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In the present document, modal verbs have the following meanings:

- shall** indicates a mandatory requirement to do something
- shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

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- may** indicates permission to do something
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The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

- 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.

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.
- 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 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.

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 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.

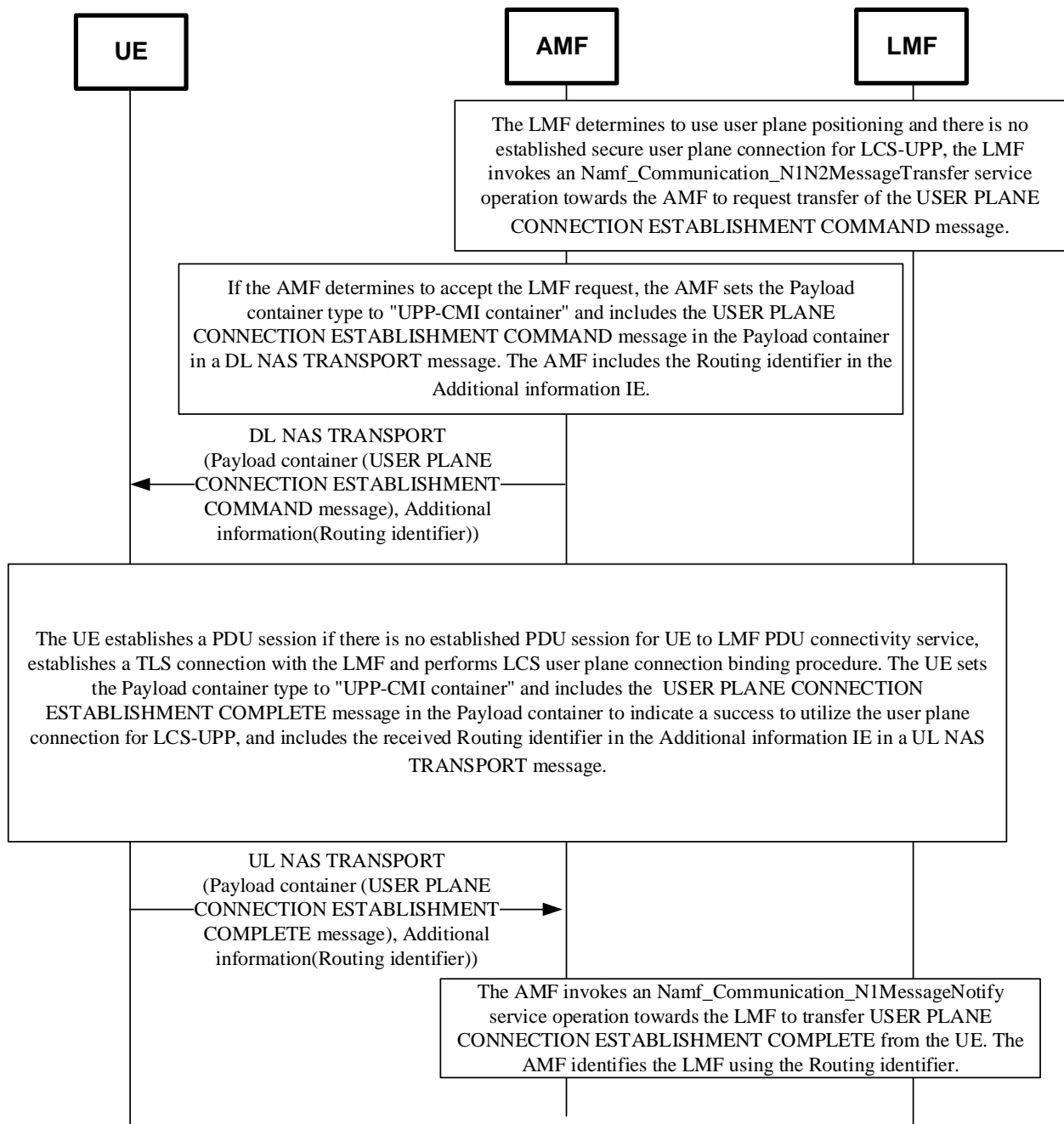


Figure 6.2.1.1.1.1: Signalling transport for network initiated user plane connection establishment procedure

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.

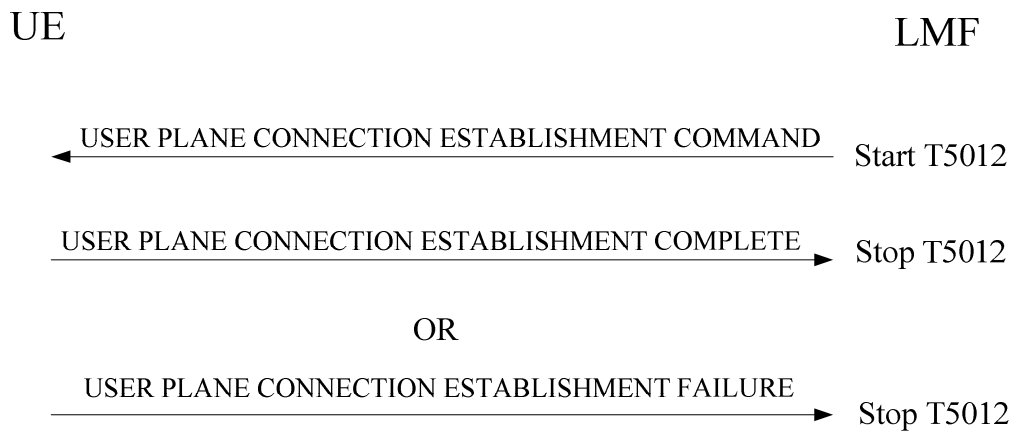


Figure 6.2.1.1.2.1: Network initiated user plane connection establishment procedure

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:

- establish a PDU session providing PDU connectivity service between the UE and the LMF, if not available, as described in clause 4.2.2;
- 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
- 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:

- create the USER PLANE CONNECTION ESTABLISHMENT COMPLETE message according to clause 10.3.2;
- send the USER PLANE CONNECTION ESTABLISHMENT COMPLETE message to the LMF;
- consider the LCS secured user plane connection between the UE and the LMF is established; and
- 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.

Additionally, if the Source LMF routing information IE is included in the USER PLANE CONNECTION ESTABLISHMENT COMMAND message for the LMF relocation as specified in clause 6.18.3 in 3GPP TS 23.273 [2], after the LCS secured user plane connection between the UE and the LMF is established successfully, the UE shall identify the source LCS secured user plane connection based on the Source LMF routing information IE, associate all

location sessions associated with the source LCS secured user plane connection to the new LCS secured user plane connection, and stop using the source LCS secured user plane connection.

6.2.1.1.4 Network initiated user plane connection establishment procedure completion by the network

Upon receipt of a USER PLANE CONNECTION ESTABLISHMENT COMPLETE message from the UE, the LMF shall stop the timer T5012 and shall consider that the LCS secured user plane connection between the UE and the LMF is established.

6.2.1.1.5 Network initiated user plane connection establishment procedure not accepted by the UE

If the USER PLANE CONNECTION ESTABLISHMENT COMMAND cannot be accepted, the UE shall:

- a0) terminate the TLS connection established for the LCS secured user plane connection, if any;
- a) generate the USER PLANE CONNECTION ESTABLISHMENT FAILURE message according to clause 10.3.3;
- b) include the Failure cause IE with the cause value set to:
 - 1) #1 "PDU session failure" if the UE failed to use an established PDU session for LCS-UP or failed to establish a PDU session for LCS-UP;
 - 2) #2 "TLS connection failure" if the UE failed to establish a TLS connection for LCS-UP;
 - 3) #3 "LCS-UP connection binding failure" if the UE received an LCS-UP CONNECTION BINDING REJECT message from the LMF;
 - 4) #4 "User plane not available" if the UE determines that the user plane is not available, e.g., due to 3GPP PS data off UE status (see 3GPP TS 24.501 [4]); or
 - 5) #111 "Protocol error, unspecified" if the establishment of the LCS secured user plane connection failed for an unspecified reason;
- c) send the USER PLANE CONNECTION ESTABLISHMENT FAILURE message to the LMF; and
- d) consider the LCS secured user plane connection between the UE and the LMF as not established.

Upon reception of a USER PLANE CONNECTION ESTABLISHMENT FAILURE message from the UE, the LMF shall stop the timer T5012, release the allocated LCS-UP binding ID value, if any, and release the association of the TLS connection with the UE, if any, abort the network initiated user plane connection establishment procedure, and consider the LCS secured user plane connection between the UE and the LMF as not established. After that, if cause value #4 "User plane not available" is not included in the USER PLANE CONNECTION ESTABLISHMENT FAILURE message, the LMF may perform the network initiated user plane connection establishment procedure as specified in clause 6.2.1.1.2. If cause value #4 "User plane not available" is included in the USER PLANE CONNECTION ESTABLISHMENT FAILURE message, the LMF should not initiate the network initiated user plane connection establishment procedure as specified in clause 6.2.1.1 and may consider to use other available positioning solutions if the location services are still needed, until the LMF receives the USER PLANE CONNECTION ESTABLISHMENT REQUEST message from the UE as specified in clause 6.2.2.1.

NOTE 1: After the release of the LCS-UP binding ID value and its association with the UE, the LMF ensures not to assign the LCS-UP binding ID value to any UE for implementation specific time.

NOTE 2: For the LMF relocation scenario, the UE can determine to send the LCS signaling messages (e.g. EventReport or LPP) to the old LMF via control plane as described in 3GPP TS 24.571 [3] or via the old LCS secured user plane connection, if available, after the UE sends the USER PLANE CONNECTION ESTABLISHMENT FAILURE message to a new LMF.

6.2.1.1.6 Abnormal cases on the network side

The following abnormal cases can be identified:

- a) Expiry of the timer T5012.

The LMF shall, on the first expiry of the timer T5012, retransmit the USER PLANE CONNECTION ESTABLISHMENT COMMAND message and shall reset and start timer T5012. This retransmission is repeated up to four times, i.e. on the fifth expiry of timer T5012, the LMF shall release the allocated LCS-UP binding ID value and its association with the UE, release the association of the TLS connection with the UE, if any, and abort the network initiated user plane connection establishment procedure.

- b) Lower layer failure before the USER PLANE CONNECTION ESTABLISHMENT COMPLETE or USER PLANE CONNECTION ESTABLISHMENT FAILURE message is received.

The LMF shall release the allocated LCS-UP binding ID value and its association with the UE, release the association of the TLS connection with the UE, if any, stop the timer T5012 and abort the network initiated user plane connection establishment procedure.

- c) Network initiated user plane connection establishment procedure and UE requested user plane connection establishment procedure collision

If the LMF receives a USER PLANE CONNECTION ESTABLISHMENT REQUEST message during the network initiated user plane connection establishment procedure, the LMF shall ignore the USER PLANE CONNECTION ESTABLISHMENT REQUEST message and proceed with the network initiated user plane connection establishment procedure.

- d) Uplink LCS-UP transport procedure and network initiated user plane connection establishment procedure collision

If the LMF receives an UL LCS-UP TRANSPORT message via an LCS secured user plane connection bound to a UE, and the network initiated user plane connection establishment procedure is ongoing, the LMF shall store the UL LCS-UP TRANSPORT message associated with the UE. After the network initiated user plane connection establishment procedure is completed successfully, the LMF shall process the stored UL LCS-UP TRANSPORT messages associated with the UE. If the network initiated user plane connection establishment procedure fails, the LMF shall discard the stored UL LCS-UP TRANSPORT messages associated with the UE.

6.2.1.1.7 Abnormal cases in the UE

The following abnormal cases can be identified:

- a) Transmission failure of USER PLANE CONNECTION ESTABLISHMENT COMPLETE message or USER PLANE CONNECTION ESTABLISHMENT FAILURE message.

The network initiated user plane connection establishment procedure shall be aborted, and the UE shall consider that the LCS secured user plane connection between the UE and the LMF is not established.

6.2.1.2 Network initiated user plane connection release procedure

6.2.1.2.1 General

The purpose of the network initiated user plane connection release procedure is to enable the network to release the LCS secured user plane connection between the UE and the LMF via the control plane. The USER PLANE CONNECTION RELEASE COMMAND message is encapsulated in the UPP-CMI container of the DL NAS TRANSPORT message, and the USER PLANE CONNECTION RELEASE COMPLETE message is encapsulated in the UPP-CMI container of the UL NAS TRANSPORT message. Figure 6.2.1.2.1.1 illustrates an example of the signalling transport for the network initiated user plane connection release procedure.

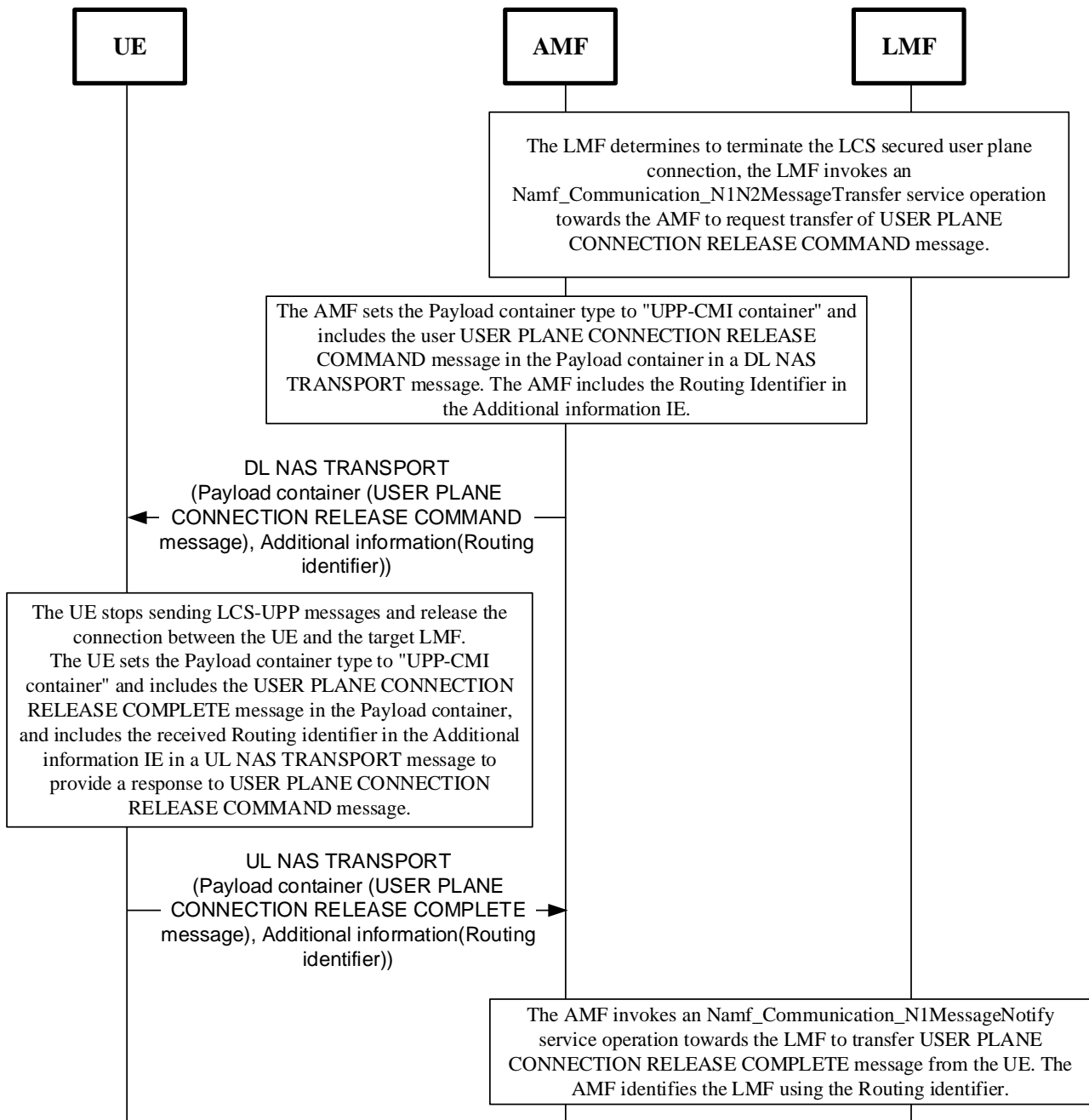


Figure 6.2.1.2.1.1: Signalling transport for network initiated user plane connection release procedure

6.2.1.2.2 Network initiated user plane connection release procedure initiation by LMF

The LMF initiates the network initiated user plane connection release procedure by sending the USER PLANE CONNECTION RELEASE COMMAND message to the UE, as shown in figure 6.2.1.2.2.1, the LMF:

- a) shall generate the USER PLANE CONNECTION RELEASE COMMAND message according to clause 10.3.6;
- b) shall send the USER PLANE CONNECTION RELEASE COMMAND message to the UE; and
- c) shall start a timer T5010 upon sending the USER PLANE CONNECTION RELEASE COMMAND message.

The LMF may include the Back-off timer value IE in the USER PLANE CONNECTION RELEASE COMMAND message.

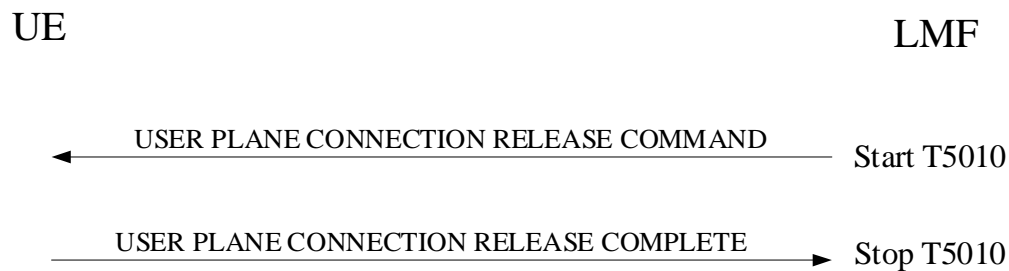


Figure 6.2.1.2.2.1: Network initiated user plane connection release procedure

6.2.1.2.3 Network initiated user plane connection release procedure accepted by UE

Upon receipt of a USER PLANE CONNECTION RELEASE COMMAND message from the LMF, the UE shall:

- a0) identify the LCS secured user plane connection to be released by using the routing information provided by the lower layer;
- a1) stop the timer T5013 of the LCS secured user plane connection identified in bullet a0) if running;
- a) stop sending LCS-UPP messages over the LCS secured user plane connection identified in bullet a0);
- b) terminate the TLS connection used for the LCS secured user plane connection identified in bullet a0);
- c) consider the LCS secured user plane connection identified in a0) between the UE and the LMF as released;
- d) create a USER PLANE CONNECTION RELEASE COMPLETE message according to clause 10.3.7; and
- e) send the USER PLANE CONNECTION RELEASE COMPLETE message to the LMF.

If the Back-off timer value IE is included in the USER PLANE CONNECTION RELEASE COMMAND message, the UE shall start the timer T5014 with the value provided in the Back-off timer value IE after sending the USER PLANE CONNECTION RELEASE COMPLETE message to the LMF. The UE shall not initiate the UE requested user plane connection establishment procedure as specified in clause 6.2.2.1, until timer T5014 expires or timer T5014 is stopped.

Upon reception of a USER PLANE CONNECTION RELEASE COMPLETE message from the UE, the LMF shall stop the timer T5010 and shall consider the LCS secured user plane connection between the UE and the LMF as released.

6.2.1.2.4 Abnormal cases on the network side

The following abnormal cases can be identified:

- a) Expiry of the timer T5010

The LMF shall, on the first expiry of the timer T5010, retransmit the USER PLANE CONNECTION RELEASE COMMAND message and shall reset and start timer T5010. This retransmission is repeated up to four times, i.e. on the fifth expiry of timer T5010, the LMF shall abort ongoing LCS-UPP procedures on this LCS secured user plane connection and locally release the LCS secured user plane connection between the UE and the LMF.

- b) Network initiated user plane connection release procedure and UE requested user plane connection release procedure collision

If the LMF receives a USER PLANE CONNECTION RELEASE REQUEST message during the network initiated user plane connection release procedure, the LMF shall ignore the USER PLANE CONNECTION RELEASE REQUEST message and proceed with the network initiated user plane connection release procedure.

6.2.1.3 Network initiated user plane connection modification procedure

6.2.1.3.1 General

The purpose of the network initiated user plane connection modification procedure is to enable the network to modify the LCS secured user plane connection between the UE and the LMF via the control plane. The USER PLANE CONNECTION MODIFICATION COMMAND message is encapsulated in the UPP-CMI container of the DL NAS TRANSPORT message, and the USER PLANE CONNECTION MODIFICATION COMPLETE message is encapsulated in the UPP-CMI container of the UL NAS TRANSPORT message.

The network initiated user plane connection modification procedure can be used if the UE supports the multiple LCS secured user plane connections and the network has indicated that it supports the multiple LCS secured user plane connections as specified in 3GPP TS 24.501 [4].

Figure 6.2.1.3.1.1 illustrates an example of the signalling transport for the network initiated user plane connection modification procedure.

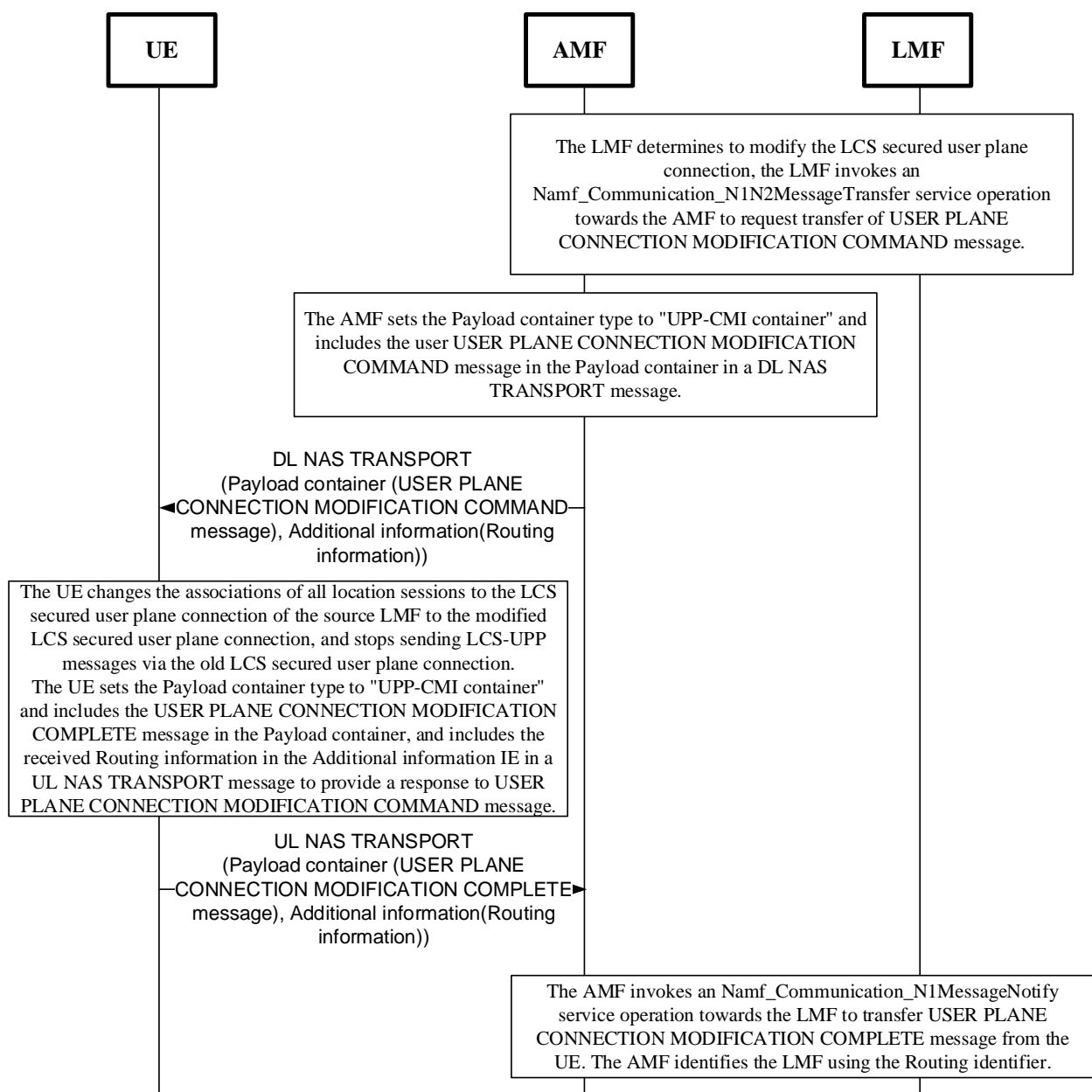


Figure 6.2.1.3.1.1: Signalling transport for network initiated user plane connection modification procedure

6.2.1.3.2 Network initiated user plane connection modification procedure initiation by LMF

The LMF initiates the network initiated user plane connection modification procedure by sending the USER PLANE CONNECTION MODIFICATION COMMAND message to the UE, as shown in figure 6.2.1.3.2.1, the LMF shall:

- a) generate the USER PLANE CONNECTION MODIFICATION COMMAND message according to clause 10.3.9;
- b) send the USER PLANE CONNECTION MODIFICATION COMMAND message to the UE; and
- c) start a timer T5015 upon sending the USER PLANE CONNECTION MODIFICATION COMMAND message.

When the network initiated user plane connection modification procedure is initiated for the LMF relocation as specified in clause 6.18.3 of 3GPP TS 23.273 [2], the LMF shall include the Source LMF routing information IE in the USER PLANE CONNECTION MODIFICATION COMMAND message.

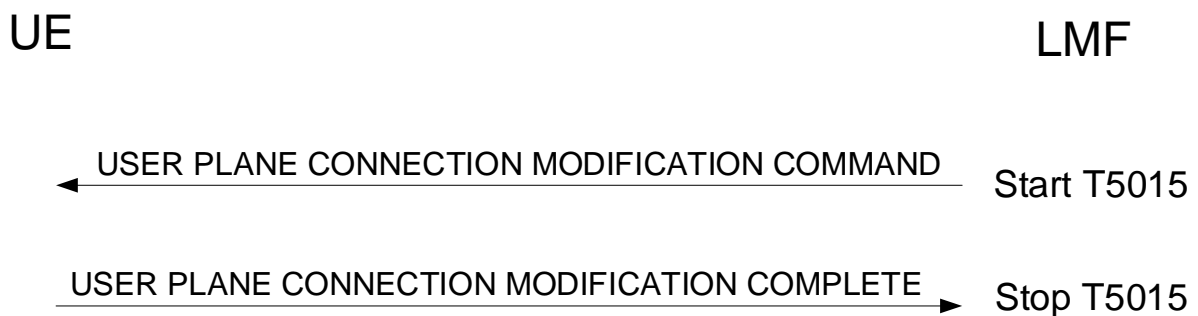


Figure 6.2.1.3.2.1: Network initiated user plane connection modification procedure

6.2.1.3.3 Network initiated user plane connection modification procedure accepted by UE

Upon receipt of a USER PLANE CONNECTION MODIFICATION COMMAND message, if the USER PLANE CONNECTION MODIFICATION COMMAND message can be accepted, the UE shall:

- a) identify the LCS secured user plane connection to be modified by using the routing information provided by the lower layer;
- b) if the source LMF routing information IE is included:
 - 1) identify the source LCS secured user plane connection based on the source LMF routing information;
 - 2) associate all location sessions associated with the source LCS secured user plane connection to the LCS secured user plane connection identified in a), if any;
 - 3) stop sending the LCS-UPP messages via the source LCS secured user plane connection; and
 - 4) start sending LCS-UPP messages for the location sessions found in 2) via the LCS secured user plane connection identified in a);
- c) create a USER PLANE CONNECTION MODIFICATION COMPLETE message according to clause 10.3.10; and
- d) send the USER PLANE CONNECTION MODIFICATION COMPLETE message to the LMF.

Upon reception of a USER PLANE CONNECTION MODIFICATION COMPLETE message from the UE, the LMF shall stop the timer T5015 and shall consider the LCS secured user plane connection between the UE and the LMF as modified.

6.2.1.3.4 Network initiated user plane connection modification procedure not accepted by UE

If the USER PLANE CONNECTION MODIFICATION COMMAND cannot be accepted, e.g., due to the source LCS secured user plane connection not found, the UE:

- a) shall include the Failure cause IE with the cause value set to:
 - 1) #5 "Source LCS secured user plane connection not found" if the source LMF routing information IE is included in the USER PLANE CONNECTION MODIFICATION COMMAND message and the LCS secured user plane connection cannot be found with the source LMF LCS-UP address; or
 - 2) #111 "Protocol error, unspecified" if the modification of the LCS secured user plane connection failed for an unspecified reason;
- b) shall generate the USER PLANE CONNECTION MODIFICATION REJECT message according to clause 10.3.11; and
- c) shall send the USER PLANE CONNECTION MODIFICATION REJECT message to the LMF.

Upon reception of the USER PLANE CONNECTION MODIFICATION REJECT message from the UE, the LMF shall stop timer T5015, consider the network initiated user plane connection modification procedure is failed.

6.2.1.3.5 Abnormal cases on the network side

The following abnormal cases can be identified:

- a) Expiry of the timer T5015

The LMF shall, on the first expiry of the timer T5015, retransmit the USER PLANE CONNECTION MODIFICATION COMMAND message and shall reset and start timer T5015. This retransmission is repeated up to four times, i.e. on the fifth expiry of timer T5015, the LMF shall abort the ongoing network initiated user plane connection modification procedure on the LCS secured user plane connection.

6.2.2 UE initiated UPP-CM procedures

6.2.2.1 UE requested user plane connection establishment procedure

6.2.2.1.1 General

The purpose of the UE requested user plane connection establishment procedure is for a UE to request to establish an LCS secured user plane connection between the UE and the LMF, as described in clause 6.18.2 of 3GPP TS 23.273 [2].

Unless the network has indicated that it supports the multiple LCS secured user plane connections as specified in clause 5.5.1.2 or clause 5.5.1.3 of 3GPP TS 24.501 [4], the UE shall not request to establish an LCS secured user plane connection if there is a prior LCS secured user plane connection that has been successfully established and has not yet been released.

The UE requests establishment of an LCS secured user plane connection by sending a USER PLANE CONNECTION ESTABLISHMENT REQUEST message to the network. The USER PLANE CONNECTION ESTABLISHMENT REQUEST message is encapsulated in the UPP-CMI container of the UL NAS TRANSPORT message. If accepted, the LMF initiates the network initiated user plane connection establishment procedure as specified in clause 6.2.1.1. Figure 6.2.2.1.1.1 illustrates an example of the NAS signalling transport for UE requested user plane connection establishment procedure messages.

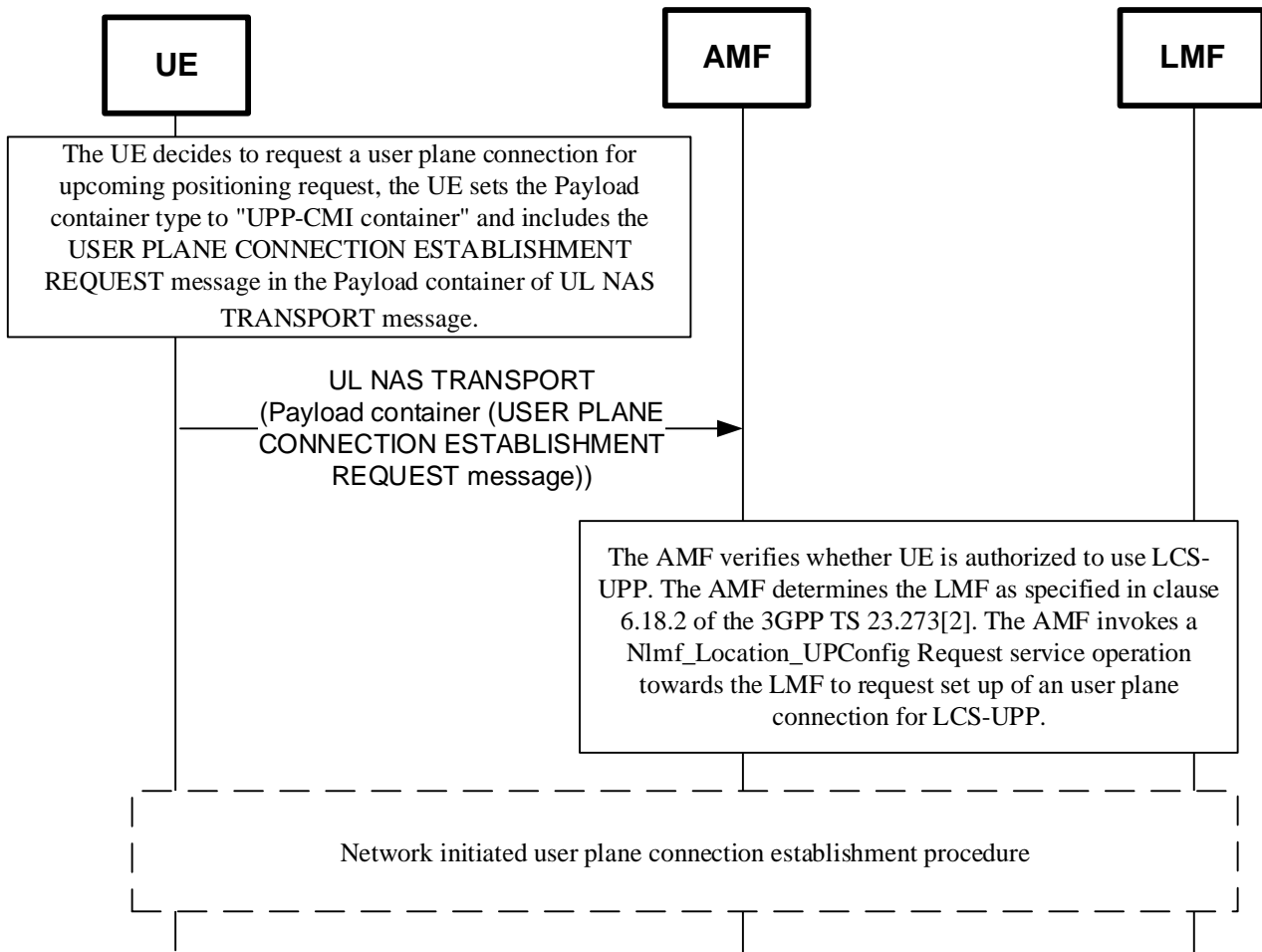


Figure 6.2.2.1.1.1: NAS signalling transport for UE requested user plane connection establishment procedure

6.2.2.1.2 UE requested user plane connection establishment procedure initiation

The UE initiates the UE requested user plane connection establishment procedure by sending the USER PLANE CONNECTION ESTABLISHMENT REQUEST message to the LMF (see example in figure 6.2.2.1.2.1). The UE shall:

- a) create the USER PLANE CONNECTION ESTABLISHMENT REQUEST message;
- b) send the USER PLANE CONNECTION ESTABLISHMENT REQUEST message to the LMF; and
- c) start a timer T5011 upon sending the USER PLANE CONNECTION ESTABLISHMENT REQUEST message.

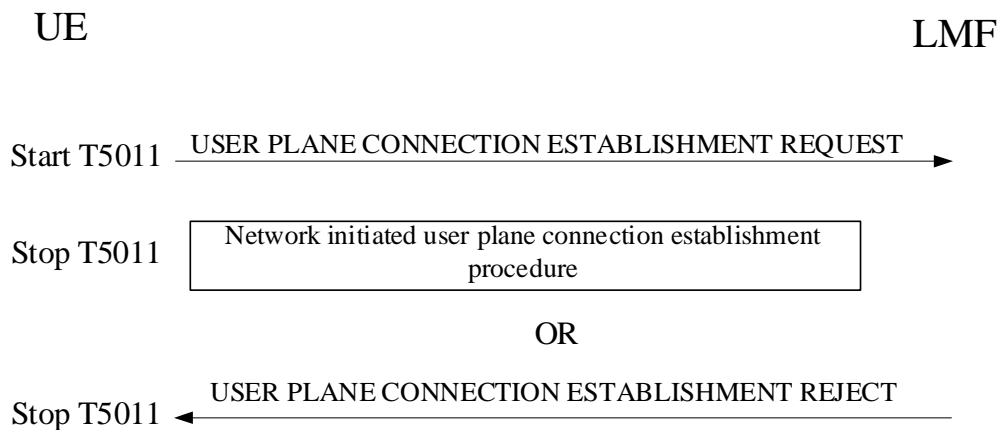


Figure 6.2.2.1.2.1: UE requested user plane connection establishment procedure

6.2.2.1.3 UE requested user plane connection establishment procedure accepted by the network

Upon receipt of a USER PLANE CONNECTION ESTABLISHMENT REQUEST message from the UE, if the LMF accepts the request to establish an LCS secured user plane connection, the LMF shall perform the network initiated user plane connection establishment procedure as specified in clause 6.2.1.1.

6.2.2.1.4 UE requested user plane connection establishment procedure not accepted by the network

If the USER PLANE CONNECTION ESTABLISHMENT REQUEST cannot be accepted, the LMF shall send a USER PLANE CONNECTION ESTABLISHMENT REJECT message.

The LMF may include the Back-off timer value IE in the USER PLANE CONNECTION ESTABLISHMENT REJECT message.

Upon reception of a USER PLANE CONNECTION ESTABLISHMENT REJECT message from the LMF, the UE shall stop the timer T5011 and shall consider the requested establishment of an LCS secured user plane connection between the UE and the LMF as not accepted.

If the Back-off timer value IE is included in the USER PLANE CONNECTION ESTABLISHMENT REJECT message, the UE shall start the timer T5014 with the value provided in the Back-off timer value IE. The UE shall not initiate the UE requested user plane connection establishment procedure, until timer T5014 expires or timer T5014 is stopped.

6.2.2.1.5 Void

6.2.2.1.6 Abnormal cases in the UE

The following abnormal cases can be identified:

- a) Expiry of the timer T5011.

The UE shall, on the first expiry of the timer T5011, retransmit the USER PLANE CONNECTION ESTABLISHMENT REQUEST message and shall reset and start timer T5011. This retransmission is repeated up to four times, i.e. on the fifth expiry of timer T5011, the UE shall abort the UE requested user plane connection establishment procedure.

6.2.2.1.7 Abnormal cases on the network side

Apart from the case described in clause 6.2.1.1.6, case c), no abnormal cases have been identified.

6.2.2.2 UE requested user plane connection release procedure

6.2.2.2.1 General

The purpose of the UE requested user plane connection release procedure is for a UE to request to release the LCS secured user plane connection between the UE and the LMF via the control plane. The UE requests release of an LCS secured user plane connection by sending a USER PLANE CONNECTION RELEASE REQUEST message to the network. The USER PLANE CONNECTION RELEASE REQUEST message is encapsulated in the UPP-CMI container of the UL NAS TRANSPORT message. If accepted, the network initiates the network initiated user plane connection release procedure as specified in clause 6.2.1.2. Figure 6.2.2.2.1.1 illustrates an example of the signalling transport for the UE requested user plane connection release procedure.

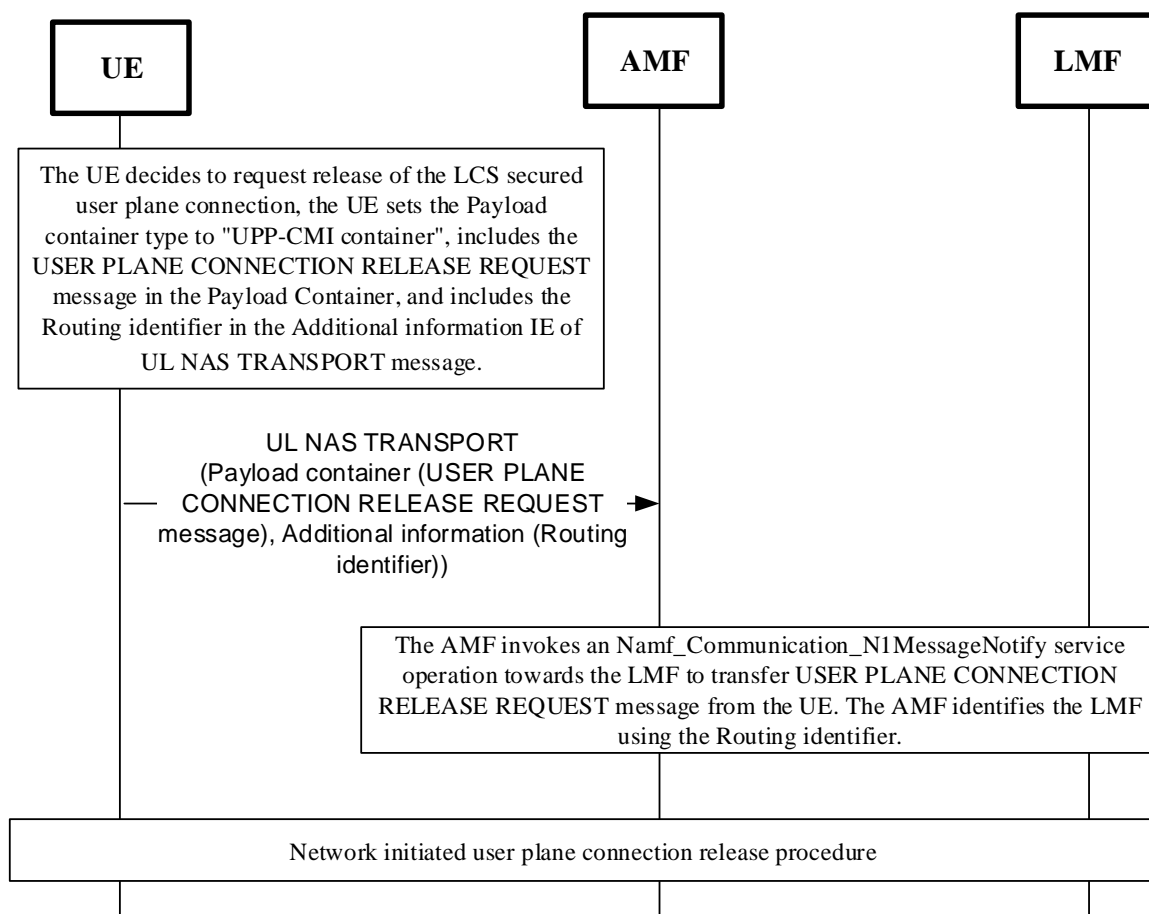


Figure 6.2.2.2.1.1: Signalling transport for UE requested user plane connection release procedure

6.2.2.2.2 UE requested user plane connection release procedure initiation by the UE

The UE initiates the UE requested user plane connection release procedure by sending the USER PLANE CONNECTION RELEASE REQUEST message to the LMF, as shown in figure 6.2.2.2.2.1, the UE:

- a) shall generate the USER PLANE CONNECTION RELEASE REQUEST message according to clause 10.3.8;
- b) may include the Failure cause IE with the cause value set to:

- 1) #1 "PDU session failure" if the UE requested user plane connection release procedure is initiated due to PDU session for the user plane positioning is released;
 - 2) #2 "TLS connection failure" if the UE requested user plane connection release procedure is initiated because the TLS connection with the LMF has failed and cannot be maintained by the UE;
 - 3) #4 "User plane not available" if the UE determines that the user plane is not available, e.g., 3GPP PS data off UE status (see 3GPP TS 24.501 [4]); or
 - 4) #111 "Protocol error, unspecified" if the UE requested user plane connection release procedure is initiated for an unspecified reason;
- c) shall send the USER PLANE CONNECTION RELEASE REQUEST message to the LMF; and
- d) shall start a timer T5013 upon sending the USER PLANE CONNECTION RELEASE REQUEST message.

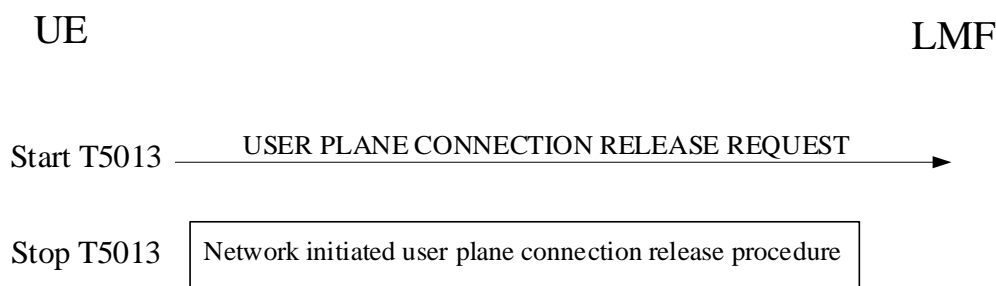


Figure 6.2.2.2.1: UE requested user plane connection release procedure

6.2.2.2.3 UE requested user plane connection release procedure accepted by the LMF

Upon reception of a USER PLANE CONNECTION RELEASE REQUEST message from the UE, the LMF shall perform the network initiated user plane connection release procedure as specified in clause 6.2.1.2.

If the Failure cause IE is included in the USER PLANE CONNECTION RELEASE REQUEST message with the cause value set to #1 "PDU session failure" or #2 "TLS connection failure", and the location services are still needed, the LMF may consider to use other available positioning solutions after the completion of the UE requested user plane connection release procedure.

If the Failure cause IE is included in the USER PLANE CONNECTION RELEASE REQUEST message with the cause value set to #4 "User plane not available", and the location services are still needed, the LMF should not initiate the network initiated user plane connection establishment procedure as specified in clause 6.2.1.1 and may consider to use other available positioning solutions if the location services are still needed, until the LMF receives the USER PLANE CONNECTION ESTABLISHMENT REQUEST message from the UE as specified in clause 6.2.2.1.

6.2.2.2.4 Abnormal cases in the UE

The following abnormal cases can be identified:

- a) Expiry of the timer T5013

The UE shall, on the first expiry of the timer T5013 retransmit the USER PLANE CONNECTION RELEASE REQUEST message and shall reset and start timer T5013. This retransmission is repeated up to four times, i.e., on the fifth expiry of timer T5013, the UE shall abort ongoing LCS-UPP procedures on this LCS secured user plane connection and locally release the LCS secured user plane connection between the UE and the LMF.

7 Elementary procedures for LCS-UPP

7.1 Overview

The main function of the Location Services User Plane Protocol (LCS-UPP) is to support generic transport of the following messages for positioning related protocols, via an LCS secured user plane connection between the UE and the LMF:

- a) LPP messages, which are specified in 3GPP TS 37.355 [13]; and
- b) LCS supplementary services messages, only including:
 - 1) messages for EventReport operations (see 3GPP TS 24.080 [11]);
 - 2) messages for PeriodicTriggeredInvoke operations (see 3GPP TS 24.080 [11]); and
 - 3) messages for MSCancelDeferredLocation operations (see 3GPP TS 24.080 [11]).

LCS-UPP procedures are performed between a Location Services User Plane (LCS-UP) entity in a UE and an LCS-UP entity in the LMF.

The following UE-initiated LCS-UPP procedures are specified:

- a) uplink LCS-UP transport procedure; and
- b) LCS-UP connection binding procedure.

The following LMF-initiated LCS-UPP procedures are specified:

- a) downlink LCS-UP transport procedure.

The uplink LCS-UP transport procedures and the downlink LCS-UP transport procedures can be performed on the LCS secured user plane connection over a PDU session via 3GPP access in 5GS as specified in clauses 4.2 and 4.3 after the network initiated user plane connection establishment procedure is completed successfully.

LCS-UPP messages are transported in an IP packet according to clause 7.2.1.

LCS-UPP is a standard L3 protocol according to 3GPP TS 24.007 [7], LCS-UPP messages are standard L3 messages according to 3GPP TS 24.007 [7] and error behaviour specified for L3 protocol according to 3GPP TS 24.007 [7] applies for LCS-UPP.

7.2 LCS-UPP message transport

7.2.1 LCS-UPP message transport in IPv4, IPv6 or IPv4v6 PDU session

In order to send an LCS-UPP message over a PDU session of IPv4, IPv6 or IPv4v6 PDU session type, the UE shall establish the TLS connection towards the LMF. The UE and the LMF shall use the TLS connection to exchange LCS-UPP messages.

7.3 LCS-UPP procedures

7.3.1 General

The main functions of the LCS-UPP procedures are to bind the TLS connection to the UE and to provide transport of payload via an LCS secured user plane connection between the UE and the LMF.

7.3.2 Uplink LCS-UP transport procedure

7.3.2.1 General

The purpose of the uplink LCS-UP transport procedure is to provide a transport of:

- a) one or more LPP messages; or
- b) a single LCS supplementary services message (see clause 7.1).

If the UE receives a DL LCS-UP TRANSPORT message, the UE shall associate the LCS session identity with the LCS secured user plane connection. If the UE receives a request from upper layers to transmit an LCS supplementary services message for an LCS session associated with the LCS secured user plane connection, the UE shall send the LCS supplementary services message via the established LCS secured user plane connection, if available. Otherwise, if the LCS secured user plane connection is not available, the UE shall send the LCS supplementary services message via control plane as described in 3GPP TS 24.571 [3].

7.3.2.2 Uplink LCS-UP transport procedure initiation by the UE

The UE initiates the uplink LCS-UP transport procedure by sending the UL LCS-UP TRANSPORT message to the LMF, as shown in figure 7.3.2.2.1.

In case a) in clause 7.3.2.1, the UE shall:

- set the LCS-UP payload type IE to "LTE Positioning Protocol (LPP) message";
- set the LCS-UP payload IE to the LPP message(s) payload; and
- set the LCS session identity IE to the routing identifier or the LCS session identity received in the DL LCS-UP TRANSPORT message.

In case b) in clause 7.3.2.1, the UE shall:

- set the LCS-UP payload type IE to "LCS supplementary services message";
- set the LCS-UP payload IE to the LCS supplementary services message payload; and
- set the LCS session identity IE to:
 - 1) the routing identifier or the LCS session identity received in the DL LCS-UP TRANSPORT message for the PeriodicTriggeredInvoke operations; or
 - 2) the deferred routing identifier or the LCS session identity received in the DL LCS-UP TRANSPORT message for the MSCancelDeferredLocation operations and the EventReport operations.

The UE shall send the UL LCS-UP TRANSPORT message to the LMF over the LCS secured user plane connection used for LCS-UPP.



Figure 7.3.2.2.1: Uplink LCS-UP transport procedure

7.3.2.3 Uplink LCS-UP transport procedure accepted by the LMF

Upon reception of a UL LCS-UP TRANSPORT message from the UE, if the LCS-UP payload type IE is set to:

- a) "LTE Positioning Protocol (LPP) message", the LCS-UP entity of the LMF shall forward the contents of the LCS-UP payload IE and the value of the LCS session identity IE to the LPP entity of the LMF; or
- b) "LCS supplementary services message", the LCS-UP entity of the LMF shall forward the contents of the LCS-UP payload IE and the value of the LCS session identity IE to the LCS supplementary services entity of the LMF.

7.3.2.4 Abnormal cases in the UE

The following abnormal case can be identified:

- a) Lower layer indication of non-delivered UL LCS-UP TRANSPORT message.

The UE shall abort the Uplink LCS-UP transport procedure.

7.3.3 Downlink LCS-UP transport procedure

7.3.3.1 General

The purpose of the downlink LCS-UP transport procedure is to provide a transport of:

- a) one or more LPP messages; or
- b) a single LCS supplementary services message (see clause 7.1).

7.3.3.2 Downlink LCS-UP transport procedure initiation by the LMF

The LMF initiates the downlink LCS-UP transport procedure by sending the DL LCS-UP TRANSPORT message to the UE, as shown in figure 7.3.3.2.1.

In case a) in clause 7.3.3.1, the LMF shall:

- set the LCS-UP payload type IE to "LTE Positioning Protocol (LPP) message";
- set the LCS-UP payload IE to the LPP message(s) payload; and
- set the LCS session identity IE to the LCS correlation identifier.

In case b) in clause 7.3.3.1, the LMF shall:

- set the LCS-UP payload type IE to "LCS supplementary services message";
- set the LCS-UP payload IE to the LCS supplementary services message payload; and
- set the LCS session identity IE to the LCS correlation identifier or the LCS session identity received in UL LCS-UP TRANSPORT message.

The LMF shall send the DL LCS-UP TRANSPORT message to the UE over the LCS secured user plane connection used for LCS-UPP.



Figure 7.3.3.2.1: Downlink LCS-UP transport procedure

7.3.3.3 Downlink LCS-UP transport of messages accepted by the UE

Upon reception of a DL LCS-UP TRANSPORT message from the LMF, if the LCS-UP payload type IE is set to:

- a) "LTE Positioning Protocol (LPP) message", the LCS-UP entity of the UE shall forward the contents of the LCS-UP payload IE and the value of the LCS session identity IE to the upper layer location services application for LPP; or
- b) "LCS supplementary services message", the LCS-UP entity of the UE shall forward the contents of the LCS-UP payload IE and the value of the LCS session identity IE to the upper layer location services application for LCS supplementary services.

7.3.3.4 Abnormal cases on the network side

The following abnormal case can be identified:

- a) Lower layer indication of non-delivered DL LCS-UP TRANSPORT message.

The LMF shall abort the downlink LCS-UP transport procedure.

7.3.4 LCS-UP connection binding procedure

7.3.4.1 General

The purpose of the LCS-UP connection binding procedure is to enable the LMF to associate the TLS connection with the UE for which the network initiated user plane connection establishment procedure is being performed.

7.3.4.2 LCS-UP connection binding procedure initiation by the UE

The UE initiates the LCS-UP connection binding procedure by sending the LCS-UP CONNECTION BINDING REQUEST message to the LMF, as shown in figure 7.3.4.2.1. The UE shall:

- a) generate the LCS-UP CONNECTION BINDING REQUEST message according to clause 10.2.3, and include the LCS-UP binding ID value as received during the network initiated user plane connection establishment procedure (see clause 6.2.1.1), which has triggered the establishment of the LCS secured user plane connection with the LMF;
- b) send the LCS-UP CONNECTION BINDING REQUEST message to the LMF over the TLS connection with the LMF; and
- c) start a timer T5110 upon sending LCS-UP CONNECTION BINDING REQUEST message.

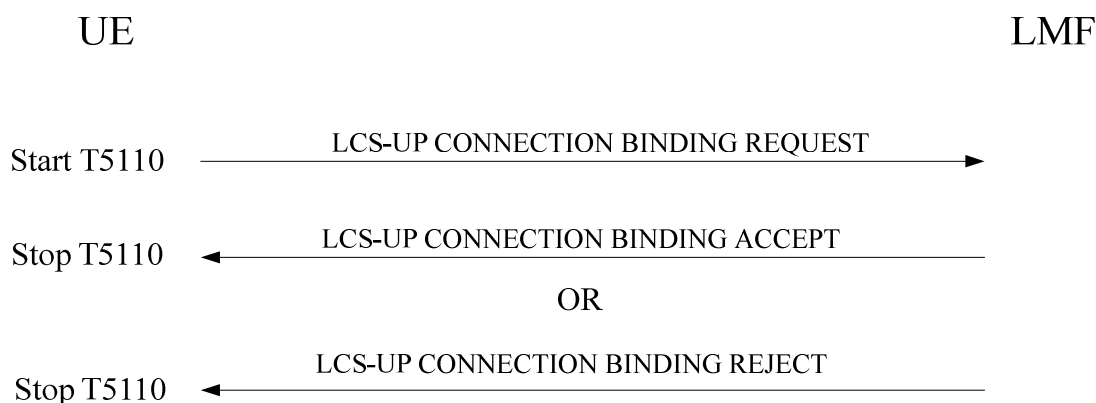


Figure 7.3.4.2.1: LCS-UP connection binding procedure initiation by the UE

7.3.4.3 LCS-UP connection binding procedure accepted by the LMF

Upon reception of an LCS-UP CONNECTION BINDING REQUEST message from the UE, the LMF shall associate the TLS connection with the UE, based on the received LCS-UP binding ID which has been provided by the LMF as specified in clause 6.2.1.1.2. After successful LCS-UP connection binding, the LMF shall:

- a) generate the LCS-UP CONNECTION BINDING ACCEPT message according to clause 10.2.4;
- b) send the LCS-UP CONNECTION BINDING ACCEPT message to the UE over the TLS connection; and
- c) release the LCS-UP binding ID value indicated in the LCS-UP CONNECTION BINDING REQUEST message and its association with the UE.

NOTE: After the release of the LCS-UP binding ID value and its association with the UE, the LMF ensures not to assign the LCS-UP binding ID value to any UE for an implementation specific time.

7.3.4.4 LCS-UP connection binding procedure completion by the UE

Upon reception of an LCS-UP CONNECTION BINDING ACCEPT message from the LMF, the UE shall stop timer T5110, and shall

- a) consider that the LCS-UP connection binding procedure is completed successfully; and
- b) delete the stored LCS-UP binding ID and continue the ongoing network initiated user plane connection establishment procedure as described in clause 6.2.1.1.3.

7.3.4.5 LCS-UP connection binding procedure not accepted by the network

Upon reception of the LCS-UP CONNECTION BINDING REQUEST message, if the LMF cannot accept the LCS-UP connection binding procedure, e.g., due to the failure of LCS-UP binding ID association, the LMF shall:

- a) generate the LCS-UP CONNECTION BINDING REJECT message according to clause 10.2.5;
- b) send the LCS-UP CONNECTION BINDING REJECT message to the UE over the TLS connection; and
- c) release the LCS-UP binding ID value indicated in the LCS-UP CONNECTION BINDING REQUEST message and its association with the UE.

NOTE: After the release of the LCS-UP binding ID value and its association with the UE, the LMF ensures not to assign the LCS-UP binding ID value to any UE for implementation specific time.

Upon reception of the LCS-UP CONNECTION BINDING REJECT message from the LMF, the UE shall stop timer T5110, consider the LCS-UP connection binding procedure is failed, delete the stored LCS-UP binding ID and continue the ongoing network initiated user plane connection establishment procedure as described in clause 6.2.1.1.5.

7.3.4.6 Abnormal cases in the UE

The following abnormal cases can be identified:

- a) Expiry of the timer T5110.

The UE shall abort the ongoing LCS-UP connection binding procedure, delete the stored LCS-UP binding ID, and continue the ongoing network initiated user plane connection establishment procedure as described in clause 6.2.1.1.5

- b) LCS-UP connection binding procedure and network initiated user plane connection establishment procedure collision.

If the UE receives a USER PLANE CONNECTION ESTABLISHMENT COMMAND message during the LCS-UP connection binding procedure, the UE shall:

- 1) abort the ongoing LCS-UP connection binding procedure;
- 2) stop timer T5110;

- 3) delete the stored LCS-UP binding ID;
- 4) abort the ongoing network initiated user plane connection establishment procedure; and
- 5) progress the network initiated user plane connection establishment procedure, as described in clause 6.2.1.1.2, initiated by the newly received USER PLANE CONNECTION ESTABLISHMENT COMMAND message.

7.3.4.7 Abnormal cases on the network side

The following abnormal case can be identified:

- a) Lower layer indication of non-delivered LCS-UP CONNECTION BINDING ACCEPT message or LCS-UP CONNECTION BINDING REJECT message.

The LMF shall abort the ongoing LCS-UP connection binding procedure and locally release the TLS connection between the UE and the LMF.

8 LCS-UPP procedures for LCS client or AF

If the LCS-UP entity is implemented both in the UE and the LCS client or the AF, LCS-UPP procedures may be performed between an LCS-UP entity in a UE and an LCS-UP entity in the LCS client or the AF in order to support the LCS supplementary services event report via user plane procedures as described in clause 6.16 of 3GPP TS 23.273 [2].

The UE uses the user plane connection information provisioned by the network, as specified in clause 5.2.1.3 of 3GPP TS 24.571 [3], to establish an LCS secured user plane connection with the LCS client or AF.

NOTE: How to manage an LCS secured user plane connection with the LCS client or the AF is out of scope of this specification.

The UE initiates the uplink LCS-UP transport procedure as defined in clause 7.3.2 to send the LCS supplementary services event report to the LCS client or AF, and the LCS client or the AF initiates the downlink LCS-UP transport procedure as defined in clause 7.3.3 to send the LCS supplementary services acknowledgement of event report to the UE.

9 Handling of unknown, unforeseen and erroneous protocol data

9.1 General

The procedures specified in the present document apply to those LCS-UPP messages and UPP-CM messages which pass the checks described in this clause.

This clause also specifies procedures for the handling of unknown, unforeseen and erroneous protocol data by the receiving entity. These procedures are called "error handling procedures", but in addition to providing recovery mechanisms for error situations they define a compatibility mechanism for future extensions of the protocols.

Clauses 9.2 to 9.7 shall be applied in order of precedence.

Detailed error handling procedures in the network are implementation dependent and may vary from PLMN to PLMN. However, when extensions of this protocol are developed, networks are assumed to have the error handling which is indicated in this clause as mandatory ("shall") and that is indicated as strongly recommended ("should").

Also, the error handling of the network is only considered as mandatory or strongly recommended when certain thresholds for errors are not reached during a dedicated connection.

For definition of semantical and syntactical errors see 3GPP TS 24.007 [7], clause 11.4.2.

9.2 Message too short or too long

9.2.1 Message too short

When a message is received that is too short to contain a complete message type information element, that message shall be ignored, cf. 3GPP TS 24.007 [7].

9.2.2 Message too long

The maximum size of a UPP-CM message transported via NAS is specified in 3GPP TS 24.501 [4].

NOTE 1: UPP-CM uses UL NAS TRANSPORT messages and DL NAS TRANSPORT messages that allow a maximum size of 65535 octets for transported UPP-CM messages.

There is no specific maximum size of an LCS-UPP message transported via user plane.

NOTE 2: Implementation specific LCS-UPP message maximum size can apply.

9.3 Unknown or unforeseen message type

If the UE receives an LCS-UPP message with message type not defined for the LCS-UPP or not implemented by the receiver, it shall ignore the LCS-UPP message.

NOTE 1: A message type not defined for the LCS-UPP in the given direction is regarded by the receiver as a message type not defined for the LCS-UPP, see 3GPP TS 24.007 [7].

If the UE receives an LCS-UPP message not compatible with the LCS-UPP state, the UE shall ignore the LCS-UPP message.

If the UE receives a UPP-CM message with message type not defined for the UPP-CM or not implemented by the receiver, it shall ignore the UPP-CM message.

NOTE 2: A message type not defined for the UPP-CM in the given direction is regarded by the receiver as a message type not defined for the UPP-CM, see 3GPP TS 24.007 [7].

If the UE receives a UPP-CM message not compatible with the UPP-CM state, the UE shall ignore the UPP-CM message.

If the network receives an LCS-UPP message or a UPP-CM message not compatible with the protocol state, the network actions are implementation dependent.

9.4 Non-semantical mandatory information element errors

When on receipt of an LCS-UPP message or a UPP-CM message,

- a) an "imperative message part" error; or
- b) a "missing mandatory IE" error

is diagnosed or when a message containing:

- a) a syntactically incorrect mandatory IE;
- b) an IE unknown in the message, but encoded as "comprehension required" (see 3GPP TS 24.007 [7]); or
- c) an out of sequence IE encoded as "comprehension required" (see 3GPP TS 24.007 [7]) is received,

the UE shall ignore the LCS-UPP message or the UPP-CM message.

When on receipt of an LCS-UPP message or a UPP-CM message,

- a) an "imperative message part" error; or

- b) a "missing mandatory IE" error

is diagnosed or when a message containing:

- a) a syntactically incorrect mandatory IE;
- b) an IE unknown in the message, but encoded as "comprehension required" (see 3GPP TS 24.007 [7]); or
- c) an out of sequence IE encoded as "comprehension required" (see 3GPP TS 24.007 [7]) is received,

the network shall either:

- a) try to treat the message (the exact further actions are implementation dependent); or
- b) ignore the LCS-UPP message or the UPP-CM message.

9.5 Unknown and unforeseen IEs in the non-imperative message part

9.5.1 IEs unknown in the message

The UE shall ignore all IEs with unknown IEs in a message, which are not encoded as "comprehension required" (see 3GPP TS 24.007 [7]).

The network shall take the same approach.

9.5.2 Out of sequence IEs

The UE shall ignore all out of sequence IEs in a message which are not encoded as "comprehension required" (see 3GPP TS 24.007 [7]).

The network shall take the same approach.

9.5.3 Repeated IEs

If an information element with format T, TV, TLV, or TLV-E is repeated in a message in which repetition of the information element is not specified in clause 10, the UE shall handle only the contents of the information element appearing first and shall ignore all subsequent repetitions of the information element. When repetition of information elements is specified, the UE shall handle only the contents of specified repeated information elements. If the limit on repetition of information elements is exceeded, the UE shall handle the contents of information elements appearing first up to the limit of repetitions and shall ignore all subsequent repetitions of the information element.

The network should follow the same procedures.

9.6 Non-imperative message part errors

9.6.1 General

This category includes:

- a) syntactically incorrect optional IEs; and
- b) conditional IE errors.

9.6.2 Syntactically incorrect optional IEs

The UE shall treat all optional IEs that are syntactically incorrect in a message as not present in the message.

The network shall take the same approach.

9.6.3 Conditional IE errors

When upon receipt of an LCS-UPP message, the UE diagnoses a "missing conditional IE" error or an "unexpected conditional IE" error, or when it receives an LCS-UPP message containing at least one syntactically incorrect conditional IE, the UE shall ignore the message.

When upon receipt of a UPP-CM message, the UE diagnoses a "missing conditional IE" error or an "unexpected conditional IE" error, or when it receives a UPP-CM message containing at least one syntactically incorrect conditional IE, the UE shall ignore the message.

When the network receives an LCS-UPP message or a UPP-CM message and diagnoses a "missing conditional IE" error or an "unexpected conditional IE" error or when it receives a message containing at least one syntactically incorrect conditional IE, the network shall either:

- a) try to treat the message (the exact further actions are implementation dependent); or
- b) ignore the message.

9.7 Messages with semantically incorrect contents

When a message with semantically incorrect contents is received, the UE shall perform the foreseen reactions of the procedural part of clauses 6 and 7. If, however no such reactions are specified, the UE shall ignore the message.

The network should follow the same procedure.

10 Message functional definitions and contents

10.1 Overview

This clause defines the structure of the messages of the Layer 3 (L3) protocols defined in the present document including LCS-UPP messages as defined in clause 10.2 and UPP-CM messages as defined in clause 10.3. These are standard L3 messages as defined in 3GPP TS 24.007 [7].

Each definition given in the present clause includes:

- a) a brief description of the message direction and use, including whether the message has:
 1. Local significance, i.e. relevant only on the originating or terminating access;
 2. Access significance, i.e. relevant in the originating and terminating access, but not in the network;
 3. Dual significance, i.e. relevant in either the originating or terminating access and in the network; or
 4. Global significance, i.e. relevant in the originating and terminating access and in the network.
- b) a table listing the Information Elements (IE) known in the message and the order of their appearance in the message. All IEs that may be repeated are explicitly indicated (The V, LV and LV-E formatted IEs, which compose the imperative part of the message, occur before the T, TV, TLV and TLV-E formatted IEs which compose the non-imperative part of the message, see 3GPP TS 24.007 [7]). In a (maximal) sequence of consecutive IEs with half octet length, the first IE with half octet length occupies bits 1 to 4 of octet N, the second IE bits 5 to 8 of octet N, the third IE bits 1 to 4 of octet N+1 etc. Such a sequence always has an even number of elements.

For each information element the table indicates:

1. The Information Element Identifier (IEI), in hexadecimal notation, if the IE has format T, TV, TLV or TLV-E. If the IEI has half octet length, it is specified by a notation representing the IEI as a hexadecimal digit followed by a "-" (example: B-).

NOTE 1: The same IEI can be used for different information element types in different messages of the same protocol.

NOTE 2: If a message includes a Type 6 IE container information element, then the same IEI can be used for different information element types in the Type 6 IE container information element and in other parts of the same message.

2. The name of the information element (which may give an idea of the semantics of the element). The name of the information element followed by "IE" or "information element" is used in this technical report as reference to the information element within a message.
 3. The name of the type of the information element (which indicates the coding of the value part of the IE), and generally, the referenced clause of clause 11 of the present document describing the value part of the information element.
 4. The presence requirement indication (M, C, or O) for the IE as defined in 3GPP TS 24.007 [7].
 5. The format of the information element (T, V, TV, LV, TLV, LV-E or TLV-E) as defined in 3GPP TS 24.007 [7].
 6. The length of the information element (or permissible range of lengths), in octets, in the message, where "?" means that the maximum length of the IE is only constrained by link layer protocol. This indication is non-normative.
- c) clauses specifying, where appropriate, conditions for IEs with presence requirement C or O in the relevant message which together with other conditions specified in the present document define when the information elements shall be included or not, what non-presence of such IEs means, and – for IEs with presence requirement C – the static conditions for presence or non-presence of the IEs or for both cases (see 3GPP TS 24.007 [12]).

10.2 LCS-UPP messages

10.2.1 UL LCS-UP transport

10.2.1.1 Message definition

The UL LCS-UP TRANSPORT message is sent by the UE to the LMF to transport the LPP message(s) or the LCS supplementary services message. See table 10.2.1.1.1.

Message type: UL LCS-UP TRANSPORT

Significance: dual

Direction: UE to network

Table 10.2.1.1.1: UL LCS-UP TRANSPORT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	UL LCS-UP TRANSPORT message identity	Message type 11.1.3	M	V	1
	LCS-UP payload type	LCS-UP payload type 11.2.2	M	V	1/2
	Spare half octet	Spare half octet 11.4	M	V	1/2
	LCS-UP payload	LCS-UP payload 11.2.1	M	LV-E	3-65537
	LCS session identity	LCS session identity 11.2.3	M	LV	2-256

10.2.2 DL LCS-UP transport

10.2.2.1 Message definition

The DL LCS-UP TRANSPORT message is sent by the LMF to the UE to transport the LPP message(s) or the LCS supplementary services message. See table 10.2.2.1.1.

Message type: DL LCS-UP TRANSPORT

Significance: dual

Direction: network to UE

Table 10.2.2.1.1: DL LCS-UP TRANSPORT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	DL LCS-UP TRANSPORT message identity	Message type 11.1.3	M	V	1
	LCS-UP payload type	LCS-UP payload type 11.2.2	M	V	1/2
	Spare half octet	Spare half octet 11.4	M	V	1/2
	LCS-UP payload	LCS-UP payload 11.2.1	M	LV-E	3-65537
	LCS session identity	LCS session identity 11.2.3	M	LV	2-256

10.2.3 LCS-UP connection binding request

10.2.3.1 Message definition

The LCS-UP CONNECTION BINDING REQUEST message is sent by the UE to the LMF to associate the TLS connection with the UE. See table 10.2.3.1.1.

Message type: LCS-UP CONNECTION BINDING REQUEST

Significance: dual

Direction: UE to network

Table 10.2.3.1.1: LCS-UP CONNECTION BINDING REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	LCS-UP CONNECTION BINDING REQUEST message identity	Message type 11.1.3	M	V	1
	LCS-UP binding ID	LCS-UP binding ID 11.3.4	M	LV	5-256

10.2.4 LCS-UP connection binding accept

10.2.4.1 Message definition

The LCS-UP CONNECTION BINDING ACCEPT message is sent by the LMF to the UE to indicate that the LMF accepted the LCS-UP connection binding procedure. See table 10.2.4.1.1.

Message type: LCS-UP CONNECTION BINDING ACCEPT

Significance: dual

Direction: network to UE

Table 10.2.4.1.1: LCS-UP CONNECTION BINDING ACCEPT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	LCS-UP CONNECTION BINDING ACCEPT message identity	Message type 11.1.3	M	V	1

10.2.5 LCS-UP connection binding reject

10.2.5.1 Message definition

The LCS-UP CONNECTION BINDING REJECT message is sent by the LMF to the UE to indicate that the LMF rejected the LCS-UP connection binding procedure. See table 10.2.5.1.1.

Message type: LCS-UP CONNECTION BINDING REJECT

Significance: dual

Direction: network to UE

Table 10.2.5.1.1: LCS-UP CONNECTION BINDING REJECT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	LCS-UP CONNECTION BINDING REJECT message identity	Message type 11.1.3	M	V	1

10.3 UPP-CM messages

10.3.1 User plane connection establishment command

10.3.1.1 Message definition

The USER PLANE CONNECTION ESTABLISHMENT COMMAND message is sent by the LMF to the UE to transport the user plane connection information and trigger the UE to establish the LCS secured user plane connection towards the LMF. See table 10.3.1.1.1.

Message type: USER PLANE CONNECTION ESTABLISHMENT COMMAND

Significance: dual

Direction: network to UE

Table 10.3.1.1.1: USER PLANE CONNECTION ESTABLISHMENT COMMAND message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	USER PLANE CONNECTION ESTABLISHMENT COMMAND message identity	Message type 11.1.3	M	V	1
	LCS-UP binding ID	LCS-UP binding ID 11.3.4	M	LV	5-256
	LMF LCS-UP address	LMF LCS-UP address 11.3.1	M	LV	3-256
22	Source LMF routing information	LMF routing information 11.3.5	O	TLV	3-n

10.3.1.2 Source LMF routing information

The LMF shall include this information element to the UE for modification of LCS secured user plane connection if there is no existing LCS secured user plane connection between the UE and the target LMF for the LMF relocation as specified in clause 6.18.3 in 3GPP TS 23.273 [2].

10.3.2 User plane connection establishment complete

10.3.2.1 Message definition

The USER PLANE CONNECTION ESTABLISHMENT COMPLETE message is sent by the UE to the LMF in response to a USER PLANE CONNECTION ESTABLISHMENT COMMAND message and confirms the availability of the required PDU connectivity service between UE and LMF. See table 10.3.2.1.1.

Message type: USER PLANE CONNECTION ESTABLISHMENT COMPLETE

Significance: dual

Direction: UE to network

Table 10.3.2.1.1: USER PLANE CONNECTION ESTABLISHMENT COMPLETE message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	USER PLANE CONNECTION ESTABLISHMENT COMPLETE message identity	Message type 11.1.3	M	V	1

10.3.3 User plane connection establishment failure

10.3.3.1 Message definition

The USER PLANE CONNECTION ESTABLISHMENT FAILURE message is sent by the UE to the LMF in response to a USER PLANE CONNECTION ESTABLISHMENT COMMAND message and indicates the failure of the establishment of an LCS secured user plane connection to the LMF. See table 10.3.3.1.1.

Message type: USER PLANE CONNECTION ESTABLISHMENT FAILURE

Significance: dual

Direction: UE to network

Table 10.3.3.1.1: USER PLANE CONNECTION ESTABLISHMENT FAILURE message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	USER PLANE CONNECTION ESTABLISHMENT FAILURE message identity	Message type 11.1.3	M	V	1
	Failure cause	Failure cause 11.3.3	M	V	1

10.3.4 User plane connection establishment request

10.3.4.1 Message definition

The USER PLANE CONNECTION ESTABLISHMENT REQUEST message is sent by the UE to the LMF to request establishment of an LCS secured user plane connection between the UE and the LMF. See table 10.3.4.1.1.

Message type: USER PLANE CONNECTION ESTABLISHMENT REQUEST

Significance: dual

Direction: UE to network

Table 10.3.4.1.1: USER PLANE CONNECTION ESTABLISHMENT REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	USER PLANE CONNECTION ESTABLISHMENT REQUEST message identity	Message type 11.1.3	M	V	1

10.3.5 User plane connection establishment reject

10.3.5.1 Message definition

The USER PLANE CONNECTION ESTABLISHMENT REJECT message is sent by the LMF to reject the USER PLANE CONNECTION ESTABLISHMENT REQUEST message received from the UE. See table 10.3.5.1.1.

Message type: USER PLANE CONNECTION ESTABLISHMENT REJECT

Significance: dual

Direction: network to UE

Table 10.3.5.1.1: USER PLANE CONNECTION ESTABLISHMENT REJECT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	USER PLANE CONNECTION ESTABLISHMENT REJECT message identity	Message type 11.1.3	M	V	1
10	Back-off timer value	GPRS timer 3 11.3.2	O	TLV	3

10.3.5.2 Back-off timer value

The LMF may include this information element to the UE to request a minimum time interval before procedure retry is allowed.

10.3.6 User plane connection release command

10.3.6.1 Message definition

The USER PLANE CONNECTION RELEASE COMMAND message is sent by the LMF to the UE to release the LCS secured user plane connection between the UE and the LMF. See table 10.3.6.1.1.

Message type: USER PLANE CONNECTION RELEASE COMMAND

Significance: dual

Direction: network to UE

Table 10.3.6.1.1: USER PLANE CONNECTION RELEASE COMMAND message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	USER PLANE CONNECTION RELEASE COMMAND message identity	Message type 11.1.3	M	V	1
10	Back-off timer value	GPRS timer 3 11.3.2	O	TLV	3

10.3.6.2 Back-off timer value

The LMF may include this information element to the UE to request a minimum time interval before procedure retry is allowed.

10.3.7 User plane connection release complete

10.3.7.1 Message definition

The USER PLANE CONNECTION RELEASE COMPLETE message is sent by the UE to the LMF in response to a USER PLANE CONNECTION RELEASE COMMAND message and indicates confirmation for the release of the LCS secured user plane connection between the UE and the LMF. See table 10.3.7.1.1.

Message type: USER PLANE CONNECTION RELEASE COMPLETE

Significance: dual

Direction: UE to network

Table 10.3.7.1.1: USER PLANE CONNECTION RELEASE COMPLETE message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	USER PLANE CONNECTION RELEASE COMPLETE message identity	Message type 11.1.3	M	V	1

10.3.8 User plane connection release request

10.3.8.1 Message definition

The USER PLANE CONNECTION RELEASE REQUEST message is sent by the UE to the LMF to request to release the LCS secured user plane connection between the UE and the LMF. See table 10.3.8.1.1.

Message type: USER PLANE CONNECTION RELEASE REQUEST

Significance: dual

Direction: UE to network

Table 10.3.8.1.1: USER PLANE CONNECTION RELEASE REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	USER PLANE CONNECTION RELEASE REQUEST message identity	Message type 11.1.3	M	V	1
21	Failure cause	Failure cause 11.3.3	O	TV	2

10.3.8.2 Failure cause

This IE is included in the message to indicate the reason for releasing the LCS secured user plane connection when the release is due to a failure.

10.3.9 User plane connection modification command

10.3.9.1 Message definition

The USER PLANE CONNECTION MODIFICATION COMMAND message is sent by the LMF to the UE to modify the LCS secured user plane connection between the UE and the LMF. See table 10.3.9.1.1.

Message type: USER PLANE CONNECTION MODIFICATION COMMAND

Significance: dual

Direction: network to UE

Table 10.3.9.1.1: USER PLANE CONNECTION MODIFICATION COMMAND message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	USER PLANE CONNECTION MODIFICATION COMMAND message identity	Message type 11.1.3	M	V	1
22	Source LMF routing information	LMF routing information 11.3.5	O	TLV	3-n

10.3.9.2 Source LMF routing information

The LMF shall include this information element to the UE for modification of user plane connection when the network initiated user plane connection modification procedure is initiated for the LMF relocation as specified in clause 6.18.3 in 3GPP TS 23.273 [2].

10.3.10 User plane connection modification complete

10.3.10.1 Message definition

The USER PLANE CONNECTION MODIFICATION COMPLETE message is sent by the UE to the LMF to accept a USER PLANE CONNECTION MODIFICATION COMMAND message. See table 10.3.10.1.1.

Message type: USER PLANE CONNECTION MODIFICATION COMPLETE

Significance: dual

Direction: UE to network

Table 10.3.10.1.1: USER PLANE CONNECTION MODIFICATION COMPLETE message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	USER PLANE CONNECTION MODIFICATION COMPLETE message identity	Message type 11.1.3	M	V	1

10.3.11 User plane connection modification reject

10.3.11.1 Message definition

The USER PLANE CONNECTION MODIFICATION REJECT message is sent by the UE to the LMF to reject a USER PLANE CONNECTION MODIFICATION COMMAND message. See table 10.3.11.1.1.

Message type: USER PLANE CONNECTION MODIFICATION REJECT

Significance: dual

Direction: UE to network

Table 10.3.11.1.1: USER PLANE CONNECTION MODIFICATION REJECT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	USER PLANE CONNECTION MODIFICATION REJECT message identity	Message type 11.1.3	M	V	1
	Failure cause	Failure cause 11.3.3	M	V	1

11 Information elements coding

11.1 Overview

11.1.1 UPP-CM and LCS-UPP message format

Within the protocols defined in the present document, every UPP-CM and LCS-UPP message is a standard L3 message as defined in 3GPP TS 24.007 [11]. This means that UPP-CM and LCS-UPP messages consist of the following parts:

- 1) message type; and
- 2) other information elements, as required.

The organization of UPP-CM and LCS-UPP messages is illustrated in the example shown in figure 11.1.1.1.

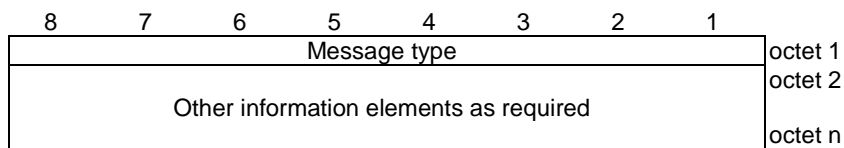


Figure 11.1.1.1: General message organization example for UPP-CM and LCS-UPP messages

Unless specified otherwise in the message descriptions of clause 10, a particular information element shall not be present more than once in a given message.

11.1.2 Field format and mapping

When a field is contained within a single octet, the lowest numbered bit of the field represents the least significant bit.

When a field extends over more than one octet, the order of bit values progressively decreases as the octet number increases. In that part of the field contained in a given octet, the lowest numbered bit represents the least significant bit. The most significant bit of the field is represented by the highest numbered bit of the lowest numbered octet of the field. The least significant bit of the field is represented by the lowest numbered bit of the highest numbered octet of the field.

For example, a bit number can be identified as a couple (o, b) where o is the octet number and b is the relative bit number within the octet. Figure 9.1.2.1 illustrates a field that spans from bit (1, 3) to bit (2, 7). The most significant bit of the field is mapped on bit (1, 3) and the least significant bit is mapped on bit (2, 7).

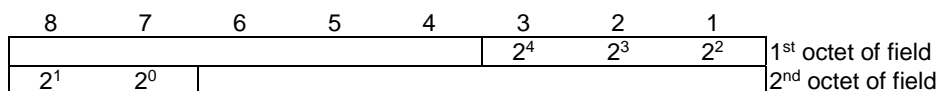


Figure 11.1.2.1: Field mapping convention

11.1.3 Message type

The Message type information element and its use are defined in 3GPP TS 24.007 [11]. Table 11.1.3.1 defines the value part of the message type information element used in the LCS-UPP and table 11.1.3.2 defines the value part of the message type information element used in the UPP-CM.

The Message type is a type 3 information element, with the length of 1 octet.

Table 11.1.3.1: Message type for LCS-UPP

Bits								
8	7	6	5	4	3	2	1	
0	1	-	-	-	-	-	-	LCS-UPP messages
0	1	0	0	0	0	0	1	UL LCS-UP transport
0	1	0	0	0	0	1	0	DL LCS-UP transport
0	1	0	0	0	0	1	1	LCS-UP connection binding request
0	1	0	0	0	1	0	0	LCS-UP connection binding accept
0	1	0	0	0	1	0	1	LCS-UP connection binding reject

Table 11.1.3.2: Message type for UPP-CM

Bits								
8	7	6	5	4	3	2	1	
1	1	-	-	-	-	-	-	UPP-CM messages
1	1	0	0	0	0	0	1	User plane connection establishment command
1	1	0	0	0	0	1	0	User plane connection establishment complete
1	1	0	0	0	0	1	1	User plane connection establishment failure
1	1	0	0	0	1	0	0	User plane connection establishment request
1	1	0	0	0	1	0	1	User plane connection establishment reject
1	1	0	0	0	1	1	0	User plane connection release command
1	1	0	0	0	1	1	1	User plane connection release complete
1	1	0	0	1	0	0	0	User plane connection release request
1	1	0	0	1	0	0	1	User plane connection modification command
1	1	0	0	1	0	1	0	User plane connection modification complete
1	1	0	0	1	0	1	1	User plane connection modification reject

11.2 LCS-UPP information elements

11.2.1 LCS-UP payload

The purpose of the LCS-UP payload information element is to transport LPP message(s) or LCS supplementary services message.

The LCS-UP payload information element is coded as shown in figure 11.2.1.1, figure 11.2.1.2, figure 11.2.1.3 and table 11.2.1.1.

The LCS-UP payload information element is a type 6 information element with a minimum length of 4 octets and a maximum length of 65538 octets.

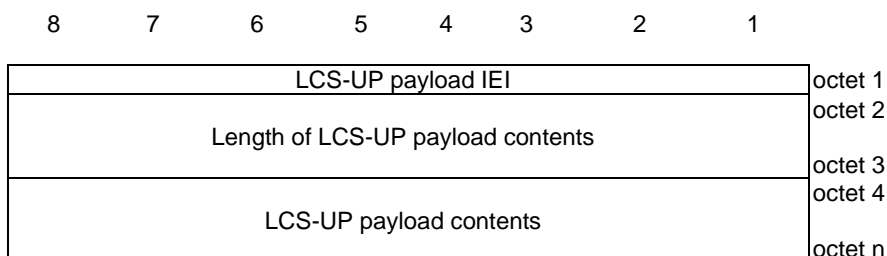


Figure 11.2.1.1: LCS-UP payload information element

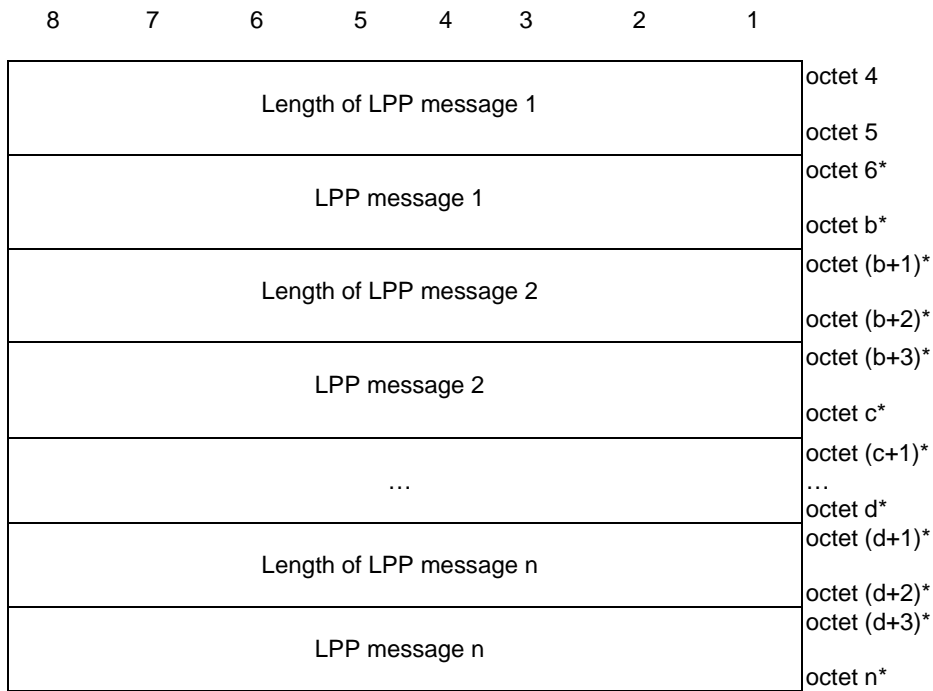


Figure 11.2.1.2: LCS-UP payload contents with LCS-UP payload type "LTE Positioning Protocol (LPP) message"

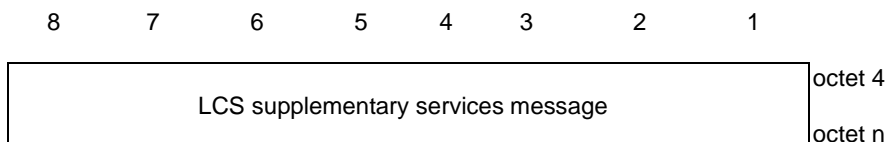


Figure 11.2.1.3: LCS-UP payload contents with LCS-UP payload type "LCS supplementary services message"

Table 11.2.1.1: LCS-UP payload information element

<p>LCS-UP payload contents (octet 4 to octet n)</p> <p>If the LCS-UP payload type is set to "LTE Positioning Protocol (LPP) message", the LCS-UP payload contents include one or more LPP message(s).</p> <p>If the LCS-UP payload type is set to "LCS supplementary services message", the LCS-UP payload contents include an LCS supplementary services message.</p>
--

11.2.2 LCS-UP payload type

The purpose of the LCS-UP payload type information element indicates information type included in the LCS-UP payload information element.

The LCS-UP payload type information element is coded as shown in figure 11.2.2.1 and table 11.2.2.1

The LCS-UP payload type information element is a type 1 information element.

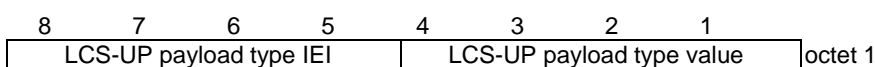


Figure 11.2.2.1: LCS-UP payload type information element

Table 11.2.2.1: LCS-UP payload type information element

LCS-UP payload type value (octet 1 bits 1 to 4)			
Bits			
4	3	2	1
0	0	0	1
LTE Positioning Protocol (LPP) message			
0	0	1	0
LCS supplementary services message			
All other values are reserved.			

11.2.3 LCS session identity

The purpose of the LCS session identity information element is to identify the LCS session transferred in the user plane between the UE and the LMF. The LCS session identity value is set to the LCS correlation identifier, the routing identifier, or the deferred routing identifier for LCS supplementary services messages and LPP messages.

The LCS session identity information element is coded as shown in figure 11.2.3.1 and table 11.2.3.1

The LCS session identity information element is a type 4 information element with a minimum length of 3 octets and a maximum length of 257 octets.

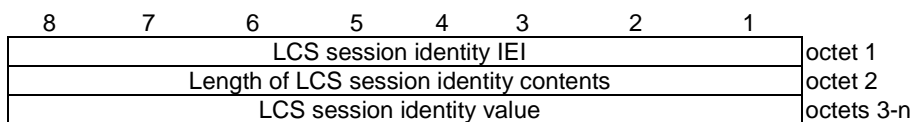


Figure 11.2.3.1: LCS session identity information element

Table 11.2.3.1: LCS session identity information element

LCS session identity value (octet 3 to octet n)	
The LCS session identity value is set to the LCS correlation identifier, routing identifier, or deferred routing identifier for LCS supplementary services messages and LPP messages. The coding of the LCS session identity value is dependent on the upper layer location services application for LPP or the upper layer location services application for LCS supplementary services.	
LCS correlation identifier, routing identifier and deferred routing identifier are specified in 3GPP TS 23.003 [10].	

11.3 UPP-CM information elements

11.3.1 LMF LCS-UP address

The purpose of the LMF LCS-UP address information element is to carry the user plane positioning address of the LMF.

The LMF LCS-UP address information element is coded as shown in figure 11.3.1.1 and table 11.3.1.1.

The LMF LCS-UP address information element is a type 4 information element with minimum length of 4 octets and maximum length of 257 octets.

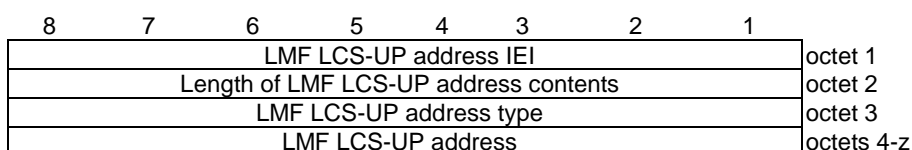


Figure 11.3.1.1: LMF LCS-UP address information element

Table 11.3.1.1: LMF LCS-UP address information element

LMF LCS-UP address type (octet 3)								
Bits								
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	IPv4
0	0	0	0	0	0	1	0	IPv6
0	0	0	0	0	0	1	1	IPv4v6
0	0	0	0	0	1	0	0	FQDN
All other values are spare. If received they shall be ignored.								
If the LMF LCS-UP address type indicates IPv4, then the LMF LCS-UP address field contains an IPv4 address in octet 4 to octet 7.								
If the LMF LCS-UP address type indicates IPv6, then the LMF LCS-UP address field contains an IPv6 address in octet 4 to octet 19.								
If the LMF LCS-UP address type indicates IPv4v6, then the LMF LCS-UP address field contains two IP addresses. The first IP address is an IPv4 address in octet 4 to octet 7. The second IP address is an IPv6 address in octet 8 to octet 23.								
If the LMF LCS-UP address type indicates FQDN, octet 4 to octet z is encoded as defined in clause 19.4.2.1 in 3GPP TS 23.003 [10].								

11.3.2 GPRS timer 3

See clause 10.5.7.4a in 3GPP TS 24.008 [14].

11.3.3 Failure cause

The purpose of the Failure cause information element is to indicate the reason of the failure of a UPP-CM procedure.

The Failure cause is a type 3 information element with a length of 2 octets.

The Failure cause information element is coded as shown in figure 11.3.3.1 and table 11.3.3.1.

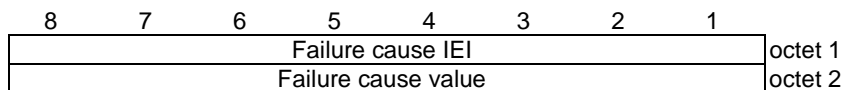


Figure 11.3.3.1: Failure cause information element

Table 11.3.3.1: Failure cause information element

Failure cause value (octet 2)								
Bits								
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	PDU session failure
0	0	0	0	0	0	1	0	TLS connection failure
0	0	0	0	0	0	1	1	LCS-UP connection binding failure
0	0	0	0	0	1	0	0	User plane not available
0	0	0	0	0	1	0	1	Source LCS secured user plane connection not found
0	1	1	0	1	1	1	1	Protocol error, unspecified
All other values are spare, and shall be ignored if received.								

11.3.4 LCS-UP binding ID

The purpose of the LCS-UP binding ID information element is to associate an LCS secured user plane connection with the UE.

The LCS-UP binding ID information element is coded as shown in figure 11.3.4.1 and table 11.3.4.1.

The LCS-UP binding ID information element is a type 4 information element with the minimum length of 6 octets and maximum length of 257 octets.

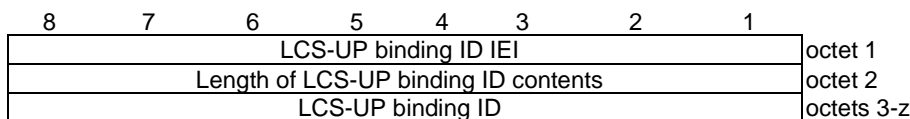


Figure 11.3.4.1: LCS-UP binding ID information element

Table 11.3.4.1: LCS-UP binding ID information element

The LCS-UP binding ID field contains the binary encoding of the LCS-UP binding ID with a minimum length of 4 octets and a maximum length of 255 octets.

11.3.5 LMF routing information

The purpose of the LMF routing information information element is to identify the LCS secured user plane connection between the UE and LMF for the LMF relocation as specified in clause 6.18.3 in 3GPP TS 23.273 [2].

The LMF routing information information element is coded as shown in figure 11.3.5.1 and table 11.3.5.1.

The LMF routing information information element is a type 4 information element with a minimum length of 3 octets.

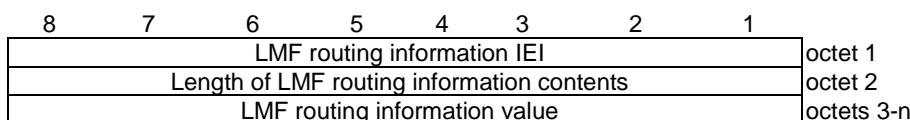


Figure 11.3.5.1: LMF routing information information element

Table 11.3.5.1: LMF routing information information element

LMF routing information value (octet 3 to octet n)
The LMF routing information value is set to the value of the srcLmfRoutingInfo (i.e source LMF Identification) specified in 3GPP TS 29.572 [16].

11.4 Spare half octet

This element is used in the description of LCS-UPP messages when an odd number of half octet type 1 information elements are used. This element is filled with spare bits set to zero and is placed in bits 5 to 8 of the octet unless otherwise specified.

12 List of system parameters

12.1 General

The description of timers in the tables of clause 12 should be considered a brief summary. The precise details are found in clauses 6 and 7, which should be considered the definitive descriptions.

12.2 Timers of LCS-UPP

Table 12.2.1: Timers of LCS-UPP – UE side

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON THE 1 st , 2 nd , 3 rd , 4 th EXPIRY (NOTE 2)
T5110	NOTE 1	Transmission of LCS-UP CONNECTION BINDING REQUEST message	LCS-UP CONNECTION BINDING ACCEPT message received or LCS-UP CONNECTION BINDING REJECT message received	Abort the LCS-UP connection binding procedure as specified in clause 7.3.4.6 (see NOTE 3)
NOTE 1: The timer value of T5110 is implementation specific e.g., dependent on the value of TCP timeout.				
NOTE 2: Typically, the procedures are aborted on the fifth expiry of the relevant timer. Exceptions are described in the corresponding procedure description.				
NOTE 3: The timers expire only once.				

12.3 Timers of UPP-CM

Timers of UPP-CM are shown in table 12.3.1 and table 12.3.2.

Table 12.3.1: Timers of UPP-CM – UE side

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON THE 1 st , 2 nd , 3 rd , 4 th EXPIRY (NOTE 1)
T5011	16s	Transmission of USER PLANE CONNECTION ESTABLISHMENT REQUEST message	USER PLANE CONNECTION ESTABLISHMENT COMMAND message received USER PLANE CONNECTION ESTABLISHMENT REJECT message received	Retransmission of USER PLANE CONNECTION ESTABLISHMENT REQUEST message
T5013	16s	Transmission of USER PLANE CONNECTION RELEASE REQUEST message	USER PLANE CONNECTION RELEASE COMMAND message received	Retransmission of USER PLANE CONNECTION RELEASE REQUEST message
T5014	NOTE 2	USER PLANE CONNECTION ESTABLISHMENT REJECT received with a back-off timer value as specified in clause 6.2.2.1.4. USER PLANE CONNECTION RELEASE COMMAND received with a back-off timer value and USER PLANE CONNECTION RELEASE COMPLETE sent as specified in clause 6.2.1.2.3.	USER PLANE CONNECTION ESTABLISHMENT COMMAND message received	None
NOTE 1: Typically, the procedures are aborted on the fifth expiry of the relevant timer. Exceptions are described in the corresponding procedure description.				
NOTE 2: The value of this timer is provided by the network.				

Table 12.3.2: Timers of UPP-CM – LMF side

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON THE 1 st , 2 nd , 3 rd , 4 th EXPIRY (NOTE 1)
T5012	NOTE 2	Transmission of USER PLANE CONNECTION ESTABLISHMENT COMMAND message	USER PLANE CONNECTION ESTABLISHMENT COMPLETE message received USER PLANE CONNECTION ESTABLISHMENT FAILURE message received	Retransmission of USER PLANE CONNECTION ESTABLISHMENT COMMAND message
T5010	16s	Transmission of USER PLANE CONNECTION RELEASE COMMAND message	A USER PLANE CONNECTION RELEASE COMPLETE message received	Retransmission of USER PLANE CONNECTION RELEASE COMMAND message
T5015	16s	Transmission of USER PLANE CONNECTION MODIFICATION COMMAND message	USER PLANE CONNECTION MODIFICATION COMPLETE message received	Retransmission of USER PLANE CONNECTION MODIFICATION COMMAND message
NOTE 1: Typically, the procedures are aborted on the fifth expiry of the relevant timer. Exceptions are described in the corresponding procedure description.				
NOTE 2: The timer value of T5012 is implementation specific and set to be inclusive NAS procedure timer handling (e.g., for PDU session establishment), TLS connection establishment, and user plane connection binding procedure.				

Annex A (informative): Network initiated user plane connection establishment procedure with the LCS-UP connection binding procedure call flow

This clause depicts the call flow between the UE and the LMF for the network initiated user plane connection establishment procedure with the LCS-UP connection binding procedure. The USER PLANE CONNECTION ESTABLISHMENT COMMAND message, the USER PLANE CONNECTION ESTABLISHMENT COMPLETE message and the USER PLANE CONNECTION ESTABLISHMENT FAILURE message, as described in clause 6.2.1.1, are transported via the control plane. The TLS connection establishment procedure and the LCS-UP connection binding procedure are performed via the user plane.

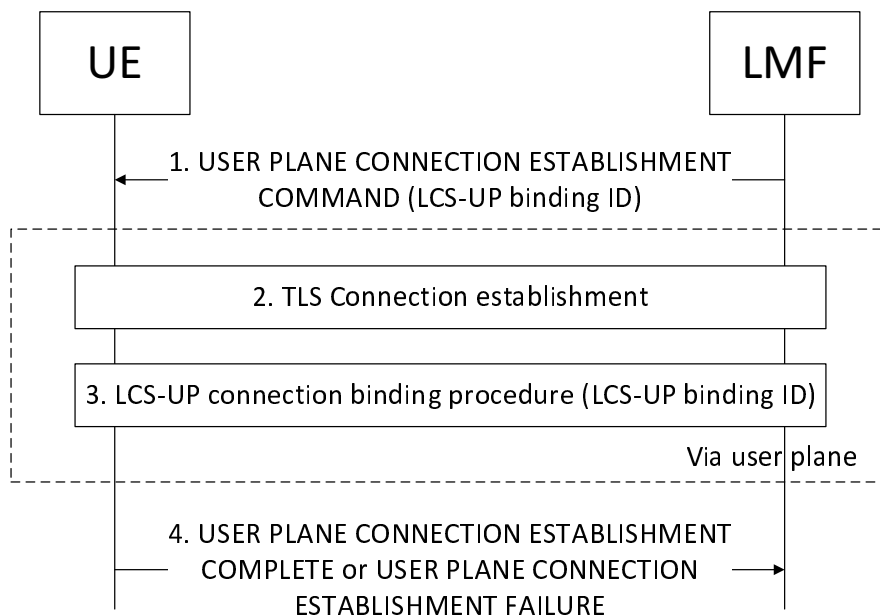


Figure A.1: Call flow for network initiated user plane connection establishment procedure with the LCS-UP connection binding procedure.

Annex B (informative): Change history

Change history							
Date	Meeting	TDoc	CR	R ev	Ca t	Subject/Comment	New version
2023-03	CT1#140	C1-231046				Draft skeleton provided by the rapporteur.	0.0.0
2023-03	CT1#140	C1-231047				Implementing the following p-CRs agreed by CT1: C1-231047; and editorial changes from the rapporteur.	0.1.0
2023-08	CT1#143	C1-235982 , C1-235982 , C1-236548 , C1-236450 , C1-236451 , C1-236454 , C1-236566				Implementing the following p-CRs agreed by CT1: C1-235982 , C1-235982 , C1-236548 , C1-236450 , C1-236451 , C1-236454 , C1-236566 ; and editorial changes from the rapporteur.	0.2.0
2023-10	CT1#144	C1-237757, C1-237760 , C1-237761 , C1-237762, C1-237763, C1-237890, C1-237909, C1-237933, C1-237956, C1-237957, C1-237958				Implementing the following p-CRs agreed by CT1: C1-237757, C1-237760 , C1-237761 , C1-237762, C1-237763, C1-237890, C1-237909, C1-237933, C1-237956, C1-237957, C1-237958; and editorial changes from the rapporteur.	0.3.0
2023-11	CT1#145	C1-239250, C1-239251. C1-239252. C1-239253. C1-239650. C1-239656. C1-239258, C1-239260, C1-239261, C1-239264, C1-239380, C1-239373, C1-239651,				Implementing the following p-CRs agreed by CT1: C1-239250, C1-239251. C1-239252. C1-239253. C1-239650. C1-239656. C1-239258, C1-239260, C1-239261, C1-239264, C1-239380, C1-239373, C1-239651; and editorial changes from the rapporteur.	1.0.0
2024-01	CT1#146	C1-240021, C1-240023, C1-240029, C1-240035, C1-240144, C1-240158, C1-240324, C1-240325, C1-240326, C1-240327, C1-240328, C1-240329, C1-240330, C1-240331, C1-240332, C1-240333, C1-240334, C1-240335, C1-240336, C1-240356, C1-240357, C1-240358, C1-240359, C1-240388, C1-240389, C1-240391, C1-240393, C1-240397, C1-240398, C1-240399, C1-240425, C1-240426				Implementing the following p-CRs agreed by CT1: C1-240021, C1-240023, C1-240029, C1-240035, C1-240144, C1-240158, C1-240324, C1-240325, C1-240326, C1-240327, C1-240328, C1-240329, C1-240330, C1-240331, C1-240332, C1-240333, C1-240334, C1-240335, C1-240336, C1-240356, C1-240357, C1-240358, C1-240359, C1-240388, C1-240389, C1-240391, C1-240393, C1-240397, C1-240398, C1-240399, C1-240425, C1-240426; and editorial changes from the rapporteur.	1.1.0

2024-03	CT1#147	C1-240754, C1-241795 , C1-241715 , C1-241764 , C1-241776 , C1-240605 , C1-241765 , C1-241842 , C1-240680 , C1-240678 , C1-240523 , C1-240756 , C1-241091 , C1-241299 , C1-241300 , C1-241301 , C1-241303 , C1-241742				Implementing the following p-CRs agreed by CT1: C1-240754 , C1-241795 , C1-241715 , C1-241764 , C1-241776 , C1-240605 , C1-241765 , C1-241842 , C1-240680 , C1-240678 , C1-240523 , C1-240756 , C1-241091 , C1-241299 , C1-241300 , C1-241301 , C1-241303 , C1-241742 ; and editorial changes from the rapporteur.	2.0.0
2024-03	CT#103					Approved in CT#103	18.0.0
2024-06	CT#104	CP-241154	0005	-	F	Correction on T5011 timer handling	18.1.0
2024-06	CT#104	CP-241154	0016	-	F	Corrections to NW handling for USER PLANE CONNECTION ESTABLISHMENT COMMAND REJECT	18.1.0
2024-06	CT#104	CP-241154	0002	1	F	Corrections to scope	18.1.0
2024-06	CT#104	CP-241154	0004	1	F	UE handling on user plane connection release	18.1.0
2024-06	CT#104	CP-241154	0015	1	F	Minor corrections to 24.572	18.1.0
2024-06	CT#104	CP-241154	0014	1	F	Corrections to message definition of USER PLANE CONNECTION ESTABLISHMENT REJECT	18.1.0
2024-06	CT#104	CP-241154	0017	2	F	Clarification on the LCS session identity and UP connection release procedure	18.1.0
2024-06	CT#104	CP-241154	0012	2	D	Editorial corrections in 24.572	18.1.0
2024-06	CT#104	CP-241154	0007	3	F	Back-off timer during the user plane connection release procedure	18.1.0
2024-06	CT#104	CP-241153	0024	-	F	Correction on T5012 timer handling	18.1.0
2024-06	CT#104	CP-241153	0026	-	F	Correction on UE requested user plane connection establishment	18.1.0
2024-06	CT#104	CP-241153	0027	-	F	Miscellaneous corrections of TS 24.572	18.1.0
2024-06	CT#104	CP-241153	0031	1	F	Modification on the user plane connection establishment procedure	18.1.0
2024-06	CT#104	CP-241153	0009	4	F	Corrections on LCS session identity value	18.1.0
2024-06	CT#104	CP-241153	0020	1	F	Miscellaneous corrections before the spec freeze	18.1.0
2024-06	CT#104	CP-241153	0021	1	F	Minor corrections	18.1.0
2024-06	CT#104	CP-241153	0006	5	F	Back-off timer during the user plane connection establishment procedure	18.1.0
2024-06	CT#104	CP-241153	0011	5	B	Addition of reject cause to establishment command reject message	18.1.0
2024-06	CT#104	CP-241153	0030	2	F	User plane connection release due to lost of PDU session or TLS failure	18.1.0
2024-06	CT#104	CP-241153	0029	2	F	Inactivity timer for user plane connection	18.1.0
2024-06	CT#104	CP-241154	0023	3	B	LCS UP connection binding to the UE	18.1.0
2024-06	CT#104					Editorial corrections	18.1.1
2024-09	CT#105	CP-242164	0035	1	F	Aligning LCS Session identity encoding with other specifications	18.2.0
2024-09	CT#105	CP-242164	0038	1	F	Corrections for T5014	18.2.0
2024-09	CT#105	CP-242164	0039	1	F	Updated scope of network initiated user plane connection establishment procedure	18.2.0
2024-09	CT#105	CP-242164	0041	1	F	Clarification and alignment of user plane connection release procedure	18.2.0
2024-09	CT#105	CP-242164	0042	1	F	Network abnormal case duplication	18.2.0
2024-09	CT#105	CP-242164	0046	1	F	Correction of Message too long clause	18.2.0
2024-09	CT#105	CP-242164	0056	1	F	Correction on LCS-UP binding ID handling at UE	18.2.0
2024-09	CT#105	CP-242164	0052	1	F	Minimum and maximum length of the LCS-UP binding ID	18.2.0
2024-09	CT#105	CP-242164	0053	1	F	LCS-UP connection binding failure conditions	18.2.0
2024-09	CT#105	CP-242206	0055	1	F	Correction on LCS-UP binding ID handling at LMF	18.2.0
2024-09	CT#105	CP-242206	0057	1	F	Release of association between binding ID and UE at LMF	18.2.0
2024-09	CT#105	CP-242206	0069	1	F	Clarification on the call flow for the user plane connection establishment procedure	18.2.0
2024-09	CT#105	CP-242206	0070	1	F	Editorial corrections to the message name and timer number	18.2.0
2024-09	CT#105	CP-242206	0050	1	F	Corrections to wrong message names	18.2.0
2024-09	CT#105	CP-242206	0036	1	F	Minor corrections	18.2.0
2024-09	CT#105	CP-242206	0044	1	F	Correction of abnormal case and style alignments	18.2.0
2024-09	CT#105	CP-242206	0047	1	F	Corrections in figures	18.2.0
2024-09	CT#105	CP-242206	0072	1	D	Correction on message name	18.2.0
2024-09	CT#105	CP-242206	0068	1	F	Miscellaneous corrections of TS 24.572	18.2.0
2024-09	CT#105	CP-242206	0062	1	F	Correction on the association of LCS-UP binding ID and UE ID	18.2.0
2024-09	CT#105	CP-242206	0071	1	F	LCS secured user plane connection failure due to user plane not available	18.2.0
2024-09	CT#105	CP-242206	0059	2	F	Correction on main function of LCS-UPP	18.2.0

2024-09	CT#105	CP-242206	0054	2	F	Correction to LCS correlation identifier and overall call flow in Annex A	18.2.0
2024-09	CT#105	CP-242206	0045	2	F	Correction of LCS-UP connection binding procedure abnormal case	18.2.0
2024-09	CT#105	CP-242206	0048	2	F	Corrections to UE requested user plane connection release	18.2.0
2024-09	CT#105	CP-242206	0040	2	F	Failure cause corrections	18.2.0
2024-09	CT#105	CP-242206	0067	2	F	Clarification on UE-request and NW-initiated procedures	18.2.0
2024-09	CT#105	CP-242201	0064	1	D	Editorial corrections on 24.572	19.0.0
2024-09	CT#105					Assigning cause values for "#X User plane not available"	19.0.1
2024-12	CT#106	CP-243176	0074	1	A	TLS connection termination	19.1.0
2024-12	CT#106	CP-243176	0082	2	A	Correction of a message	19.1.0
2024-12	CT#106	CP-243176	0077	2	A	Correction to cause value User plane not available	19.1.0
2024-12	CT#106	CP-243176	0078	1	F	Correction to wrong reference	19.1.0
2024-12	CT#106	CP-243176	0075	1	D	Editorial correction	19.1.0
2024-12	CT#106	CP-243176	0089	1	A	Alt1: TCP port number for LCS-UPP - Rel19	19.1.0
2024-12	CT#106	CP-243176	0087	2	D	Editorial corrections on 24.572	19.1.0
2024-12	CT#106	CP-243176	0079	2	F	Correction to figures of network initiated user plane connection establishment and release procedure	19.1.0
2025-03	CT#107	CP-250144	0096	-	F	Correction to DL LCS-UP TRANSPORT message	19.2.0
2025-06	CT#108	CP-251190	0097	1	F	Cause value User plane not available update for PS data off	19.3.0
2025-06	CT#108	CP-251190	0098	1	F	TCP port number for LCS-UPP	19.3.0
2025-06	CT#108	CP-251149	0111	1	A	Clarification on the failure of the user plane connection establishment	19.3.0
2025-06	CT#108	CP-251170	0105	1	F	Clarification on maximum number of LCS secured user plane connection per UE	19.3.0
2025-06	CT#108	CP-251170	0103	1	F	IEI handling	19.3.0
2025-06	CT#108	CP-251170	0101	2	F	Corrections to the handling of positioning capabilities	19.3.0
2025-09	CT#109	CP-252132	0120	1	A	Clarification on the UE requested user plane connection establishment procedure	19.4.0
2025-09	CT#109	CP-252155	0121	1	F	Clarification on UE requested user plane connection establishment procedure	19.4.0
2025-09	CT#109	CP-252155	0122	2	F	Clarification on multiple LCS-UPP connection	19.4.0
2025-12	CT#110	CP-253114	0115	3	B	Use routing information to map the user plane connection in the UE	19.5.0
2025-12	CT#110	CP-253127	0116	5	B	Include routing information for LMF relocation on new user plane connection	19.5.0
2025-12	CT#110	CP-253127	0117	4	B	Send the source LMF routing information to UE for LMF relocation	19.5.0
2025-12	CT#110	CP-253114	0127	1	F	Clarification on LCS session initiated before the LCS-UP connection	19.5.0
2025-12	CT#110	CP-253114	0128		F	Correction to the LCS Correlation ID for UPP-CM message	19.5.0
2025-12	CT#110	CP-253127	0130	1	F	Clarification to indicate the routing information to lower layer	19.5.0

History

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