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Location Services (LCS);
Mobile Station (MS) - Serving Mobile Location Centre (SMLC)
Radio Resource LCS Protocol (RRLP)
(3GPP TS 44.031 version 12.3.0 Release 12)**

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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
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1 Scope

The present document contains the definition of the Radio Resource LCS Protocol (RRLP) to be used between the Mobile Station (MS) and the Serving Mobile Location Centre (SMLC).

Clause 2 defines the functionality of the protocol. Clause 3 describes the message structure, and Clause 4 the structure of components. Clause 5 contains the ASN.1 description of the components.

1.1 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.
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- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 43.059: "Functional Stage 2 Description of Location Services in GERAN".
- [3] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".
- [4] ITU-T Recommendation X.691: "Information technology - ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)".
- [5] ITU-T Recommendation X.680: "Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation".
- [6] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".
- [7] 3GPP TS 49.031: "Location Services (LCS); Base Station System Application Part LCS Extension (BSSAP-LE)".
- [8] ICD-GPS-200, Navstar GPS Space Segment/Navigation User Interfaces.
- [9] RTCM-SC104, RTCM Recommended Standards for Differential GNSS Service (v.2.2).
- [10] 3GPP TS 44.064: "General Packet Radio Service (GPRS); Mobile Station - Serving GPRS Support Node (MS-SGSN); Logical Link Control (LLC) layer specification".
- [11] Galileo OS Signal in Space ICD (OS SIS ICD), Issue 1.42, September 2014, European Union.
- [12] IS-GPS-200, Revision D, Navstar GPS Space Segment/Navigation User Interfaces, March 7th, 2006.
- [13] IS-GPS-705, Navstar GPS Space Segment/User Segment L5 Interfaces, September 22, 2005.
- [14] IS-GPS-800, Navstar GPS Space Segment/User Segment L1C Interfaces, March 31, 2008.
- [15] Specification for the Wide Area Augmentation System (WAAS), US Department of Transportation, Federal Aviation Administration, DTFA01-96-C-00025, 2001.
- [16] IS-QZSS, Quasi Zenith Satellite System Navigation Service Interface Specifications for QZSS, Ver.1.0, June 17, 2008.
- [17] Global Navigation Satellite System GLONASS Interface Control Document, Version 5, 2002.

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

1.2 Abbreviations

For the purposes of the present document, the following abbreviations and the abbreviations given in 3GPP TR 21.905 or in 3GPP TS 43.059 apply.

ADR	Accumulated Delta-Range
BDS	BeiDou Navigation Satellite System
CNAV	Civil Navigation
ECEF	Earth-Centered, Earth-Fixed
ECI	Earth-Centered-Inertial
EGNOS	European Geostationary Navigation Overlay Service
FEC	Forward Error Correction
GAGAN	GPS Aided Geo Augmented Navigation
ICD	Interface Control Document
GANSS	Galileo and Additional Navigation Satellite Systems
GLONASS	GLObal'naya NAVigatsionnaya Sputnikovaya Sistema (Engl.: Global Navigation Satellite System)
GNSS	Global Navigation Satellite System
IOD	Issue of Data
LSB	Least Significant Bit
MSAS	Multi-functional Satellite Augmentation System
MSB	Most Significant Bit
msd	mean solar day
NAV	Navigation
NICT	National Institute of Information and Communications Technology
NTSC	National Time Service Center
PZ-90	Parametry Zemli 1990 Goda – Parameters of the Earth Year 1990
QZSS	Quasi-Zenith Satellite System
SBAS	Space Based Augmentation System
SV	Space Vehicle
USNO	US Naval Observatory
WAAS	Wide Area Augmentation System
WGS-84	World Geodetic System 1984

2 Functionality of Protocol

2.1 General

The present document defines one generic RRLP message that is used to transfer Location Services (LCS) related information between the Mobile Station (MS) and the Serving Mobile Location Centre (SMLC). Usage of the RRLP protocol on a general level is described in 3GPP TS 43.059 that includes Stage 2 description of LCS.

One message includes one of the following components:

- Measure Position Request;
- Measure Position Response;
- Assistance Data;
- Assistance Data Acknowledgement;
- Protocol Error;
- Positioning Capability Request;
- Positioning Capability Response.

Next sub-clauses describe the usage of these components.

Delivery of components may be supported in the RRLP level using pseudo-segmentation by sending several shorter messages instead of one long message. Any assistance data that is successfully delivered to an MS and acknowledged prior to the interruption of the positioning procedure by an event like handover, or by any other event that causes an MS to terminate the positioning procedure or delivery of assistance data (see 3GPP TS 43.059), shall be retained by the MS and need not be resent by the SMLC when positioning or delivery of assistance data is again re-attempted.

The RRLP maximum PDU size is 242 octets. If the amount of data that needs to be sent is larger than RRLP maximum PDU size, the RRLP pseudo-segmentation shall be used. The RRLP pseudo-segmentation is the use of several RRLP components (one in each RRLP message) to deliver a large amount of information. For SMLC to MS messages, the Assistance Data component is the one that is sent several times in order to deliver the information. For MS to SMLC messages, the Measure Position Response component may be sent twice in order to deliver the information. Legacy MS and SMLC (3GPP Rel-4 or older) may send RRLP components that are larger than the RRLP maximum PDU size. In this case lower level segmentation will be used.

2.2 Position Measurement Procedure

The purpose of this procedure is to enable the SMLC to request for position measurement data or location estimate from the MS, and the MS to respond to the request with measurements or location estimate.

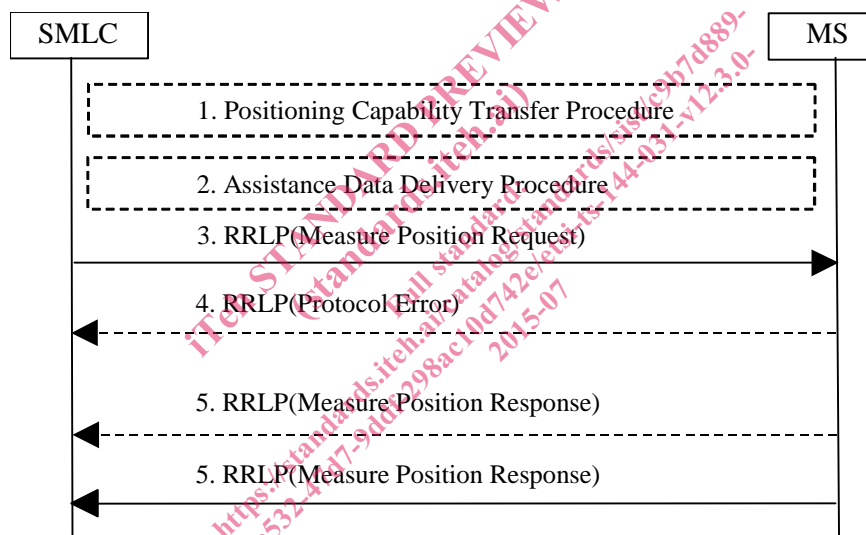


Figure 2.1: Position Measurement procedure

1. The Measure Position Request component and any Assistance Data Delivery Procedure may be preceded by a Positioning Capability Transfer procedure (see sub-clause 2.3a) to transfer the MS positioning capabilities to the SMLC.
2. The Measure Position Request component may be preceded by an Assistance Data Delivery Procedure (see sub-clause 2.3) to deliver some or all of the entire set of assistance data that is needed by the subsequent positioning procedure (steps 3-5).
3. The SMLC sends the Measure Position Request component in a RRLP message to the MS. The component includes QoS, other instructions, and possible assistance data to the MS. The RRLP message contains a reference number and an extended reference ID of the request.
4. The MS sends a RRLP message containing the Protocol Error component to the SMLC, if there is a problem that prevents the MS to receive a complete and understandable Measure Position Request component. The RRLP message contains the reference number and, if available, the extended reference ID included in the Measure Position Request received incomplete. The Protocol Error component includes a more specific reason. When the SMLC receives the Protocol Error component, it may try to resend the Measure Position Request (go back to the step 3), abort location, or start a new position measurement procedure (e.g. with updated assistance data).
5. The MS tries to perform the requested location measurements, and possibly calculates its own position. When the MS has location measurements, location estimate, or an error indication (measurements/location estimation not

possible), it sends the results in the Measure Position Response component to the SMLC. The RRLP message contains the reference number and, if received, the extended reference ID of the request originally received in the step 3. The MS may optionally send one additional Measure Position Response component in a second RRLP message to the SMLC if the amount of information it needs to transfer to the SMLC is too large to fit into one single Measure Position Response component (uplink RRLP pseudo-segmentation). This RRLP message also contains the reference number and, if received, the extended reference ID of the request originally received in the step 3. If two components are sent, the MS shall indicate in the first component that it is the first of many components and in the second one that it is the second of many components. If there is a problem that prevents the SMLC to receive a complete and understandable Measure Position Response component, the SMLC may decide to abort location, or start a new position measurement procedure instead. If additional Measure Position Response components are received by the SMLC after the 1st and optional 2nd one, they shall be ignored.

2.3 Assistance Data Delivery Procedure

The purpose of this procedure is to enable the SMLC to send assistance data to the MS related to position measurement and/or location calculation. Notice that RRLP protocol is not used by the MS to request assistance data, only to deliver it to the MS. The entire set of assistance data (i.e. the total amount of assistance data that the SMLC has decided to send in the current procedure) may be delivered in one or several Assistance Data components. In this case steps 1 and 3 below may be repeated several times by the SMLC. If several components are sent, the SMLC shall await the acknowledgement of each component before the next Assistance Data component is sent. If Assistance Data Delivery is used as part of the Position Measurement Procedure, as described in sub-clause 2.2, then some assistance data may be delivered in the final RRLP Measure Position Request.

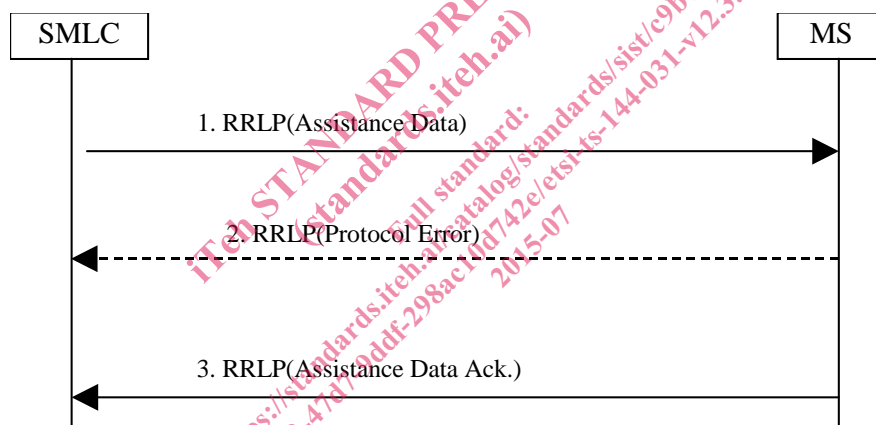


Figure 2.2: Assistance Data Delivery procedure

1. The SMLC sends the Assistance Data component to the MS. The component includes assistance data for location measurement and/or location calculation. The RRLP message contains a reference number and an extended reference ID of the delivery. The More Assistance Data To Be Sent Element in the Assistance Data component is used by the SMLC to indicate to the MS if either more Assistance Data components (in the current Assistance Data Delivery procedure) or a final RRLP Measure Position Request (if the Assistance Data Delivery Procedure forms part of a Position Measurement procedure as described in sub-clause 2.2) will be sent.
2. The MS sends a RRLP message containing the Protocol Error component to the SMLC, if there is a problem that prevents the MS to receive a complete and understandable Assistance Data component. The RRLP message contains the reference number and, if available, the extended reference ID included in the Assistance Data component received incomplete. The Protocol Error component includes a more specific reason. When the SMLC receives the Protocol Error component, it may try to resend the Assistance Data component (go back to the step 1), send a new measure Assistance Data set (e.g. with updated assistance data), or abort the delivery.
3. When the MS has received a complete Assistance Data component, it send the Assistance Data Acknowledgement component to the SMLC. The RRLP message contains the reference number of the Assistance Data originally received in step 1.

2.3a Positioning Capability Transfer Procedure

The purpose of this procedure is to enable the SMLC to obtain the positioning capabilities of the MS, the types of assistance supported and the types of assistance data that may be needed from the SMLC. MS support for this procedure can be indicated to the SMLC using the MS Classmark 3 IE for GSM (see 3GPP TS 24.008), the PS LCS Capability IE for GERAN Gb mode (see 3GPP TS 24.008) and the MS Positioning Capability IE for GERAN Iu mode (see 3GPP TS 44.118).

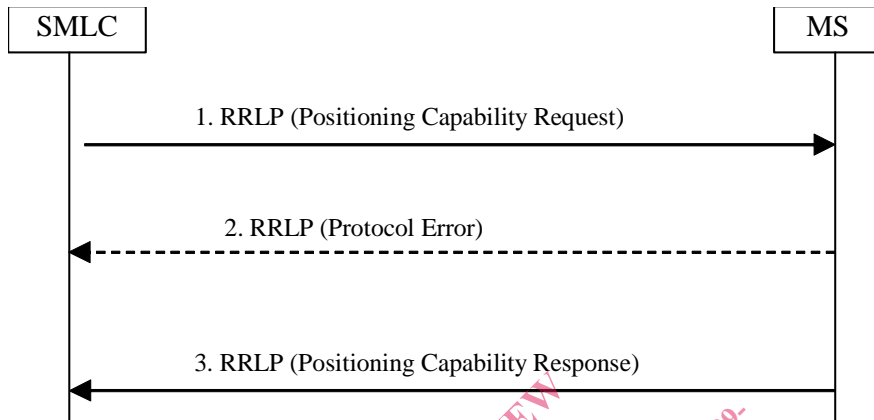


Figure 2.3: Positioning Capability Transfer procedure

1. The SMLC sends the Positioning Capability Request component to the MS. The RRLP message contains a reference number and an extended reference ID of the request. The message may contain indication of GANSS positioning support.
2. The MS sends a RRLP message containing the Protocol Error component to the SMLC, if there is a problem that prevents the MS to receive a complete and understandable Positioning Capability Request component. The RRLP message contains the reference number and the extended reference ID included in the Positioning Capability Request component. The Protocol Error component includes a more specific reason. When the SMLC receives the Protocol Error component, it may try to resend the Positioning Capability Request component (go back to the step 1) or abort the request.
3. When the MS has received a complete Positioning Capability Request component, it sends the Positioning Capability Response component to the SMLC. The component shall include the positioning capabilities of the MS and the types of supported assistance data. The component may include the types of assistance needed by the MS to obtain a location estimate or positioning measurements. The RRLP message also contains the reference number and extended Reference ID of the Positioning Capability Request originally received in step 1.

2.4 (void)

2.5 Error Handling Procedures

2.5.1 General

In this sub-clause it is described how a receiving entity behaves in cases when it receives erroneous data or detects that certain data is missing.

2.5.1a Message Too Short

When MS receives a RRLP message, that is too short to contain all mandatory IEs, the MS sends a Protocol Error component with indication "Message Too Short". If the Reference Number can be found, it is included. If the Reference Number is not available, the Reference Number of the RRLP message carrying the Protocol Error component is set to '0'. If the Extended Reference IE can be found, it shall be included in the returned Protocol Error Component. If the Extended Reference IE is not available, an Extended Reference IE shall not be included. The original sending entity that receives the Protocol Error, may then resend the original message, or abort the procedure.

2.5.2 Unknown Reference Number

A SMLC detects that it has received a RRLP message with an unknown or invalid Reference Number, when one or more of the following conditions occur:

- a Measure Position Response, Assistance Data Acknowledgement, Positioning Capability Response or Protocol Error component is received with a Reference Number that the SMLC has not sent in a Measure Position Request, Assistance Data or Positioning Capability Request component during a pending Position Measurement, Assistance Data Delivery or Positioning Capability Transfer procedure.
- a Measure Position Response, Positioning Capability Response or Protocol Error component is received with an Extended Reference IE value that the SMLC has not sent in a Measure Position Request Assistance Data or Positioning Capability Request component during a pending Position Measurement, Assistance Data Delivery or Positioning Capability Transfer procedure.
- a Measure Position Response, Positioning Capability Response or Protocol Error component is received with a Reference Number and an Extended Reference IE value that the SMLC has not sent together in the same Measure Position Request, the same Assistance Data or the same Positioning Capability Request component during a pending Position Measurement, Assistance Data Delivery or Positioning Capability Transfer procedure.

The SMLC shall then discard the message. If the SMLC receives a Measure Position Response or a Protocol Error component containing no Extended Reference ID, then the SMLC shall assume that the target MS is for Release 4 or earlier and shall only verify the received Reference Number.

2.5.3 Missing Information Element or Component Element

When MS receives a RRLP message, that does not contain IEs or component elements expected to be present, the MS sends a Protocol Error component with indication "Missing Information Element or Component Element". If the Reference Number can be found, it is included. If the Reference Number is not available, the Reference Number of the RRLP message carrying the Protocol Error component is set to '0'. If the Extended Reference IE can be found, it shall be included in the returned Protocol Error Component. If the Extended Reference IE is not available, an Extended Reference IE shall not be included. The SMLC that receives the Protocol Error, may then resend the original message, or abort the procedure.

2.5.4 Incorrect Data

When MS receives a RRLP message, that contains IEs or elements of components that are syntactically incorrect, the MS sends a Protocol Error component with indication "Incorrect Data". If the Reference Number can be found, it is included. If the Reference Number is not available, the Reference Number of the RRLP message carrying the Protocol Error component is set to '0'. If the Extended Reference IE can be found, it shall be included in the returned Protocol Error Component. If the Extended Reference IE is not available, an Extended Reference IE shall not be included. The SMLC that receives the Protocol Error, may then resend the original message, or abort the procedure.

2.5.5 Repeated Component

When after the reception of a Measure Position Request component, but before responding with a Measure Position Response or a Protocol Error component, the MS receives a new RRLP message with the Measure Position Request component, it acts as follows:

- if the old and new Measure Position Request components have the same Reference Number and, if included, the same Extended Reference IE, the MS ignores the later component;
- if the old and new Measure Position Request components have different Reference Numbers or, if included, different Extended Reference IEs or if one Measure Position Request component (old or new) contains an Extended Reference IE but the other component does not, the MS aborts activity for the former component, and starts to act according to the later component, and sends a response to that.

When after the reception of an Assistance Data component, but before responding with an Assistance Data Acknowledgement or a Protocol Error component, the MS receives a new RRLP message with the Assistance Data component, it acts as follows:

- if the old and new Assistance Data components have the same Reference Number and, if included, the same Extended Reference IE and if pseudo-segmentation does not apply (see sub-clause 2.5.9), the MS ignores the later component;
- if the old and new Assistance Data components have different Reference Numbers or, if included, different Extended Reference IEs or if one Assistance Data component (old or new) contains an Extended Reference IE but the other component does not, the MS ignores the former component and sends an acknowledgement to the latter component.

When after the reception of a Positioning Capability Request component, but before responding with a Positioning Capability Response or a Protocol Error component, the MS receives a new RRLP message with the Positioning Capability Request component, it acts as follows:

- if the old and new Positioning Capability Request components have the same Reference Number and the same Extended Reference IE, the MS ignores the later component;
- if the old and new Positioning Capability Request components have different Reference Numbers or different Extended Reference IEs, the MS aborts activity for the former component, starts to act according to the later component and sends a response to that.

When after the reception of an Measure Position Response component, the SMLC receives a new RRLP message with the Measure Position Response component, it acts as follows:

- if the old and new Measure Position Response components have the same Reference Number and, if included, the same Extended Reference IE values, the SMLC may ignore the later component;

2.5.6 (void)

2.5.7 Missing Component

When the SMLC sends a Measure Position Request component to the MS, it starts a timer. If the timer expires before the SMLC receives the last Measure Position Response component or a Protocol Error component from the MS with the same Reference Number and, if included, the same Extended Reference IE value as in the sent component, it may abort location attempt or send a new Measure Position Request.

When the SMLC receives a Measure Position Response component with the same Reference Number and, if included, the same Extended Reference IE value as in the sent component indicating that it is the second of many segments, but the first of the many segments was never received by the SMLC, it may abort location attempt or send a new Measure Position Request.

When the SMLC sends a Assistance Data component to the MS, it starts a timer. If the timer expires before the SMLC receives a Assistance Data Acknowledgement or Protocol Error component from the MS with the same Reference Number as in the sent component and, in the case of a Protocol Error component, either the same extended reference ID as in the sent component or no extended reference ID, it may abort delivery attempt or send a new Assistance Data.

When the SMLC sends a Positioning Capability Request component to the MS, it starts a timer. If the timer expires before the SMLC receives a Positioning Capability Response or Protocol Error component from the MS with the same Reference Number and the same Extended Reference ID as in the sent component, it may abort the Positioning Capability Transfer Procedure attempt or send a new Positioning Capability Request.

2.5.8 Unforeseen Component

When the MS receives a complete Assistance Data pseudo-segmentation sequence or an Assistance Data component that was sent without pseudo-segmentation, that it is not expecting, MS may discard it.

2.5.8a RRLP Procedure

The MS and SMLC shall only support one RRLP procedure at a time for either positioning, delivery of assistance data or positioning capability transfer. The normal sequence of events for either procedure is defined in sub-clause 2.2, sub-clause 2.3 or sub-clause 2.3a, respectively. If the MS is engaged in an RRLP procedure and receives a correctly encoded