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User plane Location Services (LCS) protocols and procedures;  
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In the present document, modal verbs have the following meanings:

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**may** indicates permission to do something

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**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

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# 1 Scope

The present document specifies the LCS user plane protocol (LCS-UPP) to support the Location Services in the 5G System (5GS) as specified in 3GPP TS 23.273 [2] for user plane positioning between the UE and the LMF.

The present document also specifies the user plane positioning connection management (UPP-CM) protocol to support the LCS secured user plane connection between the UE and the LMF.

The present document also specifies the LCS user plane protocol (LCS-UPP) to support location event reporting over an LCS secured user plane connection between the UE and the LCS client or the AF.

The present document also defines the message format, message contents, error handling and system parameters applied by the LCS-UPP and the UPP-CM protocol for supporting Location Services in 5GS.

---

# 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.
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- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 23.273: "5G System (5GS) Location Services (LCS); Stage 2".
- [3] 3GPP TS 24.571: "5G System (5GS) Control plane Location Services (LCS) procedures; Stage 3".
- [4] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".
- [5] 3GPP TS 23.271: "Functional stage 2 description of Location Services (LCS)".
- [6] 3GPP TS 38.305: "Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN".
- [7] 3GPP TS 24.007: "Mobile radio interface signalling layer 3; General aspects".
- [8] 3GPP TS 33.501: "Security architecture and procedures for 5G System".
- [9] 3GPP TS 24.526: "UE policies for 5G System (5GS); Stage 3".
- [10] 3GPP TS 23.003: "Numbering, addressing and identification".
- [11] 3GPP TS 24.080: "Mobile radio interface layer 3 supplementary services specification; Formats and coding".
- [12] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".
- [13] 3GPP TS 37.355: "Technical Specification Group Radio Access Network; LTE Positioning Protocol (LPP)".
- [14] 3GPP TS 24.008: "Mobile Radio Interface Layer 3 specification; Core Network Protocols; Stage 3".
- [15] 3GPP TS 29.641: "Technical Specification Group Core Network and Terminals; 3GPP registry for Service Names and Port Numbers".
- [16] 3GPP TS 29.572: "5G System; Location Management Services; Stage 3".

## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms given in 3GPP 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 3GPP TR 21.905 [1].

**LCS secured user plane connection:** A connection used for LCS signaling message transport via user plane between the UE and the LMF. The LCS secured user plane connection is achieved by a TLS connection between the UE and the LMF established over PDU connectivity service provided by a PDU session, and a successful binding procedure performed via the TLS connection.

**User plane connection information:** The information provided by LMF during the network initiated user plane connection establishment procedure.

**LCS-UP binding ID:** An identity allocated by the LMF and used to associate the UE with the LCS secured user plane connection between the UE and the LMF.

For the purposes of the present document, the following terms and definitions given in 3GPP TS 23.501 [12] apply:

**PDU connectivity service**  
**PDU session**  
**PDU session type**

### 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP 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 3GPP TR 21.905 [1].

FQDN	Fully Qualified Domain Name
LCS	LoCation Service
LCS-UP	Location Services User Plane
LCS-UPP	Location Services User Plane Protocol
LMF	Location Management Function
LPP	LTE Positioning Protocol
OMA	Open Mobile Alliance
SUPL	Secure User Plane Location
TLS	Transport Layer Security
UPP-CM	User Plane Positioning Connection Management
UPP-CMI	User Plane Positioning Connection Management Information

## 4 General

### 4.1 Overview

The user plane location services protocols described in the present document provide signalling connectivity between UE and LMF, LCS client or AF, for 5GS.

Main functions of user plane LCS protocols are:

- support of management of an LCS secured user plane connection for user plane positioning; and
- user plane transport procedures to provide transport of LPP messages and LCS supplementary services messages.

For the support of the above functions, the following procedures are supplied within this specification:

- elementary procedures for UPP-CM, in clause 6; and

- elementary procedures for LCS-UPP, in clause 7.

Security, including ciphering and integrity protection, is provided by lower layers from a user plane location services protocol perspective (see 3GPP TS 24.501 [4] for UPP-CM and clause 4.3 for LCS-UPP).

The co-existence of user plane location solutions is described in clause 5.

The UPP-CM and LCS-UPP for 5GS follow the protocol architecture model for layer 3 as described in 3GPP TS 24.007 [7].

## 4.2 LCS-UP positioning management

### 4.2.1 General

In order to ensure the transfer of LCS supplementary services messages and LPP messages via the user plane, the UE and the LMF shall perform the LCS user plane positioning management including:

- a) PDU session management (see clause 4.2.2);
- b) user plane positioning connection management (see clause 4.2.3).

### 4.2.2 PDU session management

A PDU session for the user plane positioning between the UE and the network is a prerequisite for an LCS secured user plane connection between the UE and the LMF for LCS-UPP.

The HPLMN may provide the UE with the URSP rules for the user plane positioning as defined in 3GPP TS 24.526 [9]. The UE supporting the user plane positioning can use an established PDU session or establish a PDU session for the user plane positioning based on URSP rules. The URSP rules for the user plane positioning include:

- a) the traffic descriptor containing the connection capability for user plane positioning; and
- b) the route selection descriptor containing a DNN and an S-NSSAI for the user plane positioning.

During the UE requested user plane connection establishment procedure or the network initiated user plane connection establishment procedure, if there is no established PDU session for the user plane positioning, the UE shall initiate a UE-requested PDU session establishment procedure as specified in 3GPP TS 24.501 [4] to establish a new PDU session with a DNN and an S-NSSAI used for the user plane positioning.

**NOTE:** The appropriate QoS parameters of the PDU session for the user plane positioning are up to the operator's determination.

If the PDU session for the user plane positioning is released as specified in clause 6.3.3 and clause 6.4.3 of 3GPP TS 24.501 [4], the UE may initiate the UE requested user plane connection release procedure as specified in clause 6.2.2.2.

### 4.2.3 User plane positioning connection management

The user plane positioning connection management is to support the establishment and release of the LCS secured user plane connection between the UE and the LMF.

To trigger the UE to establish or re-establish an LCS secured user plane connection between the UE and the LMF, the LMF shall provide the user plane connection information to the UE. The UE can also send the USER PLANE CONNECTION ESTABLISHMENT REQUEST message to the LMF to obtain the user plane connection information. The user plane connection information includes an address of the LMF and an LCS-UP binding ID. The LMF shall allocate the LCS-UP binding ID in order to associate the UE with the LCS secured user plane connection. The UE shall use the LCS-UP binding ID during the LCS-UP connection binding procedure to request binding the LCS secured user plane connection to the UE.

The TCP port number 65402 is used as destination TCP port number in establishment of TCP connection for the TLS connection for the LCS secured user plane connection as specified in 3GPP TS 29.641 [15].

The LMF may monitor the LCS secured user plane connection by running an implementation specific inactivity timer. Upon expiry of the implementation specific inactivity timer, the LMF shall initiate the network initiated user plane connection release procedure as specified in clause 6.2.1.2.

NOTE: In this release of specification, one or more LCS secured user plane connections are allowed for a UE and a maximum of one LCS secured user plane connection is allowed towards each LMF as specified in clause 6.18 of 3GPP TS 23.273 [2].

## 4.3 Security

An LCS secured user plane connection between the UE and the LMF for LCS-UPP is protected using a TLS based mechanism as described in 3GPP TS 33.501 [8] Annex Q.2.

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# 5 Co-existence of user plane location solutions

## 5.1 General

The user plane location solution as described in the present specification, i.e. LCS-UPP, may co-exist with other user plane location solutions such as OMA SUPL. The use of OMA SUPL in a 3GPP network is described in 3GPP TS 38.305 [6] and 3GPP TS 23.271 [5].

For UEs supporting another user plane location solution in addition to LCS-UPP, the following indications and parameters can be used to control which user plane location solution is used for such UEs:

- a) LCS-UPP bit in NAS 5GMM capability IE (see 3GPP TS 24.501 [4]);
- b) SUPL bit in NAS 5GMM capability IE (see 3GPP TS 24.501 [4]);
- c) LCS-UPP bit in NAS 5GS network feature support IE (see 3GPP TS 24.501 [4]); and
- d) SUPL bit in NAS 5GS network feature support IE (see 3GPP TS 24.501 [4]).

## 5.2 User plane location solution selection

The UE supporting one or more user plane location solution(s) (e.g. LCS-UPP, SUPL) indicates its user plane location capability(ies) to the network via the 5GMM capability IE as described in 3GPP TS 24.501 [4]. If the network accepts the user plane location solution(s) indicated by the UE, the network indicates the supported user plane location solution(s) to the UE via the 5GS network feature support as described in 3GPP TS 24.501 [4]. The user plane location solution(s) indicated as supported by the network to the UE is selected based on network supported solutions, UE supported solutions and operator policy.

After the UE receives the indication of the supported user plane location solution(s) by the network, and when needed, a user plane location solution supported by both the UE and the network can be initiated and used.

---

# 6 Elementary procedures for UPP-CM

## 6.1 Overview

### 6.1.1 General

This clause defines the UPP-CM procedures (see clause 6.2). The format and coding of the messages and information elements are specified in clause 10.3 and 11.3 respectively.

The user plane positioning connection management is to support the management of an LCS secured user plane connection between the UE and the LMF.

The UPP-CM messages defined in this clause can be included in the UPP-CMI container of the UL NAS TRANSPORT message and DL NAS TRANSPORT message defined in 3GPP TS 24.501 [4].

The UE shall provide the routing information of the corresponding LMF to the lower layer when the UE sends the USER PLANE CONNECTION ESTABLISHMENT COMPLETE message, USER PLANE CONNECTION ESTABLISHMENT FAILURE message, USER PLANE CONNECTION MODIFICATION COMPLETE message, USER PLANE CONNECTION MODIFICATION REJECT message, USER PLANE CONNECTION RELEASE COMPLETE message, or USER PLANE CONNECTION RELEASE REQUEST message.

**NOTE:** The routing information of the corresponding LMF is the routing information included in the Additional information IE of the DL NAS TRANSPORT message which carries the corresponding UPP-CM message as specified in clause 5.4.5.3.2 of 3GPP TS 24.501 [4].

## 6.1.2 Types of UPP-CM procedures

Three types of UPP-CM procedures can be distinguished:

- a) Procedures related to establishing the LCS secured user plane connection for LCS-UPP:
  - 1) Initiated by the network:
    - i) network initiated user plane connection establishment procedure.
  - 2) Initiated by the UE:
    - i) UE requested user plane connection establishment procedure.
- b) Procedures related to releasing the LCS secured user plane connection for LCS-UPP:
  - 1) Initiated by the network:
    - i) network initiated user plane connection release procedure.
  - 2) Initiated by the UE:
    - i) UE requested user plane connection release procedure.
- c) Procedure related to modifying the LCS secured user plane connection for LCS-UPP:
  - 1) Initiated by the network:
    - i) network initiated user plane connection modification procedure.

## 6.2 UPP-CM procedures

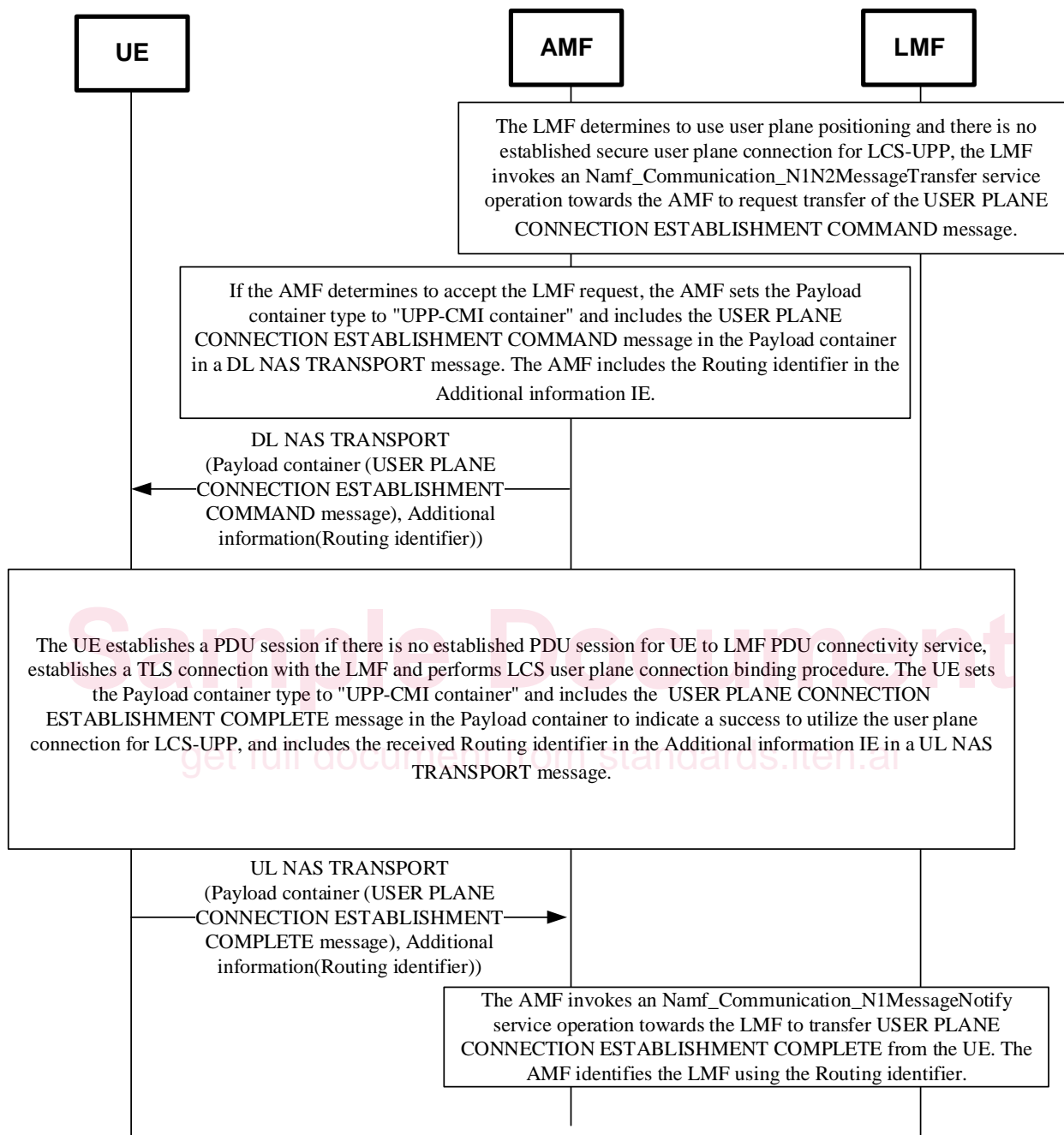
### 6.2.1 Network initiated UPP-CM procedures

#### 6.2.1.1 Network initiated user plane connection establishment procedure

##### 6.2.1.1.1 General

The purpose of the network initiated user plane connection establishment procedure is to establish an LCS secured user plane connection between the UE and the LMF as described in clause 6.18.1 of 3GPP TS 23.273 [2]. The USER PLANE CONNECTION ESTABLISHMENT COMMAND message is encapsulated in the UPP-CMI container of the DL NAS TRANSPORT message. Acknowledgement of the establishment of the LCS secured user plane connection between UE and LMF is indicated by the USER PLANE CONNECTION ESTABLISHMENT COMPLETE message, encapsulated in the UPP-CMI container of the UL NAS TRANSPORT message as defined in 3GPP TS 24.501 [4]. Figure 6.2.1.1.1.1 illustrates an example of the signalling transport for network initiated user plane connection establishment procedure messages.

NOTE: The successful establishment of an LCS secured user plane connection between the UE and the LMF does not affect the LCS session initiated over the control plane prior to the establishment of the LCS secured user plane connection.



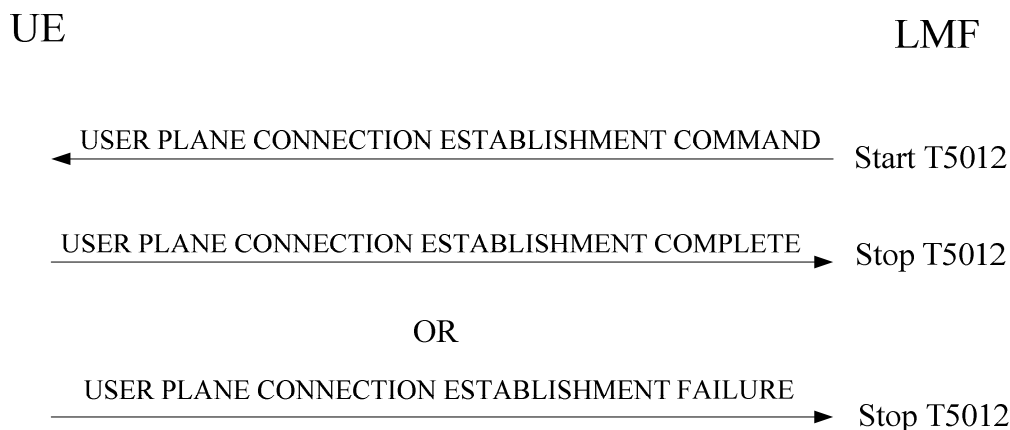
**Figure 6.2.1.1.1: Signalling transport for network initiated user plane connection establishment procedure**

#### 6.2.1.1.2 Network initiated user plane connection establishment procedure initiation by the network

The LMF initiates the network initiated user plane connection establishment procedure by sending the USER PLANE CONNECTION ESTABLISHMENT COMMAND message to the UE (see example in figure 6.2.1.1.2.1). The LMF shall:

- a0) allocate a unique LCS-UP binding ID value and associate the LCS-UP binding ID value with the UE identity (i.e., SUPI, GPSI, or both);

- a) create the USER PLANE CONNECTION ESTABLISHMENT COMMAND message according to clause 10.3.1;
- b) send the USER PLANE CONNECTION ESTABLISHMENT COMMAND message to the UE; and
- c) start a timer T5012 upon sending the USER PLANE CONNECTION ESTABLISHMENT COMMAND message.



**Figure 6.2.1.1.2.1: Network initiated user plane connection establishment procedure**

#### 6.2.1.1.3 Network initiated user plane connection establishment procedure accepted by the UE

Upon receipt of a USER PLANE CONNECTION ESTABLISHMENT COMMAND message from the LMF, the UE shall stop timer T5011, if running, and timer T5014, if running, delete the stored LCS-UP binding ID, if any, and store the LCS-UP binding ID and the LMF LCS-UP address received in the USER PLANE CONNECTION ESTABLISHMENT COMMAND message.

If the USER PLANE CONNECTION ESTABLISHMENT COMMAND message can be accepted, the UE shall:

- a) establish a PDU session providing PDU connectivity service between the UE and the LMF, if not available, as described in clause 4.2.2;
- b) establish a TLS connection between the UE and the LMF, as described in clause 4.3 after the required PDU connectivity service between the UE and the LMF is available; and
- c) perform an LCS-UP connection binding procedure as described in clause 7.3.4 after the successful TLS connection establishment.

After the LCS-UP connection binding procedure is completed successfully as described in clause 7.3.4, the UE shall:

- a) create the USER PLANE CONNECTION ESTABLISHMENT COMPLETE message according to clause 10.3.2;
- b) send the USER PLANE CONNECTION ESTABLISHMENT COMPLETE message to the LMF;
- c) consider the LCS secured user plane connection between the UE and the LMF is established; and
- d) associate the routing information provided by the lower layer as specified in 3GPP TS 24.501 [4] with the established LCS secured user plane connection.

**NOTE:** The routing information provided by the lower layer as specified in 3GPP TS 24.501 [4] is used as identification information for the UE to associate the LCS secured user plane connection to the LMF which sent the USER PLANE CONNECTION ESTABLISHMENT COMMAND message.