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Contents

Foreword

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1 Scope

The present document contains the definition of the LTE Positioning Protocol (LPP) for the radio access technologies E-UTRA/LTE and NR.

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 36.305: "Stage 2 functional specification of User Equipment (UE) positioning in E-UTRAN".

[3] 3GPP TS 23.271: "Functional stage 2 description of Location Services (LCS)".

[4] IS-GPS-200, Revision D, Navstar GPS Space Segment/Navigation User Interfaces, March 7th, 2006.

[5] IS-GPS-705, Navstar GPS Space Segment/User Segment L5 Interfaces, September 22, 2005.

[6] IS-GPS-800, Navstar GPS Space Segment/User Segment L1C Interfaces, September 4, 2008.

[7] IS-QZSS, Quasi Zenith Satellite System Navigation Service Interface Specifications for QZSS, Ver.1.1, July 31, 2009.

[8] Galileo OS Signal in Space ICD (OS SIS ICD), Issue 1.2, February 2014, European Union.

[9] Global Navigation Satellite System GLONASS Interface Control Document, Version 5.1, 2008.

[10] Specification for the Wide Area Augmentation System (WAAS), US Department of Transportation, Federal Aviation Administration, DTFA01-96-C-00025, 2001.

[11] RTCM-SC104, RTCM Recommended Standards for Differential GNSS Service (v.2.3), August 20, 2001.

[12] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); "Radio Resource Control (RRC); Protocol specification".

[13] 3GPP TS 25.331: "Radio Resource Control (RRC); Protocol Specification".

[14] 3GPP TS 44.031: "Location Services (LCS); Mobile Station (MS) - Serving Mobile Location Centre (SMLC) Radio Resource LCS Protocol (RRLP)".

[15] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".

[16] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".

[17] 3GPP TS 36.214: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer – Measurements".

[18] 3GPP TS 36.133: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management".

[19] 3GPP TS 23.003: "Numbering, addressing and identification".

[20] OMA-TS-LPPe-V1_0, LPP Extensions Specification, Open Mobile Alliance.

[21] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

[22] ITU-T Recommendation X.691 (07/2002) "Information technology - ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)" (Same as the ISO/IEC International Standard 8825-2).

[23] BDS-SIS-ICD-2.0: "BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal (Version 2.0)", December 2013.

[24] ATIS-0500027: "Recommendations for Establishing Wide Scale Indoor Location Performance", May 2015.

[25] Bluetooth Special Interest Group: "Bluetooth Core Specification v4.2", December 2014.

[26] IEEE 802.11, Part 11: "Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".

[27] IETF RFC 6225, "Dynamic Host Configuration Protocol Options for Coordinate-Based Location Configuration Information", July 2011.

[28] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".

[29] "Earth Gravitational Model 96 (EGM96)", National Geospatial-Intelligence Agency, NASA.

[30] RTCM Standard 10403.3: "Differential GNSS (Global Navigation Satellite Systems) Services" – Version 3, October 7, 2016.

[31] IGS ANTEX: "The Antenna Exchanged Format" – version 1.4, September 15, 2010.

[32] Federal Information Processing Standards Publication 197, "Specification for the ADVANCED ENCRYPTION STANDARD (AES)", November 26, 2001.

[33] NIST Special Publication 800-38A, "Recommendation for Block Cipher Modes of Operation Methods and Techniques", 2001.

[34] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[35] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

[36] 3GPP TS 38.215: "NR; Physical layer measurements".

[37] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

3 Definitions and Abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1], TS 36.305 [2] and TS 23.271 [3] apply. Other definitions are provided below.

Anchor carrier: In NB-IoT, a carrier where the UE assumes that NPSS/NSSS/NPBCH/SIB-NB for FDD or NPSS/NSSS/NPBCH for TDD are transmitted.

Location Server: a physical or logical entity (e.g., E-SMLC or SUPL SLP) that manages positioning for a target device by obtaining measurements and other location information from one or more positioning units and providing assistance data to positioning units to help determine this. A Location Server may also compute or verify the final location estimate.

NB-IoT: NB-IoT allows access to network services via E-UTRA with a channel bandwidth limited to 200 kHz.

Reference Source: a physical entity or part of a physical entity that provides signals (e.g., RF, acoustic, infra-red) that can be measured (e.g., by a Target Device) in order to obtain the location of a Target Device.

Target Device: the device that is being positioned (e.g., UE or SUPL SET).

Transmission Point (TP): A set of geographically co-located transmit antennas for one cell, part of one cell or one PRS-only TP. Transmission Points can include base station (eNodeB) antennas, remote radio heads, a remote antenna of a base station, an antenna of a PRS-only TP, etc. One cell can be formed by one or multiple transmission points. For a homogeneous deployment, each transmission point may correspond to one cell.

Observed Time Difference Of Arrival (OTDOA): The time interval that is observed by a target device between the reception of downlink signals from two different TPs. If a signal from TP 1 is received at the moment t_1, and a signal from TP 2 is received at the moment t_2, the OTDOA is $t_2 - t_1$.

PRS-only TP: A TP which only transmits PRS signals for PRS-based TBS positioning and is not associated with a cell.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply.

ADR	Accumulated Delta-Range
A-GNSS	Assisted-GNSS
AP	Access Point
ARFCN	Absolute Radio Frequency Channel Number
ARP	Antenna Reference Point
BDS	BeiDou Navigation Satellite System
BSSID	Basic Service Set Identifier
BTS	Base Transceiver Station (GERAN)
CID	Cell-ID (positioning method)
CNAV	Civil Navigation
CRS	Cell-specific Reference Signals
ECEF	Earth-Centered, Earth-Fixed
ECGI	Evolved Cell Global Identifier
ECI	Earth-Centered-Inertial
E-CID	Enhanced Cell-ID (positioning method)
EGNOS	European Geostationary Navigation Overlay Service
E-SMLC	Enhanced Serving Mobile Location Centre
E-UTRA	Evolved Universal Terrestrial Radio Access
E-UTRAN	Evolved Universal Terrestrial Radio Access Network
EOP	Earth Orientation Parameters
EPDU	External Protocol Data Unit
FDMA	Frequency Division Multiple Access
FEC	Forward Error Correction
FKP	(German) Flächen-Korrektur-Parameter (area correction parameter)
FTA	Fine Time Assistance
GAGAN	GPS Aided Geo Augmented Navigation
GLONASS	GLObal'naya NAvigatsionnaya Sputnikovaya Sistema (Engl.: Global Navigation Satellite System)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HA GNSS	High-Accuracy GNSS (RTK, PPP)
ICD	Interface Control Document
IGS	International GNSS Service
IOD	Issue of Data
IS	Interface Specification
LLA	Latitude Longitude Altitude

LPP	LTE Positioning Protocol
LPPa	LTE Positioning Protocol Annex
LSB	Least Significant Bit
MAC	Master Auxiliary Concept
MBS	Metropolitan Beacon System
MO-LR	Mobile Originated Location Request
MSAS	Multi-functional Satellite Augmentation System
MSB	Most Significant Bit
msd	mean solar day
MT-LR	Mobile Terminated Location Request
NAV	Navigation
NB-IoT	NarrowBand Internet of Things
NCGI	NR Cell Global Identifier
NICT	National Institute of Information and Communications Technology
NI-LR	Network Induced Location Request
NPRS	Narrowband Positioning Reference Signals
NR	NR Radio Access
NRSRP	Narrowband Reference Signal Received Power
NRSRQ	Narrowband Reference Signal Received Quality
NTSC	National Time Service Center of Chinese Academy of Sciences
OSR	Observation Space Representation
OTDOA	Observed Time Difference Of Arrival
PDU	Protocol Data Unit
PPP	Precise Point Positioning
PRB	Physical Resource Block
PRC	Pseudo-Range Correction
PRS	Positioning Reference Signals
posSIB	Positioning System Information Block
PZ-90	Parametry Zemli 1990 Goda – Parameters of the Earth Year 1990
QZS	Quasi Zenith Satellite
QZSS	Quasi-Zenith Satellite System
QZST	Quasi-Zenith System Time
RF	Radio Frequency
RRC	Range-Rate Correction Radio Resource Control
RSRP	Reference Signal Received Power
RSRQ	Reference Signal Received Quality
RSTD	Reference Signal Time Difference
RTK	Real-Time Kinematic
RTT	Round Trip Time
RU	Russia
SBAS	Space Based Augmentation System
SET	SUPL Enabled Terminal
SFN	System Frame Number
SLP	SUPL Location Platform
SSID	Service Set Identifier
SSR	State Space Representation
SUPL	Secure User Plane Location
SV	Space Vehicle
TB	Terrestrial Beacon
TBS	Terrestrial Beacon System
TLM	Telemetry
TOD	Time Of Day
TOW	Time Of Week
TP	Transmission Point
UDRE	User Differential Range Error
ULP	User Plane Location Protocol
USNO	US Naval Observatory
UT1	Universal Time No.1
UTC	Coordinated Universal Time
WAAS	Wide Area Augmentation System
WGS-84	World Geodetic System 1984