# ETSI TS 125 111 V15.0.0 (2018-07)


**Universal Mobile Telecommunications System (UMTS);
Location Measurement Unit (LMU) performance specification;
User Equipment (UE) positioning in UTRAN
(3GPP TS 25.111 version 15.0.0 Release 15)**

Reference
RTS/TSGR-0425111vf00

Keywords
UMTS

***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

# Intellectual Property Rights

## Essential patents

IPRs essential or potentially essential to normative deliverables 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.

## Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

# 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

# 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.

# Introduction

In order to ensure correctness and consistency of the specifications (i.e., technical specifications and technical reports) under responsibility of the Technical Specification Groups (TSG) of the 3rd Generation Partnership Project (3GPP), clear, manageable and efficient mechanisms are necessary to handle version control, change control, document updating, distribution and management.

Also, the fact that the specifications are/will be implemented by industry almost in parallel with the writing of them requires strict and fast procedures for handling of changes to the specifications.

It is very important that the changes that are brought into the standard, from the past, at present and in the future, are well documented and controlled, so that technical consistency and backwards tracing are ensured.

The 3GPP TSGs, and their sub-groups together with the Support Team are responsible for the technical content and consistency of the specifications whilst the Support Team alone is responsible for the proper management of the entire documentation, including specifications, meeting documents, administrative information and information exchange with other bodies.

# 1 Scope

The present document establishes the Location Measurement Unit (LMU) minimum RF characteristics of the FDD mode of UTRA.

# 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 TS 25.104: "Base Station (BS) radio transmission and reception (FDD)".

[2] 3GPP TS 45.004: "Modulation".

[3] 3GPP TS 25.141: "Base Station (BS) conformance testing (FDD)".

[4] 3GPP TR 25.942: "Radio Frequency (RF) system scenarios".

[5] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

# 3 Definitions and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [5] 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 [5].

**Mean power:** When applied to a W-CDMA modulated signal this is the power (transmitted or received) in a bandwidth of at least $(1+\alpha)$ times the chip rate of the radio access mode. The period of measurement shall be at least one timeslot unless otherwise stated.

NOTE: The roll-off factor $\alpha$ is defined in clause 6.8.1 of [1].

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [5] 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 [5].

| | |
|---|---|
| ACS | Adjacent Channel Selectivity |
| BS | Base Station |
| BER | Bit Error Ratio |
| BLER | Block Error Ratio |
| CW | Continuous Wave (unmodulated signal) |
| DL | Down Link (forward link) |
| FDD | Frequency Division Duplexing |
| GSM | Global System for Mobile Communications |
| LMU | Location Measurement Unit |
| UARFCN | UTRA Absolute Radio Frequency Channel Number |
| UE | User Equipment |
| UL | Up Link (reverse link) |

U-TDOA Uplink Time Difference Of Arrival
WCDMA Wideband Code Division Multiple Access

# 4 General

## 4.1 Main concepts

The LMU is either located as a separate unit in an existing network or typically located at Node B or BTS sites. Therefore the LMU radio requirements assume that the isolation between the LMU and any other network to be protected is to be at least 30dB.

The communication link between LMU and Stand-Alone SMLC is not a radio interface over the air. Requirements in this document therefore do not cover the situation when the LMU is transmitting over the air on this interface between LMU and Stand-Alone SMLC.

## 4.2 LMU Classes

The requirements in this specification apply to Wide Area LMUs and Medium Range LMUs.

Wide Area LMUs are characterised by requirements derived from Macro Cell scenarios with an LMU to UE minimum coupling loss equal to 70 dB.

Medium Range LMUs are characterised by requirements derived from Micro Cell scenarios with an LMU to UE minimum coupling loss equal to 53 dB.

For Pico Cell scenarios, the location of the BS provides sufficient accuracy; therefore, a Local Area LMUs class is not specified.

## 4.3 U-TDOA architecture

A sample architecture is shown in Figure 3.1 depicting the LMU's relationship with other network elements. The LMU is typically located at the Node B. The LMUs communicate with the SMLC that distributes UTDOA reference data from the reference LMU to other cooperating LMUs when performing UE positioning.

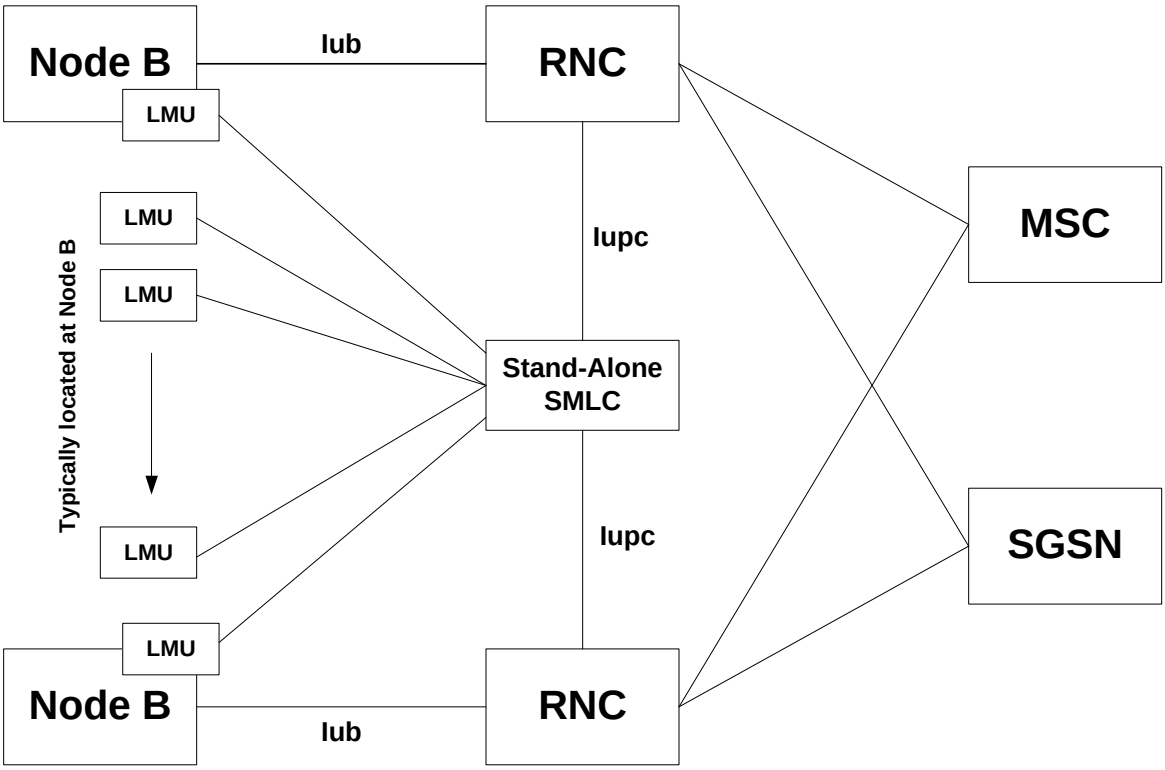


**Figure 3.1: Example of UTDOA deployment**

# 5 LMU radio characteristics

An LMU performs BS receiver functions to obtain reference data for use at a cooperating LMU. The following clause describes the required LMU radio characteristics when performing these functions.

## 5.1 Frequency bands

a) The LMU is designed to operate in the following bands:

**Table 4.1: Frequency bands**

| Operating Band | UL Frequencies UE transmit, LMU receive |
|---|---|
| I | 1920 – 1980 MHz |
| II | 1850 -1910 MHz |
| III | 1710-1785 MHz |
| IV | 1710-1755 MHz |
| V | 824 – 849MHz |
| VI | 830-840 MHz |
| VII | 2500 – 2570 MHz |
| VIII | 880 – 915 MHz |
| IX | 1749.9 – 1784.9 MHz |
| X | 1710-1770 MHz |

b) Deployment in other frequency bands is not precluded

## 5.2 Channel arrangement

The channel arrangement shall be as specified in Section 5.4 of [1].

## 5.3 Reference sensitivity level

Using the reference measurement channel specification in TS 25.104 Annex A [1], the reference sensitivity level and performance of the LMU shall be as specified in Table 4.2.

**Table 4.2: LMU reference sensitivity levels**

| LMU Class | Reference measurement channel data rate | LMU sensitivity level (dBm) | BER |
|---|---|---|---|
| Wide Area LMU | 12.2 kbps | -121 | BER shall not exceed 0.001 |
| Medium Range LMU | 12.2 kbps | -111 | BER shall not exceed 0.001 |

## 5.4 Dynamic range

Receiver dynamic range is the receiver ability to handle a rise of interference in the reception frequency channel. The receiver shall fulfil a specified BER requirement for a specified sensitivity degradation of the wanted signal in the presence of an interfering AWGN signal in the same reception frequency channel.

The BER shall not exceed 0.001 for the parameters specified in Table 4.3.

**Table 4.3: Dynamic range**

| Parameter | Level Wide Area LMU | Level Medium Range LMU | Unit |
|---|---|---|---|
| Reference measurement channel data rate | 12.2 | 12.2 | kbps |
| Wanted signal mean power | -91 | -81 | dBm |
| Interfering AWGN signal | -73 | -63 | dBm/3.84 MHz |

## 5.5 Adjacent Channel Selectivity (ACS)

Adjacent channel selectivity (ACS) is a measure of the LMU receiver ability to receive a wanted signal at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel. ACS is the ratio of the LMU receiver filter attenuation on the assigned channel frequency to the receiver filter attenuation on the adjacent channel(s).

The interference signal is offset from the wanted signal by the frequency offset Fuw. The interference signal shall be a W-CDMA signal as specified in Annex C of TS 25.104 [1].

The BER shall not exceed 0.001 for the parameters specified in Table 4.4.

**Table 4.4: LMU Adjacent channel selectivity**

| Parameter | Level Wide Area LMU | Level Medium Range LMU | Unit |
|---|---|---|---|
| Data rate | 12.2 | 12.2 | kbps |
| Wanted signal mean power | -115 | -105 | dBm |
| Interfering signal mean power | -52 | -42 | dBm |
| Fuw offset (Modulated) | 5 | 5 | MHz |

## 5.6 Blocking characteristics

The blocking characteristics are a measure of the LMU receiver ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the adjacent channels. The performance as specified in Table 4.5-4.10 shall be met with a wanted and an interfering signal coupled to the LMU antenna input using the following parameters for the blocking and narrowband blocking requirements:

**Table 4.5: Blocking performance requirement for Wide Area LMU**

| Operating Band | Center Frequency of Interfering Signal | Interfering Signal mean power | Wanted Signal mean power | Minimum Offset of Interfering Signal | Type of Interfering Signal |
|---|---|---|---|---|---|
| I | 1920 – 1980 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1900 – 1920 MHz<br>1980 – 2000 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz -1900 MHz<br>2000 MHz – 12750 MHz | -15 dBm | -115 dBm | — | CW carrier |
| II | 1850 – 1910 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1830 – 1850 MHz<br>1910 – 1930 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz – 1830 MHz<br>1930 MHz – 12750 MHz | -15 dBm | -115 dBm | — | CW carrier |
| III | 1710 – 1785 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1690 – 1710 MHz<br>1785 – 1805 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz – 1690 MHz<br>1805 MHz – 12750 MHz | -15 dBm | -115 dBm | — | CW carrier |
| IV | 1710 – 1755 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1690 – 1710 MHz<br>1755 – 1775 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz – 1690 MHz<br>1775 MHz – 12750 MHz | -15 dBm | -115 dBm | — | CW carrier |
| V | 824-849 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 804-824 MHz<br>849-869 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz – 804 MHz<br>869 MHz – 12750 MHz | -15 dBm | -115 dBm | — | CW carrier |
| VI | 810 – 830 MHz<br>840 – 860 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz – 810 MHz<br>860 MHz – 12750 MHz | -15 dBm | -115 dBm | — | CW carrier |
| VII | 2500 – 2570 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 2480 – 2500 MHz<br>2570 – 2590 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz -2480 MHz<br>2590 MHz – 12750 MHz | -15 dBm | -115 dBm | — | CW carrier |
| VIII | 880 – 915 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 860 – 880 MHz<br>915 – 925 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz -860 MHz<br>925 MHz – 12750 MHz | -15 dBm | -115 dBm | — | CW carrier |
| IX | 1749.9 – 1784.9 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1729.9 – 1749.9 MHz<br>1784.9 – 1804.9 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz – 1729.9 MHz<br>1804.9 MHz – 12750 MHz | -15 dBm | -115 dBm | — | CW carrier |
| X | 1710 – 1770 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1690 – 1710 MHz<br>1770 – 1790 MHz | -40 dBm | -115 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz – 1690 MHz<br>1790 MHz – 12750 MHz | -15 dBm | -115 dBm | — | CW carrier |
| NOTE *: The characteristics of the W-CDMA interference signal are specified in Annex C of [1] | | | | | |

**Table 4.6: Blocking performance requirement for the Medium range LMU**

| Operating Band | Center Frequency of Interfering Signal | Interfering Signal mean power | Wanted Signal mean power | Minimum Offset of Interfering Signal | Type of Interfering Signal |
|---|---|---|---|---|---|
| I | 1920 – 1980 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1900 – 1920 MHz<br>1980 – 2000 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz -1900 MHz<br>2000 MHz – 12750 MHz | -15 dBm | -105 dBm | — | CW carrier |
| II | 1850 – 1910 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1830 – 1850 MHz<br>1910 – 1930 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz – 1830 MHz<br>1930 MHz – 12750 MHz | -15 dBm | -105 dBm | — | CW carrier |
| III | 1710 – 1785 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1690 – 1710 MHz<br>1785 – 1805 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz – 1690 MHz<br>1805 MHz – 12750 MHz | -15 dBm | -105 dBm | — | CW carrier |
| IV | 1710 – 1755 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1690 – 1710 MHz<br>1755 – 1775 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz – 1690 MHz<br>1775 MHz – 12750 MHz | -15 dBm | -105 dBm | — | CW carrier |
| V | 824-849 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 804-824 MHz<br>849-869 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz – 804 MHz<br>869 MHz – 12750 MHz | -15 dBm | -105 dBm | — | CW carrier |
| VI | 810 – 830 MHz<br>840 – 860 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz – 810 MHz<br>860 MHz – 12750 MHz | -15 dBm | -105 dBm | — | CW carrier |
| VII | 2500 – 2570 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 2480 – 2500 MHz<br>2570 – 2590 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz -2480 MHz<br>2590 MHz – 12750 MHz | -15 dBm | -105 dBm | — | CW carrier |
| VIII | 880 – 915 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 860 – 880 MHz<br>915 – 925 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz -860 MHz<br>925 MHz – 12750 MHz | -15 dBm | -105 dBm | — | CW carrier |
| IX | 1749.9 – 1784.9 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1729.9 – 1749.9 MHz<br>1784.9 – 1804.9 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz – 1729.9 MHz<br>1804.9 MHz – 12750 MHz | -15 dBm | -105 dBm | — | CW carrier |
| X | 1710 – 1770 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1690 – 1710 MHz<br>1770 – 1790 MHz | -35 dBm | -105 dBm | 10 MHz | WCDMA signal * |
| | 1 MHz – 1690 MHz<br>1790 MHz – 12750 MHz | -15 dBm | -105 dBm | — | CW carrier |
| NOTE *: The characteristics of the W-CDMA interference signal are specified in Annex C of [1] | | | | | |

**Table 4.7: Blocking performance requirement (narrowband) for the Wide Area LMU**

| Operating Band | Center Frequency of Interfering Signal | Interfering Signal mean power | Wanted Signal mean power | Minimum Offset of Interfering Signal | Type of Interfering Signal |
|---|---|---|---|---|---|
| II | 1850 – 1910 MHz | - 47 dBm | -115 dBm | 2.7 MHz | GMSK modulated* |
| III | 1710 – 1785 MHz | - 47 dBm | -115 dBm | 2.8 MHz | GMSK modulated* |
| IV | 1710 – 1755 MHz | - 47 dBm | -115 dBm | 2.7 MHz | GMSK modulated* |
| V | 824 – 849 MHz | - 47 dBm | -115 dBm | 2.7 MHz | GMSK modulated* |
| VIII | 880 – 915 MHz | - 47 dBm | -115 dBm | 2.8 MHz | GMSK modulated* |
| X | 1710 – 1770 MHz | - 47 dBm | -115 dBm | 2.7 MHz | GMSK modulated* |
| NOTE *: GMSK modulation as defined in TS 45.004 [2]. | | | | | |

**Table 4.8: Narrowband blocking performance requirement for the Medium Range LMU**

| Operating Band | Center Frequency of Interfering Signal | Interfering Signal mean power | Wanted Signal mean power | Minimum Offset of Interfering Signal | Type of Interfering Signal |
|---|---|---|---|---|---|
| II | 1850 – 1910 MHz | - 42 dBm | -105 dBm | 2.7 MHz | GMSK modulated* |
| III | 1710 – 1785 MHz | - 42 dBm | -105 dBm | 2.8 MHz | GMSK modulated* |
| IV | 1710 – 1755 MHz | - 42 dBm | -105 dBm | 2.7 MHz | GMSK modulated* |
| V | 824 – 849 MHz | - 42 dBm | -105 dBm | 2.7 MHz | GMSK modulated* |
| VIII | 880 – 915 MHz | - 42 dBm | -105 dBm | 2.8 MHz | GMSK modulated* |
| X | 1710 – 1770 MHz | - 42 dBm | -105 dBm | 2.7 MHz | GMSK modulated* |
| NOTE *: GMSK modulation as defined in TS 45.004 [2]. | | | | | |

Additional blocking requirements shall be applied for the protection of the LMU receiver in the presence of GSM900, DCS1800, PCS1900, GSM850, UTRA TDD, and UTRA FDD in bands I to X.

**Table 4.9: Additional blocking performance requirement for Wide Area LMU.**

| Co-located BS type | Center Frequency of Interfering Signal | Interfering Signal mean power | Wanted Signal mean power | Type of Interfering Signal |
|---|---|---|---|---|
| Macro GSM900 | 921 – 960 MHz | +16 dBm | -115 dBm | CW carrier |
| Macro DCS1800 | 1805 – 1880 MHz | +16 dBm | -115 dBm | CW carrier |
| Macro PCS1900 | 1930 – 1990 MHz | +16 dBm | -115 dBm | CW carrier |
| Macro GSM850 | 869 – 894 MHz | +16 dBm | -115 dBm | CW carrier |
| WA UTRA-FDD Band I | 2110 – 2170 MHz | +16 dBm | -115 dBm | CW carrier |
| WA UTRA-FDD Band II | 1930 – 1990 MHz | +16 dBm | -115 dBm | CW carrier |
| WA UTRA-FDD Band III | 1805 – 1880 MHz | +16 dBm | -115 dBm | CW carrier |
| WA UTRA-FDD Band IV | 2110 – 2155 MHz | +16 dBm | -115 dBm | CW carrier |
| WA UTRA-FDD Band V | 869 – 894 MHz | +16 dBm | -115 dBm | CW carrier |
| WA UTRA-FDD Band VI | 875 – 885 MHz | +16 dBm | -115 dBm | CW carrier |
| WA UTRA-FDD Band VII | 2620 – 2690 MHz | +16 dBm | -115 dBm | CW carrier |
| WA UTRA-FDD Band VIII | 925 – 960 MHz | +16 dBm | -115 dBm | CW carrier |
| WA UTRA-FDD Band IX | 1844.9 – 1879.9 MHz | +16 dBm | -115 dBm | CW carrier |
| WA UTRA-FDD Band X | 2110 – 2170 MHz | +16 dBm | -115 dBm | CW carrier |

**Table 4.10: Additional blocking performance requirements for the LMU**

| Co-located BS type | Center Frequency of Interfering Signal | Interfering Signal mean power | Wanted Signal mean power | Type of Interfering Signal |
|---|---|---|---|---|
| Micro GSM900 | 921 – 960 MHz | -3 dBm | -105 dBm | CW carrier |
| Micro DCS1800 | 1805 – 1880 MHz | +5 dBm | -105 dBm | CW carrier |
| Micro PCS1900 | 1930 – 1990 MHz | +5 dBm | -105 dBm | CW carrier |
| Micro GSM850 | 869 – 894 MHz | -3 dBm | -105 dBm | CW carrier |
| MR UTRA-FDD Band I | 2110 – 2170 MHz | +8 dBm | -105 dBm | CW carrier |
| MR UTRA-FDD Band II | 1930 – 1990 MHz | +8 dBm | -105 dBm | CW carrier |
| MR UTRA-FDD Band III | 1805 – 1880 MHz | +8 dBm | -105 dBm | CW carrier |
| MR UTRA-FDD Band IV | 2110 – 2155 MHz | +8 dBm | -105 dBm | CW carrier |
| MR UTRA-FDD Band V | 869 – 894 MHz | +8 dBm | -105 dBm | CW carrier |
| MR UTRA-FDD Band VI | 875 – 885 MHz | +8 dBm | -105 dBm | CW carrier |
| MR UTRA-FDD Band VII | 2620 – 2690 MHz | +8 dBm | -105 dBm | CW carrier |
| MR UTRA-FDD Band VIII | 925 – 960 MHz | +8 dBm | -105 dBm | CW carrier |
| MR UTRA-FDD Band IX | 1844.9 – 1879.9 MHz | +8 dBm | -105 dBm | CW carrier |
| MR UTRA-FDD Band X | 2110 – 2170 MHz | +8 dBm | -105 dBm | CW carrier |

An additional blocking requirement may be applied for the protection of the LMU receivers when UTRA TDD is co-located with an LMU.

The current state-of-the-art technology does not allow a single generic solution for co-location with UTRA-TDD on adjacent frequencies for 30dB BS-BS minimum coupling loss.

However, there are certain site-engineering solutions that can be used in these cases. These techniques are addressed in TR 25.942 [4].

For an LMU, the static reference performance as specified in clause 5.3 should be met with a wanted and an interfering signal coupled to BS antenna input using the parameters in Table 4.11.

**Table 4.11: Blocking performance requirement for a Wide Area LMU when co-located with UTRA TDD BS in other bands.**

| Co-located BS type | Center Frequency of Interfering Signal | Interfering Signal mean power | Wanted Signal mean power | Type of Interfering Signal |
|---|---|---|---|---|
| Wide Area TDD | 2585 – 2620 MHz | +16 dBm | -115 dBm | CW carrier |

# 5.7 Intermodulation characteristics

Third and higher order mixing of the two interfering RF signals can produce an interfering signal in the band of the desired channel. Intermodulation response rejection is a measure of the capability of the receiver to receive a wanted signal on its assigned channel frequency in the presence of two or more interfering signals which have a specific frequency relationship to the wanted signal.

The static reference performance as specified in clause 5.3 shall be met for a LMU when the following signals are coupled to LMU antenna input:

- A wanted signal at the assigned channel frequency with a mean power of -115 dBm.
- Two interfering signals with the following parameters.

**Table 4.12: Intermodulation performance requirement (Wide Area LMU)**

| Operating band | Interfering Signal mean power | Offset | Type of Interfering Signal |
|---|---|---|---|
| All bands | - 48 dBm | 10 MHz | CW signal |
| | - 48 dBm | 20 MHz | WCDMA signal * |
| Note*: The characteristics of the W-CDMA interference signal are specified in Annex C of [1] | | | |

**Table 4.13: Narrowband intermodulation performance requirement (Wide Area LMU)**

| Operating band | Interfering Signal mean power | Offset | Type of Interfering Signal |
|---|---|---|---|
| II, III, IV, V, VIII, X | - 47 dBm | 3.5 MHz | CW signal |
| | - 47 dBm | 5.9 MHz | GMSK modulated* |
| * GMSK as defined in TS45.004 [2] | | | |

The static reference performance as specified in clause 5.3 shall be met for a Medium Range LMU when the following signals are coupled to LMU antenna input:

- A wanted signal at the assigned channel frequency with a mean power of -105 dBm.
- Two interfering signals with the following parameters.

**Table 4.14: Intermodulation performance requirement (Medium Range LMU)**

| Operating band | Interfering Signal mean power | Offset | Type of Interfering Signal |
|---|---|---|---|
| All bands | - 44 dBm | 10 MHz | CW signal |
| | - 44 dBm | 20 MHz | WCDMA signal * |
| Note*: The characteristics of the W-CDMA interference signal are specified in Annex C of [1] | | | |

**Table 4.15: Narrowband intermodulation performance requirement (Medium Range LMU)**

| Operating band | Interfering Signal mean power | Offset | Type of Interfering Signal |
|---|---|---|---|
| II, III, IV, V, VIII, X | - 43 dBm | 3.5 MHz | CW signal |
| | - 43 dBm | 5.9 MHz | GMSK modulated* |
| * GMSK as defined in TS45.004 [2] | | | |

## 5.8 Spurious emissions

The spurious emissions power is the power of emissions generated or amplified in a receiver that appear at the LMU antenna connector.

The power of any spurious emission shall not exceed:

**Table 4.16: General LMU spurious emission requirement**

| Band | Maximum level | Measurement Bandwidth | Note |
|---|---|---|---|
| 30MHz – 1 GHz | -57 dBm | 100 kHz | |
| 1 GHz – 12.75 GHz | -47 dBm | 1 MHz | With the exception of frequencies between 12.5 MHz below the first carrier frequency and 12.5 MHz above the last carrier frequency used by the LMU. |

In addition the following requirements shall be applied for the protection of UE, MS, and Node B, BS of the same and other systems, where the power of any spurious emission shall not exceed the limits:

**Table 4.17: Additional LMU Spurious emissions limits**

| Operating Band | Band | Maximum level | Measurement Bandwidth | Note |
|---|---|---|---|---|
| I | 1920 – 1980 MHz | -78 dBm | 3.84 MHz | |
| II | 1850 – 1910 MHz | -78 dBm | 3.84 MHz | |
| III | 1710 – 1785 MHz | -78 dBm | 3.84 MHz | |
| IV | 1710 – 1755 MHz | -78 dBm | 3.84 MHz | |
| V | 824 – 849 MHz | -78 dBm | 3.84 MHz | |
| VI | 815 – 850 MHz | -78 dBm | 3.84 MHz | |
| VII | 2500 – 2570 MHz | -78 dBm | 3.84 MHz | |
| VIII | 880 – 915 MHz | -78 dBm | 3.84 MHz | |
| IX | 1749.9 – 1784.9 MHz | -78 dBm | 3.84 MHz | |
| X | 1710 – 1770 MHz | -78 dBm | 3.84 MHz | |

In addition, the requirement in Table 4.18 may be applied to geographic areas in which both UTRA-TDD and UTRA-FDD are deployed.

**Table 4.18: Additional spurious emission requirements for the TDD bands**

| Operating Band | Band | Maximum level | Measurement Bandwidth | Note |
|---|---|---|---|---|
| I | 1900 – 1920 MHz<br>2010 – 2025 MHz | -78 dBm | 3.84 MHz | Not applicable in Japan |
| | 2010 – 2025 MHz | -52 dBm | 1MHz | Applicable in Japan |
| VI, IX | 2010 – 2025 MHz | -52 dBm | 1MHz | |

# 6 LMU measurement requirements

## 6.1 General

All tests at specified detection levels require that the LMU detection threshold be set such that the false alarm rate is at or below 5 % when no signal is present (noise only).

## 6.2 RRC States supported

UTDOA positioning technique does work in CELL_DCH and CELL_FACH state, not in URA_PCH nor CELL_PCH state.

## 6.3 Maximum response times

1) The maximum time for a Master LMU to establish a reference signal shall be, after the data capture has started, less than 5 seconds.

2) The maximum time for the distribution of the reference signal to another LMU involved in the positioning shall be less than 3 seconds.

3) The maximum time of detection of the time of arrival in an LMU given the reference signal shall be less than 15 seconds.

## 6.4 Nominal time accuracy

Nominal Time Accuracy requirement verifies the difference between the detected time of arrival and the real time of arrival.

In an AWGN environment with no fading or multi-paths, the standard deviation of the timing error of the LMU shall be less than 30 ns when the signal presence is correctly detected.

## 6.5 Multipath scenarios

The purpose of the test case is to verify the LMU receiver's performance in multipath.

For the 12.2 kbps reference measurement channel specified in 3GPP TS 25.104 Annex A [1], and with Rx diversity (using both diversity paths), the LMU shall be capable of detecting the earliest path, for at least 90 % of the location attempts, at the levels in Table 5.1.

Nominal time accuracy for multipath fading scenarios includes an additional chip duration of 260 nanoseconds over that in Section 5.4.

**Table 5.1: Multipath detection level**

| Propagation condition | Detection level: Signal to Noise level in (dB) | Note |
|---|---|---|
| Static (AWGN) | -51.2 dB | NOTE 1 |
| Multipath fading Case 1 | -47.2dB | NOTE 2 |
| Multipath fading Case 2 | - 43.8 dB | NOTE 2 |
| Multipath fading Case 3 | - 41.9 dB | NOTE 2 |
| Multipath fading Case 4 | - 39.8 dB | NOTE 2 |

NOTE 1: Static propagation condition is described in 3GPP TS 25.104 Annex B.1 [1].

NOTE 2: Multipath-fading case 1-4 is described in 3GPP TS 25.104 Annex B.2 [1].

## 6.6 Moving scenario

The purpose of the test case is to verify the LMU receiver's performance to Doppler shift.

In an AWGN environment with no fading or multi-paths, and at a speed of 250km/h, the detectability of the LMU shall be degraded by no more than 1.5 dB.

## 6.7 Cross correlation

The ability of the LMU to detect a weak terminal signal in the presence of a strong other terminal is covered in Section 5.5 when the other terminal interference is modelled as AWGN.

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2018-06 | SA#80 | - | - | - | - | Update to Rel-15 version (MCC) | 15.0.0 |

# Annex A (informative): Change history

| Change history | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | TSG | Doc. | CR | Rev | Subject/Comment | Cat | Old | New |
| 2005-08 | | | | | Initial version created | | | 0.1.0 |
| 2007-11 | | | | | Incorporate simulation results and synchronize with TS.104 | | 0.1.0 | 1.0.0 |
| 2007-12 | 38 | RP-071015 | | | Approved version at RAN TSG # 38 | | 1.0.0 | 7.0.0 |
| 2008-03 | 39 | RP-080122 | 1 | | Correcting multipath detection level in LMU performance specification | F | 7.0.0 | 7.1.0 |
| 2008-12 | SP-42 | | | | Upgraded unchanged from Rel-7 | | | 8.0.0 |
| 2009-12 | SP-46 | | | | Upgraded unchanged from Rel-8 | | | 9.0.0 |
| | SP-51 | | | | Upgraded unchanged from Rel-9 | | 9.0.0 | 10.0.0 |
| 2012-09 | SP-57 | - | - | - | Update to Rel-11 version (MCC) | | 10.0.0 | 11.0.0 |
| 2014-09 | SP-65 | - | - | - | Update to Rel-12 version (MCC) | | 11.0.0 | 12.0.0 |
| 2016-01 | SP-70 | - | - | - | Update to Rel-13 version (MCC) | | 12.0.0 | 13.0.0 |
| 2017-03 | RP-75 | - | - | - | Update to Rel-14 version (MCC) | | 13.0.0 | 14.0.0 |

# History

| Document history | | |
|---|---|---|
| V15.0.0 | July 2018 | Publication |
| | | |
| | | |
| | | |
| | | |