAN WG1#50 endorsed version	1.1.1	1.2.0
10/09/07	RAN#37	RP-070732	-		For approval at RAN#37	1.2.0	2.0.0
12/09/07	RAN_37	RP-070732	-	-	Approved version	2.0.0	8.0.0
28/11/07	RAN_38	RP-070949	0001	1	RRC state correction for LTE UE measurements	8.0.0	8.1.0
05/03/08	RAN_39	RP-080145	0003	1	Inclusion of agreements from RAN1#51bis and RAN1#52	8.1.0	8.2.0
28/05/08	RAN_40	RP-080435	0004	-	Introduction of eNode B Measurement of Received Interference Power	8.2.0	8.3.0
28/05/08	RAN_40	RP-080435	0005	-	Introduction of eNode B Measurement of Thermal Noise Power	8.2.0	8.3.0
09/09/08	RAN_41	RP-080671	0006	-	Modification to the RSRP definition	8.3.0	8.4.0
09/09/08	RAN_41	RP-080671	0007	-	Modification of RSRQ definition and removal of RSSI	8.3.0	8.4.0
03/12/08	RAN_42	RP-080985	0008	-	RSRQ Measurement Definition	8.4.0	8.5.0
04/03/09	RAN_43	RP-090237	0009	-	RSRP and RSRQ Definitions with Receiver Diversity	8.5.0	8.6.0
15/09/09	RAN_45	RP-090888	0010		Clarification on reference point of RSRP and RSRQ for EUTRA	8.6.0	8.7.0
01/12/09	RAN_46	RP-091172	0011	1	Introduction of LTE positioning	8.7.0	9.0.0
16/03/10	RAN_47	RP-100205	0012	1	Modification of RSRQ definition	9.0.0	9.1.0
01/06/10	RAN_48	RP-100590	0014	-	On alignment of RAN1/2 positioning specification	9.1.0	9.2.0
01/06/10	RAN_48	RP-100590	0015	1	Clarification of RSTD measurement	9.1.0	9.2.0
07/12/10	RAN_50	-	-	-	Creation of Rel-10 specification	9.2.0	10.0.0
15/03/11	RAN_51	RP-110258	0016	-	RSRQ Measurement with ABS	10.0.0	10.1.0
04/09/12	RAN_57	RP-121273	0018	4	UL Relative Time of Arrival	10.1.0	11.0.0
04/12/12	RAN_58	RP-121837	0019	1	Correcting inconsistency between inter-RAT UTRA measurements and requirements	11.0.0	11.1.0
10/09/14	RAN_65	RP-141484	0022	2	Inclusion of definition of WLAN Beacon RSSI in LTE specifications	11.1.0	12.0.0
08/12/14	RAN_66	RP-142105	0020	1	Introduction of MBSFN radio measurement	12.0.0	12.1.0
08/12/14	RAN_66	RP-142106	0023	3	Measurement definitions for measurements with discovery signals	12.0.0	12.1.0
09/03/15	RAN_67	RP-150361	0021	2	New E-UTRA RSRQ measurement definition	12.1.0	12.2.0
09/03/15	RAN_67	RP-150366	0026	2	Inclusion of measurement for ProSe	12.1.0	12.2.0
07/12/15	RAN_70	RP-152125	0027	1	eD2D CR for 36.214	12.2.0	13.0.0
07/12/15	RAN_70	RP-152035	0028	2	Introduction of RS-SINR measurement for Multicarrier Load Distribution	12.2.0	13.0.0
07/12/15	RAN_70	RP-152026	0029	1	Introduction of LAA	12.2.0	13.0.0
07/12/15	RAN_70	RP-152032	0030	-	Introduction of SSTF for dual connectivity enhancement	12.2.0	13.0.0

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2016-03	RAN#71	RP-160364	0031	1	B	Introduction of WLAN RSSI measurements to support WLAN/LTE Radio Interworking	13.1.0
2016-03	RAN#71	RP-160360	0032	-	F	Correction on RSSI definition of LAA in 36.214	13.1.0
2016-06	RAN#72	RP-161067	0033	2	B	Introduction of NB-IoT	13.2.0

---

# History

<b>Document history</b>		
V13.0.0	January 2016	Publication
V13.1.0	April 2016	Publication
V13.2.0	August 2016	Publication