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Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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

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- should** indicates a recommendation to do something
- should not** indicates a recommendation not to do something
- may** indicates permission to do something
- need not** indicates permission not to do something

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- can** indicates that something is possible
- cannot** indicates that something is impossible

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

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

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

In addition:

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

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

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

1 Scope

The present document specifies the operations and information coding for the Non-Access Stratum (NAS) layer protocol for supporting the Location Services (LCS) in the NG-RAN.

The present document is applicable to the User Equipment (UE) and to the Access and Mobility Management Function (AMF) or Location Management Function (LMF) in the 5G System (5GS).

The present document is developed in accordance to the general principles stated in 3GPP TS 23.273 [2].

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 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".
 - [4] 3GPP TS 36.355: "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP)".
 - [5] 3GPP TS 24.080: "Mobile radio interface layer 3 supplementary services specification; Formats and coding".
 - [6] 3GPP TS 29.572: "5G System; Location Management Services; Stage 3".
-

3 Definitions of terms, symbols and abbreviations

3.1 Terms

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].

3.2 Symbols

3.3 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].

5GCN	5G Core Network
5GS	5G System
AMF	Access and Mobility Management Function

DL	Downlink
IE	Information Element
GMLC	Gateway Mobile Location Centre
LCS	Location Services
LDR	Location Deferred Request
LMF	Location Management Function
LPP	LTE Positioning Protocol
MO-LR	Mobile Originated Location Request
MT-LR	Mobile Terminated Location Request
NAS	Non-access Stratum
UE	User Equipment
UL	Uplink

4 General

4.1 Overview

4.1.1 NAS aspect

To enable transfer of Location Services (LCS) signaling messages between the 5G core network (5GCN) and the UE, two Payload container types are defined in the downlink (DL NAS TRANSPORT message) and the uplink (UL NAS TRANSPORT message). The message protocol and procedures are described in 3GPP TS 24.501 [3].

4.1.2 LCS aspect

LCS uses the defined payload container to transfer LCS signalling messages between the UE and the network.

The corresponding LCS signaling messages include:

- a) LTE Positioning Protocol (LPP) messages (see 3GPP TS 36.355 [4])
 - Both downlink and uplink LPP messages are supported
 - Routing information is transported as the Additional information IE in UL/DL NAS TRANSPORT message for LPP messages (see 3GPP TS 24.501 [3])
- b) Location services messages
 - Messages for MO-LR operations (see 3GPP TS 24.080 [5])
 - Messages for LocationNotification operations (see 3GPP TS 24.080 [5])
 - Messages for EventReport operations (see 3GPP TS 24.080 [5])
 - Messages for PeriodicTriggeredInvoke operations (see 3GPP TS 24.080 [5])
 - Messages for CancelDeferredLocation operations (see 3GPP TS 24.080 [5])
 - Messages for MSCancelDeferredLocation operations (see 3GPP TS 24.080 [5])
 - Messages for LocationPrivacySetting operations (see 3GPP TS 24.080 [5])

Routing information associated with the LMF is transported as the Additional information IE in UL/DL NAS TRANSPORT message for Location services messages that are transported from/to the LMF (see 3GPP TS 24.501 [3])

4.2 LCS Support capabilities

4.2.1 UE support of LCS

The UE announces to the network its ability to support LCS notification mechanism or LPP messages or both, using the 5GMM capability IE defined in 3GPP TS 24.501 [3].

4.2.2 Network support of LCS

The network announces to the UE its ability to support LCS in 5GC using the 5GS network feature support IE defined in 3GPP TS 24.501 [3]. The information is taken into account by the UE, in addition to UE's LCS capabilities, for the UE to determine whether to initiate MO-LR procedure in NG-RAN as specified in 3GPP TS 23.273 [3], subclause 6.2.

5 Support of LCS signalling

5.1 General

This clause defines the NG-RAN LCS operations (subclause 5.2) and the format and coding of the messages (subclause 5.3).

The messages defined in this subclause can be transported in the UL/DL NAS Transport message defined in 3GPP TS 24.501 [3].

5.2 LCS operations

5.2.1 Network initiated location services operations

5.2.1.1 Supplementary Services Location Notification

5.2.1.1.1 General

The supplementary services Location Notification operation enables the AMF to trigger the end-user notification verification process on the UE using NAS signalling. The supplementary services messages are transported using the DL NAS Transport message and the UL NAS Transport message defined in 3GPP TS 24.501 [3]. UE Location Privacy Indication information may be included in Location Notification Return Result to indicate whether subsequent LCS requests will be allowed or disallowed by the UE. Figure 5.2.1.1.1.1 illustrates an example of the NAS signalling transport applicable to a 5GC-MT-LR procedure for immediate or deferred location.

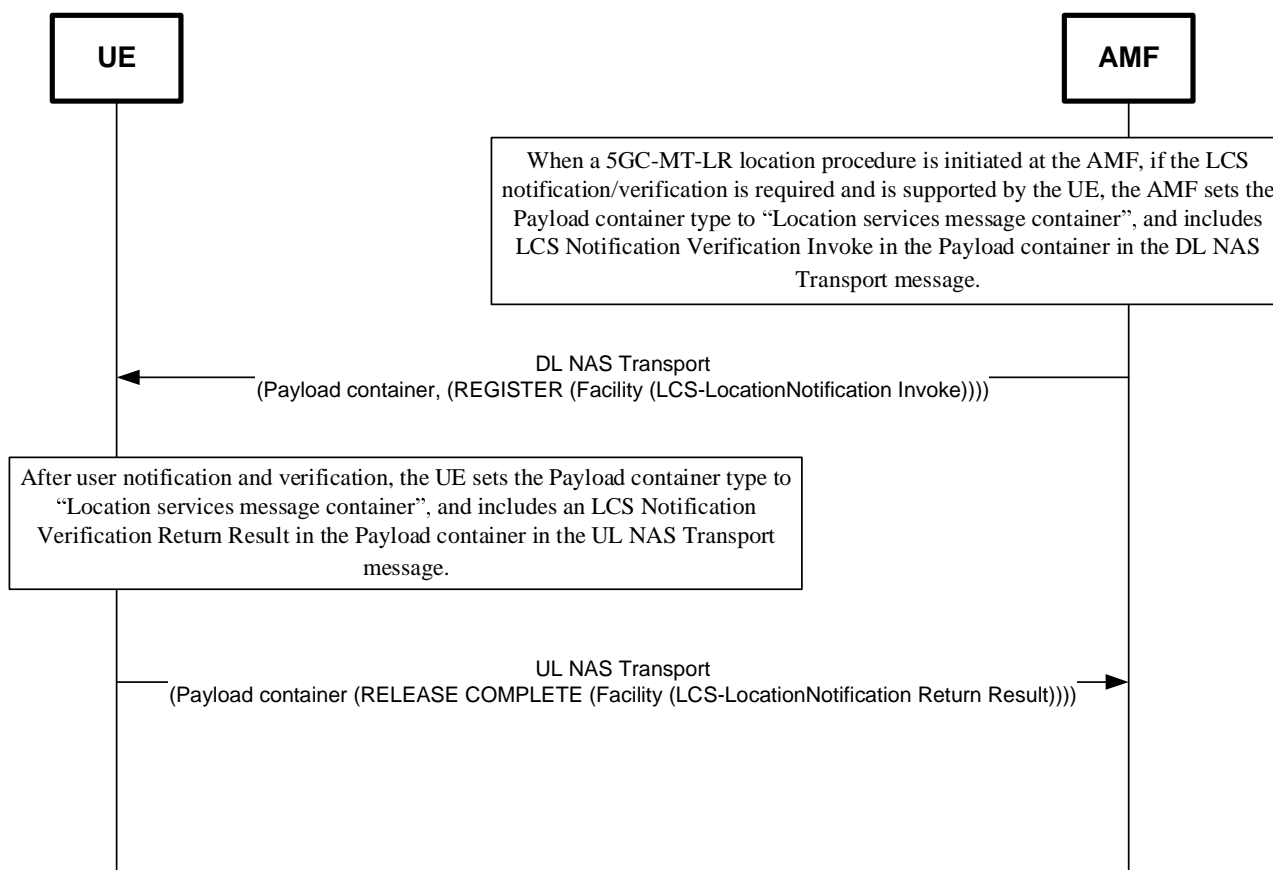


Figure 5.2.1.1.1: NAS signalling transport for Supplementary Services Location Notification

NOTE: The optional Additional Information IE of the DL/UL NAS Transport message is not used when the LCS Location Notification signalling is transported in the Payload container.

5.2.1.1.2 Normal operation

The network invokes a location notification procedure by sending a REGISTER message containing an LCS-LocationNotification invoke component to the UE as defined in 3GPP TS 24.080 [5]. This may be sent either to request verification for a 5GC-MT-LR or to notify the UE about an already authorized 5GC-MT-LR.

In case of privacy verification, the UE shall respond to the request by sending a RELEASE COMPLETE message containing the user's response and optionally UE Location Privacy Indication information in a return result component (see figure 5.2.1.1.2.1).

If the timer T(LCSN) defined in 3GPP TS 24.080 [5] expires in the network before any response from the UE (e.g. due to no response from the user), the network shall interpret this by applying the default treatment defined in 3GPP TS 23.273 [2] (i.e. disallow location if barred by subscription or allow location if allowed by subscription).

In the case of location notification, the UE shall terminate the dialogue immediately by sending a RELEASE COMPLETE message containing a LocationNotification return result.

If the UE is unable to process the request received from the network, it shall return an error indication by sending a RELEASE COMPLETE message containing a return error component. Error values are specified in 3GPP TS 24.080 [5].

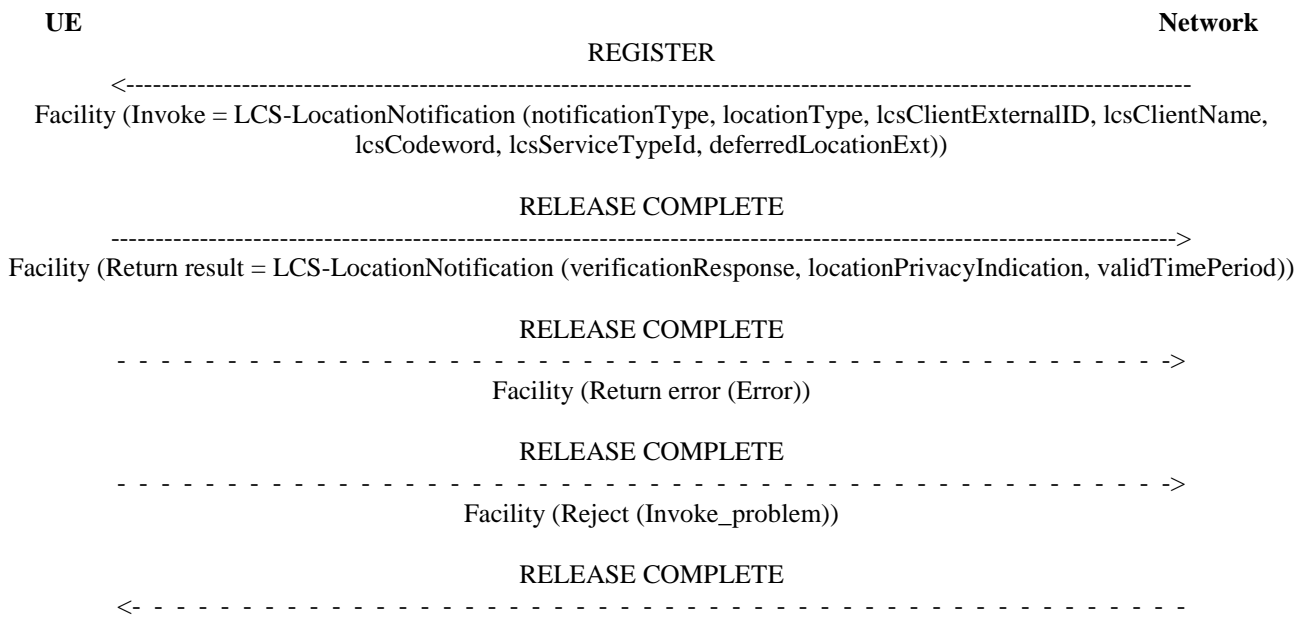


Figure 5.2.1.1.2.1: Location Notification

5.2.1.2 Positioning Information Transport

The AMF sends an LPP message and an associated Correlation Identifier in the DL NAS Transport message (refer to 3GPP TS 24.501 [3] and 3GPP TS 23.273 [2] clause 6.11.1). Figure 5.2.1.2.1 illustrates an example of the NAS signalling transport for downlink LPP messages.

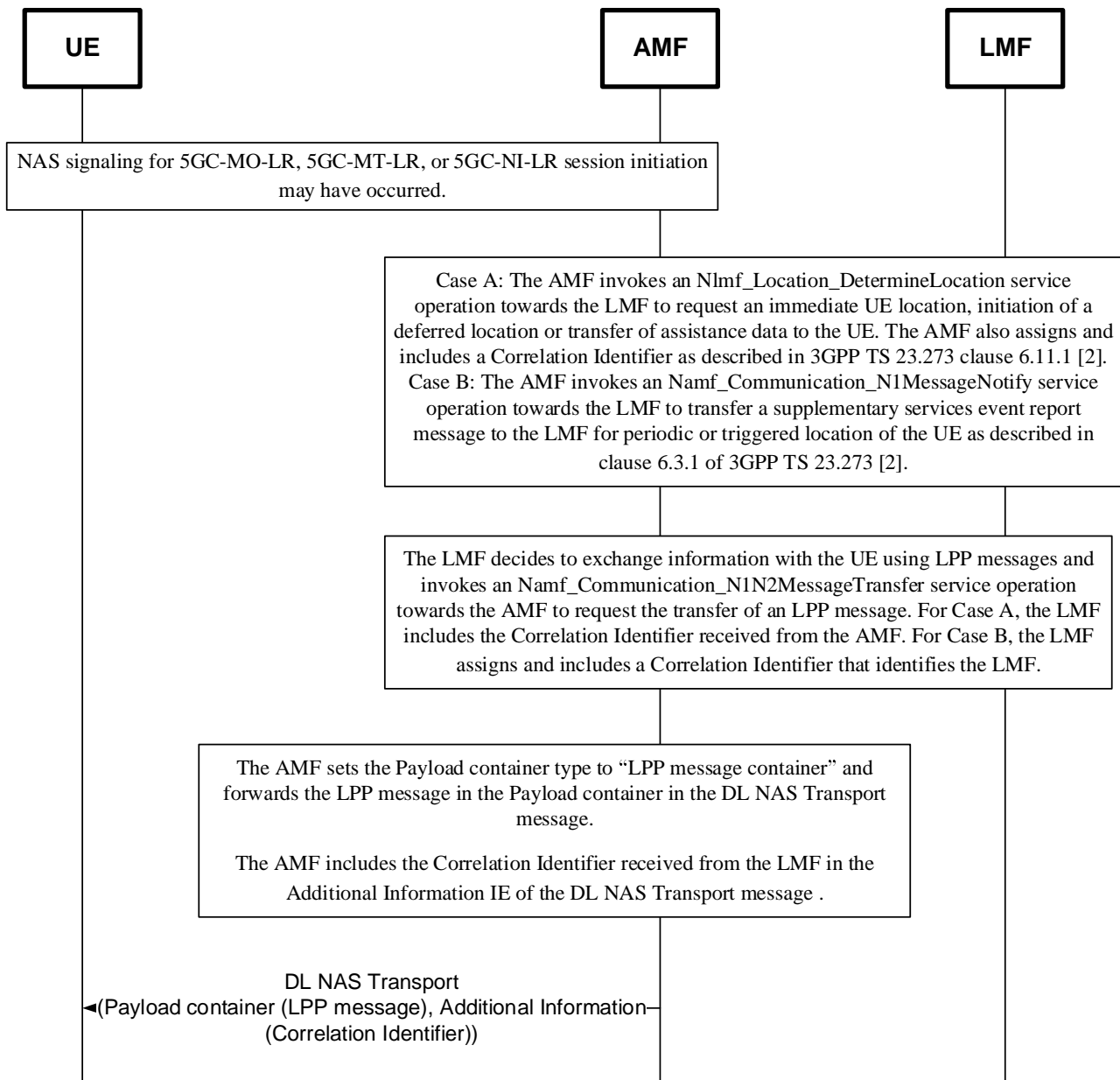


Figure 5.2.1.2.1: NAS signalling transport for downlink LPP messages

5.2.1.3 Supplementary Services Periodic or Triggered Location

5.2.1.3.1 General

The supplementary services LCS PeriodicTriggered Invoke operation enables the LMF to initiate periodic or triggered location event reporting by a target UE as described in clause 6.3.1 of 3GPP TS 23.272 [2]. The supplementary services LCS PeriodicTriggered Invoke message is transferred to the target UE via the serving AMF in a DL NAS Transport message. A response from the target UE is similarly returned to the LMF via the serving AMF and is transferred to the AMF in an UL NAS Transport message.

Figure 5.2.1.3.1.1 illustrates an example of the NAS signalling transport for initiation of periodic or triggered location,

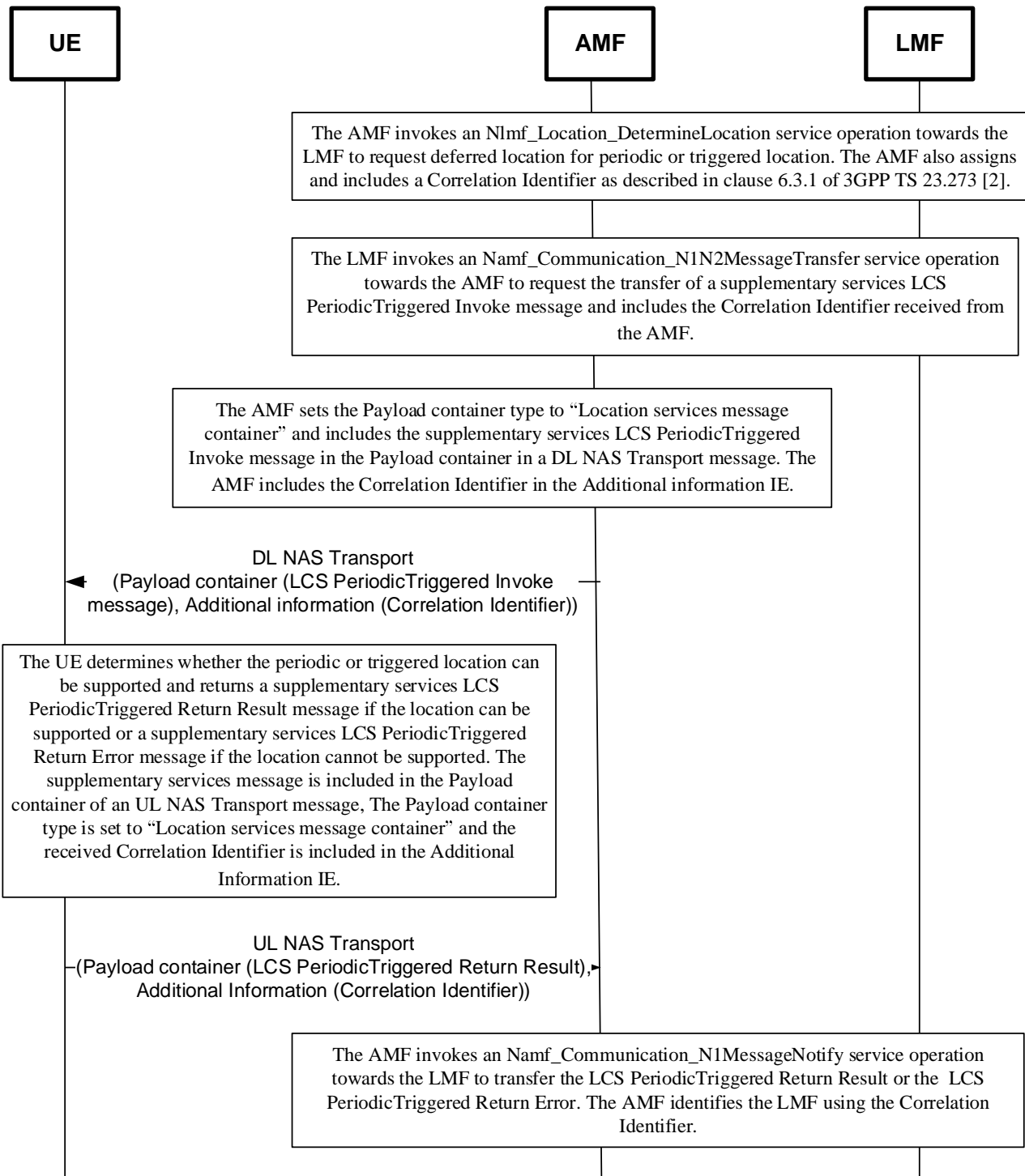


Figure 5.2.1.3.1.1: NAS signalling transport for LCS PeriodicTriggered messages

5.2.1.3.2 Normal operation

The LMF sends a REGISTER message to the UE containing the supplementary services LCS PeriodicTriggered Invoke component as defined in 3GPP TS 24.080 [5]. The REGISTER message is transported to the UE via the serving AMF as described in figure 5.2.1.3.1.1.

If the UE can support the periodic or triggered location, the UE returns a RELEASE COMPLETE message to the LMF containing an LCS PeriodicTriggered return result. The RELEASE COMPLETE message is transported to the LMF via the serving AMF as described in figure 5.2.1.3.1.1.

If the UE is unable to process or support the request received from the network, it shall return an error indication by sending a RELEASE COMPLETE message containing a return error component or reject component. Error values are specified in 3GPP TS 24.080 [5].

Figure 5.2.1.3.2.1 illustrates the signalling for normal operation between the UE and the network.

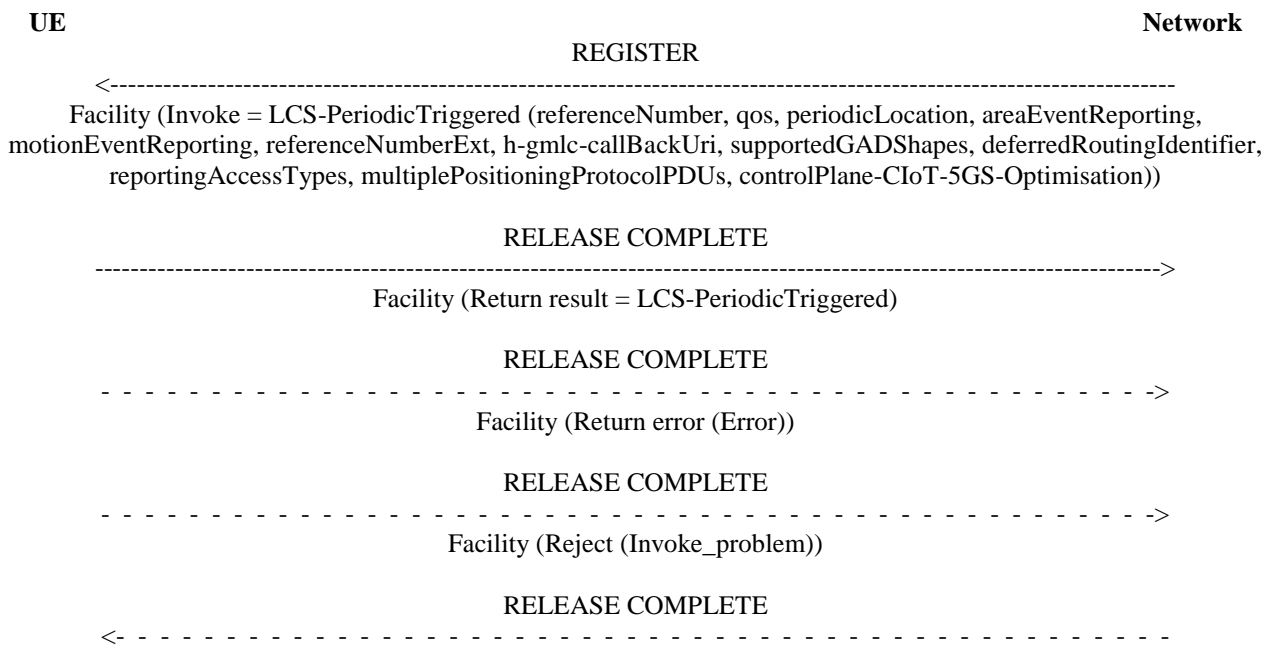


Figure 5.2.1.3.2.1: Periodic or Triggered Location Invocation

5.2.1.4 Supplementary Services Cancel Deferred Location

5.2.1.4.1 General

The supplementary services Cancel Deferred Location operation enables the AMF to cancel ongoing periodic or triggered location in a target UE using NAS signalling as described in 3GPP TS 23.273 [2] clause 6.3.3. The supplementary services Cancel Deferred Location messages are transported using the DL NAS Transport message and the UL NAS Transport message defined in 3GPP TS 24.501 [3]. Figure 5.2.1.4.1-1 illustrates an example of the NAS signalling transport.

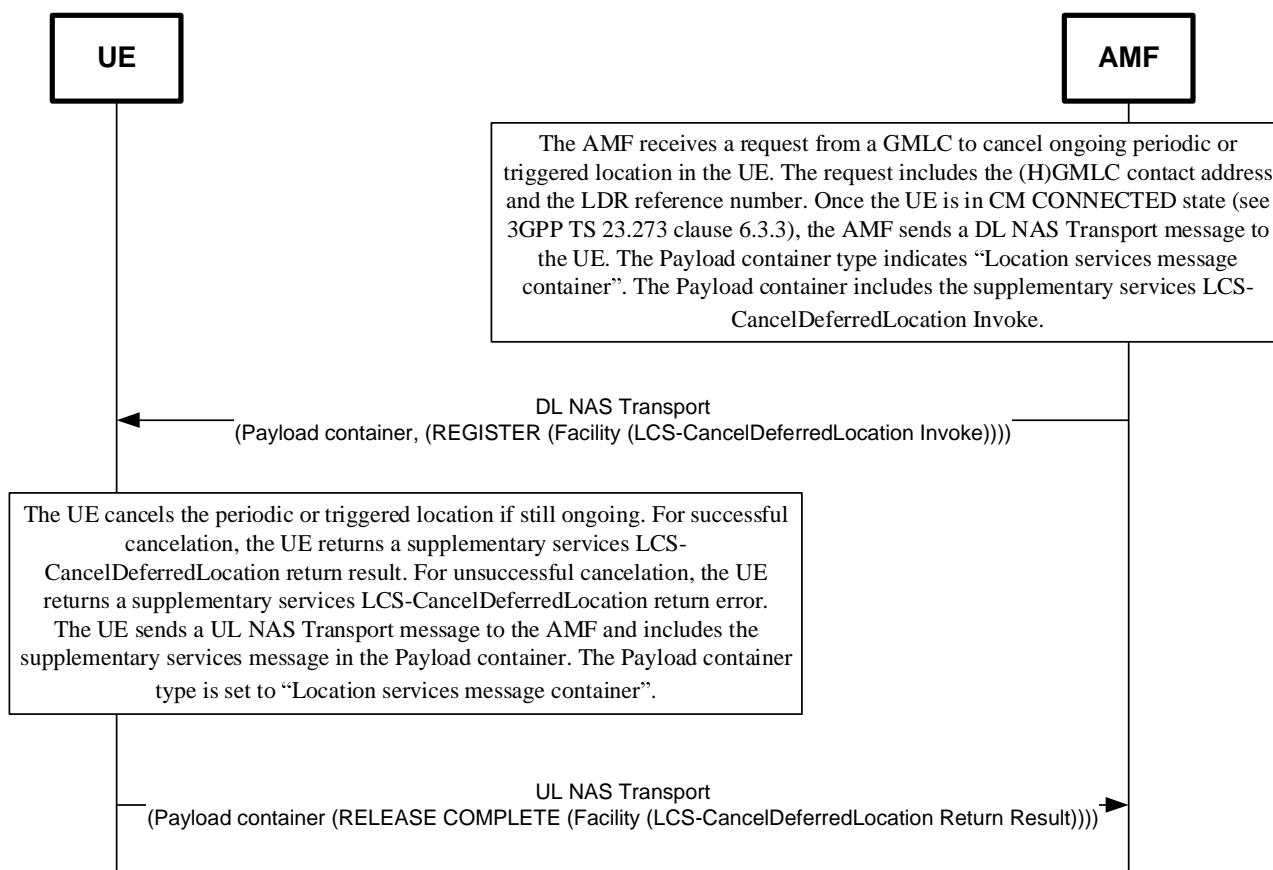


Figure 5.2.1.4.1.1: NAS signalling transport for Cancel Deferred Location

NOTE: The optional Additional Information IE of the DL/UL NAS Transport message is not used when the LCS CancelDeferredLocation signalling is transported in the Payload container.

5.2.1.4.2 Normal operation

The AMF invokes a cancel deferred location procedure by sending a REGISTER message containing an LCS-CancelDeferredLocation invoke component to the UE as defined in 3GPP TS 24.080 [5].

The UE shall terminate the ongoing periodic or triggered location if this can be identified from the information in the LCS-CancelDeferredLocation invoke component.

The UE shall then return a RELEASE COMPLETE message containing an LCS-CancelDeferredLocation return result component (see figure 5.2.1.4.2.1).

If the UE is unable to process the request received from the network or cannot identify the ongoing periodic or triggered location to be terminated, it shall return an error indication by sending a RELEASE COMPLETE message containing a return error component. Error values are specified in 3GPP TS 24.080 [5].

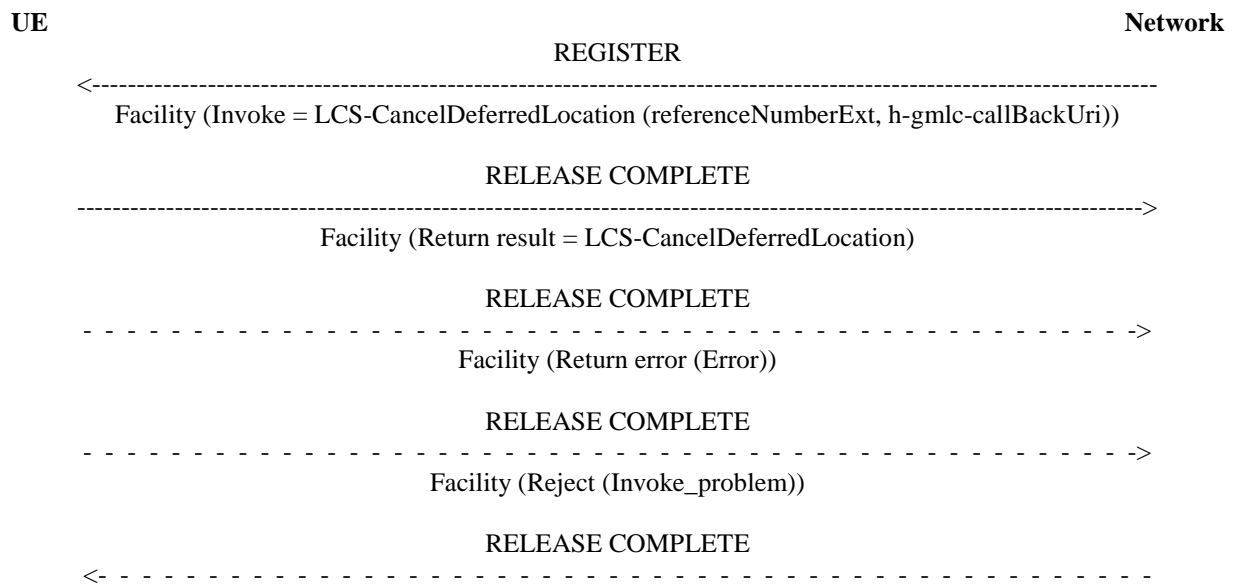


Figure 5.2.1.4.2.1: Cancel Deferred Location

5.2.2 Mobile initiated location services operations

5.2.2.1 Mobile Originiated Location Request(MO-LR)

5.2.2.1.1 General

The supplementary services MO-LR operation enables the UE to launch MO positioning session using NAS signaling. The NAS signaling are transported using the DL NAS Transport message and the Uplink NAS Transport message defined in 3GPP TS 24.501 [3]. Figure 5.2.2.1.1-1 illustrates an example of the NAS signaling transport for an MO-LR session.

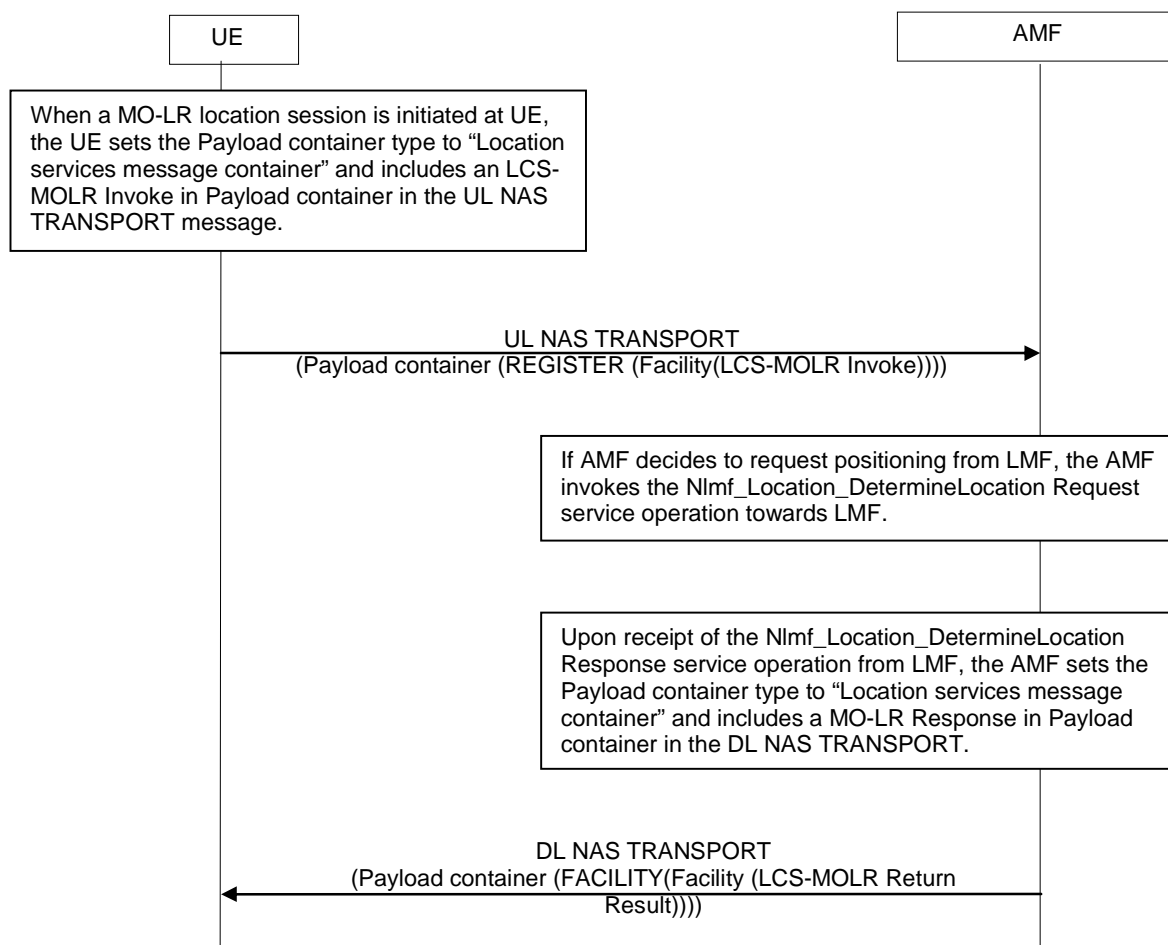


Figure 5.2.2.1.1-1: NAS signaling transport for MO-LR

NOTE: The optional Additional Information IE of the UL/DL NAS TRANSPORT message is not used when the MO-LR signaling is transported in the Payload container.

5.2.2.1.2 Normal operation

The UE invokes a MO-LR by sending a REGISTER message to the network containing a LCS-MOLR invoke component. SS Version Indicator value 1 or above shall be used.

The receiving network entity shall initiate the handling of location request in the network. The network shall pass the result of the location procedure to the UE by sending a FACILITY message to the UE containing a LCS-MOLR return result component. When location estimate is kept in the network entity and this information satisfies the requested accuracy and the requested maximum age of location, then the network may reuse this information and the positioning measurement procedure may be skipped.

The network shall pass the result of the location procedure to the UE only if the location estimate is given in a format that the UE supports, as indicated by either the presence (and content) or the absence of the parameter supportedGADShapes, which may be sent by the UE in the LCS-MOLR operation.

The UE may terminate the dialogue by sending a RELEASE COMPLETE message in the case of single location request (see figure 5.2.2.1.1-1). The UE may also initiate another location request operation by sending a FACILITY message to the network containing a LCS-MOLR invoke component (see figure 5.2.2.1.1-2). After the last location request operation the UE shall terminate the dialogue by sending a RELEASE COMPLETE message.

If the network is unable to successfully fulfil the request received from the UE (e.g. to provide a location estimate or location assistance information), it shall clear the transaction by sending a RELEASE COMPLETE message containing a return error component. Error values are specified in 3GPP TS 24.080 [5]. If the network is unable to provide a location estimate due to lack of support in the UE for the type of shape of the location estimate, then it shall use the error Facility Not Supported.

If the network has returned a result to the UE in a FACILITY message but, after some PLMN administered time period has elapsed, has not received either a new location request operation in a FACILITY message or a RELEASE COMPLETE message from the UE, the network may clear the transaction by sending a RELEASE COMPLETE message.

During the MO-LR operation the UE shall run a timer T(LCSL). This timer is started when the operation is sent, and stopped when a response is received from the network. If this timer expires the UE shall assume that the operation has failed, and may terminate the dialogue by sending a RELEASE COMPLETE message, and shall inform the user of the failure.

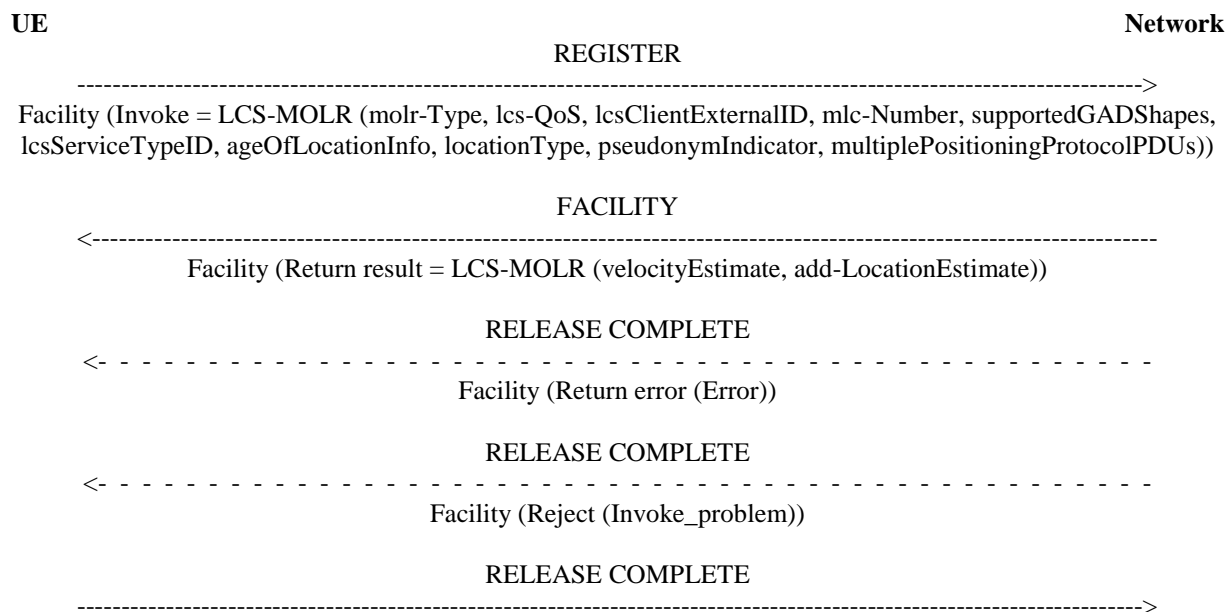


Figure 5.2.2.1.1-1: Single mobile originated location request

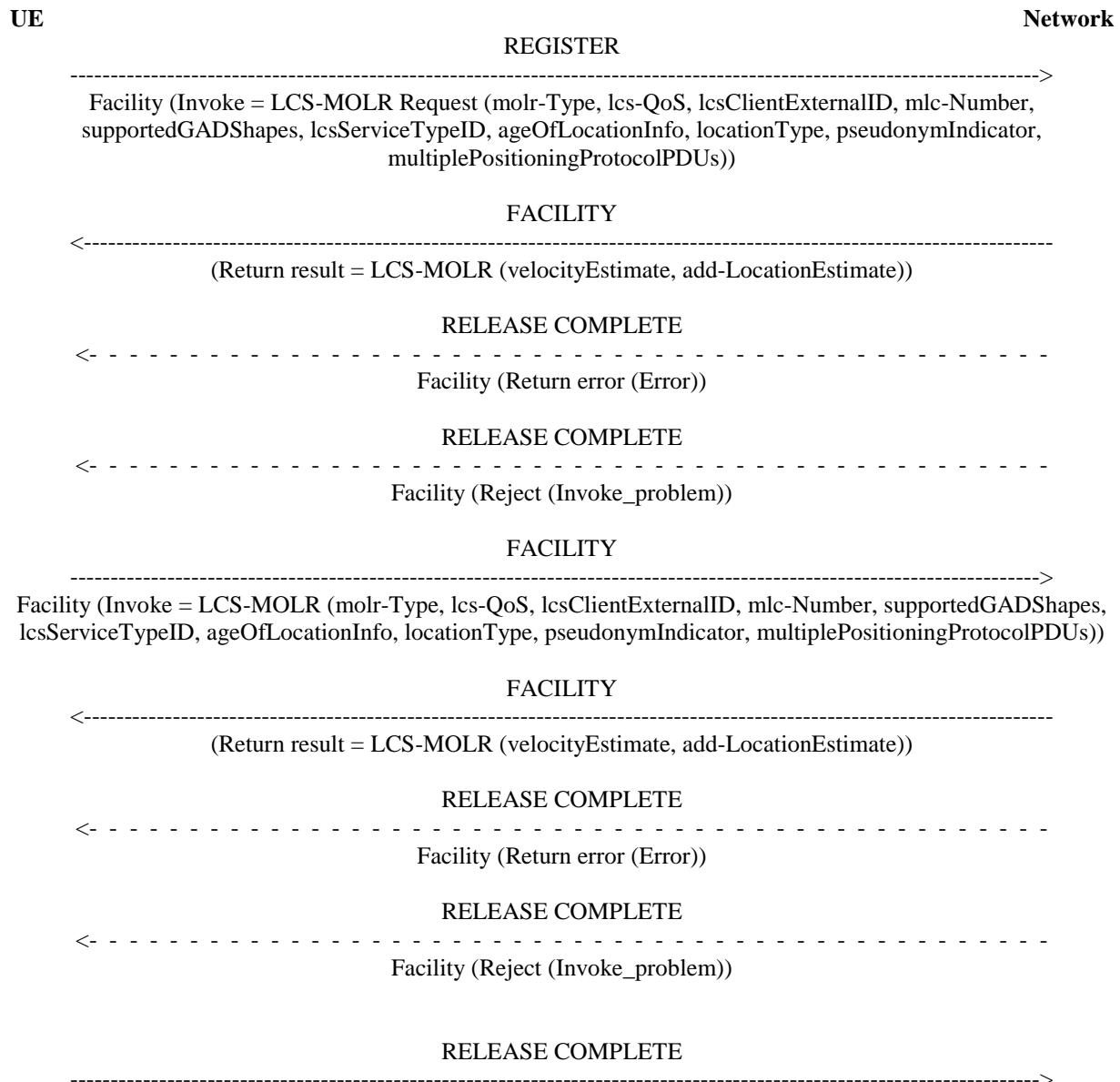


Figure 5.2.2.1.1-2: Multiple mobile originated location requests

NOTE: Only the following IEs defined in MO-LR operations in 3GPP TS 24.080 [5] are used for NG-RAN LCS:

- molr-Type
- lcs-QoS
- lcsServiceTypeID
- ageOfLocationInformation
- locationType
- mlc-Number
- lcsClientExternalID
- pseudonymIndicator
- supportedGADShapes
- multiplePositioningProtocolPDUs

NOTE: multiplePositioningProtocolPDUs IE is added to the MO-LR Request to allow for passing multiple UE positioning information LPP messages (e.g. UE location measurements or UE capabilities) to the LMF for NG-RAN LCS. Its ASN.1 description is given in 3GPP TS 24.080 [5].

5.2.2.2 UE initiated Cancel Deferred Location

5.2.2.2.1 General

The supplementary services MSCancelDeferredLocation operation enables the UE to cancel ongoing periodic or triggered location in a target LMF using NAS signalling as described in 3GPP TS 23.273 subclause 6.3.3 [2]. The supplementary services MCancelDeferredLocation messages are transported using the UL NAS TRANSPORT message and the DL NAS TRANSPORT message defined in 3GPP TS 24.501 [3]. Figure 5.2.2.2.1-1 illustrates an example of the NAS signalling transport.

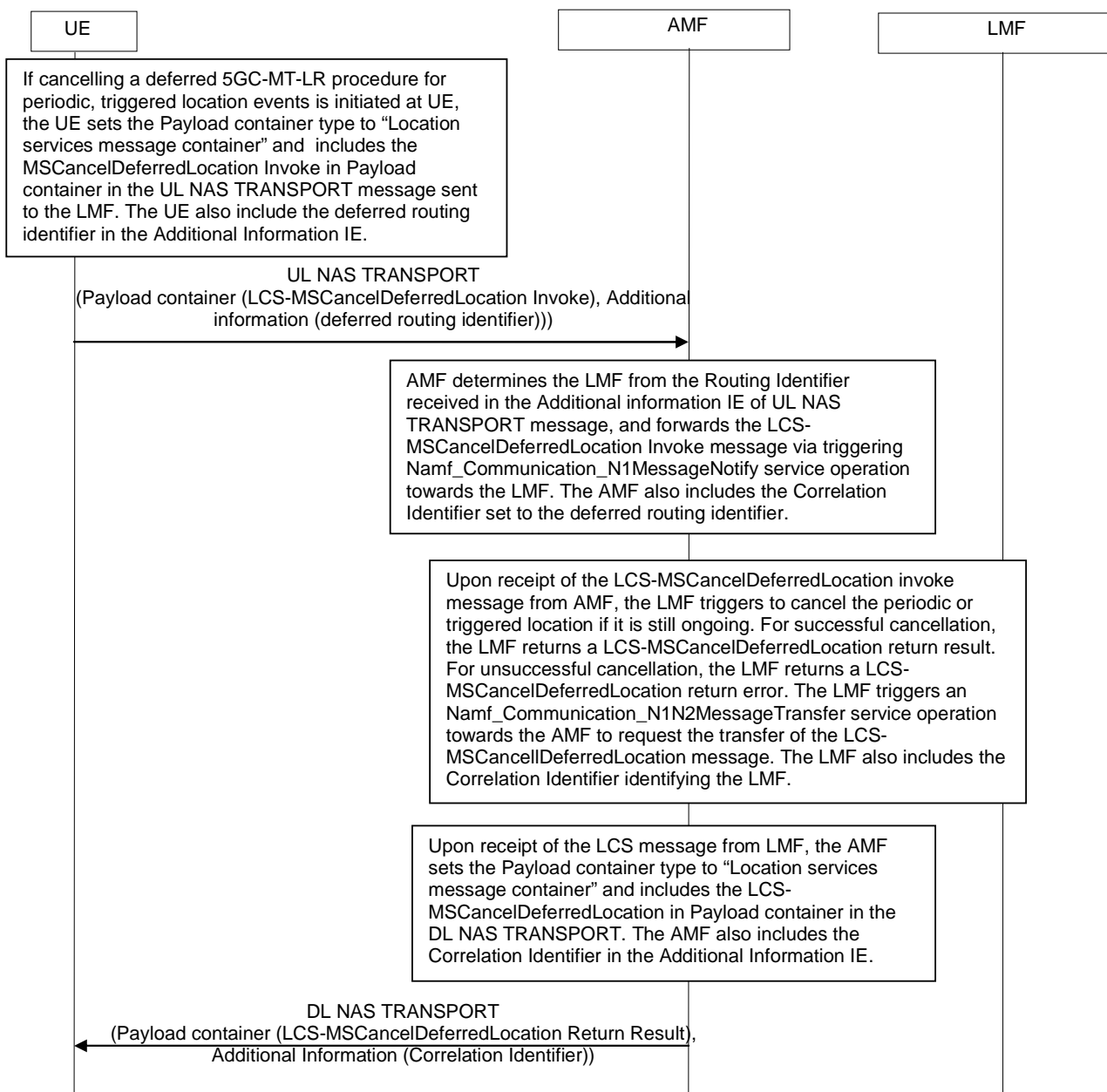


Figure 5.2.2.2.1-1: NAS signaling transport for UE initiated Cancel Deferred Location

5.2.2.2.2 Normal operation

The UE invokes a cancel deferred location procedure by sending a REGISTER message containing a LCS-MSCancelDeferredLocation invoke component to the LMF as defined in 3GPP TS 24.080 [5].

The LMF shall terminate the ongoing periodic or triggered location if this can be identified from the information in the LCS-MSCancelDeferredLocation invoke component.

The LMF shall then return a RELEASE COMPLETE message containing an LCS-MSCancelDeferredLocation return result component (see Figure 5.2.2.2.2-1).

If the LMF is unable to process the request received from the UE or can not identify the ongoing periodic or triggered location to be terminated, it shall return an error indication by sending a RELEASE COMPLETE message containing a return error component. Error values are specified in 3GPP TS 24.080 [5].

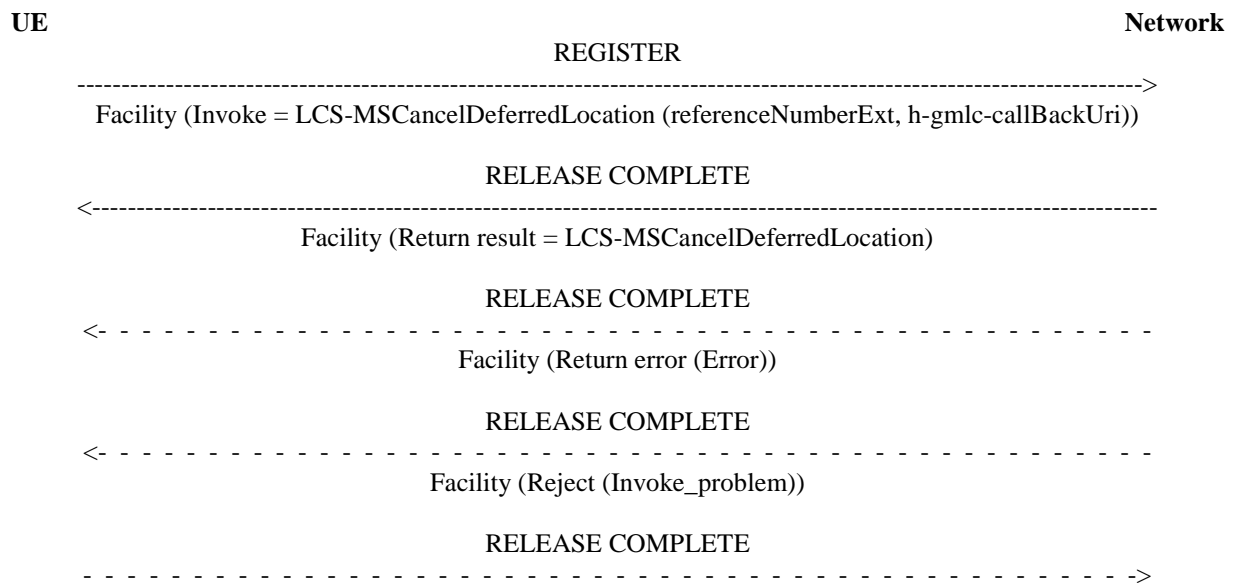


Figure 5.2.2.2-1: Cancel Deferred Location

NOTE: Only the following IEs defined in MSCancelDeferredLocation operations in 3GPP TS 24.080 [5] are used for NG-RAN LCS:

- referenceNumberExt
- h-gmlc-callBackUri

5.2.2.3 UE initiated Positioning Information Transport

The UE sends LPP message and the associated Routing Identifier in the UL NAS Transport message (refer to 3GPP TS 24.501 [3] and 3GPP TS 23.273 [2] clause 6.11.1). Figure 5.2.2.3-1 illustrates an example of the NAS signalling transport for uplink LPP messages.

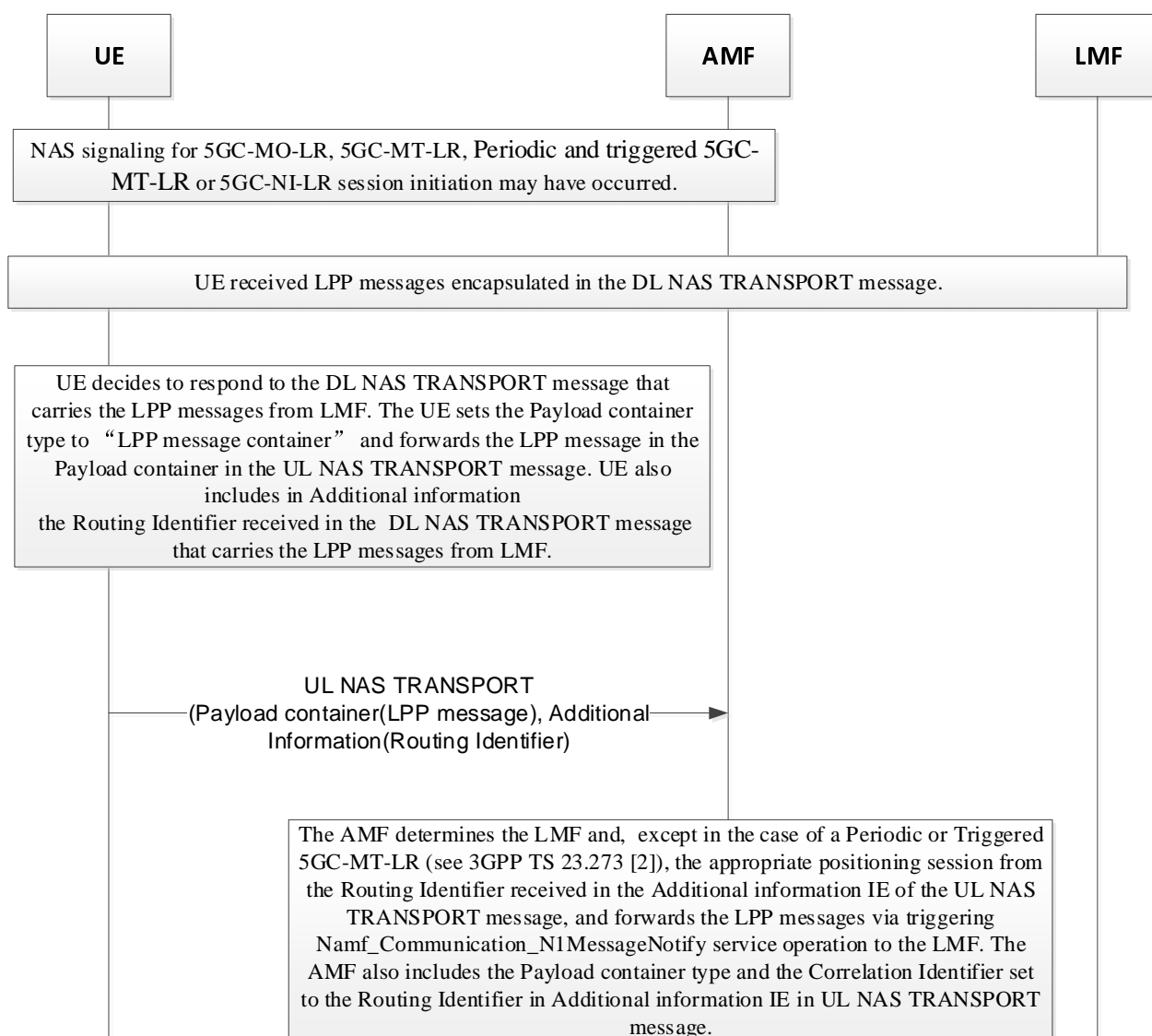


Figure 5.2.2.3-1: NAS signalling transport for uplink LPP messages

5.2.2.4 UE initiated Event Reporting Procedure

5.2.2.4.1 General

The supplementary services EventReport operation enables the UE to report the periodic or triggered location event invoked by the LMF via LCS PeriodicTriggered Invoke operation as described in clause 6.3.1 of 3GPP TS 23.273 [2] when some certain events are detected in the UE. The supplementary services EventReport message is transferred to the LMF via the serving AMF in a UL NAS TRANSPORT message defined in 3GPP TS 24.501 [3]. A response from the LMF may be returned to the UE via the serving AMF and be transferred to the UE in a DL NAS TRANSPORT message.

Figure 5.2.2.4.1-1 illustrates an example of the NAS signalling transport for EventReport messages,

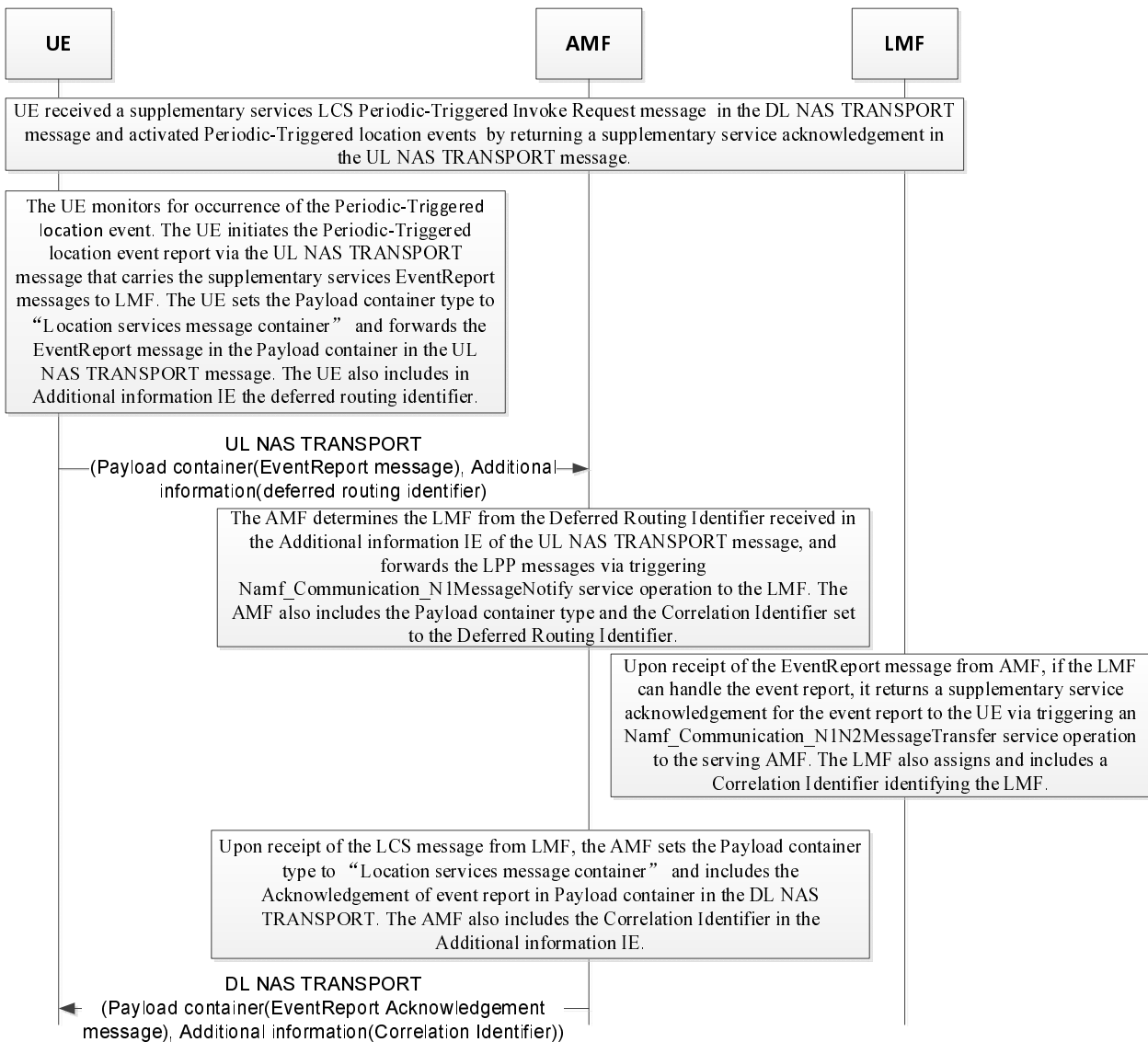


Figure 5.2.2.4.1-1: NAS signalling transport for EventReport messages

5.2.2.4.2 Normal operation

The UE invokes an EventReport procedure by sending a REGISTER message containing an EventReport component to the LMF as defined in 3GPP TS 24.080 [5].

The LMF shall return a supplementary services acknowledgement of event report if it can handle this event report.

The LMF shall then return a RELEASE COMPLETE message containing an EventReport Acknowledge component (see Figure 5.2.2.4.2-1).

If the LMF is unable to process the request received from the UE or can not identify the ongoing periodic or triggered location to be terminated, it shall return an error indication by sending a RELEASE COMPLETE message containing a return error component. Error values are specified in 3GPP TS 24.080 [5].

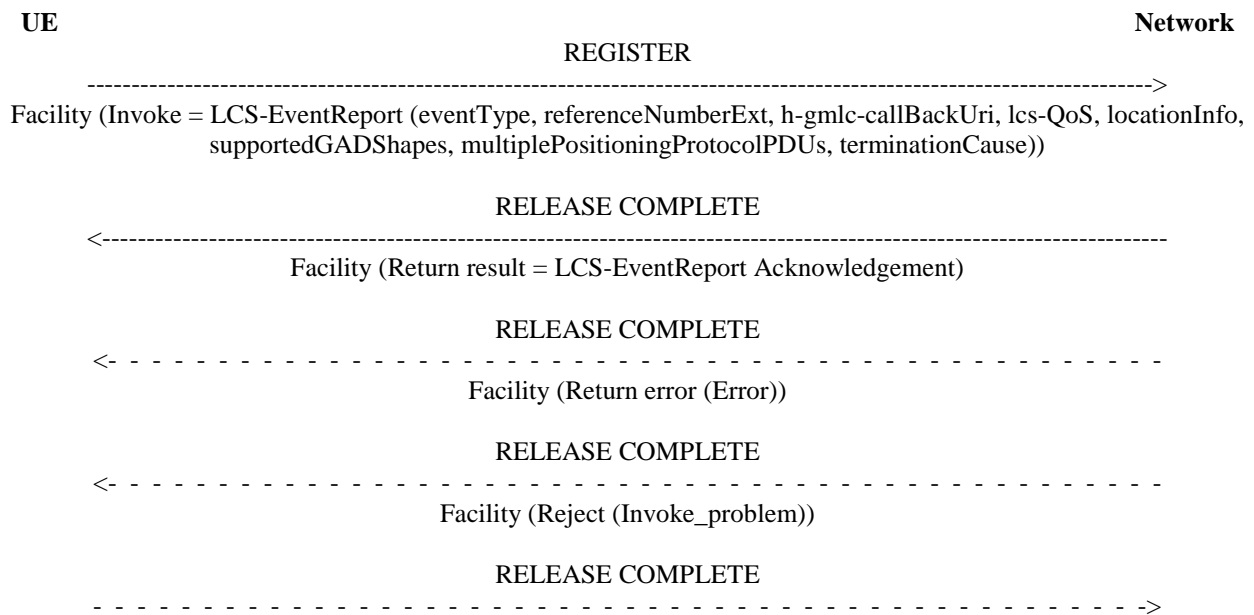


Figure 5.2.2.4.2-1: EventReport

NOTE: Only the following IEs defined in EventReport operations in 3GPP TS 24.080 [5] are used for NG-RAN LCS:

- eventType
- referenceNumberExt
- h-gmlc-callBackUri
- lcs-QoS
- locationInfo
- supportedGADShapes
- multiplePositioningProtocolPDUs
- terminationCause

5.2.2.5 UE Location Privacy Setting Procedure

5.2.2.5.1 General

The supplementary services LocationPrivacySetting operation enables the UE to update the UE Location Privacy Indication information via UE Location Privacy Setting procedure as described in clause 6.12.1 of 3GPP TS 23.273 [2] when the UE has generated or updated the UE Location Privacy Indication. The supplementary services LocationPrivacySetting message is transferred to the serving AMF in a UL NAS TRANSPORT message and an acknowledgement from the serving AMF may be returned to the UE in DL NAS TRANSPORT message defined in 3GPP TS 24.501 [3].

Figure 5.2.2.5.1-1 illustrates an example of the NAS signalling transport for UE Location Privacy Setting procedure,

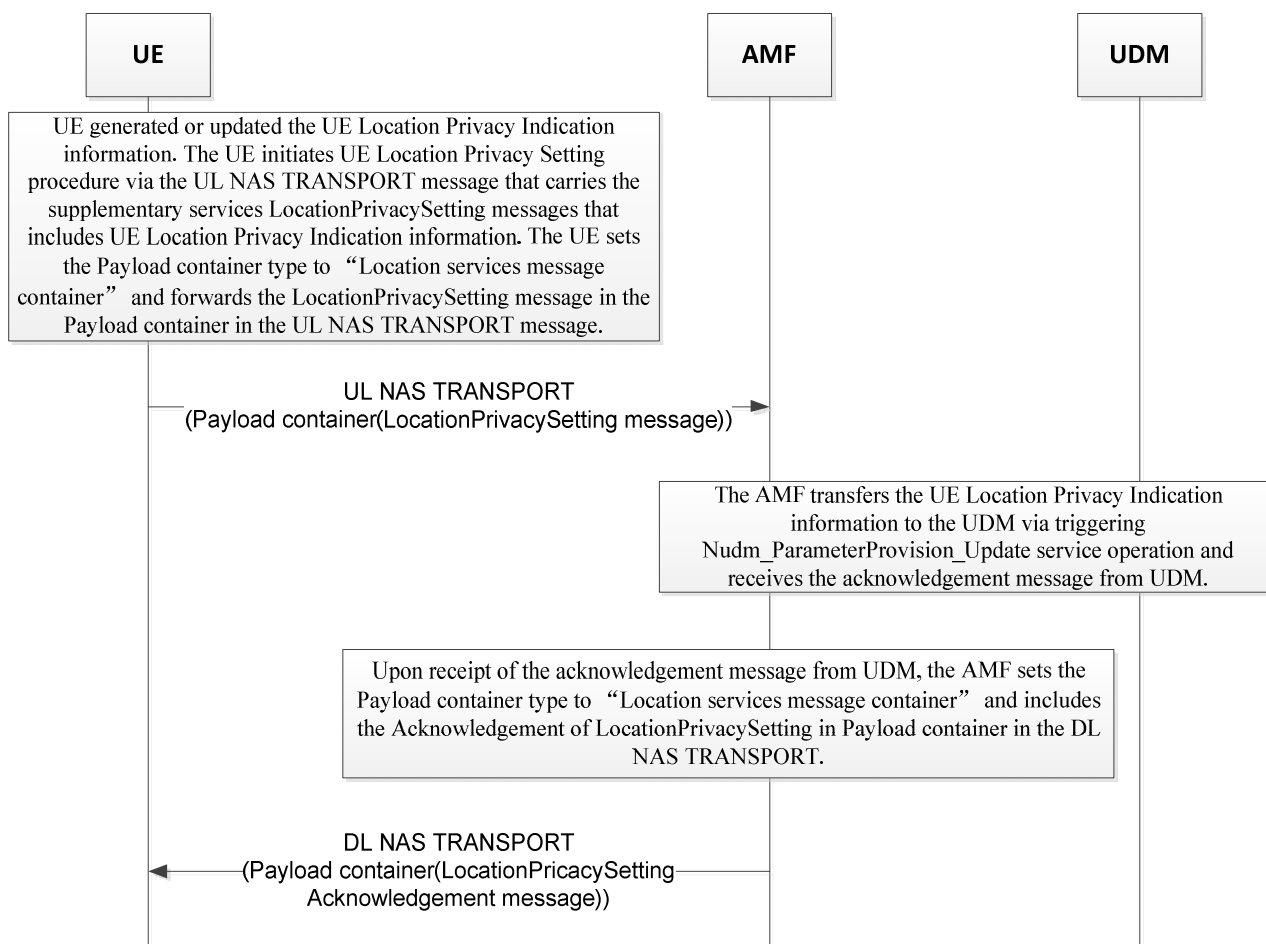


Figure 5.2.2.5.1-1: NAS signalling transport for LocationPrivacySetting messages

5.2.2.5.2 Normal operation

The UE invokes a Location Privacy Setting procedure by sending a REGISTER message containing an LocationPrivacySetting message as defined in 3GPP TS 24.080 [5]. UE's Location Privacy Indication information is included in LocationPrivacySetting message.

The AMF shall transfers the UE Location Privacy Indication information in LocationPrivacySetting message to UDM and response a supplementary services acknowledgement of LocationPrivacyIndication message

The AMF shall then return a RELEASE COMPLETE message containing a LocationPrivacySetting Acknowledgement component (see figure 5.2.2.5.2-1) if it can handle this LocationPrivacySetting message correctly.

If the AMF is unable to process the request received from the UE or can not identify that provisioning the parameters of UE Location Privacy Setting information to UDM is executed successfully, it shall return an error indication by sending a RELEASE COMPLETE message containing a return error component. Error values are specified in 3GPP TS 24.080 [5].

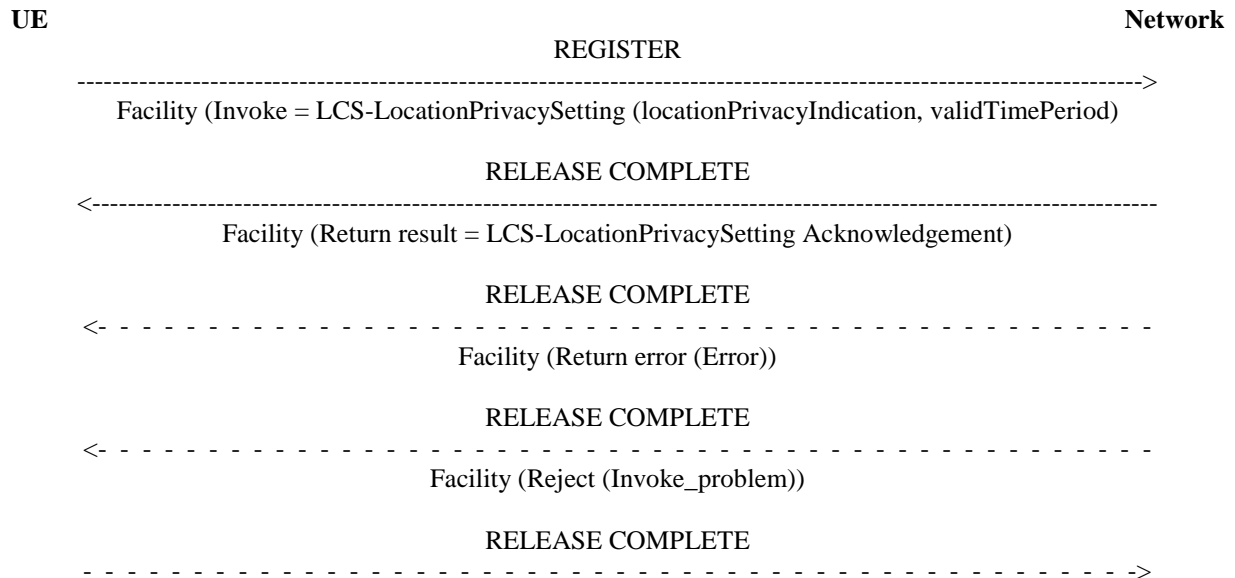


Figure 5.2.2.5.2-1: LocationPrivacySetting

NOTE: Only the following IEs defined in LocationPrivacySetting operations in 3GPP TS 24.080 [5] are used for NG-RAN LCS:

- locationPrivacyIndication
- validTimePeriod

5.3 LCS message and coding

5.3.1 Messages for Location services operations

The LCS message format and information elements coding for the MO-LR, LocationNotification, EventReport, PeriodicTriggeredInvoke, CancelDeferredLocation and LocationPrivacySetting operations (subclause 5.2) are defined in 3GPP TS 24.080 [5] for the following messages:

- Register message
- Facility message
- Release Complete message

5.3.2 Messages for LTE Positioning Protocol (LPP)

5.3.2.1 Downlink Positioning Information Transport using LPP messages

The AMF shall set the Payload container type to "LPP message container" in the DL NAS TRANSPORT message.

The AMF includes a Routing Identifier in the Additional information IE of the DL NAS TRANSPORT message which identifies the LMF and the positioning session between the AMF and LMF when a positioning session is being used.

The Routing identifier is the Correlation ID, which is defined in 3GPP TS 29.572 [6], so that the AMF can map the Routing identifier to the LMF and the Correlation identifier when the AMF receives a UL NAS TRANSPORT message including the responding LPP message.

5.3.2.2 Uplink Positioning Information Transport using LPP messages

The UE shall set the Payload container type to "LPP message container" in the UL NAS TRANSPORT message.

The UE includes a Routing Identifier received in the Additional Information IE of the DL NAS TRANSPORT message in the Additional Information IE of the UL NAS TRANSPORT message. This association of the Routing Identifier is provided at the LPP level: the UL NAS TRANSPORT message carries an LPP message that is a response to or instigated by the LPP message in the DL NAS TRANSPORT message. The Routing identifier is the Correlation ID, which is defined in 3GPP TS 29.572 [6], so that the AMF can map the Routing identifier to the Correlation identifier when the AMF receives the UL NAS TRANSPORT message.

Annex A (informative): Change history

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2019-08	CT1#119					Draft skeleton provided by the rapporteur	0.0.0
2019-10	CT1#120					Includes the following contribution agreed by CT1 at CT1#120:C1-196563	0.1.0
2019-11	CT1#121					Includes the following contributions agreed by CT1 at CT1#121:C1-198290, C1-198720	0.2.0
2019-12	CT#86	CP-193155				Presentation for information to TSG CT	1.0.0
2020-03	CT#87e	CP-200287				Implementation of pCRs CP-200102 and 103 approved by TSG CT. Presentation for approval to TSG CT.	2.0.0
2020-03	CT#87e					Version 16.0.0 created after approval	16.0.0
2020-03	CT#87e					Editorial corrections	16.0.1
2020-06	CT#88e	CP-201098	0001		B	Adding Location Privacy Setting operation	16.1.0

History

Document history		
V16.1.0	August 2020	Publication