3GPP TSG_CN#6 **NP-99446**

ETSI SMG3 Plenary Meeting #6,

Nice, France

13th – 15th December 1999

Agenda item: **5.1.3**

Source: **TSG_N WG1**

Title: **CRs on Work Item LCS**

Introduction:

This document contains **"7"** CRs agreed by **TSG_N WG1** and forwarded to **TSG_N Plenary** meeting **#6** for approval.

Tdoc	Spec	CR	Rev	CAT	Rel.	Old Ver	New Ver	Subject
N1-99D67	04.07	A676		C	R98	7.2.0	7.3.0	Modifications for LCS enhancements
N1-99C14	04.71	A001		C	R98	7.0.0	7.1.0	LCS CR for GSM 04.71
N1-99F16	09.08	A137		C	R98	7.0.0	7.1.0	Changes due to LCS enhancements
N1-99C15	09.08	A139		C	R98	7.0.0	7.1.0	LCS CR for GSM 09.08
N1-99F18	09.31	A001	2	C	R98	3.0.0	3.1.0	Addition of further LCS functionality in GSM Release 98
N1-99D71	23.108	002		A	R99	3.0.0	3.1.0	mirror R99 LCS
N1-99D72	24.007	005		A	R99	3.1.0	3.2.0	LCS Release 99 to 24.007

3GPP/SMG Meeting #9
Bad Aibling, Germany, 30 Oct- 3-Dec. 1999

Document N1-99D67
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

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04.07	CR	A035	Current Version:	7.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: CN1				
list expected approval meeting # here ↑	for approval	X	strategic	
	for information		non-strategic	X

(for SMG use only)

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: *(at least one should be marked with an X)* (U)SIM [ ] ME [ ] UTRAN / Radio [ ] Core Network [X]

Source: T1P1.5 **Date:** 5 Nov. 1999

Subject: Modifications for LCS enhancements

Work item: Location Services (LCS)

Category: *(only one category shall be marked with an X)*

F	Correction	
A	Corresponds to a correction in an earlier release	
B	Addition of feature	
C	Functional modification of feature	X
D	Editorial modification	

Release:

Phase 2	
Release 96	
Release 97	
Release 98	X
Release 99	
Release 00	

Reason for change: Introduction of additional type of LMU

Clauses affected:

Other specs affected:

Other 3G core specifications		→ List of CRs:
Other GSM core specifications	X	→ List of CRs:
MS test specifications		→ List of CRs:
BSS test specifications		→ List of CRs:
O&M specifications		→ List of CRs:

Other comments:


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<--------- double-click here for help and instructions on how to create a CR.

3 Abbreviations

Abbreviations used in this TS, are listed in GSM 01.04.

For the purposes of this TS, the following abbreviations applies:

GMM	GPRS Mobility Management
MNS	Mobile Network Signalling
N-PDU	Network Protocol Data Unit
SM	Session Management
UDT	User Data Transfer
CTS	Cordless Telephony System
LCS	Location Services

4 Introduction

4.1 General

Three models are defined for Layer 3, one model for non-GPRS services, one for GPRS services supporting Class C MSs only and one model for GPRS-services supporting Class A and Class B MSs. (The third model is a combination of the first two models listed).

The layer 3 for non-GPRS services provides the functions necessary

- for Radio Resource (RR) management;
- for Mobility Management (MM); and
- for the Connection Management (CM) functions, i.e. functions for the control, provision, and support of services offered by the network; among which there are, e.g.:
  - the functions to establish, maintain and terminate circuit-switched connections across a GSM PLMN and other networks to which the GSM PLMN is connected;
  - supporting functions for supplementary services control;
  - supporting functions for short messages service control.
  - supporting functions for location services control.

The layer 3 for non-GPRS services is composed of three sublayers comprising:

- the Radio Resource Management (RR) functions;
- the Mobility Management (MM) functions; and
- the Connection Management (CM) functions.

When CTS services are added to non-GPRS services, the following functions are added:

- CTS Radio Resource Management (CTS-RR) functions to RR; and
- CTS Mobility Management (CTS-MM) functions to MM.

The layer 3 for GPRS services is composed of four sublayers comprising :

- the Radio Resource Management (RR) functions;
- the Mobility Management (GMM and GMM-AA);
- for the Logical Link Control (LLC);
- the Connection Management (CM) functions.
- Session Management (SM) functions to activate, modify and delete the contexts for packet data protocols (PDP)
- supporting functions for short messages service control.

The Connection Management (CM) sublayer is composed of functional blocks for:

- Call Control (CC) for non-GPRS services;
- Short Message Service Support (SMS) for non-GPRS services;
- GPRS Short Message Service Support (GSMS) (for GPRS services supporting Class A, B and C MSs);
- Session Management (SM) (for GPRS services supporting Class A, B and C MSs);
- Supplementary Services Support (SS) for non-GPRS services;
- Group Call Control for non-GPRS services;
- Broadcast Call Control (BCC) for non-GPRS services;
- Connection Management of Packet Data on Signalling channels for non-GPRS services.
- Location Services support (LCS) for non-GPRS services;

Within the context of LCS, for GSM LCS ~~Phase 1~~, the services defined for an MS are equally applicable to ~~a~~an type A LMU, unless otherwise stated. The following is a list of services essential for a type A LMU.

The layer 3 for non-GPRS services provides the functions necessary

- for Radio Resource (RR) management;
- for Mobility Management (MM); and
- supporting functions for location service control.

The layer 3 for non-GPRS services is composed of three sublayers comprising:

- the Radio Resource Management (RR) functions;
- the Mobility Management (MM) functions; and
- the Connection Management (CM) functions.

The Connection Management (CM) sublayer is composed of functional block for:

- location services support (LCS) for non-GPRS services.

This Technical Specification does not consider the distribution of signalling functions among the different network equipments. The signalling functions are described between two systems which represent the MS side and the network side of the radio interface of layer 3. Only the functions in the network for signalling communication with one MS is considered.

For GPRS services, in addition to the signalling functions also the user data transfer is included in this Technical Specification.

4.2 Applicability of functional blocks

Not for all functional blocks listed in subclause 4.1, support in the MS or in the network is mandatory:

- Support of Group Call Control is optional in the MS and in the network.
- Support of Broadcast Call Control is optional in the MS and in the network.
- Connection Management of Packet Data on Signalling channels. is optional in the MS and in the network.
- Support of GPRS services is optional in the MS and in the network.
- Support of CTS services is optional in the MS. CTS services are not applicable to the network.
- Support of LCS services is optional in the MS and in the network, but not optional in a type A LMU.

Further conditions and constraints are defined in other Technical Specifications.

*** NEXT MODIFIED SECTION ***

9.2 Services provided by the Mobility Management entity

The Mobility Management (MM) sublayer provides services to the Call Control (CC) entity, the Supplementary Services Support (SS) entity, the Location Services (LCS) entity (only for type A LMU) and the Short Message Service Support (SMS) entity.

The Mobility Management services primitives are discriminated by the MMCC, MMSS, MMLCS and MMSMS prefix.

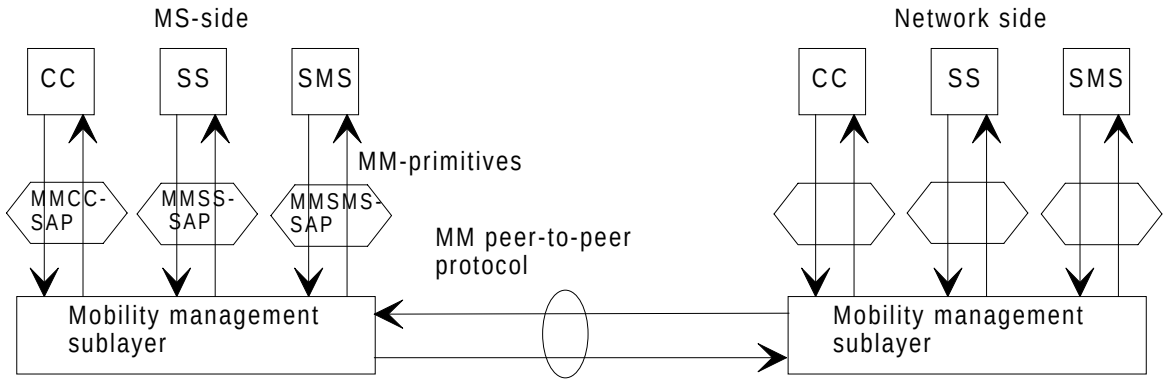
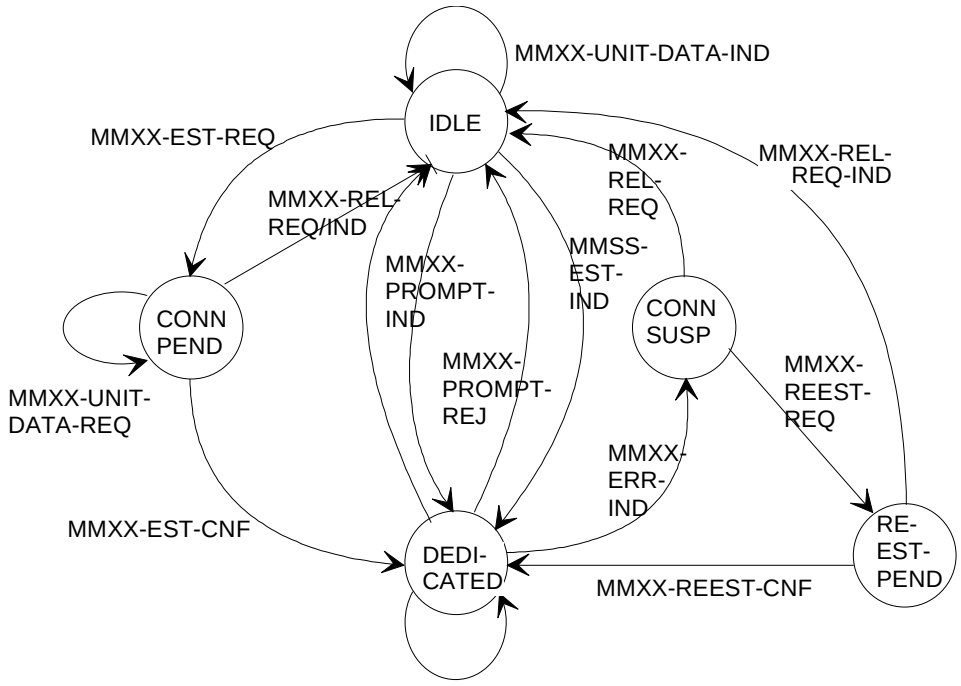


Figure 9.3: Services provided at the MMCC-SAP, MMSS-SAP, MMLCS-SAP, MMSMS-SAP - MS side

(Note: Figure 9.3 shall be updated to include the LCS PD in the same manner as the other PDs are shown)

9.2.1 Service state diagram

The primitives provided by the Mobility Management entity towards Call Control, call independent Supplementary Service Support, Location Services Support for type A LMU, and towards Short Messages Service Support and the transition between permitted states are illustrated in figure 9.4.



MMCC-SYNC-IND

(channel mode modify)

(res ass)

MMXX-DATA-REQ IND

MMXX-UNIT-DATA-REQ IND

NOTE 1: MMCC-primitives only at MMCC-SAP.
NOTE 2: The prefix MMXX is used for substitution of MMCC, MMSS, MMLCS or MMSMS.

Figure 9.4: Service graph of the Mobility Management entity - MS side

9.2.2 Service primitives

Table 9.2: Primitives and Parameters at MMCC-SAP, MMSS-SAP, MMLCS-SAP (for type A LMU) or MMSMS-SAP - MS side

PRIMITIVES	PARAMETERS	REFERENCE
MMXX_EST_REQ (see note 1)	Parameters for the appropriate CM SERVICE REQUEST (if any)	9.2.2.1
MMXX_EST_IND (see note 1)	First CM message	9.2.2.2
MMXX_EST_CNF (see note 1)	-	9.2.2.3
MMXX_REL_REQ (see note 1)	cause	9.2.2.4
MMXX_REL_IND (see note 1)	cause	9.2.2.5
MMXX_DATA_REQ (see note 1)	Layer 3 message	9.2.2.6
MMXX_DATA_IND (see note 1)	Layer 3 message	9.2.2.7
MMXX_UNIT_DATA_REQ (see note 1)	Layer 3 message	9.2.2.8
MMXX_UNIT_DATA_IND (see note 1)	Layer 3 message	9.2.2.9
MMCC_SYNC_IND (see note 2)	cause: res.ass	9.2.2.10
MMXX_REEST_REQ (see note 1)		9.2.2.11
MMXX_REEST_CNF (see note 1)		9.2.2.12
MMXX_ERR_IND (see note 1)	cause	9.2.2.13
MMXX_PROMPT_IND (see note 1)	-	9.2.2.14
MMXX_PROMPT_REJ (see note 1)	-	9.2.2.15
NOTE 1: MMXX is used as substitution for MMCC, MMSS, MMLCS or MMSMS NOTE 2: Only at MMCC-SAP		

9.2.2.1 MMXX_EST_REQ

Request used by CC, SS, LCS (for type A LMU) and SMS respectively, to request establishment of a MM connection. Several MM connections may be provided in parallel to the requesting entities. The primitive may contain parameters which are relevant for the CM SERVICE REQUEST message, e.g. to distinguish a basic call from an emergency call.

9.2.2.2 MMXX_EST_IND

Indication to CC, SS, LCS (for type A LMU) or SMS that a Mobile terminated MM connection has been established and the first message has been received from the respective peer entity. Several MM connections may be provided in parallel. If a MM connection already exists, a new MM connection using the same RR connection is indicated by this primitive if MM detects a message with a new combination of Protocol Discriminator (PD) and Transaction Identifier (TI).

9.2.2.3 MMXX_EST_CNF

Successful confirmation of the MM connection establishment by the MM sublayer to be given to the appropriate entity which has requested the service.

9.2.2.4 MMXX_REL_REQ

Used by CC, SS, LCS (for type A LMU) or SMS respectively, to request release of the MM connection. The corresponding PD/TI will be released and may be used for a new MM connection.

9.2.2.5 MMXX_REL_IND

Indication of the release of an existing MM connection or a MM connection in progress. This primitive is used in exceptional cases to indicate that the MM connection cannot be established or kept any longer and PD/TI have been released.

9.2.2.6 MMXX_DATA_REQ

Request used by the CC, SS or SMS entities for acknowledged control-data transmission.

9.2.2.7 MMXX_DATA_IND

Indication used by MM to transfer the received acknowledged control-data to the CC, SS, LCS or SMS entities.

9.2.2.8 MMXX_UNIT_DATA_REQ

Request used by the CC, SS, LCS (for type A LMU) or SMS entities for unacknowledged control-data transmission.

9.2.2.9 MMXX_UNIT_DATA_IND

Indication used by MM to transfer the received unacknowledged control-data to the CC, SS, LCS or SMS entities.

9.2.2.10 MMCC_SYNC_IND

Indication that a dedicated channel assignment has been performed and/or the channel mode has been changed (only towards the CC entity).

9.2.2.11 MMXX_REEST_REQ

Request to establish a MM connection which has been interrupted by a lower layer failure. The interruption must have been indicated by MMXX_ERR_IND.

9.2.2.12 MMXX_REEST_CNF

Confirmation of the successful re-establishment of the MM connection. The MM connection will continue with PD/TI as it had before.

9.2.2.13 MMXX_ERR_IND

Indication of a lower layer failure interrupting the MM connection. The PD/TI are still kept by MM. In case of parallel transactions this indication is passed to all CM entities for which a MM connection has been established. It is left to the decision of the appropriate CM entity to either request the re-establishment of the MM connection by MMXX_REEST_REQ or to release it by MMXX_REL_REQ.

9.2.2.14 MMXX_PROMPT_IND

Indication given by MM to inform of the completion of the MM connection to the CC, SS, LCS (for type A LMU) or SMS entities for a mobile station which supports “Network Initiated MO CM Connection Request”.

9.2.2.15 MMXX_PROMPT_REJ

Response to the MMXX_PROMPT_IND indication to the MM entity in a mobile station which supports “Network Initiated MO CM Connection Request” in case when it is impossible to establish the prompted CM connection e.g. due to lack of free transaction identifiers.

*** NEXT MODIFIED SECTION ***

10.2 Services provided by the Mobility Management entity

The Mobility Management (MM) sublayer provides services to the Call Control (CC) entity, the Supplementary Service Support (SS) entity, the Location Services (LCS) (for type A LMU) and the Short Message Service Support (SMS) entity.

The Mobility Management services primitives are recognized by the MMCC, MMSS, MMLCS and MMSMS prefix.

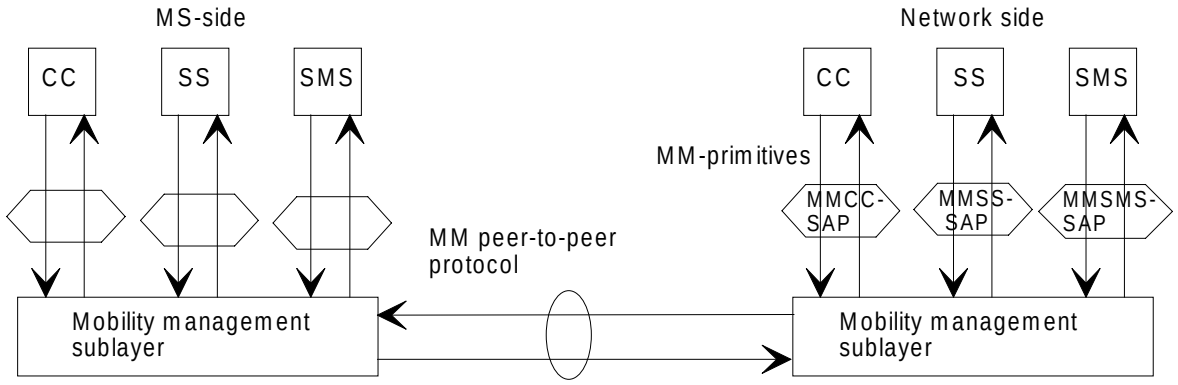
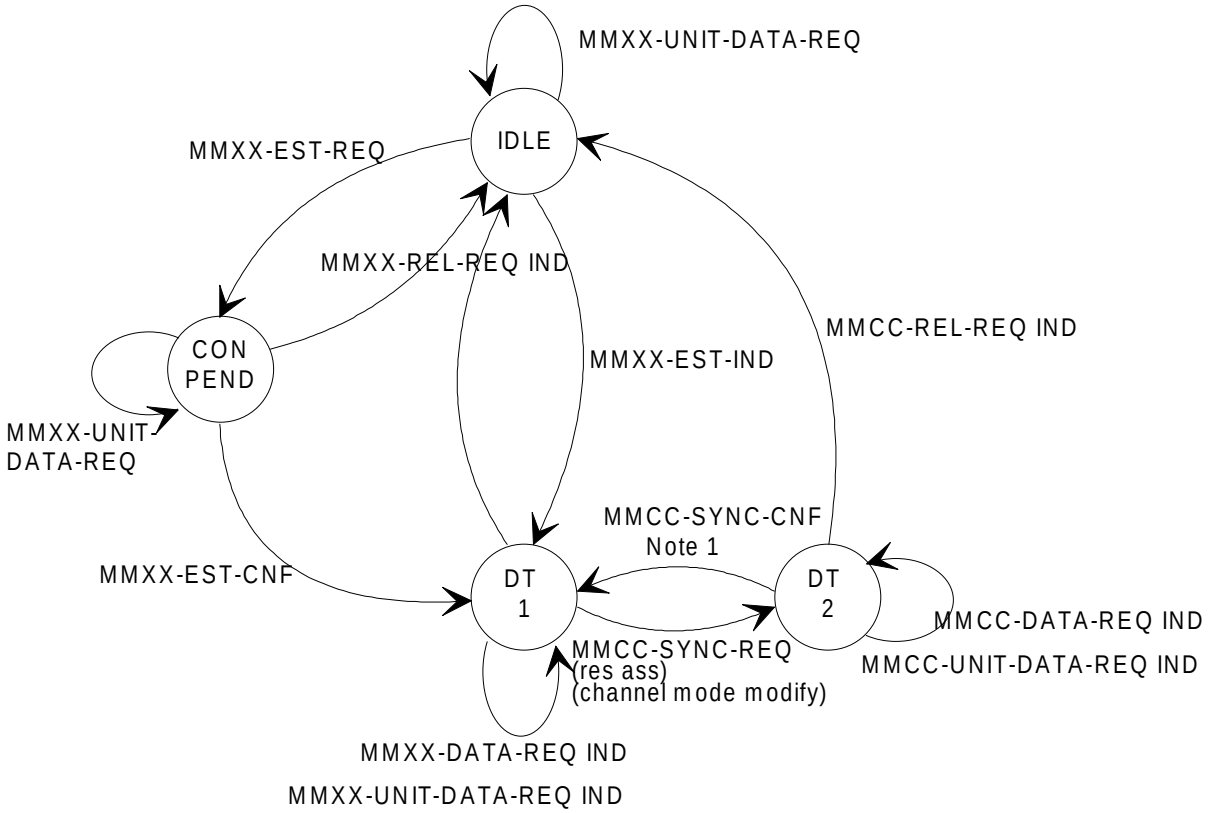


Figure 10.3: Services provided at MMCC-SAP, MMSS-SAP, MMLCS-SAP, MMSMS-SAP - Network side

(Note: Figure 10.3 shall be updated to include the new LCS PD in the same manner as for the other PDs)

10.2.1 Service state diagram

The primitives provided by the Mobility Management entity towards Call Control, Short Messages Service Support Location Services(for type A LMU) and call independent Supplementary Services Support as well as the transition between permitted states are illustrated in figure 10.4.



NOTE 1: the parameters in RR_SYNC_CNF must correspond to the parameter in RR_SYNC_REQ.
NOTE 2: MMCC-primitives only at MMCC-SAP.
NOTE 3: The prefix MMXX is used for substitution of MMCC, MMSS, MMLCS (for type A LMU) or MMSMS.

Figure 10.4: Service graph of the Mobility Management entity, towards Call Control - Network side

10.2.2 Service primitives

Table 10.2: Primitives and Parameters at MMCC-SAP, MMSS-SAP, MMSMS-SAP - Network side

PRIMITIVES	PARAMETERS	REFERENCE
MMXX_EST_REQ (see note 1)	Mobile ID	10.2.2.1
MMXX_EST_IND (see note 1)	First CM message	10.2.2.2
MMXX_EST_CNF (see note 1)	-	10.2.2.3
MMXX_REL_REQ (see note 1)	cause	10.2.2.4
MMXX_REL_IND (see note 1)	cause	10.2.2.5
MMXX_DATA_REQ (see note 1)	Layer 3 message	10.2.2.6
MMXX_DATA_IND (see note 1)	Layer 3 message	10.2.2.7
MMXX_UNIT_DATA_REQ (see note 1)	Layer 3 message	10.2.2.8
MMXX_UNIT_DATA_IND (see note 1)	Layer 3 message	10.2.2.9
MMCC_SYNC_REQ (see note 2)	cause (resource assign)	10.2.2.10
MMCC_SYNC_CNF (see note 2)	cause (resource assign)	10.2.2.11
NOTE 1: MMXX is used as substitution for MMCC, MMSS, MMLCS(for type A LMU) or MMSMS. NOTE 2: Only at MMCC-SAP.		

10.2.2.1 MMXX_EST_REQ

Request by CC, SS, LCS(for type A LMU) and SMS respectively, for the establishment of a MM connection.

10.2.2.2 MMXX_EST_IND

Indication by the MM sublayer that a MM connection is established.

10.2.2.3 MMXX_EST_CNF

Confirmation of the MM connection establishment by the MM sublayer.

10.2.2.4 MMXX_REL_REQ

Request by CC, SS, LCS(for type A LMU) or SMS respectively, for the release of the MM connection.

10.2.2.5 MMXX_REL_IND

Indication by the MM sublayer that a MM connection has been released.

10.2.2.6 MMXX_DATA_REQ

Request by the CC, SS, LCS(for type A LMU) or SMS entities for acknowledged control-data transmission.

10.2.2.7 MMXX_DATA_IND

Indication used by MM to transfer the received acknowledged control-data to the CC, SS, LCS(for type A LMU) or SMS entities.

10.2.2.8 MMXX_UNIT_DATA_REQ

Request used by the CC, SS, LCS(for type A LMU) or SMS entities for unacknowledged control-data transmission.

10.2.2.9 MMXX_UNIT_DATA_IND

Indication used by MM to transfer the received unacknowledged control-data to the CC, SS, LCS(for type A LMU) or SMS entities.

10.2.2.10 MMCC_SYNC_REQ

Request used by the CC entity to synchronize with the MM entity (resource assign).

10.2.2.11 MMCC_SYNC_CNF

Confirmation used by the MM to inform the CC entity that synchronization is completed (resource assign).

3GPP TSG-CN-WG1, Meeting #8
25-29 October 1999
Kobe, Japan

Tdoc N1-99C14

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04.71	CR	A001	Current Version:	7.0.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSGN1 *list expected approval meeting # here ↑*	for approval	X	strategic		*(for SMG use only)*
	for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: *(at least one should be marked with an X)* (U)SIM [ ] ME [ ] UTRAN / Radio [ ] Core Network [X]

Source: T1P1.5 **Date:** 25.10.99

Subject: Addition of further LCS functionality in GSM Release 98

Work item: Location Services (LCS)

Category: *(only one category Shall be marked With an X)*

F	Correction		**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature	X		Release 98	X
D	Editorial modification			Release 99	
				Release 00	

Reason for change: Replace Location Service protocol with LLP. Add Status Query and Status Update message.

Clauses affected:

Other specs affected:

Other releases of same spec		→ List of CRs:	
Other core specifications	X	→ List of CRs:	
MS test specifications / TBRs		→ List of CRs:	
BSS test specifications		→ List of CRs:	
O&M specifications		→ List of CRs:	

Other comments:

TS 04.71 V7.0.0 (1999-08)

Technical Specification

Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 Location Services (LCS) specification;

(GSM 04.71 version 7.0.0 Release 1998)

GLOBAL SYSTEM FOR
MOBILE COMMUNICATIONS

Reference
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Keywords
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Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This Technical Specification (TS) has been produced by the Special Mobile Group (SMG).

The present document defines the coding of information necessary for support of location service operation on the mobile radio interface layer 3 within the digital cellular telecommunications system.

The contents of this specification are subject to continuing work within SMG and T1P1 and may change following formal SMG and T1P1 approval. Should SMG or T1P1 modify the contents of this specification it will then be re-issued with an identifying change of release date and an increase in version number as follows:

Version 7.x.y

where:

7 GSM Phase 2+ Release 1998;

x the second digit is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.;

y the third digit is incremented when editorial only changes have been incorporated in the specification.

1 Scope

The present document contains the coding of information necessary for support of location service operation on the mobile radio interface layer 3.

Clause 4 defines generic procedures for the control of location services. In clause 5 location service support procedures are defined. Clause 6 gives the functional definitions and contents of messages for location service operations. Clause 7 gives the general format and coding for messages used for location service and the format and coding of information elements used for location service operations between the LMU and MSC. Clause 6 gives the general message format and information elements coding between the LMU and SMLC.

Clause 8 gives the specification of the LMU LCS Protocol (LLP) ~~location service~~ operations. In clause 9 LMU – SMLC messages, data types and identifiers are given.

This version does not support segmentation of messages.

2 Normative 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.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.
- For this Release 1998 document, references to GSM documents are for Release 1998 versions (version 7.x.y).

[1] GSM 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[2] GSM 04.06: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface Data Link (DL) layer specification".

[3] GSM 04.07: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface signalling layer 3; General aspects".

[4] GSM 04.08: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification".

[5] GSM 03.71: ” Digital cellular telecommunications system (Phase 2+); Location Services (LCS); (Functional description) - Stage 2”

[6] GSM 09.02: "Digital cellular telecommunications system (Phase 2+); Mobile Application Part (MAP) specification".

[7] ITU-T Recommendation X.691: "Specification of packet encoding rules for Abstract Syntax Notation One (ASN.1)".

[8] ITU-T Recommendation X.690: "Specification of basic encoding rules for Abstract Syntax Notation One (ASN.1)".

[9] ITU-T Recommendation X.680: "Specification of Abstract Syntax Notation One (ASN.1)" 1994.

[10] ITU-T Recommendation Q.773: "Transaction capabilities formats and encoding".

[11] CCITT Recommendation X.208: ""Specification of Abstract Syntax Notation One (ASN.1) 1988".

3 Abbreviations

Abbreviations used in this specification are listed in GSM 01.04 and GSM 03.71.

4 Generic procedures for the control of location services

4.1 Overview of the generic protocol and its scope

One generic protocol is defined for the control of location services at the radio interface. This protocol operates at layer 3 of the radio interface and assumes the use of layers 1 and 2 conform to GSM 05-series and GSM 04.04, GSM 04.05 and GSM 04.06. The generic protocol uses the acknowledged information transfer service available at the layer 2 - layer 3 interface.

The Functional protocol is based on the use of the Facility information element and the FACILITY message as well as other specific functional messages specified in this specification.

4.2 Functional procedures for the control of location services

4.2.1 General

This clause specifies the functional signalling procedures for the control of location services at the radio interface.

The functional protocol utilizes functions and services defined in GSM 04.08 and the functions of the data link layer as defined in GSM 04.06. This protocol utilizes also definitions in GSM 04.07.

The Common Information Element Category utilizes the Facility information element to transport the protocol defined in this specification. The use of the Facility information element is common to many services, and its contents indicates what type of procedure is being requested. This category can be signalled both in the LMU to network and the network to LMU directions.

The correlation of location service operations and their responses, is provided by the combination of the transaction identifier of the messages containing the Facility information element and the Invoke identifier present within the Facility information element itself.

4.2.2 Common Information Element Category

The Common Information Element Category uses operations defined in this specification for location services signalling. Procedures are initiated by sending an operation including an invoke component. The invoke component may yield a Return Error, Return Result or Reject component (also included in an operation) depending on the outcome of the procedure.

The operation state machines, and procedures for management of Invoke IDs specified in CCITT Recommendation Q.774 White Book are used.

A REGISTER message, a FACILITY message or RELEASE COMPLETE message is used to carry the Facility information element which includes these operations. These operations request, acknowledge or reject the desired location service procedure.

4.2.3 Location service procedures

4.2.3.1 Introduction

For location service procedures independent of any call, the initiating side must establish a MM-connection between the network and the LMU according to the rules given in GSM 04.07 and 04.08. The LMU or the network starts the transaction by transferring a REGISTER message across the radio interface. This transaction is identified by the transaction identifier associated with the REGISTER message present in the component part of the Facility information element. Following the REGISTER message one or more FACILITY messages may be transmitted, all of them related by the use of the same transaction identifier. If the transaction is no longer used, it shall be released by sending a RELEASE COMPLETE message. This procedure is specified in detail in clause 5, and the text in clause5 takes precedence over this introduction.

To convey the location service invocation, the Facility information element is used. The Facility information element present either in the REGISTER message or a subsequent message identifies the location service involved and the type of component (i.e. Invoke, Return result, Return error or Reject component).

When the REGISTER or FACILITY message contains a Facility information element and the requested service is available, a FACILITY message containing a Facility information element may be returned. One or more exchanges of FACILITY messages may subsequently occur. To terminate the service interaction and release the transaction identifier value, a RELEASE COMPLETE message is sent as specified for the specific location service procedure. The RELEASE COMPLETE message may also contain the Facility information element.

4.2.3.2 Handling of protocol errors in LCS procedures

Messages containing a Facility information element shall be checked for protocol errors before the contents of the Facility IE is acted on. The checks shall be performed in the following order:

1) The message carrying the Facility IE shall be checked for protocol errors as specified in subclause 3.7. If a protocol error is found then the procedures in subclause 5.7 apply.

2) The contents of the Facility IE shall be checked for protocol errors as specified in subclause 4.2.6. If a protocol error is found then the procedures in subclause 4.2.6 apply.

4.2.3.3 Handling of other errors in LCS procedures

If the tests specified in subclause 4.2.3.2 have been passed without the detection of a protocol error, the receiver will attempt to process the contents of the Facility Information Element. If errors occur during this processing (e.g. system failure, or information in the Facility IE is incompatible with the requested operation) then the procedures specified in the individual service specifications apply.

An example of the behaviour that could occur in this case is:

- the LMU or network sends a Facility information element containing a return error component in a FACILITY or RELEASE COMPLETE message. If the FACILITY message is used then the MM Connection may continue to be used for further signalling.

4.2.4 Multiple location service invocations

It is possible for several LCS transactions to be used simultaneously. LCS transactions can also exist in parallel with other CM-Layer and MM transactions. The handling of multiple MM connections is defined in GSM 04.07 and 04.08.

A single Facility Information Element shall not contain more than one component.

4.2.5 Recovery procedures

In case a transaction is not terminated according to the normal procedure as described in this specification the network side has to ensure that the transaction is terminated e.g. by a supervision timer.

4.2.6 Generic protocol error handling for the component part of location services operations

If a location service operation is to be rejected the operation will be denied, and provided the transaction is still in progress, an appropriate reject component will be returned in a Facility Information Element.

4.2.6.1 Single component errors

The reject component shall be sent in a RELEASE COMPLETE message.

If the component containing the error was itself sent in a RELEASE COMPLETE message then the contents of the component shall be ignored, and no reject component is sent.

4.2.6.2 Multiple component errors

If a single Facility IE contains more than one component then a RELEASE COMPLETE message with the cause "Facility rejected" and without any component shall be sent.

5 Location service support procedures

5.1 General

This clause describes the location service support procedures at the radio interface. These procedures are provided by the location service support entity defined in GSM 04.07. The location service support procedures provide the means to transfer messages for the location service procedures. These procedures are regarded as the user of the location service support.

5.2 Location service support establishment

At the beginning of each location service procedure a location service support must be established.

5.2.1 Location service support establishment at the originating side

If the entity that uses the location support procedures needs to send a REGISTER message, the location service support entity shall first request the establishment of an MM-connection. This MM-connection is established according to GSM 04.08 and 04.07. If the network is the initiating side then MM-connection establishment may involve paging the LMU.

The location service support entity shall send the REGISTER message as the first CM-message on the MM-connection. The REGISTER message is sent to the corresponding peer entity on the MM-connection and the location service support shall be regarded as being established.

5.2.2 Location service support establishment at the terminating side

At the terminating side a location service support is regarded as being established when an MM-connection is established. According GSM 04.08 this can be ascertained by the receipt of the first message, with a new transaction identifier. For successful establishment of location service support this message shall be a REGISTER message.

If the terminating side needs to reject the establishment of location services support then it may be immediately initiate location services support release (see subclause 5.4).

5.3 Location service support information transfer phase

After the establishment of the location service support both users may exchange FACILITY messages by use of the location service support.

5.4 Location service support release

At the end of each location service procedure the established location service support is released, if a permanent connection is not used.

The side closing the transaction shall release the transaction by sending the RELEASE COMPLETE message to its corresponding peer entity.

Both location service support entities release the MM-connection locally.

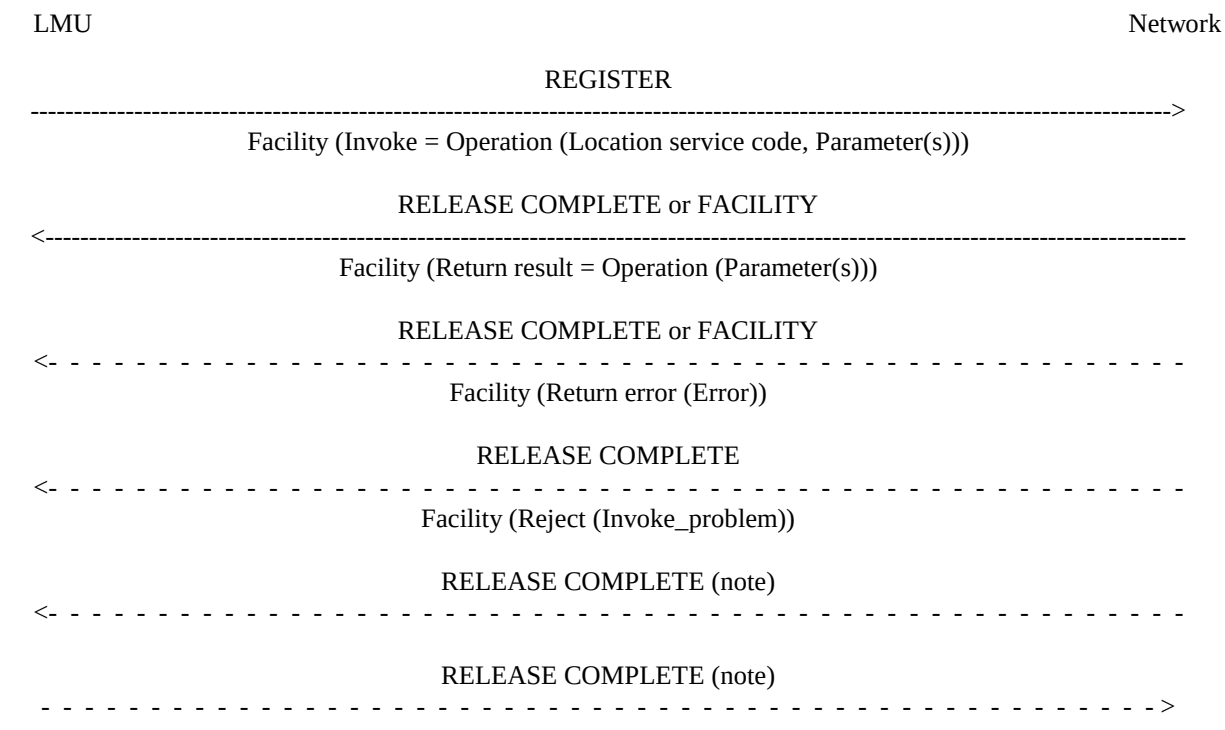
5.5 Recovery procedures

The location service support does not provide recovery procedures, i.e. the operations are transparent to the location service support.

5.6 Message flow (single operation example)

This subclause contains examples of message flows for a single transaction consisting of a single operation. These examples may not show all possibilities.

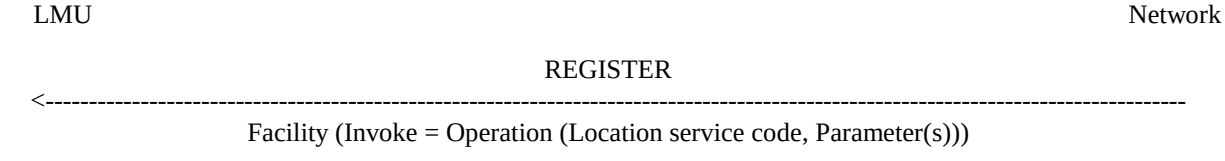
5.6.1 LMU initiated location service transaction

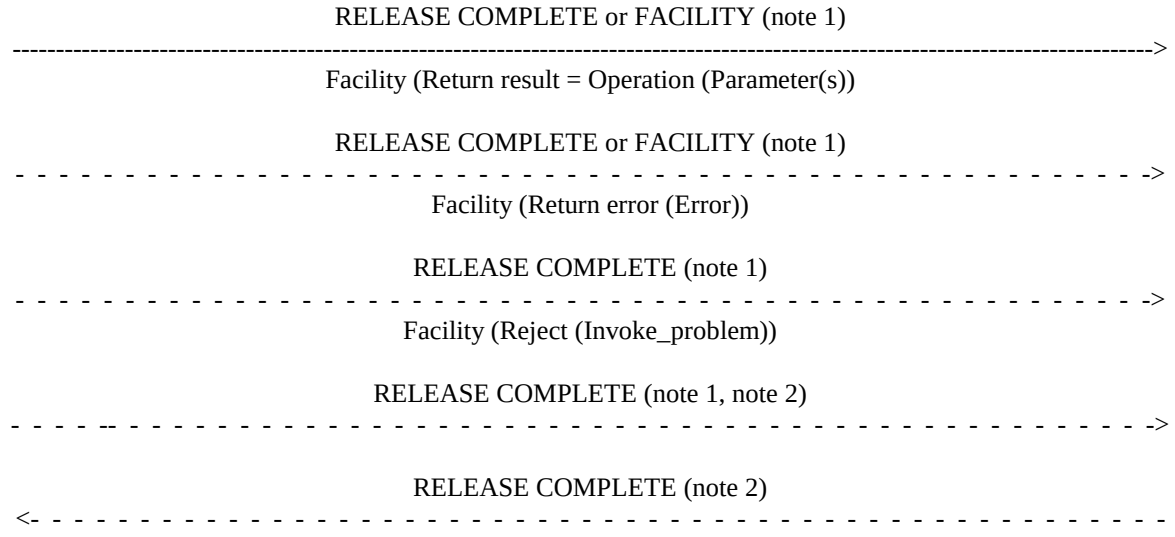


NOTE: To prevent transactions being kept open following exceptional cases, either side of the transaction may release it by sending a RELEASE COMPETE message without a Facility IE.

Figure 3.1: LMU initiated location service transaction

5.6.2 Network initiated location service transaction





NOTE 1: If the network initiated operation does not require a result, reject or error to be returned then the LMU may release the transaction by sending a RELEASE COMPLETE message without a Facility Information Element and release of transaction by LMU is allowed (i.e. Release Forbidden has not been present in Register message). If release is not allowed by LMU, the LMU sends the result using Facility message.

NOTE 2: To prevent transactions being kept open following exceptional cases, either side of the transaction may release it by sending a RELEASE COMPETE message without a Facility IE.

Figure 3.2: Network initiated location service transaction

5.7 Handling of unknown, unforeseen, and erroneous protocol data

5.7.1 General

These procedures only apply to messages where the protocol discriminator is set to indicate LCS operations according to the rules in GSM 04.07 and this specification. Messages that do not meet this criteria are treated according to other GSM technical specifications.

This subclause specifies procedures for handling of unknown, unforeseen and erroneous protocol data by the receiving entity. The procedures are called "error handling procedures", but they also define a compatibility mechanism for future extension of the protocol.

Most error handling procedures are mandatory in the LMU, but optional in the network. Detailed error handling procedures may vary from PLMN to PLMN.

In this subclause, the following terminology is used:

- An IE is defined to be syntactically incorrect in a message if it contains at least one value defined as "reserved" in this specification or GSM 04.08. However, it is not a syntactical error if a type 4 IE specifies a length indicator greater than that defined. The component part of the Facility information element is handled by a separate mechanism, and errors in the component part are not covered by this subclause.

The following procedures are listed in order of precedence.

Handling of errors in the contents of the Facility IE is described in subclause 4.2.6, and is outside the scope of this subclause.

5.7.2 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.

5.7.3 Unknown or unforeseen transaction identifier

The LMU shall ignore messages with the transaction identifier value set to "111".

If the transaction identifier value is not "111" the following procedures shall apply to the LMU:

a) If a RELEASE COMPLETE message is received specifying a transaction identifier that is not recognized as relating to a LCS transaction that is in progress then the message shall be ignored.

b) If a FACILITY message is received specifying a transaction identifier that is not recognized as relating to a LCS transaction that is in progress then a RELEASE COMPLETE message shall be sent.

c) If a REGISTER message is received specifying a transaction identifier that is not recognized as relating to a LCS transaction that is in progress and with a transaction identifier flag incorrectly set to "1", this message shall be ignored.

The network may follow the same procedures.

5.7.4 Unknown or unforeseen message type

If the LMU receives a message type not defined for the protocol discriminator or not implemented by the receiver, then a RELEASE COMPLETE message shall be sent with cause value #97 "message type non-existent or not implemented".

If the LMU receives a message type not consistent with the transaction state then a RELEASE COMPLETE message shall be sent with cause value #98 "message not compatible with control state".

The network may follow the same procedures.

5.7.5 Non-semantical mandatory Information Element Error

When on receipt of a message:

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

is diagnosed, or when a message containing:

- a syntactically incorrect mandatory IE; or
- an IE unknown in the message, but encoded as "comprehension required" (see GSM 04.08); or
- an out of sequence IE encoded as "comprehension required";

is received, the LMU shall proceed as follows:

a) If the message is not RELEASE COMPLETE it shall send a RELEASE COMPLETE message with cause "#96 - Invalid mandatory information".

b) If the message is RELEASE COMPLETE, it shall be treated as a normal RELEASE COMPLETE message.

The network may follow the same procedures.

5.7.6 Unknown and Unforeseen IEs in the non-imperative part

5.7.6.1 IEIs unknown in the message

The LMU shall ignore all IEs unknown in the message which are not encoded as "comprehension required". The network shall take the same approach.

5.7.6.2 Out of sequence IEs

The LMU shall ignore all out of sequence IEs in a message which are not encoded as "comprehension required".

The network may take the same approach.

5.7.6.3 Repeated IEs

If an information element with format T, TV or TLV (see GSM 04.07) is repeated in a message in which repetition of the information element is not specified, only the contents of the information element appearing first shall be handled and all subsequent repetitions of the information element shall be ignored. When repetition of information elements is specified, only the contents of specified repeated information elements shall be handled. If the limit on repetition of information elements is exceeded, the contents of information elements appearing first up to the limit of repetitions shall be handled and all subsequent repetitions of the information element shall be ignored.

The network may follow the same procedures.

5.7.7 Non-imperative message part errors

This category includes:

- syntactically incorrect optional IEs;
- conditional IE errors.

Errors in the content of the Facility IE are handled according to subclause 4.2.6.

5.7.7.1 Syntactically incorrect optional IEs (other than Facility)

The LMU 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.

5.7.7.2 Conditional IE errors

When the LMU upon receipt of a message 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 (other than Facility), it shall send a RELEASE COMPLETE message with cause #100 "conditional IE error".

The network may follow the same procedure.

6 Message functional definitions and contents

6.1 General

This clause defines the structure of the messages of the layer 3 protocol defined in GSM 03.71. These messages are standard L3 messages as defined in GSM 04.07.

Each definition includes:

a) a brief description of the message;

b) a table listing the information elements in the order of their appearance in the message. In a sequence of consecutive IEs with half octet length, the first IE occupies bits 1 to 4 of octet N, the second bits 5 to 8 of octet N, the third bits 1 to 4 of octet N+1 etc.;

   For each IE the table indicates:

   1) the information element identifier, in hexadecimal notation, if the IE has format T, TV or TLV. 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-);

   2) the name of the IE (which gives an idea of the semantics of the element), which is used in this and other specifications as a reference to the IE within the message;

   3) the name of the type of the IE (which indicates the coding of the value part of the IE), and a reference to a description of the value part of the IE;

   4) the presence requirement indication (M, C or O) for the IE, as defined in GSM 04.07;

   5) the format of the IE (T, V, TV, LV, TLV) as defined in GSM 04.07;

   6) the length of the IE (or permissible range of lengths), in octets, in the message, where "?" means that the maximum length of the IE is only constrained by the link layer protocol, and in the case of the facility IE by possible further considerations specified in GSM 03.71. This indication is non-normative.

c) subclauses specifying conditions for IEs with presence requirement C or O in the relevant message. Together with other conditions specified in this specification and GSM 03.71 defines when the IE shall be included or not, what non-presence of such IEs means, and (for IEs with presence requirement C) the static conditions for presence and/or non-presence of the IEs (see GSM 04.07).

6.2 Messages for location services control

Table 4.1 summarises the messages for location services control.

The logical DTAP LCS Information Request and DTAP LCS Information Report messages, that are used in LCS Stage 2 (GSM 03.71), are transported using REGISTER, FACILITY and RELEASE COMPLETE messages.

If there exists no LCS transaction between LMU and MSC, REGISTER message is used to deliver the logical message. If LCS transaction between LMU and MSC exists, FACILITY message is used to deliver the logical message. RELEASE COMPLETE message is used to indicate that LCS transaction is not any more needed, LMU can also use this message to transport logical LCS Information Response message.

Table 4.1: Messages for location service control

Messages for location service control	Reference
FACILITY	46.3
REGISTER	46.4
RELEASE COMPLETE	46.5

6.3 Facility

This message is sent by the Location Measurement Unit (LMU) or the network to request or acknowledge a location service. It is used when information is to be conveyed and the transaction already exists, but is not to be released. The location service to be invoked, and its associated parameters, are specified in the Facility information element (see table 4.2). This message contains information transparent to MSC.

Table 4.2: FACILITY message content

IEI	Information element	Type / Reference	Presence	Format	Length
	Location service Protocol discriminator	Protocol discriminator ~~5~~7.2	M	V	1/2
	Transaction identifier	Transaction identifier ~~5~~7.3	M	V	1/2
	Facility Message type	Message type ~~5~~7.4	M	V	1
	Facility	Facility ~~5~~7.5	M	LV	2-?
90	Release forbidden	Release forbidden ~~5~~7.6	O	T	1

6.4 Register

6.4.1 Register (network to LMU direction)

This message is sent by the network to the location measurement unit to assign a new transaction identifier for location service control and to request or acknowledge a location service (see table 4.3). This message contains information transparent to MSC.

Table 4.3: REGISTER message content (network to LMU direction)

IEI	Information element	Type / Reference	Presence	Format	Length
	Location service Protocol discriminator	Protocol discriminator ~~5~~7.2	M	V	1/2
	Transaction identifier	Transaction identifier ~~5~~7.3	M	V	1/2
	Register Message type	Message type ~~5~~7.4	M	V	1
	Facility	Facility ~~5~~7.5	M	LV	2-?
90	Release forbidden	Release forbidden ~~5~~7.6	O	T	1

6.4.2 Register (LMU to network direction)

This message is sent by the location measurement unit to the network to assign a new transaction identifier for location service control and to request or acknowledge a location service (see table 4.4). This message contains information transparent to MSC.

Table 4.4: REGISTER message content (LMU to network direction)

IEI	Information element	Type / Reference	Presence	Format	Length
	Location service protocol discriminator	Protocol discriminator ~~5~~7.2	M	V	1/2
	Transaction identifier	Transaction identifier ~~5~~7.3	M	V	1/2
	Register Message type	Message type ~~5~~7.4	M	V	1
	Facility	Facility ~~5~~7.5	M	LV	2-?

6.5 Release complete

This message is sent by the location measurement unit or the network to release a transaction used for location service control. It may also request or acknowledge a location service (see table 4.5). This message contains information transparent to MSC.

Table 4.5: RELEASE COMPLETE message content

IEI	Information element	Type / Reference	Presence	Format	Length
	Location service protocol discriminator	Protocol discriminator ~~5~~7.2	M	V	1/2
	Transaction identifier	Transaction identifier ~~5~~7.3	M	V	1/2
	Release Complete message type	Message type ~~5~~7.4	M	V	1
10	Cause	Cause GSM 04.08	O	TLV	4-32
11	Facility	Facility ~~5~~7.5	O	TLV	2-?

6.5.1 Cause

This information element shall be included when the functional handling of the Cause IE is specified in the service description. If the functional handling of the Cause IE is not specified, the receiving entity may ignore the IE. The Cause IE used in location services is defined in GSM 04.08 in Clause 10.5.4.11 (only applicable Cause values are used).

6.5.2 Facility

This information element shall be included as required by the service description and the procedures defined in this specification and in GSM 03.71.

7 General message format and information elements coding between LMU and MSC

The figures and text in this clause describe message contents. Within each octet, the bit designated "bit 1" is transmitted first, followed by bits 2, 3, 4, etc. Similarly, the octet shown at the top of each figure is sent first.

7.1 Overview

Within the layer 3 protocol defined in this specification, every message is a standard L3 message as defined in GSM 04.07. This means that the message consists of the following parts:

a) protocol discriminator;

b) transaction identifier;

c) message type;

d) other information elements, as required.

Unless specified otherwise, a particular information element may be present only once in a given message.

When a field extends over more than one octet, the order of bit values progressively decreases as the octet number increases. The least significant bit of the field is represented by the lowest numbered bit of the highest numbered octet of the field.

7.2 Protocol discriminator

The Protocol Discriminator (PD) and its use are defined in GSM 04.07. This specification defines the protocols relating to the PD values:

1 1 0 0 location services

7.3 Transaction identifier

For general rules, format and coding of transaction identifier values, see GSM 04.08.

7.4 Message type

The message type IE and its use are defined in GSM 04.07. Table 5.1 defines the value part of the message type IE used in the location service protocol.

Table 5.1: Message types

8	7	6	5	4	3	2	1	Message types
0	X	1	0	.	.	.	.	Clearing messages:
				0	0	0	1	- RELEASE COMPLETE
0	X	1	1	.	.	.	.	Miscellaneous message group:
				0	0	0	1	- FACILITY
				0	0	1	0	- REGISTER

NOTE 1: Bit 8 is reserved for possible future use as an extension bit, see GSM 04.07.
NOTE 2: Bit 7 is reserved for the send sequence number in messages sent from the mobile station. In messages sent from the network, bit 7 is coded with a "0", see GSM 04.07.

7.5 Facility information element

The purpose of the Facility information element is to indicate the invocation and operation of location services, identified by the corresponding operation code within the Facility information element.

The Facility information element is coded as shown in figure 5.1 and clause 8.

The Facility is a type 4 information element with no upper length limit except that given by the maximum number of octets in a L3 message, see GSM 04.06.

8	7	6	5	4	3	2	1	
Facility IEI								octet 1
Length of Facility contents								octet 2
Component(s) (note)								octet 3 etc.
NOTE: This component contains Transparent LCS Information. Encoding of this component is according to clause 8.								

Figure 5.1: Facility information element

7.6 Release forbidden

This information element is used only in MSC to LMU messages. The presence of IE indicates that the release of LCS transaction is not allowed by LMU.

8 General message format and information elements coding between LMU and SMLC

8.1 Transparent LCS Information

This clause provides the formats and encoding of Transparent LCS Information component in the Facility information element. The contents of this component is copied directly from Signal Info from MAP message (see the clause 6.1.4). Formats and encoding methods make use of and is a subset of ITU-T Recommendation Q.773 (Transaction Capabilities formats and Encoding) and T/S 43/BB. The used part of ITU-T Recommendation Q.773 respectively T/S 43/BB is almost the same as the Component Portion of TC messages.

This subclause is further based on:

- ~~ITU-T~~ CCITTRecommendation X.208~~680~~ (Specification of Abstract Syntax Notation One (ASN.1)), 1988;
- ITU-T Recommendation X.691 (Specification of packet encoding rules for Abstract Syntax Notation One);

and is consistent with these ITU-Trecommendations. BASIC-PER, unaligned variant is used.

NOTE: Concerning the general rules for encoding (structure of encoding, identifier octets, length octets, etc.) see CCITT~~ITU-T~~ Recommendations X.208~~680~~ and ITU-T Recommendation X.691. For these general rules the same exceptions apply as stated in GSM 09.02. Following ASN.1 definitions are exactly same than in ITU-T Recommendation Q.773.

```
Component ::=  CHOICE {
   invoke             [1] IMPLICIT Invoke,
   returnResultLast   [2] IMPLICIT ReturnResult,
   returnError        [3] IMPLICIT ReturnError,
   reject             [4] IMPLICIT Reject,
   returnResultNotLast [7] IMPLICIT ReturnResult }

-- The Components are sequences of data elements.

Invoke ::=     SEQUENCE {
   invokeID          InvokeIdType,
   linkedID          [0] IMPLICIT InvokeIdType OPTIONAL,
   operationCode        OPERATION,
   parameter            ANY DEFINED BY operationCode OPTIONAL }

-- ANY is filled by the single ASN.1 data type following the keyword PARAMETER or the keyword
ARGUMENT
-- in the type definition of a particular operation.

ReturnResult ::=  SEQUENCE {
   invokeID          InvokeIdType,
   result            SEQUENCE {
   operationCode        OPERATION,
   parameter            ANY DEFINED BY operationCode
   } OPTIONAL
   }

-- ANY is filled by the single ASN.1 data type following the keyword RESULT in the type definition
-- of a particular operation.

ReturnError ::=   SEQUENCE {
   invokeID          InvokeIdType,
   errorCode            ERROR,
   parameter            ANY DEFINED BY errorCode OPTIONAL }

-- ANY is filled by the single ASN.1 data type following the keyword PARAMETER in the type
definition
-- of a particular error.

Reject ::=     SEQUENCE {
   invokeID CHOICE {
      derivable         InvokeIdType,
      not-derivable        NULL },
   problem CHOICE {
      generalProblem    [0] IMPLICIT GeneralProblem,
      invokeProblem     [1] IMPLICIT InvokeProblem,
```

```
      returnResultProblem     [2] IMPLICIT ReturnResultProblem,
      returnErrorProblem      [3] IMPLICIT ReturnErrorProblem } }

InvokeIdType ::=  INTEGER (–128..127)
```

8.1.1 Operation Code

Each Operation is assigned an Operation Code to identify it. The Operation Codes for the different Operations are defined in subclause 9.2.

8.1.2 Error Code

Each Error is assigned a value (Error Code) to identify it. The Error Codes for the different Errors are defined in subclause 7.3.

8.1.3 Problem Code

The Problem Code consists of one of the four elements: General Problem, Invoke Problem, Return Result Problem or Return Error Problem. ASN.1 definitions are presented below.

```
-- PROBLEMS

GeneralProblem    ::=   INTEGER {      unrecognizedComponent (0),
                        mistypedComponent (1),
                        badlyStructuredComponent (2) }

InvokeProblem     ::=   INTEGER {      duplicateInvokeID (0),
                        unrecognizedOperation (1),
                        mistypedParameter (2),
                        resourceLimitation (3),
                        initiatingRelease (4),
                        unrecognizedLinkedID (5),
                        linkedResponseUnexpected (6),
                        unexpectedLinkedOperation (7) }

ReturnResultProblem  ::=   INTEGER {      unrecognizedInvokeID (0),
                        returnResultUnexpected (1),
                        mistypedParameter (2) }

ReturnErrorProblem   ::=   INTEGER {      unrecognizedInvokeID (0),
                        returnErrorUnexpected (1),
                        unrecognizedError (2),
                        unexpectedError (3),
                        mistypedParameter (4) }
```

9 LMU LCS Protocol ~~Location services~~ operation specifications

9.1 General

This clause specifies the abstract syntax for the LMU LCS Protocol ~~Location Service protocol~~ using the Abstract Syntax Notation One (ASN.1), defined in ~~ITU-~~CCITT Recommendation X.208~~680~~ (19~~89~~98).

The encoding rules which are applicable to the defined abstract syntax are the Packet Encoding Rules for Abstract Syntax Notation One, defined in ITU-T Recommendation X.691. For each Location Service parameter which has to be transferred by a Location Service message, there is a PDU field (an ASN.1 NamedType) whose ASN.1 identifier has the same name as the corresponding parameter, except for the differences required by the ASN.1 notation (blanks between words are removed, the first letter of the first word is lower-case and the first letter of the following words are capitalized (e.g. "bearer service" is mapped to "bearerService"). In addition some words may be abbreviated as follows:

- lmu location measurement unit;
- lcs location services;

The ASN.1 data type which follows the keywords ARGUMENT "PARAMETER" or "RESULT" (for OPERATION and ERROR) is always optional from a syntactic point of view. However, except specific mention, it has to be considered as mandatory from a semantic point of view. When in an invoke component, a mandatory element is missing in any component or inner data structure, a reject component is returned with the problem code "Mistyped Parameter". When an optional element is missing in an invoke component or in an inner data structure while it is required by the context, an error component is returned; the associated type of error is "DataMissing".

In case an element is defined as mandatory in the protocol description (GSM 04.71 including imports from GSM 09.02), but is not present according to the service description (stage 1 to stage 3), the ASN.1 protocol description takes precedence over the diagrams in the GSM 04.8x and 04.9x-series of technical specifications.

When possible operations and errors are imported from GSM 09.02 thereby making the MSC transparent to most of the messages sent to or from the LMU.

Timer values for operations which require timers are shown as ASN.1 comments.

Ellipsis Notation shall be used in the same way as described in GSM 09.02 and shall be supported on the radio interface by the LMU and the network for all operations defined in this specification including those imported from GSM 09.02.

9.2 Operation types

Table 7.1 summarizes the operations defined for LMU LCS Protocol ~~location services~~ in this specification, and shows which of these operations are Radio Interface Timing (RIT) related, Time Of Arrival (TOA) location method related, and general LMU procedures related. In this ASN.1 module, ASN.1/88 defined in CCITT X.208 recommendations (ASN.1 1988) is used.

Table 7.1: Relevance of location service operations

Operation name	Direction	Response allowed	RIT	TOA	General LMU
StartRIT	SMLC -> LMU	ReturnResult (empty) .	X		
ReportRIT	LMU -> SMLC	No	X		
StopRIT	SMLC -> LMU	ReturnResult (empty).	X		
IndicateRITError	LMU -> SMLC	No	X		
PerformTOA	SMLC -> LMU	ReturnResult		X	
~~StatusRequest~~StatusQuery	SMLC -> LMU	ReturnResult			X
StatusUpdate	LMU -> SMLC	ReturnResult (empty)			X
ResetRequest	SMLC -> LMU	ReturnResult (empty).			X
OMRequest	SMLC -> LMU	ReturnResult			X
OMReport	LMU -> SMLC	ReturnResult			X

This specification defines the following operations (transparent to MSC):

- StartRIT
- ReportRIT
- StopRIT
- IndicateRITError
- PerformTOA
- ~~StatusRequest~~StatusQuery
- StatusUpdate
- ResetRequest
- OMRequest
- OMReport

```
-- LLP~~CS~~-Operations module defines the operations transparent to MSC

LLP~~CS~~-Operations
-- { LLP~~CS~~-Operations object identifier }

DEFINITIONS ::=

BEGIN


IMPORTS
   OPERATION
FROM TCAPMessages {
   ccitt recommendation q 773 modules (2) messages (1) version2 (2)}

      SystemFailure,
   DataMissing,
   UnexpectedDataValue,
   FacilityNotSupported,
   UnknownSubscriber,
FROM MAP-Errors {
   ccitt identified-organization (4) etsi (0) mobileDomain (0)
   gsm-Network (1) modules (3) map-Errors (10) version4 (4)}


   UnDefinedError
FROM LLP~~CS~~-Errors
-- {}

      StartRITReq,
   ReportRITRsp,
      ErrorRITRsp,
   PerformTOAReq,
   TOAResultRsp,
   StatusReq,
```

```
   StatusRsp,
   ResetReq,
   OMREQ-REP,
   StatusRep
OMRequest,
   OMRequestRsp,
   OMReport,
   OMReportRsp
FROM -LLPCS-DataTypes {
   ccitt identified-organization (4) etsi (0) mobileDomain (0)
   gsm-Network (1) modules (3) map-LCS-DataTypes (n) version4 (4)}
;

-- OPERATION definitions based on macro notation

StartRIT::= OPERATION      -- identifier StartRIT-Measurement
   ARGUMENT
      startRITReq    StartRITReq
   RESULT
      startRITRsp    StartRITRsp
   ERROR {

   SystemFailure,
   DataMissing,
   UnexpectedDataValue,
   ResourcesNotAvailable,
   UnDefinedError
   }

ReportRIT::= OPERATION     -- identifier ReportRIT-Measurement
   ARGUMENT
      reportRITrsp      ReportRITRsp

StopRIT::= OPERATION    -- identifier StopRIT-Measurement
   ARGUMENT
      stopRITReq     StopRITReq
   RESULT
      StopRITRsp     StopRITRsp

IndicateRITError ::= OPERATION
   ARGUMENT
      errorRITRsp    ErrorRITRsp

PerformTOA::= OPERATION    -- identifier PerformTOA-Measurment
   ARGUMENT
      performTOAReq     PerformTOAReq
   RESULT
      toaResultRsp      TOAResultRsp
   ERROR {
   SystemFailure,
   DataMissing,
   UnexpectedDataValue,
   ResourcesNotAvailable,
   UnDefinedError
   }

StatusRequestStatusQuery::= OPERATION
   ARGUMENT
      statusReq         StatusReq
   RESULT
      statusRsp         StatusRsp
   ERROR {
   }

ResetRequest::= OPERATION
   ARGUMENT
      resetReq       ResetReq
   RESULT
      resetRsp       ResetRsp
   ERROR {
   SystemFailure,
   UnDefinedError
   }
```

```
OMRequest ::= OPERATION       -- identifier O&M Request
   ARGUMENT
      OMRequestomRequest         OMREQ-REP
   RESULT
      OMRequestRspomRequestRsp      OMREQ-REP
   ERROR {
   SystemFailure,
   DataMissing,
   UnexpectedDataValue,
   ResourceNotAvailable,
   UnDefinedError
}
```

```
OMReport ::= OPERATION        -- identifier O&M Report
   ARGUMENT
      OMRequestomRequest         OMREQ-REP
   RESULT
      OMRequestRspomRequestRsp      OMREQ-REP
   ERROR {
   SystemFailure,
   DataMissing,
   UnexpectedDataValue,
   ResourceNotAvailable,
   UnDefinedError
}
```

```
StatusUpdate ::= OPERATION    -- identifier Status Update
   ARGUMENT
      statusUpdateReq         StatusUpdateReq
   RESULT
      statusUpdateRsp         StatusUpdateRsp
   ERROR {
   SystemFailure,
   DataMissing,
   UnexpectedDataValue,
   ResourceNotAvailable,
   UnDefinedError
}
```

```
END
```

9.2.1 Operation types description

For each operation type this subclause provides a brief prose description.

9.2.1.1 StartRIT (network --> LMU)

This operation type is invoked by the network to request RIT measurement information from an LMU. ~~If a single RIT measurement is asked for, the measurement results can be returned using the return result component of the operation.~~

9.2.1.2 ReportRIT (LMU -->network)

This operation type is invoked by an LMU to report to the network RIT measurement information. This operation is used to report periodical measurements.

9.2.1.3 StopRIT (network --> LMU)

This operation type is invoked by the network to request an LMU to stop on-going RIT measurements and reporting.

9.2.1.4 IndicateRITError (LMU --> network)

This operation type is invoked by an LMU to indicate error situations.

9.2.1.5 PerformTOA (network --> LMU)

This operation type is invoked by the network to request an LMU to perform TOA location mesurements. The measurement results are returned using the return result component of the operation.

9.2.1.6 ~~StatusRequest~~StatusQuery (network --> LMU)

This operation type is invoked by the network to request status an LMU The status is returned using the return result component of the operation.

9.2.1.7 StatusUpdate (LMU --> network)

This operation type is invoked by an LMU to report status of LMU, e.g. after reset or periodically.

9.2.1.~~8~~7 ResetRequest (network --> LMU)

This operation type is invoked by the network to reset an LMU.

9.2.1.~~9~~8 OMRequest (network --> LMU)

This operation type is invoked by the network to request a specific O&M activity to LMU

9.2.1.~~10~~9 OMReport (LMU -> network)

This operation type is invoked by the LMU to report an O&M event to Network or asking for reporting O&M information from Network.

10.3 Error types

10.3.1 Error types ASN.1 specification

The following ASN.1 module provides an ASN.1 specification of errors. Errors from MAP are imported in the LCS-Protocol module in subclause 9.2. In this ASN.1 module, ASN.1/88 defined in CCITT X.208 recommendations (ASN.1 1988) is used.

```
LLPCS-Errors
-- { LLPCS-Errors object identifier }

DEFINITIONS ::=

BEGIN

IMPORTS

ERROR FROM
TCAPMessages FROM {
   ccitt recommendation q 773 modules (2) messages (1) version2 (2) }
;

-- The MAP errors

-- error types definition
UnDefinedError ::=ERROR

END
```

10.3.2 Error types description

For each error type this subclause provides a brief prose description.

10.3.2.4 SystemFailure

This error is returned by the LMU or the network, when it cannot perform an operation because of a failure.

10.3.2.5 DataMissing

This error is returned by the network or the LMU when an optional parameter is missing in an invoke component or an inner data structure, while it is required by the context of the request.

10.3.2.6 UnexpectedDataValue

This error is returned by the network or the LMU when it receives a parameter with an unexpected value, without type violation.

10.3.2.7 ResourcesNotAvailable

This error is returned by the network or the LMU if temporarily there are no resources.

10.3.2.9 UnDefinedError

This error is returned by the LMU or the network when any other error type is not applicable.

10.4 Operations and errors implementation

For the actual implementation of location services, operations and errors have to be defined by value. The following ASN.1 module, imports operation types from the ASN.1 module described in subclause 9.2 and operation and error types from MAP. It defines operations by allocating operations and errors a local value. For the involved operations and errors the same local values as in MAP are allocated. In this ASN.1 module, ASN.1/88 defined in CCITT X.208 recommendations (ASN.1 1988) is used.

```
LLPCS-Protocol
-- { LLPCS-Protocol object identifier }

DEFINITIONS ::=

BEGIN

IMPORTS

      SystemFailure,
   DataMissing,
   UnexpectedDataValue,
   FacilityNotSupported,
   UnknownSubscriber,
FROM MAP-Errors {
   ccitt identified-organization (4) etsi (0) mobileDomain (0)
   gsm-Network (1) modules (3) map-Errors (10) version4 (4)}


   UnDefinedError
FROM LLPCS-Errors
-- { LLPCS-Errors object identifier }

      StartRIT,
   ReportRIT,
   StopRIT,
      IndicateRITError,
   PerformTOA,
   StatusRequestStatusQuery,
   ResetRequest,
   OMRequest,
   OMReport,
   StatusUpdate
FROM --LLPCS-Operations
-- { LLPCS-Operations object identifier }
-- allocate local values for errors

systemFailure  SystemFailure ::= localValue 10
dataMissing    DataMissing ::= localValue 11
unexpectedDataValue  UnexpectedDataValue ::= localValue 12
facilityNotSupported FacilityNotSupported ::= localValue 13
unknownSubscriber    UnknownSubscriber ::= localValue 14
unDefinedError UnDefinedError ::= localValue 50

startRIT StartRIT ::= localValue 10
reportRIT   ReportRIT ::= localValue 11
stopRIT  StopRIT ::= localValue 12
indicateRITError  IndicateRITError ::= localValue 13
performTOA  PerformTOA ::= localValue 20
statusRequeststatusQuery  StatusRequestStatusQuery ::= localValue 30
resetRequest   ResetRequest ::= localValue 31
omRequest   OMRequestOMRequest OM_REQ_REP ::= LocalValue 32
omReport OMReportOMReport OM_REQ_REP ::= LocalValue 33
StatusUpdate   StatusUpdate ::= LocalValue 34

END
```

11 LMU LCS Protocol (LLP) ~~MLC-LMU~~ messages

11.1 Messages, data types and identifiers

11.1.1 General

This clause defines the External Signal Info IE, that contains Signal Info string. Signal Info string contains the MLC-LMU messages defined by ASN.1 and coded by PER (X.691). In this ASN.1 module, ASN.1/94 defined in ITU-T X.680 recommendations (ASN.1 1994) is used.

11.1.2 ASN.1 data types

```
LLP~~CS~~-DataTypes
-- { LLP~~CS~~-DataTypes object identifier }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS

ExtensionContainer

~
FROM MAP-ExtensionDataTypes {

~
   ccitt identified-organization (4) etsi (0) mobileDomain (0)

~
   gsm-Network (1) modules (3) map-ExtensionDataTypes (21) version4 (4)}



;


StartRITReq ::= SEQUENCE {
   rit-MeasurementType     RIT-MeasurementType,
   rit-ReliabilityInfo     RIT-ReliabilityInfo,
   rit-ReportingType       RIT-ReportingType,
   rit-RequestedQuality    RIT-ReferenceQuality,
   rit-Environment         RIT-Environment,
   rit-NeigborNumber       RIT-NeighborNumber,
   rit-NeighborType        RIT-NeighborType,
   rit-CIMethod         CIMethod,
   rit-BTSInfo          RIT-BTSInfo       OPTIONAL,
   extensionContainer      ExtensionContainer   OPTIONAL,
   ...
}

StartRITRsp ::= SEQUENCE {
   extensionContainer      ExtensionContainer   OPTIONAL,
   ...
}

StopRITReq ::= SEQUENCE {
extensionContainer      ExtensionContainer   OPTIONAL,
   ...
}

StopRITRsp ::= SEQUENCE {
extensionContainer      ExtensionContainer   OPTIONAL,
   ...
}

ReportRIT ::= SEQUENCE {
   rit-ReferenceIDInfo  RIT-ReferenceIDInfo,
   rit-ResponseInfo SET (SIZE(0..~~1531~~)) OF RIT-ResponseInfo,
   extensionContainer      ExtensionContainer   OPTIONAL,
   ...
```

```
}

StatusReq ::= SEQUENCE {
   eExtensionContainer     ExtensionContainer   OPTIONAL,
   ...
}

StatusRsp ::= SEQUENCE {
   statusTime           StatusTime,
   rit-Status           RIT-Status,
   toa-Status           TOA-Status,
   omStatus          OMStatus,
   extensionContainer      ExtensionContainer   OPTIONAL,
   ...
}

ErrorRITRsp ::= SEQUENCE {
   rit-ErrorType        RIT-ErrorType,
   rit-ErrorReason         RIT-ErrorReason,
   extensionContainer      ExtensionContainer   OPTIONAL,
   ...
   }

PerformTOA ::= SEQUENCE {
   toa-MeasurementDeviceInfo  TOA-MeasurementDeviceInfo,
   toa-ChannelDescr        TOA-ChannelDescr,
   toa-SignalDescr         TOA-SignalDescr,
   toa-TimingDescr         TOA-TimingDescr,
   toa-MeasurementOpt      TOA-MeasurementOpt   OPTIONAL,
   extensionContainer      ExtensionContainer   OPTIONAL,
   ...
}



TOAResultRsp ::= SEQUENCE {
   toa-TimingReferenceInfo    TOA-TimingReferenceInfo,
   toa-Measurements        TOA-MeasurementInfo,
   extensionContainer      ExtensionContainer   OPTIONAL,
   ...
}

OMREQ-REP ::= SEQUENCE {
      omData            OM-Data        OPTIONAL,
      extensionContainer      ExtensionContainer   OPTIONAL,
      ...
}
StatusUpdateReq ::= SEQUENCE {
   statusReason            StatusReason,
   statusTime              StatusTime,
   ritStatus               RIT-Status,
   toaStatus               TOA-Status,
   omStatus                OMStatus,
   extensionContainer      ExtensionContainer   OPTIONAL,
      …
}


StatusUpdateRsp ::= SEQUENCE {
extensionContainer      ExtensionContainer   OPTIONAL,
   ...
}

ResetReq ::= SEQUENCE {
extensionContainer      ExtensionContainer   OPTIONAL,
   ...
}

ResetRsp ::= SEQUENCE {
extensionContainer      ExtensionContainer   OPTIONAL,
   ...
}

-- DATA TYPES DEFINITION

OM-Data ::= OCTET STRING (SIZE(1..244))

-- RIT measurement Type information
```

```
RIT-MeasurementType ::= INTEGER {
   atdMeasure (0),
   atdOrOtdMeasure (1),
   rtdMeasure (2)
} (0..7)

-- RIT Reliability Information
RIT-ReliabilityInfo ::= SEQUENCE {
   rit-ReliabilityFormat      ValueUnit,
   rit-Reliability         RIT-Reliability
}

ValueUnit ::= INTEGER {
   tensOfMeters (0),
   hundredsOfMeters (1)
} (0..3)

RIT-Reliability ::= INTEGER (1..63)

-- RIT Reporting Type information
RIT-ReportingType ::= SEQUENCE {
   rit-ReportingPeriodInfo    RIT-ReportingPeriodInfo OPTIONAL,
   rit-ChangeLimit         ChangeLimit       OPTIONAL,
   rit-Deviation~~Limit~~Info     RIT-Deviation~~Limit~~Info  ~~OPTIONAL~~
}

RIT-ReportingPeriodInfo ::= SEQUENCE {
   rit-ReportingPeriodFormat  ValueUnit,
   rit-ReportingPeriod     ReportingPeriod
}

ReportingPeriod ::= INTEGER (1..120)

ChangeLimit ::= INTEGER (1..255)

RIT-Deviation~~Limit~~Info ::= CHOICE {
   rit-DeviationLimit      RIT-DeviationLimit,
   rit-MonitorPeriodInfo   RIT-MonitorPeriodInfo
}

RIT-DeviationLimit ::= SEQUENCE {
   ~~rit-~~DeviationLimit      DeviationLimit,
   ~~rit-~~MonitorPeriod       MonitorPeriod
}

RIT-MonitorPeriodInfo ::= SEQUENCE {
   monitorPeriod           MonitorPeriod  OPTIONAL
}


DeviationLimit ::= INTEGER (1..255)

MonitorPeriod::= INTEGER (1..64)

RIT-ReferenceQuality ::= INTEGER {
   stdTOA-tensofMeters (0),
   stdTOA-hundredsofMeters (1),
   snrEstimate (2),
   undefinedRelativeQuality (3)
} (0..7)

-- RIT Environment Information
RIT-Environment ::= INTEGER {
   heavyMultiPathAndNLOS (0),
      -- bad urban or urban heavy multipath and NLOS conditions
   lightMultiPathAndLOS (1),
      -- suburban or rural ligth multipath and LOS conditions
   mixedEnvironement (2)
      -- not defined or mixed environment

} (0..7)


RIT-NeighborNumber ::= INTEGER (0..15~~31~~)

RIT-NeighborType ::= INTEGER {
   listedNeighbors (0),
   listedAndSystemInfo2or5 (1),
   systemInfoType2or5 (2),
```

```
   allNeighbors (3)
} (0..7)

CIMethod ::= INTEGER {
   notCi (0),  -- report ci and carrier instead of CI
   ci (1)      -- report CI if possible
} (0..3)

-- element contains information of base stations
-- to be measured
RIT-BTSInfo ::= SEQUENCE {
   rit-BTSList SET (SIZE(1..31)) OF RIT-BTSList-- list of btss
}

RIT-BTSList ::= SEQUENCE {
   rit-ListCi     CI,
   rit-TimeSlotScheme      TimeSlotScheme,
   rit-ListBSIC         BSIC,
   rit-ListBCCHCarrier     BCCHCarrier
}

CI ::= INTEGER (0..65535)

TimeSlotScheme ::= INTEGER {
   schemeUnknown (0),
   equalLength    (1),
   variousLength (2)
} (0..7)

BSIC ::= INTEGER (0..63)

BCCHCarrier ::= INTEGER (0..1023)

RIT-ReferenceIDInfo ::= SEQUENCE {
   rit-ReferenceLAC        LAC,        -- defined earlier
   rit-ReferenceCI         CI,         -- defined earlier
   rit-ReferenceFrameNbr      FrameNumber,   -- defined earlier
   rit-ResponseType        RIT-ResponseType,
   rit-ReferenceTimeSlot      TimeSlot,      -- defined earlier
   rit-ReferenceRXLevel    RXLevel,    -- defined earlier
   rit-ReferenceQuality    RIT-ReferenceQualityType
}

RIT-ResponseType ::= CHOICE {
   rit-NoATReference       RIT-NoATReference,
   rit-ATReference         RIT-ATReference
}

RIT-NoATReference ::= NULL

RIT-ATReference ::= SEQUENCE {
   rit-CommonClock         CommonClock,
   rit-ReferenceATValue    ReferenceATValue,
   rit-ReferenceATChange      ATChange
}

RIT-ReferenceQualityType ::= SEQUENCE {
   qualityType          RIT-ReferenceQuality,
   referenceQuality        ReferenceQuality
}

ReferenceQuality ::= INTEGER (0..64)

-- Measured RTD values from one neighbor
RIT-ResponseInfo ::= SEQUENCE {


   rit-NeighborCellIDInfo     RIT-CellIDInfo,
   rit-NeighborTimeSlot    TimeSlot,
   rit-NeighborRxLevel     RXLevel,
   rit-NeighborFrameNumber    FrameNumber    OPTIONAL,
   rit-NeighborQuality     MeasurementQuality,
   rit-NeighborATDRTD      ATDRTD,
   rit-NeighborATDRTDChange   ATDRTDChange
}

RIT-CellIDInfo ::= CHOICE {
   rit-NeighborCI       CI,
   rit-NeighborBTS         RIT-NeighborBTS
```

```
}

RIT-NeighborBTS ::= SEQUENCE {
   rit-NeighborBSIC        BSIC,
   rit-NeighborBCCHCarrier    BCCHCarrier
}

FrameNumber ::= INTEGER (0..2715647)

LAC ::= INTEGER (0..65535)

CommonClock ::= INTEGER {
   gpsClock    (0),
   glonass  (1)
} (0..7)

ReferenceATValue ::= INTEGER (0..159999999999)

ATDRTD ::= INTEGER (0..923200)

ATChange ::= INTEGER (-1000..1000)

TimeSlot ::= INTEGER (0..7)

RXLevel ::= INTEGER (0..63) -- range -150 to -24 with 2dBm steps

MeasurementQuality ::= INTEGER (0..64)

ATDRTDChange ::= INTEGER (-1000..1000)


-- STATUS ELEMENTS

StatusReason ::= ENUMERATED {
   powerUp (0),             -- no knowledge about previous states
   unsucSWReset (1),        -- unsuccessful recovery
   sucSWReset (2),          -- successful recovery
   unknownError (3),        -- unknown selfdiagnosis error
   unrelTBError (4),        -- unreliable timebase error
   periodicReport (5),      -- periodic status report
   …
}

StatusTime ::= SEQUENCE {
   referenceLAC         LAC,     -- defined earlier
   referenceCI          CI,      -- defined earlier
   referenceFrameNumber    FrameNumber -- defined earlier
}

RIT-Status ::= RIT-Jobs

RIT-Jobs ::= INTEGER (0..63)

TOA-Status ::= TOA-Jobs

TOA-Jobs ::= INTEGER (0..63)

OMStatus ::= OMJobs

OMJobs ::= INTEGER (0..63)    -- Range: FFS

-- ERROR RIT ELEMENTS

RIT-ErrorType ::= INTEGER {
   permament (0),
   temporary (1)
} (0..3)

RIT-ErrorReason ::= INTEGER {


   noNeighbors (0),
   noReferenceClock (1),
   notSupportedType (2),
   undefinedError (3)
} (0..15)


-- TOA DEFINITIONS
```

```
-- MEASUREMENTDEVICE INFORMATION
TOA-MeasurementDeviceInfo ::= SEQUENCE {
   measurementDeviceList SET (SIZE(1..86)) OF TOA-LMUMeasurementDevice
      -- list of measurement devices
}

TOA-LMUMeasurementDevice ::= INTEGER (0..75)


-- CHANNEL DESCRIPTION
TOA-ChannelDescr ::= SEQUENCE {
   toa-FrequencyListType     TOA-FrequencyListType,
   toa-hoppingUsed         TOA-HoppingUsed   OPTIONAL,
   toa-channelType         TOA-ChannelType,
   toa-numberOfBursts      TOA-NumberOfBurst
}

TOA-FrequencyListType ::= CHOICE {
   frequencyListOnly       FrequencyListOnly,
   frequencyListAndIndex      FrequencyListAndIndex,
   frequencyIndexOnly      FrequencyIndexOnly
}

FrequencyListOnly ::= SEQUENCE {
   toa-arfcnList SET (SIZE(1..64)) OF TOA-ARFCNumber
               -- list of channels
}

FrequencyListAndIndex ::= SEQUENCE {
   toa-arfcnList SET (SIZE(1..64)) OF TOA-ARFCNumber,
               -- list of channels
   frequencyIndex          FrequencyIndex
}

FrequencyIndexOnly ::= SEQUENCE {
   frequencyIndex          FrequencyIndex
}

FrequencyIndex ::= INTEGER (0..31)


TOA-ARFCNumber ::= BCCHCarrier   -- defined earlier

TOA-HoppingUsed ::= CHOICE {
   hoppingOn            TOA-Hopping,
   hoppingOff           NULL
}

TOA-Hopping ::= SEQUENCE {
   toa-maio          MAIO,
   toa-hsn           HSN,
   toa-MsframeNumber    ModuloFrameNumber
}

MAIO ::= INTEGER (0..63) -- Mobile Allocation Index Offset

HSN ::= INTEGER (0..63) -- Hopping Sequence Number

ModuloFrameNumber ::= INTEGER (0..84863)

TOA-ChannelType ::= INTEGER {
   tchf(0),


   tchhscn0 (1),
   tchhscn1 (2)
} (0..7)

TOA-NumberOfBurst ::= INTEGER (0..7)


-- SIGNAL DESCRIPTION
TOA-SignalDescr ::= SEQUENCE {
   toa-BurstType        TOA-BurstType
}

TOA-BurstType ::= CHOICE {
   toa-AccessBurst         TOA-AccessBurst,  -- access burst
```

```
   toa-TSC           TSC         -- normal burst
}

TOA-AccessBurst ::= SEQUENCE {
   toa-HOReference         HOReference,
   toa-BSIC          BSIC  -- defined earlier
}

HOReference ::= INTEGER (0..255)

TSC ::= INTEGER (0..7)


-- TIMING DESCRIPTION

TOA-TimingDescr ::= SEQUENCE {
   toa-TimeReference       TOA-TimeReference,
   toa-timeUncertainty     TimeUncertainty
}

TOA-TimeReference ::= CHOICE {
   toa-gpsTime          TOA-GPSTime,
   toa-gsmStartTime        TOA-GSMStartTime
}

TOA-GPSTime ::= SEQUENCE {
   toa-GPSStartTime        GPSStartTime,
   toa-GPSSV            GPSSV

}

GPSStartTime ::= INTEGER (0..14999999) -- unit is microseconds

GPSSV ::= INTEGER (0..31)

TOA-GSMStartTime ::= SEQUENCE {
   toa-arfcn            BCCHCarrier,   -- defined earlier
   toa-bsic          BSIC,    -- defined earlier
   toa-GSMStartTime  GSMTime
}

GSMTime ::= SEQUENCE {
   toa-GSMTimeframeNumber     GSMTimeFrameNumber,
   toa-timeSlot         TimeSlot,
   toa-bitNumber        BitNumber
}

GSMTimeFrameNumber ::= INTEGER (0..42323)

BitNumber ::= INTEGER (0..156)

TimeUncertainty ::= INTEGER (0..15)


-- MEASUREMENT OPTIONS

TOA-MeasurementOpt    ::= SEQUENCE {


   toa-LMUMethod        TOA-Method,
   toa-Environment         TOA-Environment,
   toa-MeasurementType     TOA-MeasurementType
}

TOA-Method ::= INTEGER (0..7)

TOA-Environment ::= INTEGER {
   heavyMpathAndNLOS (0),
   lightMpathAndLOS (1),
   mixed (2)
} (0..7)

TOA-MeasurementType ::= INTEGER {
   reportTOA-only (0),
   reportAOA-only (1),
   reportTOAandAOA (2)
} (0..3)
```

```
-- TIMING INFO

TOA-TimingReferenceInfo ::= CHOICE {
   toa-GPSTimeInfo         NULL,
   toa-GSMTimeInfo         TOA-GSMTimeInfo
}

TOA-GSMTimeInfo ::= SEQUENCE {
   toa-bcch          BCCHCarrier,   -- defined earlier
   toa-bsic          BSIC     -- defined earlier
}


-- THE ACTUAL TOA MEASUREMENTS

TOA-MeasurementInfo ::= SEQUENCE {
   toaMeasurements SET (SIZE(1..68)) OF TOA-Measurements
      -- list of measurementDevices
}

TOA-Measurements  ::= SEQUENCE {
   toa-MeasurementDeviceID    MeasurementDeviceID,
   toa-AddMeasurementInfo     TOA-AddMeasurementInfo,
   toa-measuredPeakList    TOA-MeasuredPeakList
}


-- MEASUREMENT DEVICE ID IE

MeasurementDeviceID ::= INTEGER (0..57)


-- MEASUREMENT INFO IE IN RESULT MESSAGE

TOA-AddMeasurementInfo ::= SEQUENCE {
   toa-Method           TOA-Method,          -- defined earlier
   toa-Diversity        TOA-Diversity,
   toa-NumberOfBurst       TOA-NumberOfBurst,      -- defined earlier
   toa-AOA           TOA-AOA        OPTIONAL,
   toa-AOAUncertainty      TOA-AOAUncertainty   OPTIONAL
}

TOA-Diversity ::= INTEGER {
   noDiversity (0),
   diversity (1)
} (0..3)


TOA-AOA ::= INTEGER (0..3599)

TOA-AOAUncertainty ::= INTEGER (0..31)


-- PEAKS LIST OF MEASURED TOAs

TOA-MeasuredPeakList ::= SEQUENCE {
   toa-measuredPeaks SET (SIZE(0..47)) OF TOA-MeasuredPeaks
      -- list of peaks
}


-- MEASURED TOA IE

TOA-MeasuredPeaks ::= SEQUENCE {
   toa-MeasuredTOA         MeasuredTOA,
   toa-QualityInfo         TOA-QualityInfo
}

MeasuredTOA ::= INTEGER (-131072..131071)
   -- the absolute TOA value

TOA-QualityInfo ::= SEQUENCE {
   toa-Uncertainty         TOA-Uncertainty      OPTIONAL,
   snrEstimate          SNREstimate       OPTIONAL,
   toaSignalStrength       TOASignalStrength    OPTIONAL
}

TOA-Uncertainty ::= INTEGER (0..63)
   -- the uncertainty of the TOA estimate
```

```
SNREstimate ::= INTEGER (-30..33)
   -- the estimated value for Signal Noise Radio

TOASignalStrength ::= INTEGER (0..63)
   -- range -150 to -24 with 2dBm steps

END



-- The definition below will be imported from MAP specification.
--
--
-- MAP-ExtensionDataTypes {
--   ccitt identified-organization (4) etsi (0) mobileDomain (0)
--   gsm-Network (1) modules (3) map-ExtensionDataTypes (21) version4 (4)}
--
-- DEFINITIONS
--
-- IMPLICIT TAGS
--
-- ::=
--
-- BEGIN
--
-- EXPORTS
--
-- PrivateExtension,
-- ExtensionContainer;
--
--
--
-- MAP-EXTENSION  ::= CLASS {
-- &ExtensionType          OPTIONAL,
-- &extensionId   OBJECT IDENTIFIER }
-- -- The length of the Object Identifier shall not exceed 16 octets and the
-- -- number of components of the Object Identifier shall not exceed 16
--
--
--
-- data types
--
-- ExtensionContainer ::= SEQUENCE {
-- privateExtensionList [0]PrivateExtensionList OPTIONAL,
-- pcs-Extensions [1]PCS-Extensions OPTIONAL,
-- ...}
--
-- PrivateExtensionList ::= SEQUENCE SIZE (1..maxNumOfPrivateExtensions) OF
--          PrivateExtension
--
-- PrivateExtension ::= SEQUENCE {
-- extId    MAP-EXTENSION.&extensionId
--          ({ExtensionSet}),
--
-- extType     MAP-EXTENSION.&ExtensionType
--          ({ExtensionSet}{@extId})   OPTIONAL}
--
-- maxNumOfPrivateExtensions  INTEGER ::= 10
--
-- ExtensionSet      MAP-EXTENSION ::=
--    {...
--     -- ExtensionSet is the set of all defined private extensions
-- }
--
-- Unsupported private extensions shall be discarded if received.
--
--
-- PCS-Extensions ::= SEQUENCE {
-- ...}
--
-- END
```

11.1.3 Identifiers definition

In the informative annexes the contents of the identifiers used in operation and error types description are further discussed.

Annex A (informative): RIT messages

A.1 Introduction

This annex describes the contents of Radio Interface Timing (RIT) related messages.

A.2 Messages

The messages below are considered to be transported between the SMLC and the LMU.

A.2.1 RIT Measurement Request Message

The RIT Measurement Request is a message from the SMLC to the LMU. As a response to it the LMU performs Real Time Difference (RTD) or Absolute Time Difference (ATD) measurements. It contains the following information elements.

Table 1. RIT Measurement Request message content.

Information element	*Type/Reference*	*Presence*
Message Type	Message Type A.2.1.1.1	M
Measurement Instructions	Measurement Instructions A.2.1.1.2	M
BTS List	BTS List A.2.1.1.3	C

A.2.1.1 RIT Measurement Request Message Information Elements

A.2.1.1.1 Message Type IE

This IE contains the type of the message. This IE is mandatory.

A.2.1.1.2 Measurement Instructions IE

The purpose of the Measurement Instructions IE is to inform the LMU about the measurement type (RTD/ATD), measurement result reporting rate, and tell which BTSs should be measured. This IE is mandatory, and it contains the following fields:

Measurement Type

This field indicates whether AT of reference BTS is required.

‘0’: AT of reference BTS should be reported. If AT of reference BTS can not be measured, no ATD/RTD measurements are reported.

‘1’: AT of reference BTS should be reported . If AT of reference BTS can not be measured, ATD/RTD measurements are reported anyhow.

‘2’: ATD/RTD measurements timestamped with frame number of the reference BTS should be performed.

Reliability Format

This field describes the units of the Reliability field.

‘0’: Reliability is told in tens of meters.

‘1’: Reliability Period is told in hundreds of meters.

Reliability

This field indicates what is the desired 90 % RIT reliability.

Range: 1 – 63

Note: Name and definiton of this field are FFS.

Reporting Period Format

This field describes the units of the Reporting Period field. This field is optional. If this field is included, RIT Measurement Responses shall be send with the period indicated in this and Reporting Period fields.

‘0’: Reporting Period is told in tens of seconds.

‘1’: Reporting Period is in tens of minutes.

Reporting Period

This field describes the value for the reporting period, i.e. the required time period between the RIT Measurement Response messages. Its units and multiplication factor are defined in the Reporting Period Format field. This field is conditional and included only if the Reporting Period Format is included.

Range: 0-120

Change Limit

This field indicates the limit for the change of AT or ATD /RTD values in units of 0.02 micro-seconds. If any AT or ATD/RTD value has changed more than the value in this field since the last RIT Measurement Response, a new RIT Measurement Response message is sent. This field is optional. If this field is included, RIT Measurement Responses shall be send when some RIT value has changed more than this limit.

Range: 1-255

Deviation Limit

This field indicates the limit for the deviation of the AT or ATD/RTD values. If any time the predicted AT or ATD/RTD value (based on reported AT or ATD/RTD values and changes in the last RIT Measurement Response) has deviated more than the value in this field compared to the current measurement result, a new RIT Measurement Response message is sent. This field is optional. If this field is included, RIT Measurement Responses shall be send when the first deviation of some RIT value is more than this limit. The values are in units of 0.02 micro-seconds.

Range: 1-255

Note: Predicted AT or ATD/RTD value means the value that is calculated (extrapolated) based on AT or ATD/RTD value and AT or ATD/RTD Change value in last RIT Measurement Response message.

Monitor Period

This field indicates the requested time period for monitoring the time derivative of AT or ATD/RTD values, i.e. on how long monitor period the reported AT or ATD/RTD change is based. The value is in tens of seconds. This field conditional and included if Deviation Limit field is included or this field may be included optionally if RTD or ATD change is requested to be reported in RIT Measurement Response message.

Range: 1- 64

Requested Quality Type

Requested Quality Type field defines the quality type that should be used in RIT Measurement Response message in Reference Quality and Neighbor Quality fields.

‘0’: Std of TOA measurements in tens of meters.

‘1’: Std of TOA measurements in hundreds of meters.

‘2’: SNR estimate.

‘3’: Undefined relative quality value.

‘4’: Reserved.

Environment Characterization

Environment Characterization field gives a LMU information about expected multipath and NLOS in the area.

‘0’: possibly heavy multipath and NLOS conditions (e.g. bad urban or urban)

‘1’: no or light multipath and usually LOS conditions (e.g. suburban or rural)

‘2’: not defined or mixed environment

‘3’: reserved

‘4’: reserved (i.e. several values should be reserved)

Neighbor Number

This field indicates the maximum number of neighbor BTSs that the LMU should try to report.

Range: 0-15~~31~~

Neighbor Type

This field indicates which neighbor BTSs are used for RIT measurements. If the value of the Neighbor Number field is lower than the total number of BTSs in the required list, then the BTS are selected in the order of the list.

‘0’: Neighbor BTSs listed in the BTS List IE are used for RIT measurements in the order of the list.

‘1’: If possible, neighbor BTSs listed in the BTS List IE are used, otherwise neighbors received in SYSTEM INFORMATION 2 or 5 message are used in the order of received signal strength.

‘2’: Neighbor BTSs indicated in SYSTEM INFORMATION TYPE 2 or 5 are used for RIT measurements (i.e. this is normal operation) in the order of received signal strength.

‘3’: All neighbor BTSs that can be received (i.e. reported BTSs are not limited to BTSs listed in SYSTEM INFORMATION TYPE 2 or 5 or BTS List IE). Support of this option in LMU is optional.

CellIdMethod

CellIdMethod field indicates whether CI or BSIC and BCCH carrier is used to identify neighbor BTSs in RIT Measurement Responses.

‘0’ = BSIC and BCCH carrier are used to identify the cell, even if CI is available.

‘1’ = CI is used to identify the neighbor cell, if it is available, otherwise BSIC and BCCH carrier are used.

A.2.1.1.3 BTS List IE

This information element indicates neighbor BTSs that are used for RIT measurements. This IE is conditional. If Neighbor Type field in the Measurement Instructions IE is ‘0’ or ‘1’ this field must be included. The first BTS on the list is the reference BTS that should be used as reference when reporting the RTD or AT values. If this reference BTS is not available, the LMU can select the used reference BTS based on signal strength.

This IE contains the following fields.

Number of BTSs

This field indicates, how many BTSs are included in this IE.

Range: 1 to 31.

The following fields are repeated the number of times included in Number of BTSs field.

CI

This field indicates the Cell Identity of the particular BTS. The purpose of the Cell Identity value is to identify a BTS within a location area.

Range: 0 - 65535

Note: Here is assumed that when LMU starts to make measurements, it firsts goes to the requested frequencies, and starts to decode BSICs and CIs from those specific frequencies. Because of this procedure the risk that there would be two BTSs with same CIs and same Channel numbers is minimal (i.e. there is no need to transmit LAC).

Time Slot Scheme

The Time Slot Scheme field indicates what kind of transmission scheme the particular BTS is using. If the LMU measures signals from BTSs from other time slots than 0 or 4, and it is informed about the burst length schemes used by BTSs, then it can compensate for the possible error. (This is necessary if the LMU averages bursts from different time slots, and the BTS uses varying lengths of bursts.)

‘0’ = the burst scheme is unknown (The time slot should remain the same)

‘1’ = all time slots are 156.25 bits long

‘2’ = time slots 0 and 4 are 157 bits long and other time slots are 156 bits long

BSIC

This field indicates the BSIC (Base Station Identity Code) of the particular BTS.

Range: 0 - 63

BCCH Carrier

This field indicates the absolute RF channel number of the particular BTS.

Range: 0 - 1023

A.2. ~~1.~~2 RIT Measurement Response Message

The RIT Measurement Response is a message from the LMU to the SMLC. It is the response to the RIT Measurement Request. It contains the following information elements.

Table 2. RIT Measurement Response message content.

Information element	*Type/Reference*	*Presence*
Message Type	Message Type A.2.2.1.1	M
RIT Measurement	RIT Measurement A.2.2.1.2	M

A.2.2.1~~1.3~~ RIT Measurement Response Message Information Elements

A.2.2.1~~1.3~~.1 Message type IE

This IE contains the type of the message. This IE is mandatory.

A.2.2.11.3.2 RIT Measurement IE

This IE includes the required RIT measurements. The length of this IE depends on the number of measured neighbor BTSs. This IE is mandatory.

Reference LAC

This field indicates the Location Area Code of the reference BTS. The purpose of the Location Area Code is to identify a location area.

Range: 0 - 65535

Reference CI

This field indicates the Cell Identity value of the reference BTS. The purpose of the Cell Identity value is to identify a cell within a location area.

Range: 0 - 65535

Reference Frame Number

This field indicates the frame number of the last measured burst from the reference BTS.

Range: 0 - 2715647

Response Type

This field indicates whether AT of reference BTS is reported or not.

‘0’: AT of reference BTS is not reported

‘1’:AT of reference BTS is reported

Common Clock

This field indicates the type of the common reference clock for AT measurement. This field is included only if the Response Type field is ‘1’.

‘0’: GPS clock is used.

‘1’: Reserved for future use (e.g. Synchronized atomic clocks, or GLONASS)

Reference AT

This field indicates the measured AT value for the serving BTS. It is the starting moment of a time slot. It is counted as elapsed time in units of 0.004 micro-seconds since last minute change. This field is included only if the Response Type field is ‘1’.

Range: 0 – 15,999,999,999

Reference AT Change

This field indicates the first time derivative of the AT value for the reference BTS. This value is based on measurements made during Monitor Period**.** This field is conditional and included if the Monitor Period field has been present in RIT measurement request message and Response Type field is ‘1’. The range is -0.05 … 0.05 ppm and resolution is 0,00005 ppm.

Range: -1000 … 1000

Reference Time Slot

Reference Time Slot indicates the time slot relative to which the LMU reports the reference BTS measurements. This field is mandatory.

Range: 0 to 7

Note: If the LMU does not know timeslot scheme, the LMU reports the used timeslot. The LMU can only report results based on one time slot (N) or two time slots (N and N+4). If the LMU knows timeslot scheme, the LMU can make measurements from several timeslots and reports that the used timeslot is zero (and makes correction).

Reference RX Level

RX Level field includes the received signal strength of the reference BTS.

The RX Level is expressed in 2 dBm steps within the range -150 .. –24 dBm.

Range: 0 .. 63

Quality Type

Quality type field defines the used quality type of Reference Quality field and Neighbor Quality field.

‘0’: Std of TOA measurements from the BTS. Values are expressed in tens of meters.

‘1’: Std of TOA measurements from the BTS. Values are expressed in hunderts of meters.

‘2’: SNR estimate. Range is –30 … +33 dB.

‘3’: Undefined relative quality value.

‘4’: Reserved.

Reference Quality

Serving Quality field includes the quality value of made measurements from the serving BTS. Range is defined by Quality Type field. This Reference Quality field can be e.g. used to evaluate the reliability of RIT measurements in the SMLC.

Range: 0 to 64

Number of Measured Neighbors

This field indicates the number of different neighbor BTSs.

Note: If the LMU can not measure any neighbor BTSs, then this value is set to ‘0’.

Range: 0 – 15~~31~~

The following fields are repeated the number of times included in Number of Measured Neighbors field.

CellIdType

This field indicates is the identity method of the cell.

‘0’ = Cell identity is told using BSIC and BCCH carrier.

‘1’ = Cell identity is told using CI.

Neighbor CI

This field indicates the Cell Identity of the particular neighbor cell. The purpose of the Cell Identity value is to identify a cell within a location area.

Neighbor CI field is a conditional field and it is included only if CellIdType is set ‘1’ and CI value of the given cell is available.

Range: 0 - 65535

Neighbor BSIC

This field indicates the BSIC (Base Station Identity Code of the base station).

BSIC field is conditional and it is included only if CellIdType is set '0'.

Range: 0 - 63

Neighbor BCCH Carrier

This field indicates the absolute RF channel number of the neighbor base station. BCCH carrier field is conditional and it is included only if CellIdType is set '0'.

Range: 0 - 1023

Neighbor RX Level

RX Level field includes the received signal strength on the neighbor BTS.

The RX Level is expressed in 2 dBm steps within the range -150 .. –24 dBm.

Range: 0 .. 63

Neighbor Frame Number

This field indicates the calculated value of the neighbor BTS's frame that would have been received at the same time or immediately after as the last measured frame from the reference BTS. This field is optional.

Range: 0 - 2715647

Neighbor Time Slot

Neighbor Time Slot indicates the time slot relative to which the LMU reports the serving BTS measurements. This field is mandatory.

Range: 0 to 7

Note: If the LMU does not know timeslot scheme, the LMU reports the used timeslot. The LMU can only report results based on one time slot (N) or two time slots (N and N+4). If the LMU knows timeslot scheme, the LMU can make measurements from several timeslots and reports that the used timeslot is zero (and makes correction).

Neighbor Quality

Neighbor Quality field includes the quality of made RIT measurements from neighbor BTS. The intepretation of the Neighbour Quality field is defined by Quality Type field. This Neighbor Quality field can be e.g. used to evaluate the reliability of RIT measurements in the SMLC. This field is mandatory.

Range: 0 to 64

ATD/RTD Value

This field indicates the measured ATD/RTD value between the receptions of signals from the reference and the neighbor BTS. This ATD/RTD value is the difference in reception of signal (the starting moment of time slot) from reference BTS compared to the signal (next starting moment of a time slot) from the neighbor BTS (i.e. this value is always positive). This field is mandatory. The reporting resolution of ATD/RTD value is 0.005 micro-seconds.

Range: 0 … 923200

Note: The reported ATD/RTD value may be based on some filtering or estimation algorithm. I.e. the reported value is not the last measurement result, it is the best estimate of real RTD value at the time of last measurement.

ATD/RTD Change

This field indicates the first time derivative of the ATD/RTD value between the receptions of signals from the reference and the neighbor BTS. This value is based on measurements made during Monitor Period**.** This field is conditional and

included if the Monitor Period field has been present in RIT measurement request message. The range is -0.05 … 0.05 ppm and resolution is 0,00005 ppm.

Range: -1000 … 1000

A.2.~~2~~3 RIT Measurement Stop Message

The RIT Measurement Stop is a message from the SMLC to the LMU. It is sent when the SMLC wants the LMU to stop doing RIT measurements and reporting them. It contains the following information elements.

Table 5. RIT Measurement Stop message content.

Information element	*Type/Reference*	*Presence*
Message Type	Message Type A.2.3.1.1	M

A.2.~~2~~3.1 RIT Measurement Stop Message Information Elements

A.2.3.1.1.~~1.~~ Message type IE

This IE contains the type of the message. This IE is mandatory.

A.2.~~3~~4 RIT Measurement Error Message

The RIT Measurement Error is a message from the LMU to the SMLC. It is sent any time when the LMU can not perform RIT measurements asked for in the RIT Measurement Request. This message can be returned in return result (after reception of measurement command) or as separate message (during periodic measurement). It contains the following information elements.

Table 6. RIT Measurement Error message content.

Information element	*Type/Reference*	*Presence*
Message Type	Message Type A.2.4.1.1	M
Error Type	RIT Error Type A.2.4.1.2	M
RIT Error	RIT Error A.2.4.1.3	M

A.2.~~3~~4.1 RIT Measurement Error Message Information Elements

A.2.~~3~~4.1.1 Message type IE

This IE contains the type of the message. This IE is mandatory.

A.2.~~3~~4.1.2 RIT Error Type IE

This IE indicates whether the error is temporarily (e.g. GPS reset) or permanent errors. Permanent error requires actions in SMLC, temporarily error informs that LMU can not send results temporarily (but it is expected to recover without any actions from SMLC).

‘0’ = Permanent error

‘1’ = Temporarily error

A.2.~~3~~4.1.3 RIT Error IE

The purpose of the RIT Error IE is to provide the indication of error and the reason for it, when the LMU can not report required RIT results. This IE is mandatory. This IE has the following fields.

Error Reason

This field indicates the reason for error.

‘0’: There were no neighbor BTSs to be received.

‘1’: No ATD measurements were possible, since the common reference clock was not available.

‘2’: Requested type of measurements is not supported.

‘3’: Undefined error.

Annex B (informative): TOA messages

B.1 Messages

The following TOA related messages are exchanged between the SMLC and the LMU.

1. Perform TOA Measurement (MLC->LMU)
2. TOA Measurement Result (response to 1. LMU-> MLC)

B.1.1 Perform TOA Measurement Message

The Perform TOA Measurement is a message from the SMLC to the LMU. As a response to it the LMU measures Time Of Arrival of MS transmitted signals. The signal characteristics are specified in the message. It contains the following information elements.

Table 1. Perform TOA Measurement message content.

Information element	*Type/Reference*	*Presence*
Message Type	Message Type IE 3.1	M
Measurement Device Info	Measurement Device Info IE 3.2	M
Channel Description	Channel Description IE 3.3	M
Signal Description	Signal Description IE 3.4	M
Timing Description	Timing Description IE 3.5	M
Measurement Options	Measurement Options IE 3.6	O

B.1.2 TOA Measurement Result Message

The TOA Measurement Result is a message from the LMU to the MLC. It is a response to the Perform TOA Measurement message and contains the following information elements.

Table 2. TOA Measurement Result message content.

Information element	*Type/Reference*	*Presence*
Message Type	Message Type IE 3.1	M
Number of Measurement Devices	Number of Measurement Devices IE 3.7	M
Timing Info	Timing Info IE 3.8	M
The following is repeated "Number of Measurement Devices" times		
Measurement Device ID	Measurement Device	M

	ID IE 3.10	
Measurement Info	Measurement Info IE 3.11	M
Number of Peaks	Number of Peaks IE 3.12	M
The following is repeated "Number of Peaks" times		
Measured TOA	Measured TOA IE 3.13	M
TOA Quality	TOA Quality IE 3.14	M

B.2 Information element encodings

B.2.1 Message Type IE

This IE contains the type of the message.

Range: 0 – 255

B.2.2 Measurement Device Info IE

This IE indicates the LMU Measurement Devices that are addressed with the message. (One physical LMU may contain several devices, e.g. an LMU co-located with a three sector site would normally contain three devices). It contains the following fields:

Number of Measurement Devices

This field indicates the number of LMU Measurement Devices that are addressed with the message. This field is mandatory.

Range: 1-68

The following field is repeated "Number of Measurement Devices" times

Measurement Device ID

This field indicates the ID of the LMU Measurement Device.

Range: 0 -57

B.2.3 Channel Description IE

The purpose of the Channel Description IE is to inform the LMU about the physical channel used by MS. This IE contains the following fields:

Frequency List Type

This field describes the format of the frequency information. If both frequency list and index is provided then the LMU shall store the frequency list and its associated index. If only an index is provided the LMU shall use the associated frequency list.

'0': Frequency list only

'1': Frequency list and index

'2': Frequency list index only

Frequency list index

This field identifies a frequency list either provided with this message or stored by the LMU. This field is present when "Frequency List Type" is equal to 1 or 2.

Range: 0-31

Number of ARFCNs

This field indicates the number of frequencies used by MS. This field is present if "Frequency List Type" is equal to 0 or 1.

Range: 1-64

The following field is repeated the number of times indicated by the "Number of ARFCNs" field.

ARFCN

This field indicates the absolute radio frequency number. This field is present if "Frequency List Type" is equal to 0 or 1.

Range: 0-1023

Hopping

This field indicates if frequency hopping is used. This field is mandatory.

'0': No hopping

'1': Hopping

MAIO

This field indicates the Mobile Allocation Index Offset used in the frequency hopping algorithm (see GSM 05.02). This field is present if Hopping='1'.

Range: 0-63

HSN

This field indicates the Hopping Sequence Number used in the frequency hopping algorithm (see GSM 05.02). This field is present if Hopping='1'.

Range: 0-63

Frame Number

This field indicates the Frame Number modulo 84864 of the first burst expected from the MS. It is used in the frequency hopping algorithm (see GSM 05.02). This field is present if Hopping='1'.

Range: 0-84863

Channel Type

This field indicates the channel type. This field is mandatory.

'0': TCH/F

'2': TCH/H SCN=0

'3': TCH/H SCN=1

Number of Bursts

This field indicates the number of bursts to measure TOA on. This field is mandatory. The field is coded as follows

Value	Number of Bursts
0	5

1	10
2	20
3	40
4	70
5	140
6	280
7	560

B.2.4 Signal Description IE

The purpose of the Signal Description IE is to inform the LMU about the signal transmitted by MS. It contains the following fields:

Burst Type

This field contains the burst type transmitted by MS.

'0': Access Burst

'1': Normal Burst

Handover Reference

This field contains the handover reference number which together with BSIC completely defines the data portion of the access burst. This field is present when Burst Type = '0'.

Range: 0 -255

BSIC

This field indicates the BSIC (Base Station Identity Code) which together with Handover Reference Number defines the data portion of an access burst. This field is present when Burst Type= '0'.

Range: 0 – 63

TSC

This field indicates the Training Sequence Code used by MS. This field is present when Burst Type='1'.

Range: 0-7

B.2.5 Timing Description IE

This IE provides information about the predicted arrival time of MS signals. It contains the following fields:

Time Reference

This field indicates the used clock reference. This field is mandatory.

'0': GPS time

'1': GSM time

'2'-'3': Reserved for future use

GPS Start Time

This field indicates the predicted signal arrival time expressed in GPS time. The signal arrival time (TOA) is defined as the start point of a time slot. It is counted in units of 4 micro-second modulo 60s. To remove any ambiguity, let RT denote the reception time, ST denote the start time, and T an arbitrary time. Then if

1) (ST-RT) mod 60s <= 40s

then the indicated start time is the next time when T mod 60s is equal to ST.

It is possible that a request arrives late so that 1) is not fulfilled but before all bursts have been transmitted. It is in such a case possible to perform measurements on the remaining bursts if condition

2) (RT-ST) mod 60s ≤ Δ.

is fulfilled. Here Δ denotes the length of the complete measurement interval. It can be derived from the fields Channel Type and the Number of Bursts.

Should however neither of 1) or 2) be fulfilled then the request arrived too late and the bursts were missed.

This field is present when Time Reference='0'

Range: 0 – 14,999,999

GPS SV

This IE identifies a GPS clock SV (Space Vehicle) used for time stamping. Value 0 means that all available GPS sources should be used for deriving a time stamp. This field is present if Time Reference = '0'.

Range: 0-31

BCCH

This field indicates the ARFCN (BCCH) of the BTS whose clock is used as reference for Start Time. This field is present when Time Reference='1'.

Range: 0 – 1023

BSIC

This field indicates the Base Station Identity Code of the BTS whose clock is used as reference for Start Time. This field is present when Time Reference='1'.

Range: 0 – 63

GSM Start Time

This field indicates the predicted signal arrival time expressed in GSM time. It is expressed as Frame Number FN modulo 42432, Time slot Number TN and Bit Number BN. The reference point for signal arrival time (TOA) is defined as the start point of a time slot. The start time can encode only an interval of time of 42 432 frames, that is to say around 195.8 seconds. To remove any ambiguity, let RFN denote the frame number at reception, and FN' denote an arbitrary frame number. Then if

1) (FN-RFN) mod 42432 ≤ 31623

then the indicated starting FN is the next time when FN' mod 42432 is equal to FN.

It is possible that a request arrives late so that 1) is not fulfilled but before all bursts have been transmitted. It is in such a case possible to perform measurements on the remaining bursts if the condition

2) (RFN-FN) mod 42432 ≤ Δ.

is fulfilled. Here Δ denotes the length of the complete measurement interval. It can be derived from the fields Channel Type and the Number of Bursts.

Should however neither of 1) or 2) be fulfilled then the request arrived too late and the bursts were missed.

This field is present when Time Reference='1'. It contains the following subfields:

FN (mod 42432):

Range: 0 – 42432

TN:

Range: 0 – 7

BN:

Range: 0 – 156

Start Time Uncertainty

This field indicates the uncertainty in the arrival of the signal from MS. Expressed in GSM bit periods (i.e. 48/13 micro-seconds). The burst is expected to arrive in the interval

[Start Time - Start Time Uncertainty, Start Time + Start Time Uncertainty]

This field is mandatory. The field is coded as follows.

Value	Uncertainty
0	2
1	3
2	4
3	5
4	7
5	10
6	13
7	17
8	20
9	25
10	35
11	45
12	55
13	65
14	90
15	140

B.2.6 Measurement Options IE

This IE indicates options for TOA measurement. It contains the following fields.

Method

This field defines the TOA algorithm to be used by LMU. A value of zero indicates that a default algorithm may be used. Remaining values are vendor specific. This field is mandatory.

Range: 0 – 7

Environment Characterization

This field indicates the expected multipath environment. This field is mandatory.

‘0’: possibly heavy multipath and NLOS conditions (e.g. bad urban or urban)

‘1’: no or light multipath and usually LOS conditions (e.g. suburban or rural)

‘2’: not defined or mixed environment

‘3’: reserved

‘4’: reserved (i.e. several values should be reserved)

Measurement Type

This field indicates whether LMU shall include an estimate of the Time of Arrival (TOA) and/or Angle of Arrival (AOA) with the measurement result.

'0': Report TOA only

'1': Report AOA only

'2': Report TOA and AOA

B.2.7 Number of Measurement Devices IE

This IE indicates the number of LMU Measurement Devices that are reporting with the message.

Range: 1-68

B.2.8 Timing Info IE

This IE provides information about the used clock source for TOA measurement. It contains the following fields:

Time Reference

This field indicates the used clock reference. This field is mandatory.

'0': GPS time
'1': GSM time

'2'-'3': Reserved for future use

BCCH

This field indicates the ARFCN (BCCH) of the BTS whose clock is used as clock reference. This field is present when Time Reference='1'.

Range: 0 – 1023

BSIC

This field indicates the Base Station Identity Code of the BTS whose clock is used as clock reference. This field is present when Time Reference='1'.

Range: 0 – 63

B.2.10 Measurement Device ID IE

This IE indicates the ID of the reporting LMU Measurement Device.

Range: 0 -57

B.2.11 Measurement Info IE

This IE indicates additional information related to the signal measurement.

Method

This field indicates the used method for TOA measurement. This field is mandatory.

Range: 0 – 7

Diversity

This field indicates if diversity was used for measurements. This field is mandatory.

'0': Diversity was not used.

'1': Diversity was used.

Measured Number of Bursts

This field indicates the number of bursts used for TOA measurement. It is expressed as a ratio N = (number measured)/(number requested). This field is mandatory. It is coded as follows.

0	$0 \le N < 1/7$
1	$1/7 \le N < 2/7$
2	$2/7 \le N < 3/7$
3	$3/7 \le N < 4/7$
4	$4/7 \le N < 5/7$
5	$5/7 \le N < 6/7$
6	$6/7 \le N < 1$
7	N=1

Angle of Arrival

This field indicates the Angle of Arrival in units of 0.1 degrees. This field is optional.

Range: 0 - 3599

AOA Uncertainty

This field indicates the quality of Angle of Arrival (AOA) estimate in units of 0.1 degrees. It is defined as follows. Let Θ denote the estimated AOA, Θ_0 denote the true AOA, and r denote the uncertainty. Then Prob($|\Theta-\Theta_0| < r$) = 67%, i.e. with 67% confidence the true AOA lies in the interval [Θ-r, Θ+r]. The uncertainty r, expressed in degrees, is mapped to a number K, with the following formula:

$$r = C\left((1+x)^K - 1\right)$$

with C = 0.446 and x = 0,25. With $0 \le K \le 30$, a useful range between 0.1 degrees and 360 degrees is achieved for the uncertainty. K is the value being sent. A value of 31 means that the measurement failed. This field is optional.

Range: 0 -31

B.2.12 Number of Peaks IE

This IE indicates the number of peaks (i.e. TOA values) reported.

Range: 0 - 47

B.2.13 Measured TOA IE

This IE indicates the absolute TOA value (modulo the duration of a TDMA frame) determined by LMU. Expressed in units of 0.004 micro-seconds relative to the starting time.

Range: -131072 - +131071

B.2.14 TOA Quality IE

This IE indicates the TOA quality determined by LMU. It contains the following fields:

TOA Uncertainty

This field indicates the uncertainty of the TOA estimate. It is defined as follows. Let τ denote the estimated TOA, τ_0 denote the true TOA, and r denote the uncertainty. Then Prob($|\tau-\tau_0| < r$) = 67%, i.e. with 67% confidence the true TOA lies in the interval [τ-r, τ+r]. The uncertainty r, expressed in nanoseconds, is mapped to a number K, with the following formula:

$$r = C\left((1+x)^K - 1\right)$$

with C = 25 and x = 0.12. With $0 \leq K \leq 62$, a suitably useful range between 3 ns and 28 μs is achieved for the uncertainty. A value of 63 means that the measurement failed. This field is optional.

Range: 0 - 63

SNR Estimate

This field indicates the estimated Signal To Noise ratio. Values are expressed in steps of 1 dB ranging from –30 to + 33. This field is optional.

Range: 0 - 63

TOA Signal Strength

This field indicates the estimated Signal Strength. Values are expressed in steps of 2dBm from –150 to –24 dBm. This field is optional.

Range: 0 - 63

Annex C (informative): Status Messages

C.1 Introduction

This annex describes the contents of messages related to the status of an LMU.

C.2 Messages

The messages below are considered to be transported between the SMLC and the LMU.

C.2.1 S~~tatus Request~~tatus Query Message

The S~~tatus Request~~tatus Query is a message from the SMLC to the LMU. It contains the following information elements.

Table 1. S~~tatus Request~~tatus Query message content.

Information element	*Type/Reference*	*Presence*
Message Type	Message Type C.~~5~~2.1.1.1	M

C.2.1.1 S~~tatus Request~~tatus Query Message Information Elements

C.2.1.1.1 Message Type IE

This IE contains the type of the message. This IE is mandatory.

C.2.2 Status Query Resultponse Message

The Status Query Resultponse is a message from the LMU to the SMLC. It contains the following information elements.

Table 2. Status Query Resultponse message content.

Information element	*Type/Reference*	*Presence*
Message Type	Message Type C.2~~5~~.2.1.1	M
Time	Time C.2~~5~~.2.1.2	M
RIT Status	RIT Status C.2~~5~~.2.1.3	M
TOA Status	TOA Status C.2~~5~~.2.1.4	M
O&M Status	O&M Status C.2~~5~~.2.1.5	M

C.2.2.1 Status Query Resultponse Message Information Elements

C.2.2.1.1 Message Type IE

This IE contains the type of the message. This IE is mandatory.

C.2.2.1.2 Time IE

This IE contains the time stamp for this message. This IE is mandatory, and it contains the following fields:

Reference LAC

This field indicates the Location Area Code of the reference BTS. The purpose of the Location Area Code is to identify a location area.

Range: 0 - 65535

Reference CI

This field indicates the Cell Identity value of the reference BTS. The purpose of the Cell Identity value is to identify a cell within a location area.

Range: 0 - 65535

Reference Frame Number

This field indicates the frame number of the last measured burst from the reference BTS.

Range: 0 - 2715647

C.2.2.1.3 RIT Status IE

The purpose of the RIT Status IE is to inform the SMLC about the status of on-going RIT related activity. This IE is mandatory, and it contains the following fields:

RIT Jobs

This field indicates the number of on-going RIT related jobs, i.e. the number of neighbor BTSs that are tried to be measured. Notice that 0 means that no RIT related activity is on-going.

Range: 0 – 63

C.2.2.1.4 TOA Status IE

The purpose of the TOA Status IE is to inform the SMLC about the status of on-going TOA related activity. This IE is mandatory, and it contains the following fields:

TOA Jobs

This field indicates the number of on-going TOA related jobs, i.e. the number of MSs that are tried to be measured. Notice that 0 means that no TOA related activity is on-going.

Range: 0 – 63

C.2.2.1.5 O&M Status IE

The purpose of the O&M Status IE is to inform the SMLC about the status of on-going O&M related activity. This IE is mandatory, and it contains the following fields:

O&M Jobs

This field indicates the number of on-going O&M related jobs.

Range: 0 – 63

C.2.3. Status ~~Report~~ Update Message

The Status ~~Report~~Update is a message from the LMU to the SMLC. It contains the following information elements.

Table 2. Status Response message content.

Information element	*Type/Reference*	*Presence*
Message Type	Message Type C.2.3.1.1	M
Reason for Status Update	Reason for Status Update C.2.3.1.2	M
Time	Time C.2.2.1.2	M
RIT Status	RIT Status C.2.2.1.3	M
TOA Status	TOA Status C.2.2.1.4	M
O&M Status	O&M Status C.2.2.1.5	M

C.2.3.1. Status Update Message Information Elements

C.2.3.1.1. Message Type IE

This IE contains the type of the message. This IE is mandatory.

C.2.3.1.2. Reason for Status Update IE

This IE contains the reason for sending this Status Update Message. This IE is mandatory, and it contains the following fields:

Reason Code

This field indicates Reason code for sending this Status Update Message.

‘0’: power up (no knowledge about previous states)

‘1’: SW reset, unsuccessful recovery

‘2’: SW reset, successful recovery

‘3’: unknown selfdiagnosis error

'4': unreliable timebase error

‘5’: periodic status report, normal operation

Annex D (informative):
Status of Technical Specification GSM 04.71

Status of Technical Specification GSM 04.~~XX~~71		
Date	**Version**	**Remarks**
11.12.98	0.0.1	First Draft by Nokia to Clearwater T1P1 meeting
8.1.99	0.0.2	Second Draft by Nokia to Austin T1P1 meeting
29.1.99	0.0.3	Third Draft by Nokia to Chicago T1P1 meeting
5.2.99	1.0.0	Accepted version based on in Chicago T1P1 meeting
18.3.99	1.0.1	Updated according to agreement in Dallas T1P1 meeting
12.5.99	1.0.2	Updated according to agreement in Savannah T1P1 meeting
9.6.99	1.1.0	Updated according to agreement in Cambridge T1P1 meeting
10.6.99	2.0.0	Update to version 2.0.0
Text and figures: **ASN.1:** **Stylesheet**: **Rapporteur**:		

History

Document history		
V7.0.0	August 1999	Publication

3GPP/SMG Meeting #9
Bad Aibling, Germany, 30 Oct- 3-Dec. 1999

SMG#30bis
Frankfurt, Germany, 06 Dec 1999

***Document* N1-99F16**
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

***Document* N2-99K38**
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

09.08	CR	A137	Current Version:	7.0.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: SMG#30bis	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑	for information		non-strategic	X	

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: (U)SIM [ ] ME [ ] UTRAN / Radio [ ] Core Network [X]
(at least one should be marked with an X)

Source: T1P1.5 **Date:** 18 Nov 1999

Subject: Changes due to LCS enhancements

Work item: Location Services

Category: *(only one category shall be marked with an X)*

F	Correction		**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature	X		Release 98	X
D	Editorial modification			Release 99	
				Release 00	

Reason for change: Note about segmentation of LCS related messages.

Clauses affected: 6

Other specs affected:

Other 3G core specifications		→ List of CRs:	LCS CR to 08.08
Other GSM core specifications	X	→ List of CRs:	
MS test specifications		→ List of CRs:	
BSS test specifications		→ List of CRs:	
O&M specifications		→ List of CRs:	

Other comments:


help.doc

<--------- double-click here for help and instructions on how to create a CR.

6 BSSMAP messages transferred on the E-interface

The following BSSMAP messages, defined in GSM 08.08 subclause 3.2.1, are transferred on the E-interface:

ASSIGNMENT REQUEST (MSC-A -> MSC-I)

Excluded information element: CIRCUIT IDENTITY CODE

ASSIGNMENT COMPLETE (MSC-I -> MSC-A)

Excluded information element: CIRCUIT POOL, CIRCUIT IDENTITY CODE

ASSIGNMENT FAILURE (MSC-I -> MSC-A)

Excluded information elements: CIRCUIT POOL, CIRCUIT POOL LIST

* HANDOVER REQUEST (MSC-A -> MSC-T and MSC-I -> MSC-A)

Excluded information element: CIRCUIT IDENTITY CODE

* HANDOVER REQUEST ACKNOWLEDGE (MSC-T -> MSC-A and MSC-A -> MSC-I)

Excluded information element: CIRCUIT POOL, CIRCUIT IDENTITY CODE

* HANDOVER COMPLETE (MSC-T -> MSC-A)

* HANDOVER FAILURE (MSC-T -> MSC-A and MSC-I -> MSC-A)

Excluded information elements: CIRCUIT POOL, CIRCUIT POOL LIST

HANDOVER PERFORMED (MSC-I -> MSC-A)

* HANDOVER DETECT (MSC-T -> MSC-A)

CLEAR REQUEST (MSC-I -> MSC-A)

SAPI "n" REJECT (MSC-I -> MSC-A)

CONFUSION (MSC-T -> MSC-A, MSC-A -> MSC-T,
MSC-I -> MSC-A and MSC-A -> MSC-I)

\# MSC INVOKE TRACE (MSC-A -> MSC-I)

\# BSS INVOKE TRACE (MSC-I -> MSC-A and MSC-A -> MSC-T)

CIPHER MODE COMMAND (MSC-A -> MSC-I)

CIPHER MODE COMPLETE (MSC-I -> MSC-A)

CIPHER MODE REJECT (MSC-I -> MSC-A)

** QUEUING INDICATION (MSC-T -> MSC-A, MSC-I -> MSC-A,
and MSC-A -> MSC-I)

CLASSMARK UPDATE (MSC-I -> MSC-A and MSC-A -> MSC-T)

CLASSMARK REQUEST (MSC-A -> MSC-I)

CONNECTION ORIENTED INFORMATION (MSC-I -> MSC-A, MSC-A->MSC-I)

PERFORM LOCATION REQUEST	(MSC-I->MSC-A, MSC-A -> MSC-I)
PERFORM LOCATION ABORT	(MSC-I->MSC-A, MSC-A -> MSC-I)
PERFORM LOCATION RESPONSE	(MSC-I -> MSC-A, MSC-A->MSC-I)

All other BSSMAP messages shall be considered as non-existent on the E-interface.

Note: Segmentation procedures for LCS CONNECTION ORIENTED INFORMATION message in GSM 08.08 apply to the corresponding message on the E-interface.

Some of the messages above are qualified by *, ** or #. This signifies whether the message, when sent on the E-interface, is considered as:

- handover related message (*);
- handover related when sent as a response to HANDOVER REQUEST (**); or
- trace related message (#).

3GPP TSG-CN-WG1, Meeting #8
25-29 October 1999
Kobe, Japan

Tdoc N1-99C15

CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

09.08	CR	A139	Current Version:	7.0.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSGN1	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑	for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: (U)SIM [ ] ME [ ] UTRAN / Radio [ ] Core Network [X]
(at least one should be marked with an X)

Source: T1P1.5 **Date:** 25.10.99

Subject: Addition of further LCS functionality in GSM Release 98

Work item: Location Services (LCS)

Category: *(only one category Shall be marked With an X)*

F	Correction		**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature	X		Release 98	X
D	Editorial modification			Release 99	
				Release 00	

Reason for change: Replacing LOCATION INFORMATION COMMAND and LOCATION INFORMATION REPORT messages with CONNECTION ORIENTED INFORMATION message. Location request related messages PERFORM LOCATION REQUEST, PERFORM LOCATION RESPONSE and PERFORM LOCATION ABORT needs to be added in BSSMAP messages transferred on the E-interface.

Clauses affected: 6

Other specs affected:

Other 3G core specifications		→ List of CRs:	
Other GSM core specifications	X	→ List of CRs:	LCS CR to 08.08
MS test specifications		→ List of CRs:	
BSS test specifications		→ List of CRs:	
O&M specifications		→ List of CRs:	

Other comments:


help.doc

<--------- double-click here for help and instructions on how to create a CR.

6 BSSMAP messages transferred on the E-interface

The following BSSMAP messages, defined in GSM 08.08 subclause 3.2.1, are transferred on the E-interface:

ASSIGNMENT REQUEST (MSC-A -> MSC-I)

Excluded information element: CIRCUIT IDENTITY CODE

ASSIGNMENT COMPLETE (MSC-I -> MSC-A)

Excluded information element: CIRCUIT POOL, CIRCUIT IDENTITY CODE

ASSIGNMENT FAILURE (MSC-I -> MSC-A)

Excluded information elements: CIRCUIT POOL, CIRCUIT POOL LIST

* HANDOVER REQUEST (MSC-A -> MSC-T and MSC-I -> MSC-A)

Excluded information element: CIRCUIT IDENTITY CODE

* HANDOVER REQUEST ACKNOWLEDGE (MSC-T -> MSC-A and MSC-A -> MSC-I)

Excluded information element: CIRCUIT POOL, CIRCUIT IDENTITY CODE

* HANDOVER COMPLETE (MSC-T -> MSC-A)

* HANDOVER FAILURE (MSC-T -> MSC-A and MSC-I -> MSC-A)

Excluded information elements: CIRCUIT POOL, CIRCUIT POOL LIST

HANDOVER PERFORMED (MSC-I -> MSC-A)

* HANDOVER DETECT (MSC-T -> MSC-A)

CLEAR REQUEST (MSC-I -> MSC-A)

SAPI "n" REJECT (MSC-I -> MSC-A)

CONFUSION (MSC-T -> MSC-A, MSC-A -> MSC-T,
MSC-I -> MSC-A and MSC-A -> MSC-I)

\# MSC INVOKE TRACE (MSC-A -> MSC-I)

\# BSS INVOKE TRACE (MSC-I -> MSC-A and MSC-A -> MSC-T)

CIPHER MODE COMMAND (MSC-A -> MSC-I)

CIPHER MODE COMPLETE (MSC-I -> MSC-A)

CIPHER MODE REJECT (MSC-I -> MSC-A)

** QUEUING INDICATION (MSC-T -> MSC-A, MSC-I -> MSC-A,
and MSC-A -> MSC-I)

CLASSMARK UPDATE (MSC-I -> MSC-A and MSC-A -> MSC-T)

CLASSMARK REQUEST (MSC-A -> MSC-I)

~~LOCATION INFORMATION COMMAND (MSC-A -> MSC-I)~~

CONNECTION ORIENTED INFORMATION~~LOCATION INFORMATION REPORT~~ (MSC-I -> MSC-A, MSC-A->MSC-I)

PERFORM LOCATION REQUEST	(MSC-I->MSC-A, MSC-A -> MSC-I)
PERFORM LOCATION ABORT	(MSC-I->MSC-A, MSC-A -> MSC-I)
PERFORM LOCATION RESPONSE	(MSC-I -> MSC-A, MSC-A->MSC-I)

All other BSSMAP messages shall be considered as non-existent on the E-interface.

Some of the messages above are qualified by *, ** or #. This signifies whether the message, when sent on the E-interface, is considered as:

- handover related message (*);
- handover related when sent as a response to HANDOVER REQUEST (**); or
- trace related message (#).

3GPP TSG CN WG1/SMG3 WPA #9 *Document* ***N1-99F18***

Revision of N1-99D70

e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

Bad Aibling, Germany, 30 Nov - 3 Dec 1999

CHANGE REQUEST

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09.31	CR	A001r2	Current Version:	7.0.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: SMG#30bis *list expected approval meeting # here ↑*	for approval	X	strategic		*(for SMG use only)*
	for information		non-strategic	X	

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: *(at least one should be marked with an X)* (U)SIM [ ] ME [ ] UTRAN / Radio [ ] Core Network [X]

Source: T1P1.5 **Date:** 3 Dec 1999

Subject: Addition of further LCS functionality in GSM Release 98

Work item: Location Services

Category: *(only one category shall be marked with an X)*

F	Correction		**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature	X		Release 98	X
D	Editorial modification			Release 99	
				Release 00	

Reason for change:

Segmentation introduced to intermediate transport layer.
Modifications to correct GPS Assitance Data IE and the coding of Satellite Related Data.

New LCS Cause values are needed to indicate failure of positioning due to not supported functionality (Facility not supported), ongoing inter-BSC handover (Handover ongoing) and overload situation (Congestion).

Cell Global Identification and Location Area Identification should be possible as alternatives of Network Element Identity IE in order to ensure that cell or location area can be identified uniquely.

Couple of editorial corrections has been made.

Clauses affected: 5, 9, 10

Other specs affected:

Other 3G core specifications	[ ]	→ List of CRs:
Other GSM core specifications	[ ]	→ List of CRs:
MS test specifications	[ ]	→ List of CRs:
BSS test specifications	[ ]	→ List of CRs:
O&M specifications	[ ]	→ List of CRs:

Other comments:

<--------- double-click here for help and instructions on how to create a CR.

5. *** MODIFIED SECTION ***

5.2. Connection Oriented Information Transfer

The Connection Oriented Information transfer procedure is applicable to the Lb and Ls interfaces. It enables both way transfer of BSSLAP messages between an SMLC and the BSC serving a target MS. The initiator of the procedure can be either the BSC serving the target MS, the visited MSC for the target MS or the SMLC. The procedure is only valid while a location request procedure for the target MS is ongoing. The procedure makes use of SCCP connection oriented signaling on the Lb and Ls interfaces and uses the same SCCP connection as the location request procedure for the particular target MS.

5.2.1. Successful Operation

An SMLC, MSC or BSC with a BSSLAP message or message segment to transfer concerning a particular target MS sends a BSSMAP-LE Connection Oriented Information message to a recipient carrying the following parameters:

BSSLAP APDU (M)

If the sender is an NSS based SMLC, the message is transferred to the VMSC for the target MS. The recipient MSC shall then transfer the message to the serving BSC using procedures defined in GSM 08.08.

If the sender is a BSS based SMLC, the message is transferred to the serving BSC for the target MS. The BSC shall then perform the positioning operation requested by the BSSLAP APDU (refer to GSM 08.71). If the BSSLAP APDU contains an RRLP APDU, the BSC shall transfer this to the target MS.

If the sender is a BSC or MSC and the intended recipient is the SMLC for a target MS, the message is transferred to the SMLC. The SMLC shall then perform interpretation of the BSSLAP APDU.

5.2.2. Abnormal Conditions

At an intermediate entity, if a received BSSMAP-LE Connection Oriented Information message contains unrecognized information or if the message cannot be sent on, the message shall be discarded.

At the receipient entity. if a received BSSMAP-LE Connectioin Oriented Information message contains invalid or unrecognized information as defined for BSSAP-LE, any ongoing positioning procedure shall be terminated and associated resources may be released. If the receipient is a BSC, the SMLC shall be notified – e.g. using a BSSLAP Reject or Abort. If the receipient is an SMLC, a new positioning attempt (e.g. using a different position method) may be started.

~~5.2.3~~5.2.3. Segmentation

If the size of an embedded BSSLAP message is too large to fit into one BSSMAP-LE message, the sending entity divides the BSSLAP message to a necessary number of BSSMAP-LE messages. In the BSSLAP APDU IE it includes as many octets as possible. The sending entity sends the bits of the BSSLAP message in order from the beginning of the BSSLAP message.

The message identification and segment numbering mechanisms are not required to support segmentation for connection oriented information transfer.

In case of handover interrupting the information transfer procedure, the exception procedures described in GSM 03.71 shall be used.

5.3. Connectionless Information Transfer

The Connectionless Information transfer procedure is applicable to the Lb, Ls and Lp interfaces. It enables both way transfer of LLP messages between an SMLC and a Type B LMU. The procedure also enables both way transfer of SMLCPP messages between two SMLCs. The initiator of the procedure can be a BSC, MSC or SMLC. The procedure makes use of SCCP connectionless signaling.

5.3.1. Successful Operation

An SMLC, MSC or BSC needing to transfer an LLP message concerning a Type B LMU or an SMLCPP message sends a BSSMAP-LE Connectionless Information message to a recipient carrying the following parameters:

Source Entity (M)

Destination Entity (M)

Return Error Request (O)

APDU (M)

The source entity identifies the sender. The recipient entity identifies the final destination. The Return Error Request may be included to request notification in the event of unsuccessful transfer. If the recipient entity is not the final destination, the recipient shall transfer the BSSMAP-LE Connectionless Information message to either the final destination or an intermediate MSC or BSC capable of onward transfer to the final destination.

5.3.2. Unsuccessful Operation

If the message cannot be transferred by an intermediate entity and the Return Error Request is not included, the message shall be discarded. If the Return Error Request is included, the intermediate entity shall send a BSSMAP-LE Connectionless Information message to, or towards, the original source containing the following parameters:

Source Entity (M)

Destination Entity (M)

Return Error Cause (M)

APDU (C)

The Source entity shall indicate the Destination Entity in the original received message. The Destination Entity shall indicate the Source Entity in the original message. The Return Error cause shall indicate the reason for unsuccessful transfer. The APDU shall contain any originally received APDU.

If a received BSSMAP-LE Connectionless Information message containing a Return Error Cause cannot be transferred by an intermediate entity, it shall be discarded with no return error message.

5.3.3. Abnormal Conditions

At an intermediate entity, if a received BSSMAP-LE Connectionless Information message contains unrecognized or invalid information, the message shall be discarded.

At the recipient entity. if a received BSSMAP-LE Connectioinless Information message contains invalid or unrecognized information as defined for BSSAP-LE, the message shall be discarded.

~~5.3.4~~5.3.4. Segmentation

If the size of an embedded LLP or SMLCPP message is too large to fit into one BSSMAP-LE message, the sending entity divides the LLP or SMLCPP message to a necessary number of BSSMAP-LE messages. In the APDU IE it includes as many octets as possible. The sending entity sends the bits of the LLP or SMLCPP message in order from the beginning of the message.

The order number of a segment in the Segment Number field in the APDU IE is incremented by one starting from one, i.e. the value is 1 for the first segment, 2 for the next and so on. The segment number '0' is reserved to indicate that segment numbering is not used – e.g. because the lower layers ensure in sequence transfer of message segments. If segment numbering is used, the receiving entity recognizes that a segment is missing or duplicated, when

- There is more than one segment with the same segment number and same Message ID.
- The segment number does not increase by steps of one.

If the recipient recognizes a missing or duplicated element, it shall discard the entire message (i.e. all received segment with the message ID).

The message identity in the Message ID field in the APDU IE is used to recognize a particular message to which that segment belongs. The sending entity can select any of the available values (1-255) that is not currently used between it and the receiving entity. The message ID value '0' is reserved to indicate that individual message identification is not used – e.g. because the lower layers support segmentation or ensure correct in sequence transfer of individual segments and messages.

In case of handover interrupting the information transfer procedure, the exception procedures described in GSM 03.71 shall be used.

*** NEXT MODIFIED SECTION ***

9. Message Functional Definitions and Contents

9.1 BSSMAP-LE PERFORM LOCATION REQUEST message

This message is sent to request a location estimate for a target MS and contains sufficient information to enable location according to the required QoS using any positioning method supported by the PLMN and, where necessary, MS. The message is also used to request LCS assistance data transfer to an MS or request a deciphering keys for LCS broadcast assistance data The message can be sent from the BSC to the SMLC and from the MSC to the SMLC.

Table 9.1: BSSMAP-LE PERFORM LOCATION REQUEST message content

Information element	Type / Reference	Presence	Format	Length in octets
Message type	Message Type ~~17.1.1.1~~	M	V	1
Location Type	Location Type	M	TLV	4
Cell Identifier	Cell Identifier	M	TLV	3-10
Classmark Information Type 3	Classmark Information Type 3	O	TLV	2-n
LCS Client Type	LCS Client Type	O	TLV	3
Chosen Channel	Chosen Channel	O	TLV	2-n
LCS Priority	LCS Priority	O	TLV	3
LCS QoS	LCS QoS	O	TLV	6
GPS Assistance Data	GPS Assistance Data	O	TLV	3-n
BSSLAP APDU	APDU	O	TLV	2-n

9.1.1 Location Type

This parameter defines the type of locatin information being requested.

9.1.2 Cell Identifier

This parameter gives the current cell location of the target MS. The format shall either be the cell global identification or the LAC plus CI form.

9.1.3 Classmark Information Type 3

This parameter indicates the positioning methods supported by the MS as obtained from the MS Classmark 3 received earlier from the target MS.

9.1.4 LCS Client Type

This parameter defines the type of the originating LCS Client. It may be included to assist an SMLC to appropriately prioritize a location request

9.1.5 Chosen Channel

This parameter defines the type of radio channel currently assigned to the target MS.

9.1.6 LCS Priority

This parameter defines the priority of the location request.

9.1.6 LCS QoS

This parameter provides the required Quality of Service for the LCS Request. Quality of Service may include horizontal accuracy, vertical accuracy and allowed response time.

9.1.7 GPS Assistance Data

This parameter identifies the specific GPS assistance data that may be requested.

9.1.8 BSSLAP APDU

This parameter provides additional measurements (e.g. timing advance) for the target MS from the BSC. The measurements are contained inside a BSSLAP APDU.

9.2 BSSMAP-LE PERFORM LOCATION RESPONSE message

This message is sent in response to a BSSMAP-LE Perform Location Request to return a successful location estimate for a target MS or to indicate some failure in obtaining this. The message is also sent in response to a BSSMAP-LE Perform Location Request to return deciphering keys or an indication that LCS assistance data has been successfully delivered to an MS. The message can be sent from the SMLC to the BSC and from the SMLC to the MSC.

Table 9.2: BSSMAP-LE PERFORM LOCATION RESPONSE message content

Information element	Type / Reference	Presence	Format	Length in octets
Message type	Message Type	M	V	1
Location Estimate	Geographic Location	C	TLV	2-22
Positioning Data	Positioning Data	O	TLV	2-n
Deciphering Keys	Deciphering Keys	O	TLV	10-n
LCS Cause	LCS Cause	O	TLV	3

9.2.1 Location Estimate

This parameter provides a location estimate for the target MS in the case of a successful location attempt.

9.2.2 Positioning Data

This parameter provides additional information for the positioning attempt from the SMLC.

9.2.3 Deciphering Keys

This parameter provides one or more deciphering keys that can be used to decode LCS broadcast assitance data by the MS. The SMLC shall provide the current deciphering key for the MS's present location. The SMLC may also provide additional deciphering keys applicable either after the current deciphering key or to data broadcast by other SMLCs.

9.2.4 LCS Cause

The LCS Cause is included if and only if a requested location estimate was not successfully obtained (e.g. location estimate not available or does not meet the required QoS), requested deciphering keys were not successfully returned or requested LCS assistance data was not successfully transferred to the MS. The parameter provides the reason for the failure. If the LCS Cause is included, the Location Estimate~~, Current Deciphering Key~~ and ~~Next~~ Deciphering Key shall not be included.

9.3 BSSMAP-LE PERFORM LOCATION ABORT message

This message is sent by the instigator of a location request to abort the positioning attempt or the request for assistance data or deciphering keys. This message can be sent from the MSC to the SMLC and from the BSC to the SMLC.

Table 9.3: BSSMAP-LE PERFORM LOCATION ABORT message content

Information element	Type / Reference	Presence	Format	Length in octets
Message type	Message Type	M	V	1
LCS Cause	LCS Cause	M	TLV	3

9.3.1 LCS Cause

The LCS Cause provides the reason for the aborting the location attempt.

9.4 BSSMAP-LE LMU CONNECTION REQUEST message

This message is sent to request the establishment of a signaling connection between an LMU and an SMLC. The message can be sent from an SMLC to an MSC and from an MSC to an SMLC.

Table 9.4: BSSMAP-LE LMU CONNECTION REQUEST message content

Information element	Type / Reference	Presence	Format	Length in octets
Message type	Message Type	M	V	1
IMSI	IMSI	M	TLV	3-10
Sender Address	Signaling Point Code	O	TLV	2-n
Security	Security	O	TLV	2-n
Call Number	ISDN Address	O	TLV	3-n

9.4.1 IMSI

This parameter identifies the LMU using its E.212 IMSI.

9.4.2 Sender Address

This parameter provides the SS7 signaling point code for the sender of the message. The parameter is mandatory for message transfer between an MSC and SMLC on the Ls interface.

9.4.3 Security

This parameter indicates if authentication or ciphering are required for the LMU. This parameter may be included for message transfer from an SMLC. If the parameter is absent, authentication and ciphering shall be assumed not to be required.

9.4.4 Call Number

This parameter may be included in an LMU connection request sent by an MSC to enable the SMLC to subsequently establish a TCH to the LMU.

9.5 BSSMAP-LE LMU CONNECTION ACCEPT message

This message is sent in response to a BSSMAP-LE LMU Connection Request message to accept the establishment of a signaling connection between an LMU and an SMLC. The message can be sent from an SMLC to an MSC and from an MSC to an SMLC.

Table 9.5: BSSMAP-LE LMU CONNECTION ACCEPT message content

Information element	Type / Reference	Presence	Format	Length in octets
Message type	Message Type	M	V	1
Security	Security	O	TLV	3
Call Number	ISDN Address	O	TLV	3-n

9.5.1 Security

This parameter indicates if authentication or ciphering are required for the LMU. This parameter may be included for message transfer from an SMLC. If the parameter is absent, authentication and ciphering shall be assumed not to be required.

9.5.2 Call Number

This parameter may be included in an LMU connection accept sent by an MSC to enable the SMLC to subsequently establish a TCH to the LMU.

9.6 BSSMAP-LE LMU CONNECTION REJECT message

This message is sent in response to a BSSMAP-LE LMU Connection Request message to reject the establishment of a signaling connection between an LMU and an SMLC. The message can be sent from an SMLC to an MSC and from an MSC to an SMLC.

Table 9.6: BSSMAP-LE LMU CONNECTION REJECT~~REQUEST~~ message content

Information element	Type / Reference	Presence	Format	Length in octets
Message type	Message Type	M	V	1
Reject Cause	LMU Cause	M	TLV	3-10

9.6.1 Reject Cause

This parameter provides the reason for the rejection of an LMU connection.

9.7 BSSMAP-LE LMU CONNECTION RELEASE message

This message is sent to release a signaling connection between an LMU and an SMLC. The message can be sent from an SMLC to an MSC and from an MSC to an SMLC.

Table 9.7: BSSMAP-LE LMU CONNECTION RELEASE message content

Information element	Type / Reference	Presence	Format	Length in octets
Message type	Message Type	M	V	1
Release Cause	LMU Cause	M	TLV	3-10

9.7.1 Release Cause

This parameter provides the reason for the release of an LMU connection.

9.8 BSSMAP-LE CONNECTION ORIENTED INFORMATION message

This message is sent in association with an existing signaling connection between an SMLC and another enity to transfer information between the SMLC and other entity belonging to a higher level protocol. The message can be sent from an SMLC to an MSC, from an MSC to an SMLC, from a BSC to an SMLC and from an SMLC to a BSC.

Table 9.8: BSSMAP-LE CONNECTION ORIENTED INFORMATION message content

Information element	Type / Reference	Presence	Format	Length in octets
Message type	Message Type	M	V	1
BSSLAP APDU	APDU	M	TLV	3-n

9.8.1 BSSLAP APDU

This parameter contains a BSSLAP message.

9.9 BSSMAP-LE CONNECTIONLESS INFORMATION message

This message conveys signaling information associated with a higher protocol level between an SMLC and another entity when there is no existing signaling connection association. The message can be sent from an SMLC to an MSC, from an MSC to an SMLC, from a BSC to an SMLC, from an SMLC to a BSC and from an SMLC to another SMLC..

Table 9.9: BSSMAP-LE CONNECTIONLESS INFORMATION message content

Information element	Type / Reference	Presence	Format	Length in octets
Message type	Message Type	M	V	1
Source Identity	Network Element Identity	M	TLV	3-n
Destination Identity	Network Element Identity	M	TLV	3-n
APDU	APDU	O	TLV	3-n
Return Error Request	Return Error Request	O	TLV	2
Return Error Cause	Return Error Cause	O	TLV	3

9.9.1 Source Identity

This parameter identifies the original source of the message. The original source can either be an SMLC or a Type B LMU. The source is identified by association with either a location area or a cell site.

9.9.2 Destination Identity

This parameter identifies the final destination of the message. The final destination can either be an SMLC or a Type B LMU. The destination is identified by association with either a location area or a cell site.

9.9.3 APDU

This parameter contains an embedded APDU. For information transfer between an SMLC and Type B LMU this shall be an LLP APDU. For information transfer between two peer SMLCs, this shall be an SMLCPP APDU.

9.9.4 Return Error Request

This pareameter may be included to request an error response if BSSMAP-LE message cannot be delivered successfully to its final destination. This parameter shall not be included if the Return Error cause is present.

9.9.5 Return Error Cause

This parameter indicates an error response for a BSSMAP-LE connectionless information message that could not be delivered to its final destination. The APDU should be present and the same as the APDU in the original undelivered

message. The source and destination identies shall be included and the same as the destination and source identities, respectively, in the original undelivered message.

**** Next Modified Section *****

10.2 Information Element Identifiers

The next list shows the coding of the Information Element Identifiers used in the present document.

Table 10.2/GSM 09.31: Information Element Identifier coding

8 7 6 5 4 3 2 1	Information element	*Reference*
0 0 1 1 1 1 1 0	LCS QoS	*10.15*
0 0 1 1 1 1 1 1	LCS Priority	*10.14*
0 1 0 0 0 0 1 1	Location Type	*10.16*
0 1 0 0 0 1 0 0	Geographic Location	*10.8*
0 1 0 0 0 1 0 1	Positioning Data	*10.18*
0 1 0 0 0 1 1 0	LCS Cause	*10.12*
0 1 0 0 0 1 1 1	LCS Client Type	*10.13*
0 1 0 0 1 0 0 0	APDU	*10.3*
0 1 0 0 1 0 0 1	Network Element Identity	*10.17*
0 1 0 0 1 0 1 0	GPS Assistance Data	*10.9*
0 1 0 0 1 0 1 1	Deciphering Keys	*10.7*
0 1 0 0 1 1 0 0	Return Error Request	*10.19*
0 1 0 0 1 1 0 1	Return Error Cause	*10.20*
0 0 0 1 0 0 1 1	Classmark Information Type 3	*10.6*
0 0 0 0 0 1 0 1	Cell Identifier	*10.4*
0 0 1 0 0 0 0 1	Chosen Channel	*10.5*
0 0 0 0 0 0 0 0	IMSI	*10.10*
0 0 0 0 0 0 0 1	ISDN Address	*10.11*
0 0 0 0 0 0 1 0	Security	*10.21*
0 0 0 0 0 0 1 1	Signaling Point Code	*10.22*

10.3 APDU

This is a variable length information element that conveys an embedded message or message segment associated with a higher level protocol.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2-3	Length indicator							
Octet 43	Spare	Protocol ID						
Octet 5	Spare			S	Segment Number			
Octet 6	Message ID							
Octet 74 to Octet n	The rest of the information element contains a message whose content and encoding are defined according to the protocol ID.							

Figure 10.3.1/GSM 09.31: APDU IE

Length Indicator (octets 2-3)

The most significant bit is bit 8 of Octet 2, and the least significant bit is bit 1 in Octet 3. The length indicator defines the total number of octets after length indicator.

Protocol ID (bits 7-1 of octet 4~~3~~)

0000000 reserved
0000001 BSSLAP
0000010 LLP
0000011 SMLCPP

S (Segmentation Bit, bit 5~~8~~ of octet 5~~3~~)

0 final segment in a segmented message or a non-segmented message or segmenting not indicated
1 non-final segment in a segmented message

Segment Number (bits 4-1 of octet 5)

This field contains a 4 bit binary representation of the segment number. The first segment has the value '0000', the next '0001', and so on. The value '0' indicates that segment numbering is not used.

Message ID (octet 6)

This field contains a 8 bit binary representation of the message identity, i.e. values 0-255 are possible.

This field is used to identify to which messages different segments belong to. The value '0' indicates that message identification is not used.

Embedded Message (octets 7~~4~~-n)

BSSLAP the embedded message is as defined in GSM 08.71
LLP the embedded message contains a Facility Information Element as defined in GSM 04.71 excluding the Facility IEI and length of Facility IEI octets defined in GSM 04.71.

SMLCPP the embedded message is as defined in GSM 08.31

*** NEXT MODIFIED SECTION ***

10.9 GPS Assistance Data

This is a variable length information element identifying the GPS assistance data requested for an MS.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	H	G	F	E	D	C	B	A
Octet 4	spare							
~~**Octet 3**~~	~~spare~~					~~Eph~~	~~ACQ~~	~~SAT~~
Octet 5~~4~~ to Octet 8+2n	Satellite related data							

Figure 10.9.1/GSM 09.31: GPS Assistance Data IE

Octet 3
bit A Almanac
0 : Almanac is not requested
1 : Almanac is requested

bit B UTC Model
0 : UTC Model is not requested
1 : UTC Model is requested

bit C Ionospheric Model
0 : Ionospheric Model is not requested
1 : Ionospheric Model is requested

bit D Navigation Model
0 : Navigation Model is not requested – octets 5 to 8+2n are not present
1 : Navigation Model is requested – octets 5 to 8+2n are present

bit E DGPS Corrections
0 : DGPS Corrections are not requested
1 : DGPS Corrections are requested

bit F Reference Location
0 : Reference Location is not requested
1 : Reference Location is requested

bit G Reference Time
0 : Reference Time is not requested
1 : Reference Time is requested

bit H Acquisition Assistance
0: Acquisition Assistance is not requested
1: Acquisition Assistance is requested

At least one of bits A, B, C, D, E, F, G or H, shall be set to the value "1".

~~SAT – Satellite related data (bit 1 of octet 3)~~
~~0 : Satellite related data is not requested – octets 4 to 8+2n are not present~~
~~1 : Satellite related data is requested – octets 4 to 8+2n are present~~

~~ACQ – Acquisition Assistance (bit 2 of octet 3)~~
~~0 : Acquisition Assistance is not requested~~
~~1 : Acquisition Assistance is requested~~

~~Eph – Ephemeris Compression (bit 3 of octet 3)~~
~~This field indicates the compression method for ephemeris update.~~
~~0: Ephemeris compression can be incorporated into requested Navigation Model information.~~
~~1: Ephemeris compression cannot be incorporated in requested Navigation Model information.~~

	8	7	6	5	4	3	2	1
~~**Octet 4**~~	~~H~~	~~G~~	~~F~~	~~E~~	~~D~~	~~C~~	~~B~~	~~A~~
Octet 5	GPS Week		Eph	Spare				
Octet 6	GPS Week							
Octet 7	GPS_Toe							
Octet 8	~~Spare~~ NSAT				T-Toe limit			
Octet 9	spare		SatID 1					
Octet 10	IODE 1							
…								
Octet 7+2n	spare		SatID n					
Octet 8+2n	IODE n							

Figure 10.9.2/GSM 09.31: Coding of Satellite Related Data

~~Octets 4 and 5~~

~~bit A Almanac~~
~~0 : Almanac is not requested~~
~~1 : Almanac is requested~~

~~bit B UTC Model~~
~~0 : UTC Model is not requested~~
~~1 : UTC Model is requested~~

~~bit C Ionospheric Model~~
~~0 : Ionospheric Model is not requested~~
~~1 : Ionospheric Model is requested~~

~~bit D Navigation Model~~
~~0 : Navigation Model is not requested~~
~~1 : Navigation Model is requested~~

~~bit E DGPS Corrections~~
~~0 : DGPS Corrections are not requested~~
~~1 : DGPS Corrections are requested~~

~~bit F Reference Location~~
~~0 : Reference Location is not requested~~
~~1 : Reference Location is requested~~

~~bit G Reference Time~~
~~0 : Reference Time is not requested~~
~~1 : Reference Time is requested~~

~~bit H spare~~
~~At least one of bits A, B, C, D, E, F, or G shall be set to the value "1".~~

Eph – Ephemeris Compression (bit 6 of octet 5~~4~~)
This field indicates the compression method for ephemeris update.
0: Ephemeris compression can be incorporated into requested Navigation Model information.
1: Ephemeris compression cannot be incorporated in requested Navigation Model information.

GPS Week (bits 7-8 octet 5 and octet 6)
This field contains a 10 bit binary representation of the GPS Week of the assistance currently held by the MS. The most significant bit of the GPS Week is bit 8 in octet 5 and the least significant bit is bit 1 in octet 6.

GPS_Toe (octet 7)
This field contains a binary representation of the GPS time of ephemeris in hours of the latest ephemeris set contained in handset memory (range 0-167).

NSAT (octet 8, bits 5-8~~4-7~~)
This field containss a binary representation of the number of satellites to be considered for the current GPS assistance request.

T-Toe limit (octet 8, bits 1-4~~3~~)
This field contains a binary representation of the ephemeris age tolerance of the MS to the network in hours (range 0-10).

SatID x (x = 1,2, ... n) (octet 7 + 2x, bits 1-6)
This field contains a binary representation of the identity of a satellite for which the assistance request is applicable. The number of satellite fields is indicated in the field NSAT.

IODE x (x = 1,2, ... n) (octet 8 + 2x)
This field contains a binary representation of the Issue of Data Ephemeris, which identifies the sequence number for the satellite x (x = 1, 2, …, n).

*** NEXT MODIFIED SECTION ***

10.12 LCS Cause

The LCS Cause parameter is of variable length IE and provides the reason for an unsuccessful location request.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	Cause value							
Octet 4	Diagnostic value (note 1)							

note 1: the inclusion of this octet depends on the cause value

Figure 10.12.1/GSM 09.31: LCS Cause IE

Table 10.12.1/GSM 09.31: Cause value

LCS Cause value (octet 3~~2~~) Bits 8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	Unspecified
0 0 0 0 0 0 0 1	System Failure
0 0 0 0 0 0 1 0	Protocol Error
0 0 0 0 0 0 1 1	Data missing in position request
0 0 0 0 0 1 0 0	Unexpected data value in position request
0 0 0 0 0 1 0 1	Position method failure
0 0 0 0 0 1 1 0	Target MS Unreachable
0 0 0 0 0 1 1 1	Location request aborted
0 0 0 0 1 0 0 0	Facility not supported
0 0 0 0 1 0 0 1	Inter-BSC Handover Ongoing
0 0 0 0 1 0 1 0	Congestion
0 0 0 0 1 0 1~~0~~ 1~~0~~ to 1 1 1 1 1 1 1 1	*unspecified* in this version of the protocol

Diagnostic value (octet 4): this octet may be included if the cause value indicates “position method failure”, the binary encoding of this octet shall encode the same set of values as defined for the PositionMethodFailure-Diagnostic in GSM 09.02. Values outside those defined in GSM 09.02 shall be ignored by a receiver.

10.13 LCS Client Type

This information element identifies the type of LCS Client.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	Client Category				Client Subtype			

Figure 10.13.1/GSM 09.31: LCS Client Type IE

The client category (bits 8-5 of octet 3~~2~~) and the client subtype (bits 4-1 of octet 3~~2~~) are coded as follows.

Client Category	Client Subtype	Explanation
0000		Value Added Client
	0000	unspecified
	all values	reserved
0010		PLMN operator
	0000	unspecified
	0001	broadcast service
	0010	O&M
	0011	anonymous statistics
	0100	Target MS service support
	other values	reserved
0011		Emergency services
	0000	unspecified
	other values	reserved
0100		Lawful Intercept services
	0000	unspecified
	other values	reserved
0101 – 1111	all values	reserved

10.14 LCS Priority

This information element defines the priority level of a location request.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	This octet is coded as the LCS-Priority octet in GSM 09.02.							

Figure 10.14.1/GSM 09.31: LCS Priority IE

10.15 LCS QoS

This information element defines the Quality of Service for a location request.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	spare							VERT
Octet 4	HA	Horizontal Accuracy						
Octet 5	VA	Vertical Accuracy						
Octet 6	RT		spare					

Figure 10.15.1/GSM 09.31: LCS QoS ~~Cell Identifier~~ IE

Octet 3
VERT = vertical coordinate indicator
0 : vertical coordinate not requested
1 : vertical coordinate is requested

Octet 4
bit 8 HA = horizontal accuracy indicator
0 : Horizontal Accuracy is not specified
1 : Horizontal Accuracy is specified
bits 7-1 Horizontal Accuracy :
spare (set all zeroes) if HA=0
set to 7 bit uncertainty code in GSM 03.32 if HA=1

Octet 5 – applicable only if VERT = 1
bit 8 VA = vertical accuracy indicator
0 : Vertical Accuracy is not specified
1 : Vertical Accuracy is specified
bits 7-1 Vertical Accuracy :
spare (set all zeroes) if VA=0
set to 7 bit uncertainty altitude code in GSM 03.32 if VA=1

Octet 6
bits 8-7 RT = response time category
00 : Response Time is not specified
01 : Low Delay
10 : Delay Tolerant
11 : reserved
bits 6-1 spare

10.16 Location Type

This is a variable length information element defining the type of location information being requested.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	Location Information							
Octet 4	Positioning Method							

Figure 10.16.1/GSM 09.31: Location Type IE

Coding of location information (octet 3):

00000000 current geographic location
00000001 location assistance information for the target MS
00000010 deciphering keys for broadcast assistance data for the target MS
all other values are reserved

Positioning Method (octet 4)
This octet shall be included if the location information in octet 3 indicates “location assistance information for the target MS” and shall be omitted otherwise.

00000000 reserved
00000001 Mobile Assisted E-OTD
00000010 Mobile Based E-OTD
00000011 GPS
all other values are reserved

10.17 Network Element Identity

This is a variable length information element identifying a network element. by association with either a designated cell site or a designated location area.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	spare				Identity Discrminator			
Octet 4 to Octet n	Network Element Identification							

Figure 10.17.1/GSM 09.31: Network Element Identity IE

Identity Discriminator (bits 4-1 of octet 3)

0000 Identification using the MCC + MNC + LAC + CI as defined in GSM 03.03
0001 Identification using LAC + CI as defined in GSM 03.03
0100 Identification using the MCC + MNC + LAC as defined in GSM 03.03
0101 Identification using the LAC as defined in GSM 03.03
All other values are reserved.

	8	7	6	5	4	3	2	1
Octet 4 to Octet 10	MCC+MNC+LAC+CI							

Figure 10.17.1/GSM 09.31: Coding of Network Element Identification using the MCC + MNC + LAC + CI

Octets 4 to 10 are coded as the Cell Identification of the Cell Identifier IE for Cell identification discriminator = 0000 defined in GSM 08.08.

	8	7	6	5	4	3	2	1
Octet 4 to Octet 7	LAC+CI							

Figure 10.17.2/GSM 09.31: Coding of Network Element Identification using the LAC + CI

Octets 4 to 7 are coded as the Cell Identification of the Cell Identifier IE for Cell identification discriminator = 0001 defined in GSM 08.08.

	8	7	6	5	4	3	2	1
Octet 4 to Octet 6	MCC+ MNC							
Octet 7 to Octet 8	LAC							

Figure 10.17.3/GSM 09.31: Coding of Network Element Identification using the MCC + MNC + LAC

Octets 4 to 8 are coded as the corresponding octets in the Cell Identification of the Cell Identifier List IE for Cell identification discriminator = 0100 defined in GSM 08.08.

	8	7	6	5	4	3	2	1
Octet 4	LAC							
Octet 5	LAC - continued							

Figure 10.17.24/GSM 09.31: Coding of Network Element Identification using the LAC

Octets 4 to 5 are coded as the corresponding octets in the Cell Identification of the Cell Identifier List IE for Cell identification discriminator = 0101 defined in GSM 08.08.

	~~8~~	~~7~~	~~6~~	~~5~~	~~4~~	~~3~~	~~2~~	~~1~~
~~Octet 4~~	~~LAC~~							
~~Octet 5~~	~~LAC - continued~~							
~~Octet 6~~	~~CI value~~							
~~Octet 7~~	~~CI value - continued~~							

~~**Figure 10.17.3/GSM 09.31: Coding of Network Element Identification using the LAC + CI**~~

10.18 Positioning Data

This is a variable length information element providing positioning data associated with a successful or unsuccessful locatiomn attempt for a target MS.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	spare				Positioning Data Discriminator			
Octets 4-4+m	Positioning Method 1							
Octets ..-4+nm	Positioning Method n							

Figure 10.18.1/GSM 09.31: Positioning Data IE

The positioning data discrminator (bits 4-1 of octet 3) defines the type of data provided for each positioning method:

0000 indicate usage of each positioning method that was attempted either successfully or unsuccessfully all other values are reserved

Coding of the postioning method octets for positioning data discrminator = 0:

Octet x	positioning method	usage

Coding of positioning method (bits 8-4):

00000 Timing Advance
00001 TOA
00010 AOA
00011 Mobile Assisted E-OTD
00100 Mobile Based E-OTD
00101 Mobile Assisted GPS
00110 Mobile Based GPS
00111 Conventional GPS
01000 to 01111 reserved for GSM
10000 to 11111 reserved for network specific positioning methods

Coding of usage (bits 3-1)

000 Attempted unsuccessfully due to failure or interruption
001 Attempted successfully: results not used to generate location
010 Attempted successfully: results used to verify but not generate location
011 Attempted successfully: results used to generate location
100 Attempted successfully: case where MS supports multiple mobile based positioning methods and the actual method or methods used by the MS cannot be determined

10.19 Return Error Request

The Return Error Request parameter indicates a request from the source of a BSSMAP-LE connectionless information message for an error response if the message cannot be delivered to its final destination.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							

Figure 10.19.1/GSM 09.31: Return Error Request IE

10.20 Return Error Cause

The Return Error Cause parameter provides the reason for unsuccessful delivery of a BSSMAP-LE Connectionless Information message to its final destination.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	Cause value							

Figure 10.20.1/GSM 09.31: Return Error Cause IE

Table 10.20.1/GSM 09.31: Cause value

Cause value (octet 3~~2~~) Bits 8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	Unspecified
0 0 0 0 0 0 0 1	System Failure
0 0 0 0 0 0 1 0	Protocol Error
0 0 0 0 0 0 1 1	Destination unknown
0 0 0 0 0 1 0 0	Destination unreachable
0 0 0 0 0 1 0 1	Congestion
0 0 0 0 0 1 1 0 to 1 1 1 1 1 1 1 1	*unspecified* in this version of the protocol

10.21 Security

This information element defines what security measures are needed for signaling to an LMU.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	spare						CIPH	AUTH

Figure 10.21.1/GSM 09.31: Security IE

Coding of octet 3:

bit 1 AUTH = authentication indicator
0 : authentication of LMU not required
1 : authentication of LMU required

bit 2 CIPH = ciphering indicator
0 : ciphering of LMU signaling data not required
1 : ciphering of LMU signaling data required

10.22 Signaling Point Code

This is a variable length information element providing that provides the signaling point code of a network element.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octets 3-n	Signaling Point Code value							

Figure 10.22.1/GSM 09.31: Signaling Point Code IE

There are three options for the coding of Signaling Point Code value; 2 octets containing a 14 bit ITU code, 3 octets containing a 24 bit unstructured code and 3 octets containing a 24 bit ANSI structured code.

Encoding of 14 bit ITU signaling point code:

Octet 3	0	0	signaling point code (high order bits)
Octets 4	signaling point code (low order bits)		

Encoding of a 24 bit unstructured signaling point code:

Octet 3	signaling point code (high order octet)
Octet 4	signaling point (second octet)
Octets 5	signaling point code (low order octet)

Encoding of a 24 bit ANSI structured signaling point code:

Octet 3	Network Identifier
Octet 4	Network Cluster
Octets 5	Network Cluster Member

3GPP/SMG Meeting #9
Bad Aibling, Germany, 30 Oct- 3-Dec. 1999

Document N1-99D71
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

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23.108	**CR**	**002**	Current Version:	3.0.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to:	CN1	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic	X	

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: *(at least one should be marked with an X)*	(U)SIM		ME		UTRAN / Radio	X	Core Network	X

Source:	Ericsson on behalf of T1P1.5
Subject:	mirror R99 LCS CR
Work item:	Location Services (LCS)

Category: *(only one category shall be marked with an X)*

Correction	
Corresponds to a correction in an earlier release	X
Addition of feature	
Functional modification of feature	
Editorial modification	

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change:	Mapping of Release'98
Clauses affected:	2

Other specs affected:

her 3G core specifications		→ List of CRs:
her GSM core specifications		→ List of CRs:
test specifications		→ List of CRs:
S test specifications		→ List of CRs:
M specifications		→ List of CRs:

Other comments:

2 Normative 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.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] GSM 01.02: "Digital cellular telecommunications system (Phase 2+); General description of a GSM Public Land Mobile Network (PLMN)".

[2] GSM 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[3] TS 22.002: "Digital cellular telecommunications system (Phase 2+); Bearer Services (BS) supported by a GSM Public Land Mobile Network (PLMN)".

[4] GSM 02.03: "Digital cellular telecommunications system (Phase 2+); Teleservices supported by a GSM Public Land Mobile Network (PLMN)".

[5] GSM 02.09: "Digital cellular telecommunications system (Phase 2+); Security aspects".

[6] TS 22.011: "Digital cellular telecommunications system (Phase 2+); Service accessibility".

[7] GSM 02.17: "Digital cellular telecommunications system (Phase 2+); Subscriber identity modules Functional characteristics".

[8] GSM 02.40: "Digital cellular telecommunications system (Phase 2+); Procedures for call progress indications".

[9] GSM 03.01: "Digital cellular telecommunications system (Phase 2+); Network functions".

[10] TS 23.003: "Digital cellular telecommunications system (Phase 2+); Numbering, addressing and identification".

[11] GSM 03.13: "Digital cellular telecommunications system (Phase 2+); Discontinuous Reception (DRX) in the GSM system".

[12] TS 23.014: "Digital cellular telecommunications system (Phase 2+); Support of Dual Tone Multi-Frequency signalling (DTMF) via the GSM system".

[12a] TS 23.071: “Digital cellular telecommunications system (Phase 2+); Location Services; Functional description – Stage 2”.

[13] GSM 03.20: "Digital cellular telecommunications system (Phase 2+); Security related network functions".

[14] TS 23.022: "Digital cellular telecommunications system (Phase 2+); Functions related to Mobile Station (MS) in idle mode".

[15] GSM 04.02: "Digital cellular telecommunications system (Phase 2+); GSM Public Land Mobile Network (PLMN) access reference configuration".

[16] GSM 04.03: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface Channel structures and access capabilities".

[17] GSM 04.04: "Digital cellular telecommunications system (Phase 2+); layer 1 General requirements".

[18] GSM 04.05: "Digital cellular telecommunications system (Phase 2+); Data Link (DL) layer General aspects".

[19] GSM 04.06: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface Data Link (DL) layer specification".

[20] TS 24.007: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface signalling layer 3 General aspects".

[21] TS 24.010: "Digital cellular telecommunications system ; Mobile radio interface layer 3 Supplementary services specification General aspects".

[22] GSM 04.11: "Digital cellular telecommunications system (Phase 2); Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface".

[23] GSM 04.12: "Digital cellular telecommunications system (Phase 2+); Short Message Service Cell Broadcast (SMSCB) support on the mobile radio interface".

[23a] TS 24.071: “Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 location services specification.

[23b] GSM 04.31 “Digital cellular telecommunication system (Phse 2+);Location Services;Mobile Station (MS) – Serving Mobile Location Centre (SMLC); Radio Resource LCS Protocol (RRLP)”.

[24] TS 24.080: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 supplementary services specification Formats and coding".

[25] TS 24.081: "Digital cellular telecommunications system (Phase 2+); Line identification supplementary services - Stage 3".

[26] TS 24.082: "Digital cellular telecommunications system (Phase 2+); Call Forwarding (CF) supplementary services - Stage 3".

[27] TS 24.083: "Digital cellular telecommunications system (Phase 2+); Call Waiting (CW) and Call Hold (HOLD) supplementary services - Stage 3".

[28] TS 24.084: "Digital cellular telecommunications system (Phase 2+); MultiParty (MPTY) supplementary services - Stage 3".

[29] TS 24.085: "Digital cellular telecommunications system (Phase 2+); Closed User Group (CUG) supplementary services - Stage 3".

[30] TS 24.086: "Digital cellular telecommunications system (Phase 2+); Advice of Charge (AoC) supplementary services - Stage 3".

[31] GSM 04.88: "Digital cellular telecommunications system (Phase 2+); Call Barring (CB) supplementary services - Stage 3".

[32] GSM 05.02: "Digital cellular telecommunications system (Phase 2+); Multiplexing and multiple access on the radio path".

[33] GSM 05.05: "Digital cellular telecommunications system (Phase 2+); Radio transmission and reception".

[34] GSM 05.08: "Digital cellular telecommunications system (Phase 2+); Radio subsystem link control".

[35] GSM 05.10: "Digital cellular telecommunications system (Phase 2+); Radio subsystem synchronization".

[36] TS 27.001TS 27.001: "Digital cellular telecommunications system (Phase 2+); General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".

[37] TS 29.002: "Digital cellular telecommunications system (Phase 2+); Mobile Application Part (MAP) specification".

[38] TS 29.007: "Digital cellular telecommunications system (Phase 2+); General requirements on interworking between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN)".

[39] GSM 11.10: "Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) conformity specification".

[40] GSM 11.21: "Digital cellular telecommunications system (Phase 2); The GSM Base Station System (BSS) equipment specification".

[41] ISO/IEC 646 (1991): "Information technology - ISO 7-bit coded character set for information interchange".

[42] ISO/IEC 6429: "Information technology - Control functions for coded character sets".

[43] ISO 8348 (1987): "Information processing systems - Data communications - Network service definition".

[44] CCITT Recommendation E.163: "Numbering plan for the international telephone service".

[45] CCITT Recommendation E.164: "Numbering plan for the ISDN era".

[46] CCITT Recommendation E.212: "Identification plan for land mobile stations".

[47] ITU-T Recommendation F.69 (1993): "Plan for telex destination codes".

[48] CCITT Recommendation I.330: "ISDN numbering and addressing principles".

[49] CCITT Recommendation I.440 (1989): "ISDN user-network interface data link layer - General aspects".

[50] CCITT Recommendation I.450 (1989): "ISDN user-network interface layer 3 General aspects".

[51] ITU-T Recommendation I.500 (1993): "General structure of the ISDN interworking recommendations".

[52] CCITT Recommendation T.50: "International Alphabet No. 5".

[53] CCITT Recommendation Q.931: ISDN user-network interface layer 3 specification for basic control".

[54] CCITT Recommendation V.21: "300 bits per second duplex modem standardized for use in the general switched telephone network".

[55] CCITT Recommendation V.22: "1200 bits per second duplex modem standardized for use in the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[56] CCITT Recommendation V.22bis: "2400 bits per second duplex modem using the frequency division technique standardized for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[57] CCITT Recommendation V.23: "600/1200-baud modem standardized for use in the general switched telephone network".

[58] CCITT Recommendation V.26ter: "2400 bits per second duplex modem using the echo cancellation technique standardized for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[59] CCITT Recommendation V.32: "A family of 2-wire, duplex modems operating at data signalling rates of up to 9600 bit/s for use on the general switched telephone network and on leased telephone-type circuits".

[60] CCITT Recommendation V.110: "Support of data terminal equipments (DTEs) with V-Series interfaces by an integrated services digital network".

[61] CCITT Recommendation V.120: "Support by an ISDN of data terminal equipment with V-Series type interfaces with provision for statistical multiplexing".

[62] CCITT Recommendation X.21: "Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for synchronous operation on public data networks".

[63] CCITT Recommendation X.25: "Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".

[64] CCITT Recommendation X.28: "DTE/DCE interface for a start-stop mode data terminal equipment accessing the packet assembly/disassembly facility (PAD) in a public data network situated in the same country".

[65] CCITT Recommendation X.30: "Support of X.21, X.21 bis and X.20 bis based data terminal equipments (DTEs) by an integrated services digital network (ISDN)".

[66] CCITT Recommendation X.31: "Support of packet mode terminal equipment by an ISDN".

[67] CCITT Recommendation X.32: "Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and accessing a packet switched public data network through a public switched telephone network or an integrated services digital network or a circuit switched public data network".

[68] CCITT Recommendation X.75 (1988): "Packet-switched signalling system between public networks providing data transmission services".

[69] CCITT Recommendation X.121: "International numbering plan for public data networks".

[70] ETS 300 102-1: "Integrated Services Digital Network (ISDN); User-network interface layer 3 Specifications for basic call control".

[71] ETS 300 102-2: "Integrated Services Digital Network (ISDN); User-network interface layer 3 Specifications for basic call control".

[72] ISO/IEC10646: “Universal Multiple-Octet Coded Character Set (UCS)”; UCS2, 16 bit coding.

[73] TS 22.060: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Service Description; Stage 1".

[74] TS 23.060: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Service Description; Stage 2".

[75] GSM 03.64: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Overall description of the GPRS radio interface; Stage 2".

[76] GSM 04.60: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station - Base Station System (MS-BSS) interface; Radio Link Control and Medium Access Control (RLC/MAC) layer specification".

[77] IETF RFC 1034: "Domain names - Concepts and Facilities " (STD 7).

[78] GSM 04.65: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Subnetwork Dependent Convergence Protocol (SNDCP)".

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24.007	CR	005	Current Version:	3.1.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: CN1	for approval	X	strategic		*(for SMG use only)*
list expected approval meeting # here ↑	for information		non-strategic	X	

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: *(at least one should be marked with an X)* (U)SIM [ ] ME [ ] UTRAN / Radio [ ] Core Network [X]

Source: Ericsson on behalf of T1P1.5 **Date:** 15 Nov 1999

Subject: Mirror R99 LCS CR to 04.07

Work item: Location Services (LCS)

Category: *(only one category shall be marked with an X)*

F	Correction		**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature	X		Release 98	
D	Editorial modification			Release 99	X
				Release 00	

Reason for change: Introduction of additional type of LMU

Clauses affected: 3, 4.1, 9.2, 9.2.1, 9.2.2, 9.2.2.1, 9.2.2.2, 9.2.2.4, 9.2.2.7, 9.2.2.8, 9.2.2.14, 10.2, 10.2.1, 10.2.2, 10.2.2.1, 10.2.2.4, 10.2.2.6-10.2.2.9

Other specs affected:

Other 3G core specifications		→ List of CRs:	
Other GSM core specifications		→ List of CRs:	
MS test specifications		→ List of CRs:	
BSS test specifications		→ List of CRs:	
O&M specifications		→ List of CRs:	

Other comments:


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3G TS 24.007 V3.1.0 (1999-10)

Technical Specification

3rd Generation Partnership Project; Technical Specification Group Core Network; Mobile radio interface signalling layer 3; General aspects (3G TS 24.007 version 3.1.0)

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Contents

Foreword

This Technical Specification has been produced by the 3GPP.

This TS defines the architecture of layer 3 and its sublayers on the GSM Um interface, i.e. the interface between Mobile Station and network within the 3GPP system.

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of this TS, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version 3.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 Indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the specification;

1 Scope

This Technical Specification (TS) defines the principal architecture of layer 3 and its sublayers on the GSM Um interface, i.e. the interface between Mobile Station (MS) and network; for the CM sublayer, the description is restricted to paradigmatic examples, call control, supplementary services, and short message services for non-GPRS services. It also defines the basic message format and error handling applied by the layer 3 protocols.

For CTS services, this Technical Specification (TS) defines the principal architecture of layer 3 on the GSM Um* interface, i.e. the interface between a CTS capable Mobile Station (CTS-MS) and a Fixed Part (FP).

The corresponding protocols are defined in other Technical Specifications, see subclause 4.3.4.

For non-GPRS services the communication between sublayers and adjacent layers and the services provided by the sublayers are distributed by use of abstract service primitives. But only externally observable behaviour resulting from the description is normatively prescribed by this Technical Specification.

For GPRS services in addition the local information transfer and stimuli sent between sublayers is informatively included within Annex C of in this Technical Specification.

2 Normative 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.

[1] GSM 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[2] GSM 03.01: "Digital cellular telecommunications system (Phase 2+); Network functions".

[3a] GSM 03.60: “Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS) Description; Stage 2”.

[3b] GSM 03.56: “Digital cellular telecommunications system (Phase 2+); GSM Cordless Telephony System (CTS), phase 1; CTS Architecture Description; Stage 2”.

[3] GSM 04.01: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface General aspects and principles".

[3b] GSM 03.71: “Digital cellular telecommunications system (Phase 2+); Location Services (LCS) Functional Description; Stage 2”.

[4] GSM 04.05: "Digital cellular telecommunications system (Phase 2+); Data Link (DL) layer General aspects".

[5] GSM 04.06: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface Data Link (DL) layer specification".

[6] GSM 04.08: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification".

[7] GSM 04.10: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 Supplementary services specification General aspects".

[8a] GSM 04.71: “Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification; Location Services (LCS) ”.

[8] GSM 04.11: "Digital cellular telecommunications system (Phase 2+); Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface".

[9] GSM 04.80: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 supplementary services specification Formats and coding".

[10] GSM 04.81: "Digital cellular telecommunications system (Phase 2+); Line identification supplementary services - Stage 3".

[10a] GSM 04.60: "Digital cellular telecommunications system (Phase 2+);
General Packet Radio Services (GPRS); Mobile Station (MS) - Base Station System (BSS) interface; Radio Link Control and medium Access Control (RLS/MAC) layer specification"

[10b] GSM 04.56: "Digital cellular telecommunications system (Phase 2+);
GSM Cordless Telephony System (CTS), phase 1; CTS Radio Interface Layer 3 specification

[11] GSM 04.82: "Digital cellular telecommunications system (Phase 2+); Call Forwarding (CF) supplementary services - Stage 3".

[11a] GSM 04.64 ; "Digital cellular telecommunications system (Phase 2+); Mobile Station - GPRS support node (MS-SGSN) Logical Link Control Layer Specification".

[12] GSM 04.83: "Digital cellular telecommunications system (Phase 2+); Call Waiting (CW) and Call Hold (HOLD) supplementary services - Stage 3".

[12a] GSM 04.65: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station (MS) - Serving GPRS Support Node (SGSN); Subnetwork Dependent Convergence Protocol (SNDCP)".

[13] GSM 04.84: "Digital cellular telecommunications system (Phase 2+); MultiParty (MPTY) supplementary services - Stage 3".

[14] GSM 04.85: "Digital cellular telecommunications system (Phase 2+); Closed User Group (CUG) supplementary services - Stage 3".

[15] GSM 04.86: "Digital cellular telecommunications system (Phase 2+); Advice of Charge (AoC) supplementary services - Stage 3".

[16] GSM 04.88: "Digital cellular telecommunications system (Phase 2+); Call Barring (CB) supplementary services - Stage 3".

[17] GSM 04.90: "Digital cellular telecommunications system (Phase 2+); Unstructured supplementary services operation - Stage 3".

[18] CCITT Recommendation X.200: "Reference Model of Open systems interconnection for CCITT Applications".

3 Abbreviations

Abbreviations used in this TS, are listed in GSM 01.04.

For the purposes of this TS, the following abbreviations applies:

GMM GPRS Mobility Management

MNS Mobile Network Signalling

N-PDU Network Protocol Data Unit

SM Session Management

UDT User Data Transfer

CTS Cordless Telephony System

LCS Location Services

4 Introduction

4.1 General

Three models are defined for Layer 3, one model for non-GPRS services, one for GPRS services supporting Class C MSs only and one model for GPRS-services supporting Class A and Class B MSs. (The third model is a combination of the first two models listed).

The layer 3 for non-GPRS services provides the functions necessary

- for Radio Resource (RR) management;
- for Mobility Management (MM); and
- for the Connection Management (CM) functions, i.e. functions for the control, provision, and support of services offered by the network; among which there are, e.g.:
  - the functions to establish, maintain and terminate circuit-switched connections across a GSM PLMN and other networks to which the GSM PLMN is connected;
  - supporting functions for supplementary services control;
  - supporting functions for short messages service control.
  - supporting functions for location services control.

The layer 3 for non-GPRS services is composed of three sublayers comprising:

- the Radio Resource Management (RR) functions;
- the Mobility Management (MM) functions; and
- the Connection Management (CM) functions.

When CTS services are added to non-GPRS services, the following functions are added:

- CTS Radio Resource Management (CTS-RR) functions to RR; and
- CTS Mobility Management (CTS-MM) functions to MM.

The layer 3 for GPRS services is composed of four sublayers comprising :

- the Radio Resource Management (RR) functions;
- the Mobility Management (GMM and GMM-AA);
- for the Logical Link Control (LLC);
- the Connection Management (CM) functions.
- Session Management (SM) functions to activate, modify and delete the contexts for packet data protocols (PDP)
- supporting functions for short messages service control.

The Connection Management (CM) sublayer is composed of functional blocks for:

- Call Control (CC) for non-GPRS services;
- Short Message Service Support (SMS) for non-GPRS services;
- GPRS Short Message Service Support (GSMS) (for GPRS services supporting Class A, B and C MSs);
- Session Management (SM) (for GPRS services supporting Class A, B and C MSs);
- Supplementary Services Support (SS) for non-GPRS services;
- Group Call Control for non-GPRS services;
- Broadcast Call Control (BCC) for non-GPRS services;
- Connection Management of Packet Data on Signalling channels for non-GPRS services.
- Location Services support (LCS) for non-GPRS services;

Within the context of LCS, for GSM LCS ~~Phase I~~, the services defined for an MS are equally applicable to a~~n~~type A LMU, unless otherwise stated. The following is a list of services essential for a type A LMU.

The layer 3 for non-GPRS services provides the functions necessary

- for Radio Resource (RR) management;
- for Mobility Management (MM); and
- supporting functions for location service control.

The layer 3 for non-GPRS services is composed of three sublayers comprising:

- the Radio Resource Management (RR) functions;
- the Mobility Management (MM) functions; and
- the Connection Management (CM) functions.

The Connection Management (CM) sublayer is composed of functional block for:

- location services support (LCS) for non-GPRS services.

This Technical Specification does not consider the distribution of signalling functions among the different network equipments. The signalling functions are described between two systems which represent the MS side and the network side of the radio interface of layer 3. Only the functions in the network for signalling communication with one MS is considered.

For GPRS services, in addition to the signalling functions also the user data transfer is included in this Technical Specification.

4.2 Applicability of functional blocks

Not for all functional blocks listed in subclause 4.1, support in the MS or in the network is mandatory:

- Support of Group Call Control is optional in the MS and in the network.
- Support of Broadcast Call Control is optional in the MS and in the network.
- Connection Management of Packet Data on Signalling channels. is optional in the MS and in the network.
- Support of GPRS services is optional in the MS and in the network.
- Support of CTS services is optional in the MS. CTS services are not applicable to the network.
- Support of LCS services is optional in the MS and in the network, but not optional in LMU.

Further conditions and constraints are defined in other Technical Specifications.

4.3 Technique of description

Layer 3 and its sub-layers are specified by:

- their service specification, see subclause 4.3.1;
- their protocol specification, see subclause 4.3.3;
- the specification of functions, see clause 5.

4.3.1 Service description

The services of signalling layer 3 and its sublayers are described in terms of:

- services provided to upper (sub-)layers at the service access points;
- services assumed from lower (sub-)layers at the service access points;

Layer 3 and its supporting lower layers provide the Mobile Network Signalling (MNS) Service and User Data Transfer (UDT) Service (for GPRS services only) to the upper layers.

The service provided/assumed at the service access points are described by means of abstract service primitives and parameters as recommended in CCITT Recommendation X.200.

4.3.2 Abstract service primitives

The abstract service primitives consist of requests, responses, indications and confirmations. The general syntax of a primitive is specified in GSM 04.01.

4.3.3 Protocols and peer-to-peer communication

By use of the services provided by lower (sub-)layers, peer entities in a (sub-)layer in the MS and the network exchange information. Exchange of information between two peer entities is performed according to the corresponding (sub-)layer protocols. A protocol is a set of rules and formats by which the information (control information and user data) is exchanged between the two peers. The information is exchanged by use of messages which are defined in the protocol. (Therefore, the messages are also called Protocol Data Units, PDUs).

There are several protocols of the RR sublayer, one protocol of the LLC sublayer, three protocols of the MM sublayer, and several protocols of the CM sublayer. For each functional block of the CM sublayer as defined in subclause 4.1 there is one protocol. The CM protocols are specified in the Technical Specifications identified in subclause 4.3.4.

In the model used in this ETS, there is:

1) for non-GPRS services:

- one RR sub-layer entity in the MS and one RR sub-layer entity in the network;
- one MM sub-layer entity in the MS and one MM sub-layer entity in the network;

  for each functional block of the CM sublayer as defined in subclause 4.1 which is supported in the MS (in the network), there are, depending on the protocol, one or more entities in the MS (in the network). Two different entities of the same functional block in the MS (in the network) are called parallel entities. The entities of the same functional block in the MS correspond in a one-to-one relation to the entities of the functional block in the network. The corresponding entities are called peer entities.

2) for CTS services (in addition to non-GPRS services)

- one RR sub-layer entity in the MS and one in the CTS fixed part. These RR sub-layers include one CTS-RR sub-entity on each side.
- one MM sub-layer entity in the MS and one in the CTS fixed part These MM sub-layers include one CTS-MM sub-entity on each side.
- for each functional block of the CM sublayer as defined in subclause 4.1 which is supported in the MS (in the fixed part), there are, depending on the protocol, one or more entities in the MS (in the fixed part). Two different entities of the same functional block in the MS (in the fixed part) are called parallel entities. The entities of the same functional block in the MS correspond in a one-to-one relation to the entities of the functional block in the fixed part. The corresponding entities are called peer entities.

3) for GPRS services supporting Class C MSs :

- one RR sublayer entity (RR) in the MS and one RR sublayer entity in the network;
- six LLC sublayer entities (QoS1-QoS4, signalling, SMS) in the MS and six LLC sublayer entities in the network;
- one or more MM sublayer entities (GMM and/or 1-n GMM-AA) in the MS and one MM sublayer entity in the network (GMM or GMM-AA, i.e. the network don’t know if several MM sublayer entities belong to the same MS or not);
- one SM entity in the MS’s CM sublayer and one SM sublayer entity in the network’s CM sublayer;

- one or more GSMS functional blocks in the CM sublayer if supported.:

4) for non-GPRS and GPRS services supporting Class A and Class B MSs :

- two RR sublayer entities (RR) in the MS and two RR sublayer entities in the network;
- six LLC sublayer entities (QoS1-QoS4, signalling, SMS) in the MS and six LLC sublayer entities in the network;
- two or more MM sublayer entities (GMM + MM or 1-n GMM-AA + MM or GMM + 1-n GMM-AA + MM) in the MS and one or two MM sublayer entity in the network (GMM + MM or GMM-AA);
- one SM entity in the MS's CM sublayer and one SM entity in the network's CM sublayer;
- for each functional block of the CM sublayer as defined in subclause 4.1 which is supported in the MS (in the network), there are, depending on the protocol, one or more entities in the MS (in the network). Two different entities of the same functional block in the MS (in the network) are called parallel entities. The entities of the same functional block in the MS correspond in a one-to-one relation to the entities of the functional block in the network. The corresponding entities are called peer entities.

As each sub-layer entity is specified by one and only one protocol, it is also called a protocol entity or protocol control entity.

For GPRS-services supporting Class A and Class B MSs, the MM entities of the MM-sublayer are able to exchange information by means of GMM PDUs as well as MM PDU's. This means if a mobile is GPRS attached, non-GPRS mobility management procedures may make use of GRPS mobility management messages.

When two peer protocol entities exchange PDUs, a transaction is said to be established (or: to be active; or: to exist). It depends from the protocol when exactly a protocol entity considers the transaction to be active, normally this is the case.

- from the moment when it has passed the first suitable message to lower (sub-) layers or received the first suitable message from its peer entity.

up to the moment when it has released the transaction.

4.3.4 Contents of layer 3 related Technical Specifications

The Radio Resource (RR) management protocol is defined in GSM 04.08:

- the Mobility Management (MM) protocol is defined in GSM 04.08;
- the Session Management (SM) protocol is defined in GSM 04.08;
- the Call Control (CC) protocol is defined in GSM 04.08;
- the Supplementary Services (SS) protocol is defined in GSM 04.10, GSM 04.8x and GSM 04.9x;
- the Short Message Service (SMS) protocol is defined in GSM 04.11;
- the Group Call Control (GCC) protocol is defined in GSM 04.68;
- the protocols for Packet Data on Signalling channels (PDS), PDSS1 and PDSS2, are defined in GSM 04.63;
- the Logical Link Control (LLC) protocol is defined in GSM 04.64;
- the GPRS Radio Resource (GRR) protocol is defined in GSM 04.60 and GSM 04.08.
- the CTS Radio Resource (CTS-RR) sub-protocol is defined in GSM 04.56;
- the CTS Mobility Management (CTS-MM) sub-protocol is defined in GSM 04.56;
- the CTS additions to the Call Control (CC) protocol are defined in GSM 04.56.
- the Location Services (LCS) protocol is defined in GSM 03.71 and GSM 04.71.

5 Structure of layer 3 functions

5.1 Basic groups of functions

Most functions of layer 3 and its sub-layers are described by the service specifications and protocol specifications of the (sub-)layers.

These functions are in the model realised by protocol control entities, see subclause 4.3.3.

In addition, routing functions are contained in layer 3 which are related to the transport of messages, e.g. multiplexing and splitting. These routing functions are defined in the Radio Resource Management and Mobility Management sub-layers.

1) They have the task to pass the messages from upper (sub-)layers to lower (sub-)layers.

2) They also have the task to pass messages provided by lower (sub-layers) to the appropriate sub-layer and, if applicable, entity.

The routing functions with task 2 make use of the protocol discriminator (PD) which is part of the message header.

A CM sublayer protocol may also define a transaction identifier (TI) as a part of the message header. This is at least the case if there are parallel entities of the same functional block, see subclause 4.3.3. If it is a part of a message, the TI is also used by the routing functions.

- The MM-sublayer routing function passes the messages of the CM entities as well as of the MM, GMM,GMM-AA and CTS-MM entities of its own sublayer to the service access point of RR, GRR, LLC or CTS-RR. Furthermore it multiplexes them in case of parallel transactions.

- The routing function of Radio Resource Management distributes the messages to be sent according to their message type and protocol discriminator (PD), to the actual channel configuration, and, if applicable, to further information received from upper sub-layers to the appropriate service access point of layer 2 (identified by SAPI and logical channel). Paging messages received from the PPCH are always routed to GMM, while paging messages received from the PCH are distributed to GMM or MM based on the temporary identifier (TMSI or TLL).

- The messages provided at the different service access points of layer 2 are distributed by the RR sublayer routing function according to their protocol discriminator (PD). Messages with a PD equal to RR are passed to the RR entity of the own sublayer, all other messages are passed to the MM sublayer at the service access point RR-SAP.

- The routing function of MM-sublayer passes Standard L3 messages according to the protocol discriminator (PD) and, if applicable, the transaction identifier (TI) or the PDP address towards the MM entity or towards the CM entities via the various MM-SAP's. GPRS L3 messages are routed to mobility management or session management according to the protocol discriminator.

- The routing function of LLC passes the messages according to the SAPIs to the MM sublayer or to the SNDCP entities.

The message (message header or other parts of the message) are neither changed nor removed by the RR routing function or MM routing function before passing it to the appropriate service access point.

5.2 Protocol architecture

The protocol architecture is visualised for each of the three models:

- Figure 5.1/GSM 0407 shows the protocol architecture for a MS not supporting the GPRS service, restricting the representation of CM sublayer protocols to four paradigmatic examples, CC, LCS, SS, and SMS. Note that the protocol stack for a class C GPRS service may be present in the MS, but it is not active simultaneously.

- Figure 5.2 shows the protocol architecture for a MS supporting the Class C GPRS service. (Note that the protocol stack for a circuit switched services may be present in the MS, but it is not active simultaneously)

- Figure 5.3 shows the protocol architecture for non-GPRS and GPRS-services supporting Class A and Class B MSs

- Figure 5.4 shows the protocol architecture for a MS supporting CTS services in addition to non-GPRS services.

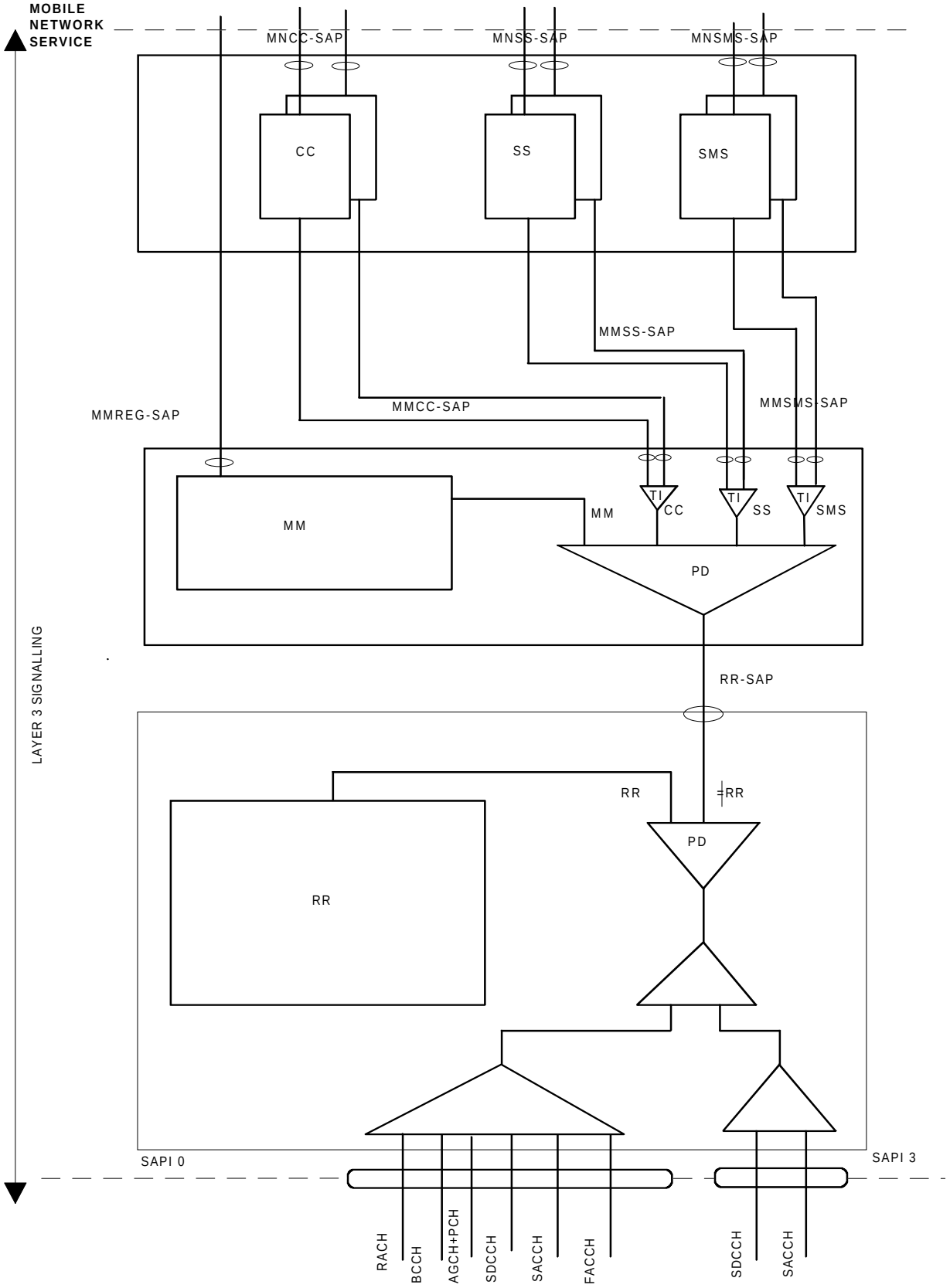


Figure 5.1: Protocol Architecture not supporting GPRS service- MS side

(Note: Figure 5.1 shall be updated to include the new PD for LCS in the same manner as the other PDs are shown)

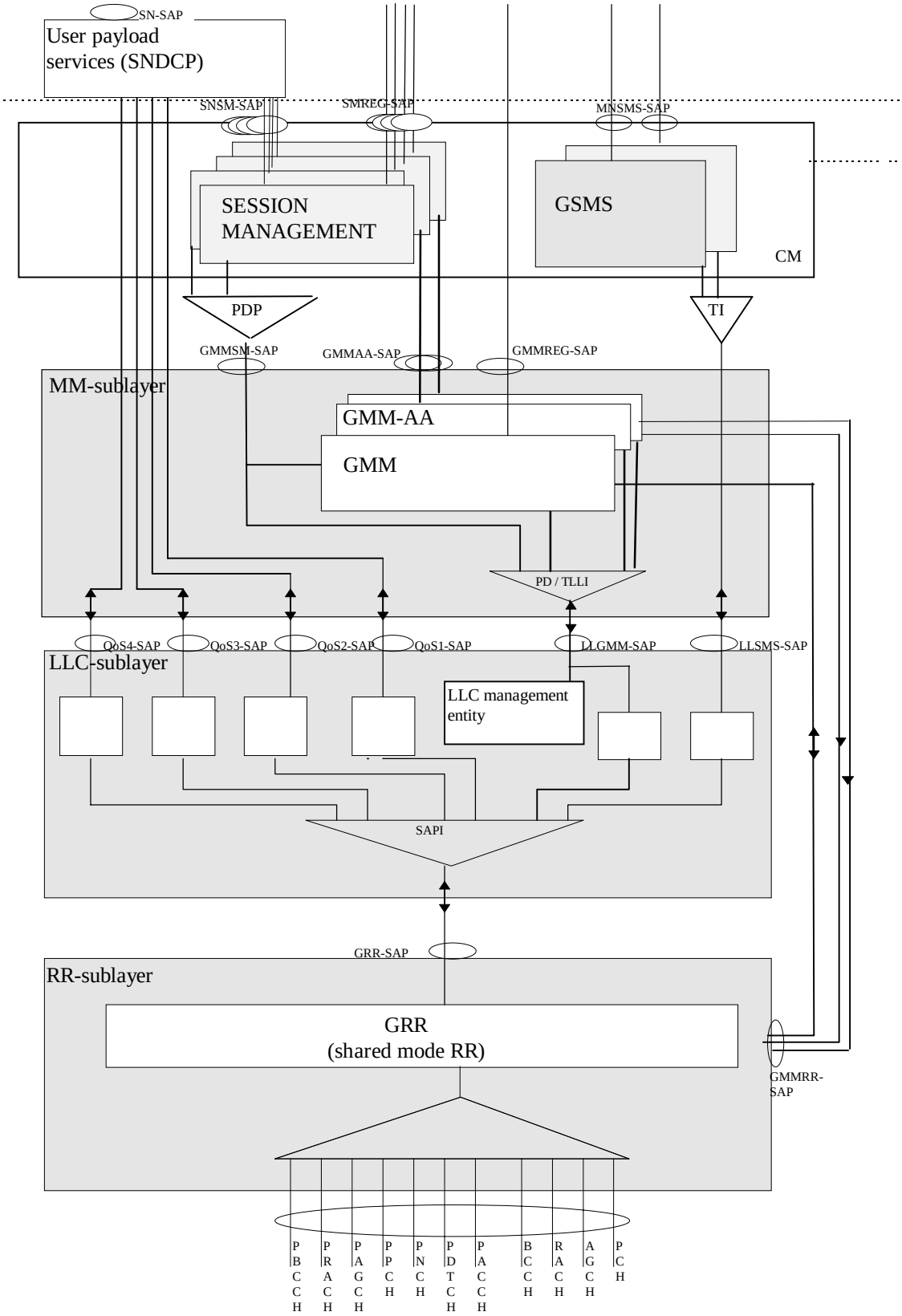


Figure 5.2, Protocol architecture supporting GPRS class C MSs, MS - side

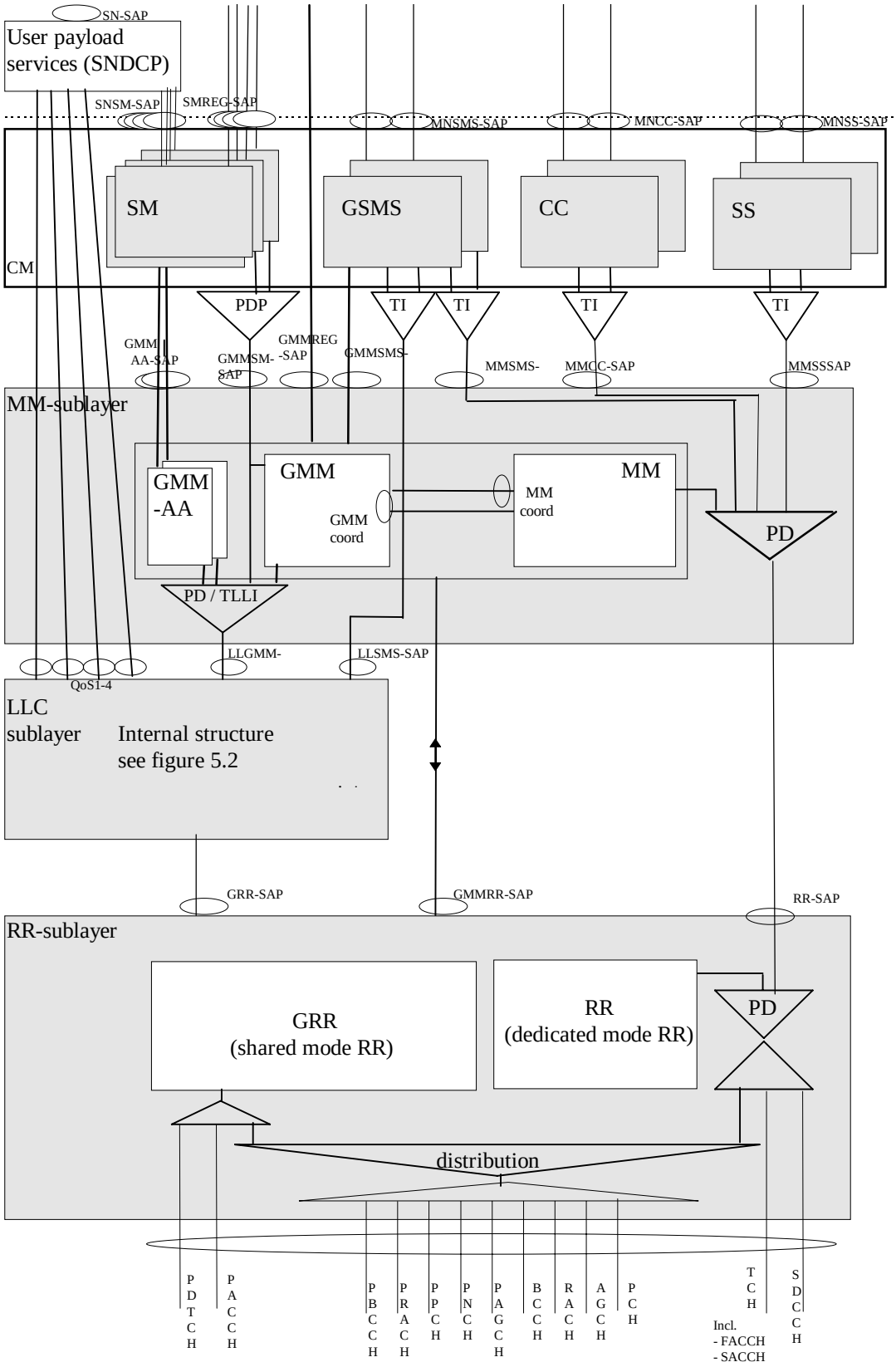


Figure 5.3/ GSM 04.07, Protocol architecture supporting GPRS class A and B MSs, MS - side

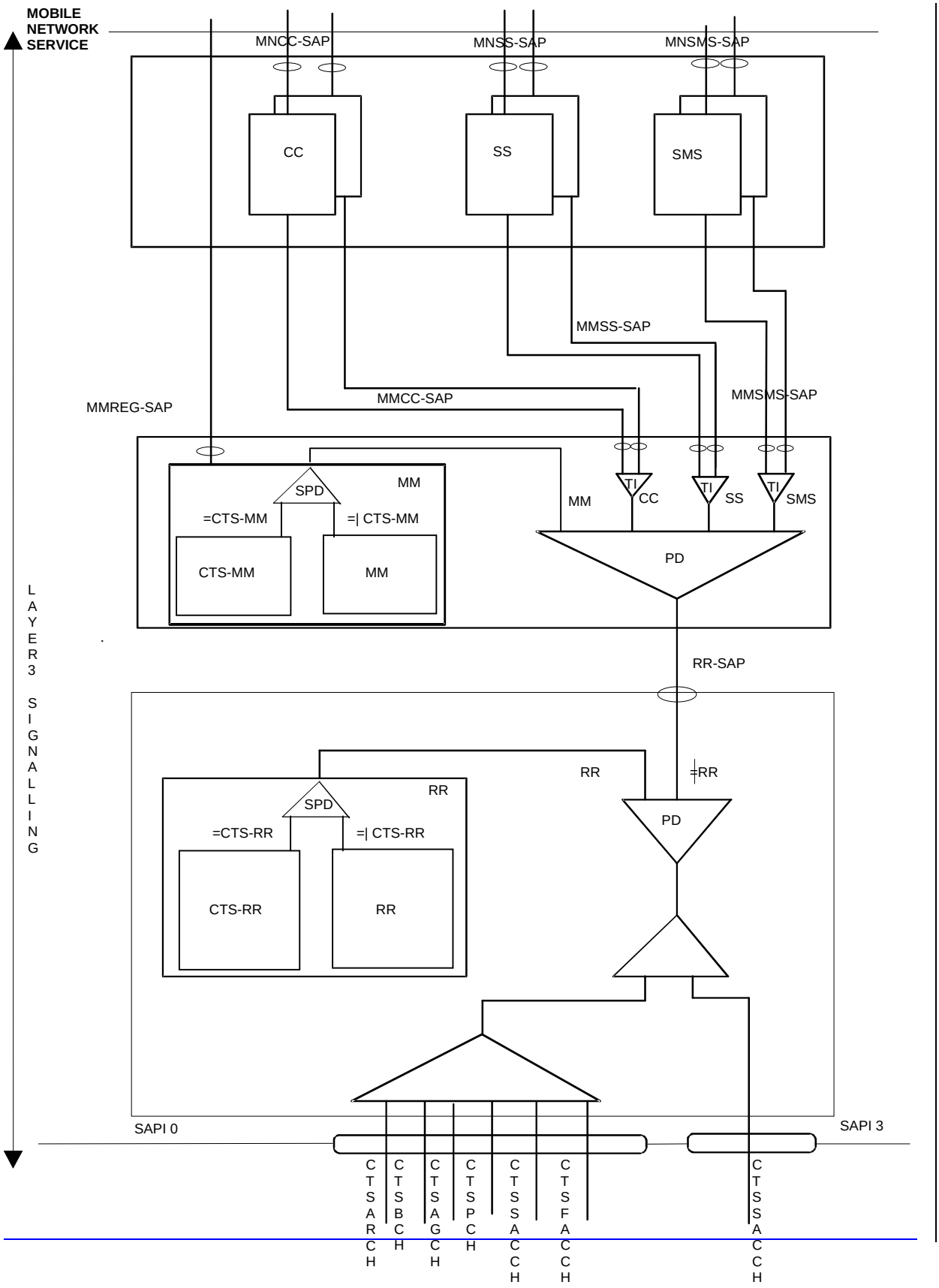


Figure 5.4/ GSM 04.07, Protocol architecture supporting CTS services in addition to non- GPRS services, MS - side

As shown in figure 5.1 a hierarchy of 3 sublayers is defined:

- the RR sublayer provides services to the MM sublayer and utilizes the services of signalling layer 2;
- the MM sublayer provides common services to the entities of the Connection Management (CM) sublayer;
- the CM sublayer includes, among others, the CC, SS, and SMS entities, which are independent entities.

Figure 5.2 defines four sublayers for GPRS services :

- the RR sublayer provides services to the MM and LLC sublayers;
- the LLC sublayer provides services to the MM sublayer, the SNDCP and GSMS entities and uses services of the RR sublayer;
- the MM sublayer provides services to the SM entities of the CM. The MM sublayer either includes (a.) one GMM entity for non-anonymous access or (b.) one or more GMM-AA entities for anonymous access or (c.) one GMM entity and one or more GMM-AA entities;
- the CM sublayer includes the SM and GSMS entities. The SM entity provides services to the SNDCP entity and uses services of the MM sublayer. The GSMS entity is identical to the SMS entity for non-GPRS services except it uses the services from the LLC sublayer

Figure 5.3 defines four sublayers for non-GPRS and GPRS-services supporting Class A and Class B MSs :

- the RR sublayer provides services to the MM and LLC sublayers;
- the LLC sublayer provides services to the MM sublayer, the SNDCP and GSMS entities and uses services of the RR sublayer;
- the MM sublayer provides services to the SNDCP entity and to the entities of the Connection Management (CM) sublayer. In addition to the MM entity for non-GPRS services, the MM sublayer further includes either (a.) one GMM entity for non-anonymous access or (b) one or more GMM-AA entities for anonymous access or (c.) one GMM entity and one or more GMM-AA entities;
- the CM sublayer includes, among others, the CC, SS, GSMS and SM entities, which are independent entities.

  The SM entity provides services to the SNDCP entity and uses services of the MM sublayer.
  The GSMS entity is an extension of the SMS entity for non-GPRS services. For message transfer it uses the services both from the LLC sublayer and the MM entity of the MM sublayer. Furthermore it retrieves from the MM entity information about which transport service to use.

Figure 5.4 defines three sub-layers for CTS services:

- the RR sublayer provides services (including CTS services) to the MM sublayer and uses the services of signalling layer 2;
- the MM sublayer provides common services to the entities of the Connection Management (CM) sublayer; it provides also specific CTS services to the entities above CM.
- the CM sublayer includes, among others, the CC, SS, and SMS entities, which are independent entities.

6 Services provided by signalling layer 3 at the MS side

The different classes of services provided by signalling layer 3 at the MS side are accessible at the following service access points:

- registration services at the MMREG-SAP or GMMREG-SAP;
- Call Control services for normal and emergency calls including call related Supplementary Services Support services at the MNCC-SAP;
- Short Message Services Support services at the MNSMS-SAP;
- Call independent Supplementary Services Support services at the MNSS-SAP;

- Location Services Support services at the MNLCS-SAP;
- other services corresponding to further functional blocks of the CM sublayer at the appropriate service access points. These services are not further described in this clause;
- Session Management services at the SMREG-SAP and at the SNSM-SAP
- Logical Link Control services at the QoS1-SAP, QoS2-SAP, QoS3-SAP and QoS4-SAP.

6.1 Registration services

The registration services (location updating, IMSI attach/detach) are provided at the service access point MMREG-SAP. As opposed to all other MN-Services, these services are provided by and can be directly accessed at the Mobility Management sublayer.

6.1.1 Service state diagram for MS not supporting GPRS service

The registration services provided at the service access point MMREG-SAP are illustrated in the state of figure 6.1 below.

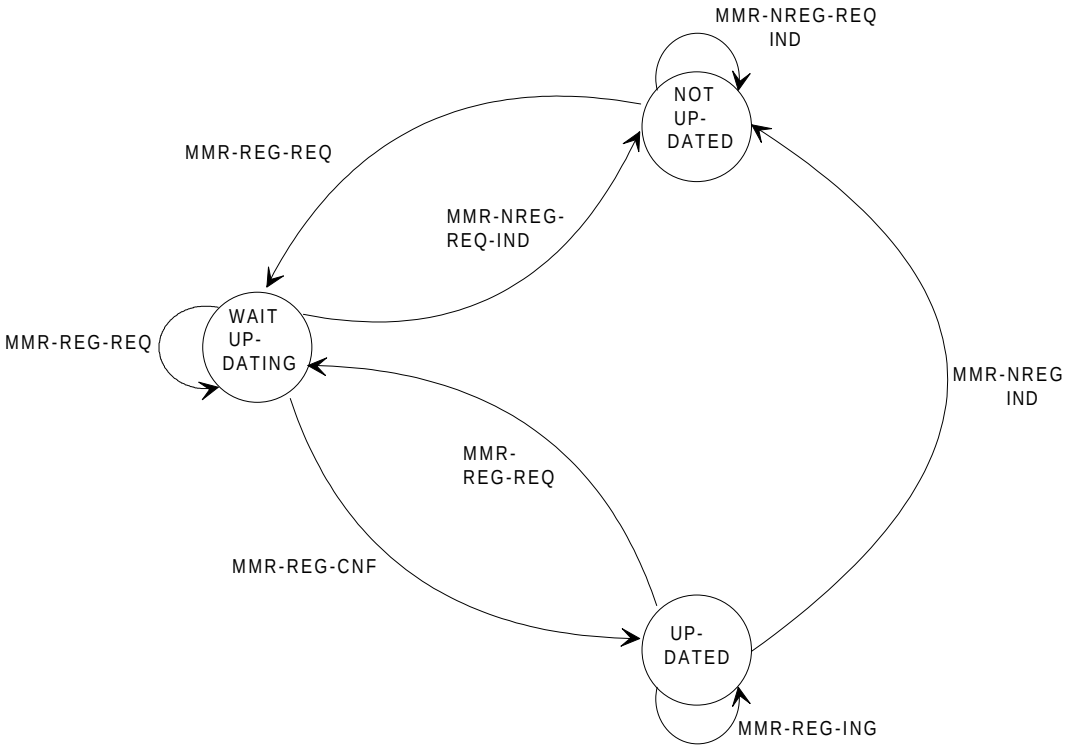


Figure 6.1: Registration services provided at MMREG-SAP - MS side

6.1.2 Service primitives

Table 6.1: Primitives and Parameters at the MMREG-SAP - MS side

PRIMITIVE	PARAMETER	REFERENCE
MMR_REG_REQ	IMSI	6.1.2.1
MMR_REG_CNF	-	6.1.2.2
MMR_NREG_REQ	-	6.1.2.4
MMR_NREG_IND	cause	6.1.2.5

6.1.2.1 MMR_REG_REQ

Registration request, triggered by activation of the IMSI, e.g., by activation of the MS with inserted SIM, insertion of the SIM into the activated MS, pressing of a reset button.

6.1.2.2 MMR_REG_CNF

Registration confirmation. Indicates to the user that the MS is ready to start a transaction.

6.1.2.3 **[reserved]**

6.1.2.4 MMR_NREG_REQ

Request to cancel the registration, stimulated either by removing the SIM or automatically in the power off phase.

6.1.2.5 MMR_NREG_IND

Indication that registration has been cancelled or that registration was not possible. Only emergency services are available to the user.

6.1.3 Registration Services for CTS-Services

The registration services (attach/detach, enrolment/de-enrolment) are provided for CTS services at the service access point MMREG-SAP.

Table 6.1.3: Primitives and Parameters at the MMREG-SAP - MS side for CTS

PRIMITIVE	PARAMETER	REFERENCE
MMR_CTS_ATTACH_REQ	IMSI	6.1.3.1
MMR_CTS_ATTACH_CNF	-	6.1.3.2
MMR_CTS_ATTACH_REJ	IFPSI, cause	6.1.3.3
MMR_CTS_DETACH_IND	-	6.1.3.4
MMR_CTS_ENROLL_REQ	IMSI	6.1.3.5
MMR_CTS_ENROLL_CNF	-	6.1.3.6
MMR_CTS_ENROLL_REJ	IFPSI, cause	6.1.3.7
MMR_CTS_ DE_ENROLL_IND	-	6.1.3.8

6.1.3.1 MMR_CTS _ATTACH_REQ

MS initiates the CTS attach. CTS-MM is requested to send a CTS ATTACH REQUEST message to the fixed part.

6.1.3.2 MMR_CTS _ATTACH_CNF

The CTS attach was successful. The fixed part confirmed the attach, i.e. the CTS ATTACH ACCEPT message was received by the MS.

6.1.3.3 MMR_CTS _ATTACH_REJ

The CTS attach has failed. The fixed part rejected the attach attempt, i.e. the CTS ATTACH REJECT message was received by the MS.

6.1.3.4 MMR_CTS _DETACH_IND

MS initiates CTS detach. CTS-MM is requested to send a CTS DETACH INDICATION message. The detach procedure is initiated.

6.1.3.5 MMR_CTS _ENROLL_REQ

MS initiates the CTS enrolment. CTS-MM is requested to send a CTS ENROLMENT REQUEST message to the fixed part.

6.1.3.6 MMR_CTS _ENROLL_CNF

The CTS enrolment was successful. The fixed part confirmed the enrolment, i.e. the CTS ENROLMENT ACCEPT message was received by the MS.

6.1.3.7 MMR_CTS _ENROLL_REJ

The CTS enrolment has failed. The fixed part rejected the enrolment attempt, i.e. the CTS ENROLMENT REJECT message was received by the MS.

6.1.3.8 MMR_CTS _DE_ENROLL_IND

FP initiates CTS de-enrolment. CTS-MM is requested to send a CTS DE-ENROLMENT INDICATION message. The de-enrolment procedure is initiated.

6.2 Call Control services

The Call Control services are provided by multiple CC entities at the service access point MNCC-SAP.

The Call Control service class consists of the following services:

- Mobile originated and Mobile terminated call establishment for normal calls;
- Mobile originated call establishment for emergency calls;
- call maintaining;
- call termination;
- call related Supplementary Services Support.

6.2.1 Service state diagram

The Call Control services provided at the service access point MNCC-SAP are illustrated in the state diagram of figure 6.2.

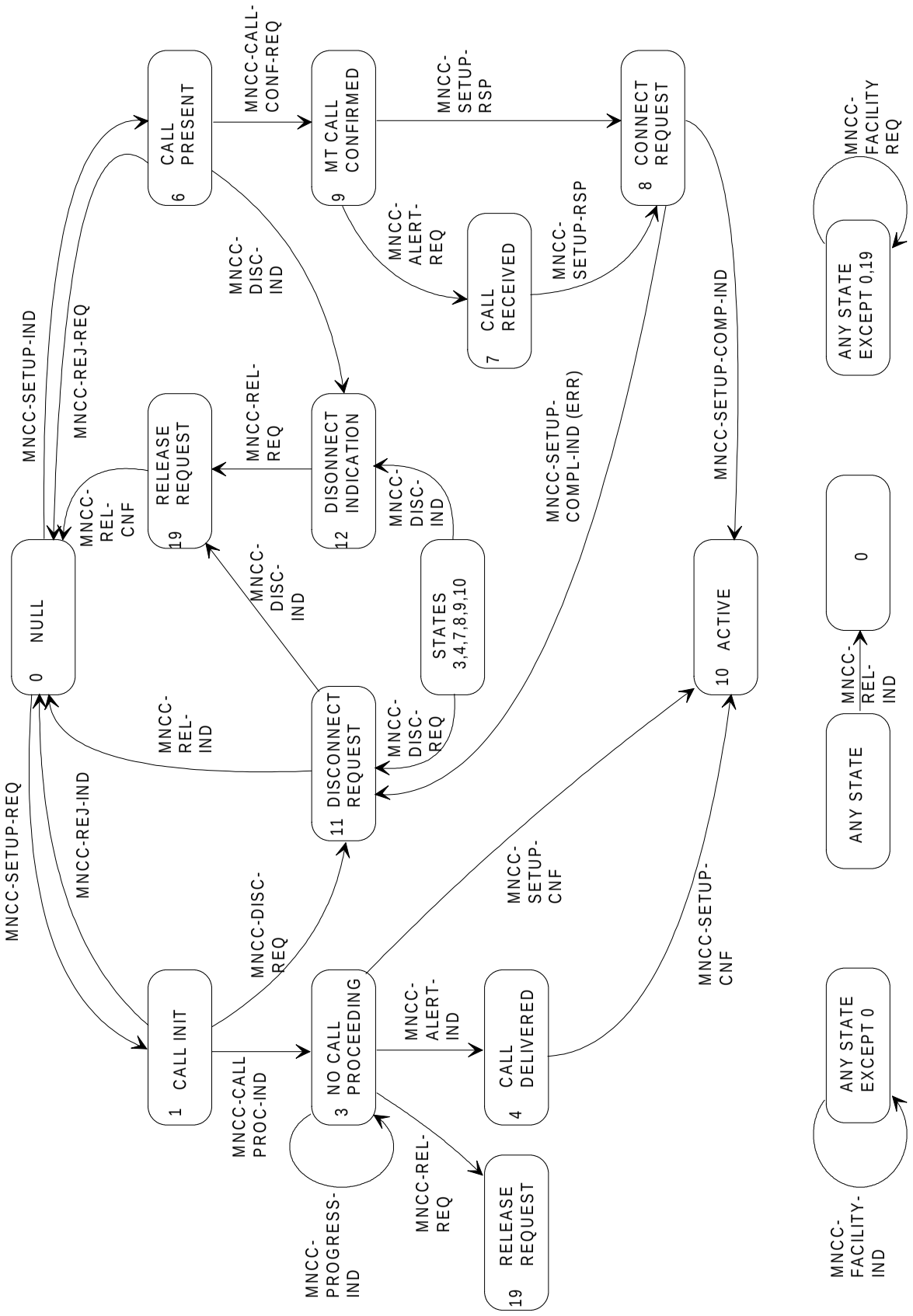


Figure 6.2: Service graph of Call Control entity - MS side (page 1 of 2)

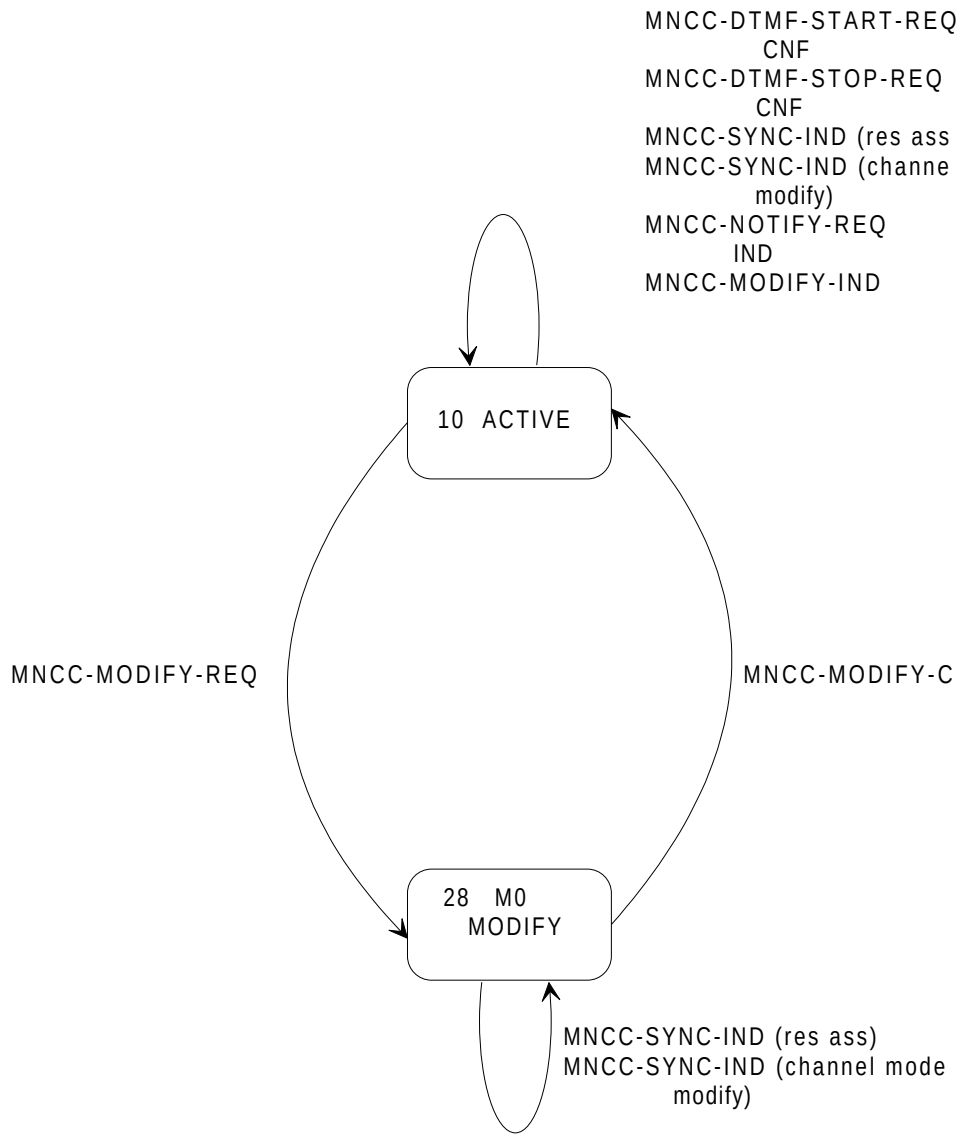


Figure 6.2: Service graph of Call Control entity - MS side Active state (page 2 of 2)

6.2.2 Service primitives

Table 6.2: Primitives and parameters at MNCC-SAP - MS side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
MNCC_SETUP_REQ	SETUP or EMERGENCY SETUP	6.2.2.1
MNCC_SETUP_IND	SETUP	6.2.2.2
MNCC_SETUP_RSP	CONNECT	6.2.2.3
MNCC_SETUP_CNF	CONNECT	6.2.2.4
MNCC_SETUP_COMPLETE_REQ	-	6.2.2.5
MNCC_SETUP_COMPLETE_IND	-	6.2.2.6
MNCC_REJ_REQ	RELEASE COMPLETE	6.2.2.7
MNCC_REJ_IND	cause	6.2.2.8
MNCC_CALL_CONF_REQ	CALL CONFIRMED	6.2.2.9
MNCC_CALL PROC_IND	CALL PROCEEDING	6.2.2.10
MNCC_PROGRESS_IND	PROGRESS	6.2.2.11
MNCC_ALERT_REQ	ALERTING	6.2.2.12
MNCC_ALERT_IND	ALERTING	6.2.2.13
MNCC_NOTIFY_REQ	NOTIFY	6.2.2.14
MNCC_NOTIFY_IND	NOTIFY	6.2.2.15
MNCC_DISC_REQ	DISCONNECT	6.2.2.16
MNCC_DISC_IND	DISCONNECT	6.2.2.17
MNCC_REL_REQ	RELEASE	6.2.2.18
MNCC_REL_IND	RELEASE	6.2.2.19
MNCC_REL_CNF	RELEASE or RELEASE COMPLETE	6.2.2.20
MNCC_FACILITY_REQ	facility	6.2.2.21
MNCC_FACILITY_IND	facility	6.2.2.22
MNCC_START_DTMF_REQ	START DTMF	6.2.2.23
MNCC_START_DTMF_CNF	START DTMF ACK or START DTMF REJ	6.2.2.24
MNCC_STOP_DTMF_REQ	STOP DTMF	6.2.2.25
MNCC_STOP_DTMF_CNF	STOP DTMF ACK	6.2.2.26
MNCC_MODIFY_REQ	MODIFY	6.2.2.27
MNCC_MODIFY_IND	MODIFY	6.2.2.28
MNCC_MODIFY_RES	MODIFY COMPLETE	6.2.2.29
MNCC_MODIFY_CNF	MODIFY COMPLETE	6.2.2.30
MNCC_SYNC_IND	cause (res. ass., channel mode modify)	6.2.2.31

6.2.2.1 MNCC_SETUP_REQ

Request to send a SETUP or EMERGENCY SETUP message to initiate Mobile originating establishment of either a normal or an emergency call.

6.2.2.2 MNCC_SETUP_IND

Receipt of a SETUP message, the Mobile terminated call establishment has been initiated.

6.2.2.3 MNCC_SETUP_RES

Response to send a CONNECT message to indicate call acceptance by the Mobile terminated user; call control is requested to attach the user connection (if it is not yet attached).

6.2.2.4 MNCC_SETUP_CNF

Receipt of a CONNECT message, the Mobile originated call has been accepted by the remote called user.

6.2.2.5 MNCC_SETUP_COMPL_REQ

Request to send a CONNECT ACKNOWLEDGE message, the mobile originating call has been accepted.

6.2.2.6 MNCC_SETUP_COMPL_IND

Receipt of a CONNECT ACKNOWLEDGE message, the Mobile terminated call establishment has been completed; for a data call, the user is informed that the user connection is attached.

6.2.2.7 MNCC_REJ_REQ

Request to reject a Mobile terminated call if the call is refused or if the call cannot be accepted, e.g., because of missing compatibility.

6.2.2.8 MNCC_REJ_IND

Indication that the Mobile originated call has been rejected, e.g. if the MM connection cannot be provided or if the call establishment initiation has been rejected by the network.

6.2.2.9 MNCC_CALL_CONF_REQ

Request to confirm a Mobile terminated call by sending a CALL CONFIRMED message. A bearer capability different from that given in MNCC_SETUP_IND may be offered to the remote calling user.

6.2.2.10 MNCC_CALL_PROC_IND

Indication to the Mobile originating user that call establishment has been initiated in the Network and no more call establishment information will be accepted by the Network.

6.2.2.11 MNCC_PROGRESS_IND

Indication to the Mobile user that a PROGRESS message or a message containing a *progress* IE has been received, e.g., because the call is progressing in the PLMN/ISDN environment, or because the call has left the PLMN/ISDN environment, or because in-band tones/announcement are available.

6.2.2.12 MNCC_ALERT_REQ

Request to send an ALERTING message from the called Mobile user to the remote calling user to indicate that user alerting has been initiated.

6.2.2.13 MNCC_ALERT_IND

Indication of the receipt of an ALERTING message, alerting to the remote called user has been initiated.

6.2.2.14 MNCC_NOTIFY_REQ

Request to send information pertaining to a call, such as user suspended, to the Network by the Mobile user.

6.2.2.15 MNCC_NOTIFY_IND

Indication to the Mobile user that information pertaining to a call, such as remote user suspended, has been received from the Network.

6.2.2.16 MNCC_DISC_REQ

Request to send a DISCONNECT message to the Network in order to clear the end-to-end connection.

6.2.2.17 MNCC_DISC_IND

Indication of reception of a DISCONNECT message, by which the Network indicates that the end-to-end connection is cleared.

6.2.2.18 MNCC_REL_REQ

Request of the Mobile user to send a RELEASE message to inform the Network that the user intends to release the call reference and the corresponding MM connection so that the Network can release its MM connection and the correspondent call reference.

6.2.2.19 MNCC_REL_IND

Indication to the Mobile originating or terminated user that a RELEASE message has been received and the Network intends to release its MM connection. The Mobile user is requested to release the call reference and the corresponding MM connection.

6.2.2.20 MNCC_REL_CNF

Confirmation of the Mobile user's request to release the MM connection and call reference in the Network. The Mobile user may release the call reference and the corresponding MM connection.

6.2.2.21 MNCC_FACILITY_REQ

Request to transport a *facility* IE for a call related supplementary service invocation.

6.2.2.22 MNCC_FACILITY_IND

Indication that a *facility* IE for a call related supplementary service invocation has been received.

6.2.2.23 MNCC_START_DTMF_REQ

Request to send a START DTMF message in order to start a DTMF control operation.

6.2.2.24 MNCC_START_DTMF_CNF

Confirmation of the receipt of a START DTMF ACKNOWLEDGE or START DTMF REJECT message that the start of a DTMF control operation has been acknowledged or rejected.

6.2.2.25 MNCC_STOP_DTMF_REQ

Request to send a STOP DTMF message in order to stop a DTMF control operation.

6.2.2.26 MNCC_STOP_DTMF_CNF

Confirmation of the receipt of STOP DTMF ACKNOWLEDGE message, the DTMF control operation has been stopped.

6.2.2.27 MNCC_MODIFY_REQ

Request to start Mobile originating in-call modification by sending a MODIFY message.

6.2.2.28 MNCC_MODIFY_IND

RECEIPT OF A MODIFY message, a Mobile terminating in-call modification has been initiated.

6.2.2.29 MNCC_MODIFY_RES

Response to send a MODIFY COMPLETE message to indicate Mobile terminating in-call modification completion by the Mobile user.

6.2.2.30 MNCC_MODIFY_CNF

Receipt of a MODIFY COMPLETE message, the Mobile originating in-call modification has been completed.

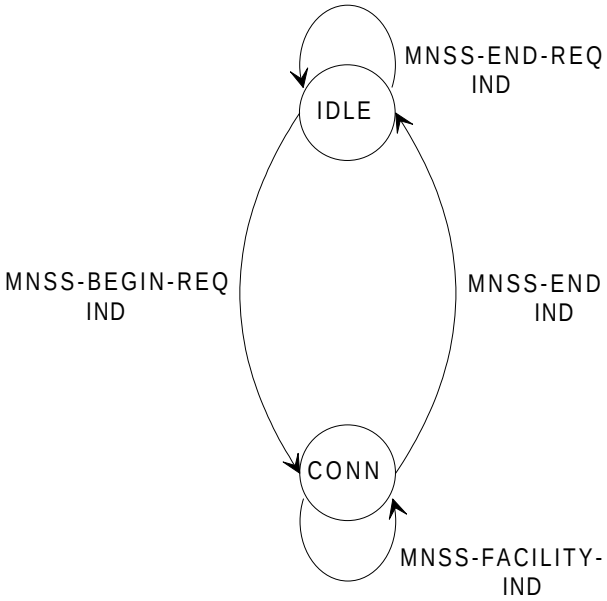
6.2.2.31 MNCC_SYNC_IND

Indication that a dedicated channel assignment has been performed (res. ass. = "resource assigned") and/or the channel mode has been changed.

6.3 Call independent Supplementary Services Support

6.3.1 Service state diagram

The primitives provided by the call independent Supplementary Services Support entity and the transitions between permitted states are shown in figure 6.3.



STATES:

IDLE - No SS signalling transaction pending

CONN - SS signalling transaction established

Figure 6.3: Service graph of the call independent Supplementary Services Support entity - MS side

6.3.2 Service primitives

Table 6.3: Primitives and Parameters at MNSS-SAP - MS side

PRIMITIVES	PARAMETERS (Info elements of message)	REFERENCE
MNSS_BEGIN_REQ	REGISTER	6.3.2.1
MNSS_BEGIN_IND	REGISTER	6.3.2.2
MNSS_FACILITY_REQ	FACILITY	6.3.2.3
MNSS_FACILITY_IND	FACILITY	6.3.2.4
MNSS_END_REQ	REL COMPLETE	6.3.2.5
MNSS_END_IND	REL COMPLETE	6.3.2.6

6.3.2.1 MNSS_BEGIN_REQ

Request to send a REGISTER message in order to establish a signalling transaction for the provision of call independent supplementary services. The request for a call independent supplementary service invocation may be included.

6.3.2.2 MNSS_BEGIN_IND

Receipt of a REGISTER message, a signalling transaction is established for the provision of call independent supplementary services after receipt of a REGISTER message. The indication of a supplementary service invocation may be included.

6.3.2.3 MNSS_FACILITY_REQ

Request to send a FACILITY message for the provision of a call independent supplementary service invocation.

6.3.2.4 MNSS_FACILITY_IND

Receipt of a FACILITY message for a call independent supplementary service invocation.

6.3.2.5 MNSS_END_REQ

Request to send a RELEASE COMPLETE message in order to release the signalling transaction. The request for transfer of a supplementary service facility may be included.

6.3.2.6 MNSS_END_IND

Receipt of a RELEASE COMPLETE message, the signalling transaction has been released. The indication of a supplementary service facility may be included.

6.4 Short Message Services Support

The service provided by the CM sublayer to support the short message service are defined in GSM 04.11.

6.5 Session Management Services for GPRS-Services

Session Management services are provided at the SMREG-SAP and the SNSM-SAP for anonymous and non-anonymous access. The non-anonymous and anonymous access procedures for PDP context activation and PDP context deactivation are available at the SMREG-SAP. In addition there exists a PDP context modification for non-anonymous PDP contexts.

Before SNDCP initiates any user data transfer, the PDP context activation procedure must be performed.

6.5.1 Session Management Services for SMREG-SAP

Table 6.5: Primitives and Parameters at SMREG-SAP - MS side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
SMREG-PDP-ACTIVATE-REQ	PDP type, QoS, NSAPI, APN, Data mode	6.5.1.1
SMREG-PDP-ACTIVATE-CNF	PDP type, PDP address, QoS, NSAPI, PDP config options	6.5.1.2
SMREG-PDP-ACTIVATE-REJ	cause	6.5.1.3
SMREG-PDP-ACTIVATE-IND	PDP type, QoS, NSAPI, APN	6.5.1.4
SMREG-PDP-DEACTIVATE-REQ	NSAPI(s)	6.5.1.5
SMREG-PDP-DEACTIVATE-CNF	NSAPI(s)	6.5.1.6
SMREG-PDP-DEACTIVATE-IND	NSAPI(s)	6.5.1.7
SMREG-PDP-MODIFY-IND	QoS(s), NSAPI(s)	6.5.1.8
SMREG-AA-PDP-ACTIVATE-REQ	server address, QoS, NSAPI, Data mode	6.5.1.9
SMREG-AA-PDP-ACTIVATE-CNF	QoS	6.5.1.10
SMREG-AA-PDP-ACTIVATE-REJ	cause	6.1.5.11
SMREG-AA-PDP-DEACTIVATE-REQ	NSAPI	6.5.1.12
SMREG-AA-PDP-DEACTIVATE-IND	NSAPI	6.5.1.13

6.5.1.1 SMREG-PDP-ACTIVATE-REQ

The MS initiates a PDP context activation. SM is requested to send the ACTIVATE PDP CONTEXT REQUEST message to the network. The PDP context is pending activation.

6.5.1.2 SMREG-PDP-ACTIVATE-CNF

The MS initiated PDP context activation succeeded. The network confirmed the PDP context activation, i.e. the ACTIVATE PDP CONTEXT ACCEPT message was received from the network. Then SM has ordered SNDCP to establish the needed LLC links. The PDP context is active.

6.5.1.3 SMREG-PDP-ACTIVATE-REJ

The PDP context activation failed, the PDP context is not activated. One reason for failure is that the network rejected the activation attempt, which means the ACTIVATE PDP CONTEXT FAILURE message was received. Another reason is e.g. that it was not possible to establish the needed LLC links.

6.5.1.4 SMREG-PDP-ACTIVATE-IND

The network asked for a PDP context activation. The REQUEST PDP CONTEXT ACTIVATION message was received from the network. The MS reacts either by initiating a new PDP context activation or by rejecting the network's request.

6.5.1.5 SMREG-PDP-DEACTIVATE-REQ

The MS initiates a PDP context deactivation: SM is requested to send a DEACTIVATE PDP CONTEXT REQUEST message to the network. The PDP context is pending deactivation.

6.5.1.6 SMREG-PDP-DEACTIVATE-CNF

The MS initiated PDP context deactivation has been done. The network confirmed the PDP context activation, i.e. the ACTIVATE PDP CONTEXT ACCEPT message was received from the network. Then SM has ordered SNDCP to locally release not further needed LLC links. The PDP context has been deactivated.

6.5.1.7 SMREG-PDP-DEACTIVATE-IND

A network initiated a PDP context deactivation has been performed. The DEACTIVATE PDP CONTEXT REQUEST message has been received from the network. The MS has acknowledged with the DEACIVATE PDP CONTEXT ACCEPT message. The PDP context has been deactivated, Not further needed LLC links were locally released,

6.5.1.8 SMREG-PDP-MODIFY-IND

A network initiated a PDP context modification has been performed. The MODIFY PDP CONTEXT REQUEST message has been received from the network. The modification has been acknowledged by sending the MODIFY PDP CONTEXT ACCEPT message. One or several PDP contexts have been modified. LLC links are adjusted.

6.5.1.9 SMREG-AA-PDP-ACTIVATE-REQ

The MS initiates an anonymous PDP context activation. SM is requested to send the ACTIVATE AA PDP REQUEST message to the network. The anonymous PDP context is pending activation.

6.5.1.10 SMREG-AA-PDP-ACTIVATE-CNF

The MS initiated anonymous PDP context activation succeeded. The network confirmed the PDP context activation, i.e. the ACTIVATE AA PDP CONTEXT ACCEPT message was received from the network. Then SM has ordered SNDCP to establish the needed LLC links. The anonymous PDP context is active.

6.5.1.11 SMREG-AA-PDP-ACTIVATE-REJ

The PDP context activation failed, the PDP context is not activated. One reason for failure is that the network rejected the activation attempt, which means the AA ACTIVATE PDP CONTEXT FAILURE message was received. Another reason is e.g. that it was not possible to establish the needed LLC links.

6.5.1.12 SMREG-AA-PDP-DEACTIVATE-REQ

The MS initiates the anonymous PDP context deactivation:

6.5.1.13 SMREG-AA-PDP-DEACTIVATE-IND

The MS anonymous PDP context deactivation has been performed. For example the MS's ready timer has expired, or the MS has left the routing area. Also the network may have requested deactivation, which means a DEACTIVATE AA PDP CONTEXT REQUEST message was received from the network.

The session management services provided at the service access point SMREG-SAP are illustrated in the state machines of figure 6.4 and 6.5 below. Note, that the state machine describes only one PDP context within the SM entity.

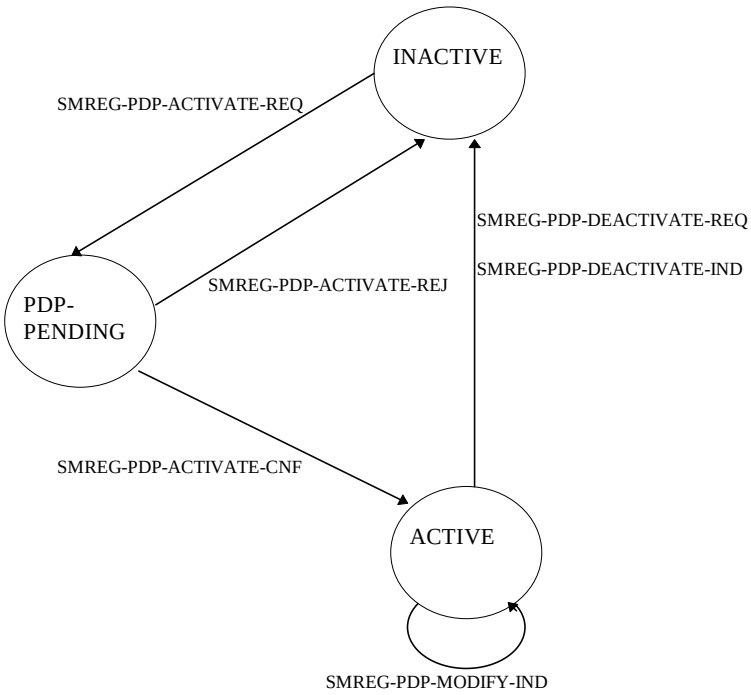


Figure 6.4: Session Management service states at the SMREG-SAP for GPRS non-anonymous PDP context handling - MS side

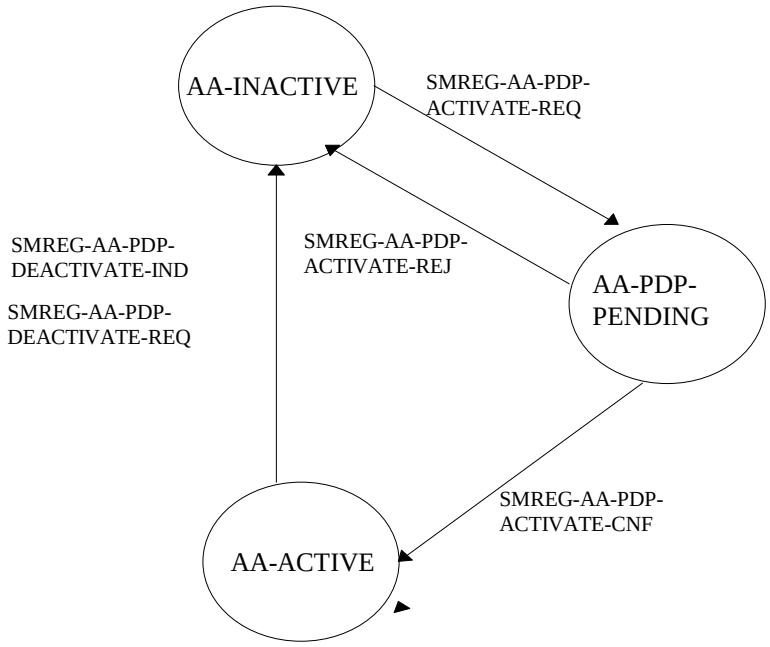


Figure 6.5:Session management services states at SMREG-SAP for GPRS anonymous services - MS side

6.5.2 Session Management Services for SNSM-SAP

6.5.2.1 Service primitives

This section is informative, the service primitives are defined in GSM 04.65 [12]. They are included here to provide a complete overview of the radio interface protocol architecture.

Table 6.5.2: Service primitives and parameters at SNSM-SAP - MS side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
SNSM-ACTIVATE-IND	NSAPI, QoS, SAPI	6.5.2.1.1
SNSM-ACTIVATE-RSP	-	6.5.2.1.2
SNSM-DEACTIVATE-IND	NSAPI	6.5.2.1.3
SNSM-DEACTIVATE-RSP	-	6.5.2.1.4
SNSM-MODIFY-IND	NSAPI, QoS, SAPI	6.5.2.1.5
SNSM-MODIFY-RSP	-	6.5.2.1.6
SNSM-STATUS-REQ	-	6.5.2.1.7

6.5.2.1.1 SNSM-ACTIVATE-IND

Indication used by the SM entity to inform the SNDCP entity that an NSAPI has been activated for data transfer. It also informs the SNDCP entity about the negotiated QoS profile and the SAPI assigned for this NSAPI. The request is sent by SM towards SNDCP during an ongoing PDP context activation procedure.

6.5.2.1.2 SNSM-ACTIVATE-RSP

Response used by the SNDCP entity to inform the SM entity that the indicated NSAPI is now in use and that the acknowledged peer-to-peer LLC operation for the indicated SAPI is established, if necessary.

6.5.2.1.3 SNSM-DEACTIVATE-IND

Indication used by the SM entity to inform the SNDCP entity that an NSAPI has been deallocated and cannot be used by the SNDCP entity anymore. The request is sent by SM towards SNDCP during an ongoing MS initiated as well as network initiated PDP context activation procedure.

6.5.2.1.4 SNSM-DEACTIVATE-RSP

Response used by the SNDCP entity to inform the SM entity that the NSAPI indicated is no longer in use and that the acknowledged peer-to-peer LLC operation for the associated SAPI is released, if necessary.

6.5.2.1.5 SNSM-MODIFY-IND

Indication used by the SM entity to trigger change of the QoS for an NSAPI and indication of the SAPI to be used. The request is sent by SM towards SNDCP during an ongoing PDP context modification procedure.

6.5.2.1.6 SNSM-MODIFY-RSP

Response used by the SNDCP entity to inform the SM entity that the indicated NSAPI and QoS profile are now in use and the acknowledged peer-to-peer LLC operations for the appropriate SAPIs are established and/or released, if necessary.

6.5.2.1.7 SNSM-STATUS-REQ

This primitive is used by the SNDCP entity to inform the SM entity that SNDCP cannot continue its operation due to errors at the LLC layer (as indicated with LL-Release.indication) or at the SNDCP layer. The Cause parameter indicates the cause of the error.

6.6 Registration Services for GPRS-Services

The attach/detach procedures comprise the registration services which are provided at the GMMREG-SAP for non-anonymous access.

It shall be noted, that the registration services for mobiles of class A or B may depend on the service states for GPRS and non-GPRS services. Therefore the internal access points MMCOORD and the GMMCOORD (see figure 5.3) are used by GMM and MM to inform each other about the relevant conditions. No service primitives between the entities within the same sublayer, i.e. the MM sublayer, are defined in 04.07. The Mobility Management for class A and B mobiles is further specified in 04.08.

6.6.1 Registration Services for GMMREG-SAP

Table 6.6.1: Service primitives and parameters at GMMREG-SAP - MS side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
GMMREG-ATTACH-REQ	attach-type, READY-timer, STANDBY-timer	6.6.1.1
GMMREG-ATTACH-CNF	PLMNs MT-caps, attach-type.	6.6.1.2
GMMREG-ATTACH-REJ	cause	6.6.1.3
GMMREG-DETACH-REQ	detach-type, power-off/normal-detach	6.6.1.4
GMMREG-DETACH-CNF	detach-type	6.6.1.5
GMMREG-DETACH-IND	detach-type	6.6.1.6

6.6.1.1 GMMREG-ATTACH-REQ

MS initiates the GPRS and/or IMSI attach. GMM is requested to send an ATTACH REQUEST message to the network. The attachment is registration pending in the MS.

6.6.1.2 GMMREG-ATTACH-CNF

The attach (either GPRS-attach or IMSI-attach or both) was successful. The network confirmed the attach, i.e. the ATTACH ACCEPT message was received by the MS. The LLC and RR sublayer will be informed by GMM about the TLLI to be used.

6.6.1.3 GMMREG-ATTACH-REJ

The attach (either GPRS-attach or IMSI-attach or both) has failed. The network rejected the attach attempt, i.e. the message ATTACH REJECT was received from the network.

6.6.1.4 GMMREG-DETACH-REQ

MS initiates GPRS and/or IMSI detach: GMM is requested to send a DETACH REQUEST message, the detach procedure is initiated. In case of MS initiated detach at power-off, the procedure is terminated in the MS after sending the DETACH REQUEST message.

6.6.1.5 GMMREG-DETACH-CNF

The MS initiated detach (either GPRS-attach or IMSI-attach or both) has been completed.
The network confirmed the detach, i.e. the message DETACH ACCEPT was received from the network. This finalises the detach procedure (normal, not at power off). Any PDP context possibly activated before is deactivated.

6.6.1.6 GMMREG-DETACH-IND

A network initiated detach has been performed. Or the detach has been performed locally due to expiration of the standby timer or a failed routing area update. In the first case the DETACH REQUEST message was from the network. Any PDP context possibly activated before is deactivated.

The registration services provided at the service access point GMMREG-SAP are illustrated in the state machine of figure 6.6 below. Note, that in state registered the MS may be suspended from GPRS mobility management due to an ongoing CS connection. The registration procedure Routing Area Updating, which is not provided at the GMMREG-SAP, is not visible within the diagram.

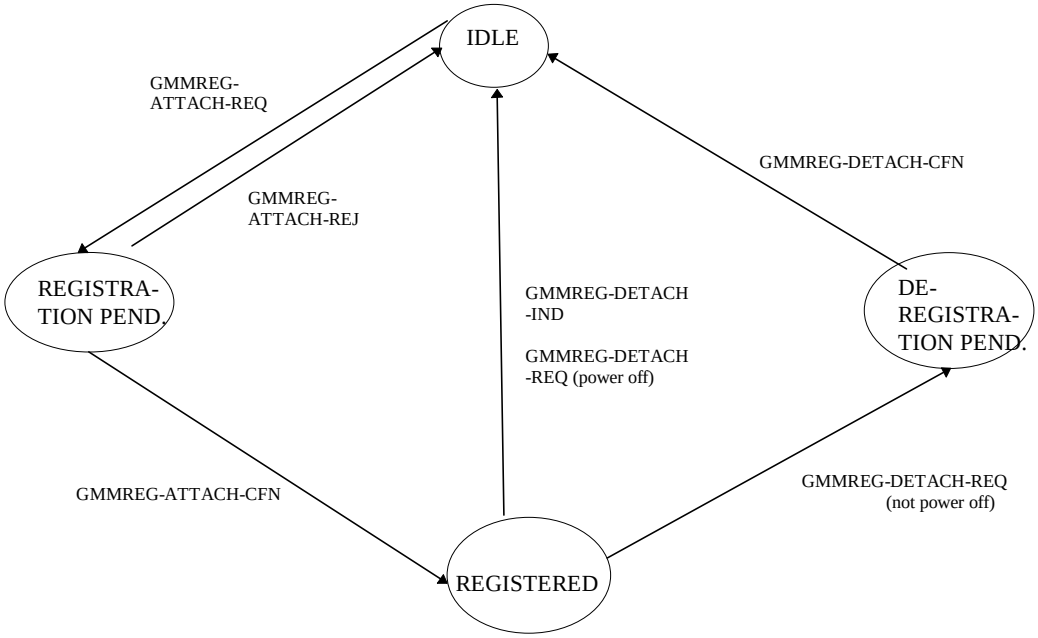


Figure 6.6: Registration services states at GMMREG-SAP for GPRS non-anonymous attach and detach - MS side.

6.7 Services provided to SNDCP entities by GPRS Logical Link Control services

This section is informative, the service primitives are defined in GSM 04.64 [11]. They are included here to provide a complete overview of the radio interface protocol architecture.

Logical Link Control services are provided at the QoS1-SAP - QoS4 SAP towards the SNDCP and at the LLSMS-SAP towards SMS.

6.7.1 Service state diagram for QoS1-SAP, QoS2-SAP, QoS3-SAP and QoS4-SAP

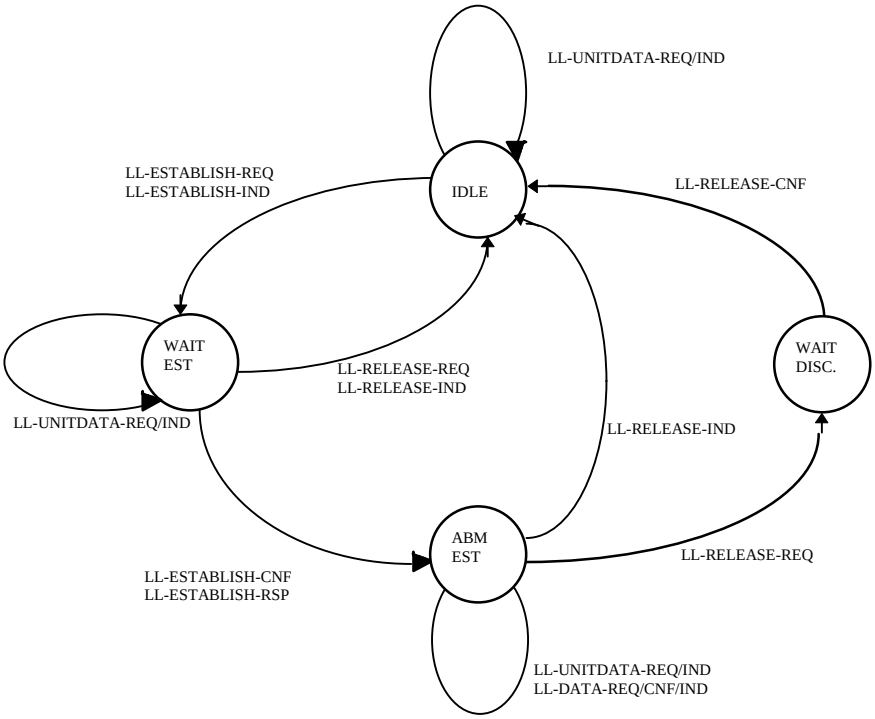


Figure 6.7: States to establish and release ABM mode operation

6.7.2 Service primitives for QoS1-SAP, QoS2-SAP, QoS3-SAP and QoS4-SAP

Table 6.7.2: Service primitives and parameters at QoS1 to QoS4 - MS side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
LL-ESTABLISH-REQ	TLLI, SNDCP requested parameters (XID)	6.7.2.1
LL-ESTABLISH-CNF	TLLI, SNDCP negotiated parameters (XID)	6.7.2.2
LL-ESTABLISH-IND	TLLI, SNDCP requested parameters (XID), N201	6.7.2.3
LL-ESTABLISH-RSP	TLLI, SNDCP negotiated parameters (XID)	6.7.2.4
LL-RELEASE-REQ	TLLI	6.7.2.5
LL-RELEASE-CFN	TLLI	6.7.2.6
LL-RELEASE-IND	TLLI	6.7.2.7
LL-XID-REQ	TLLI, SNDCP requested parameters (XID)	6.7.2.8
LL-XID-IND	TLLI, SNDCP requested parameters (XID), N201	6.7.2.9
LL-XID-RSP	TLLI, SNDCP negotiated parameters (XID)	6.7.2.10
LL-XID-CNF	TLLI, SNDCP negotiated parameters (XID), N201	6.7.2.11
LL-DATA-REQ	TLLI, N-PDU, local reference	6.7.2.12
LL-DATA-CNF	TLLI, local reference	6.7.2.13
LL-DATA-IND	TLLI, N-PDU	6.7.2.14
LL-UNITDATA-REQ	TLLI, N-PDU, protect, cipher	6.7.2.15
LL-UNITDATA-IND	TLLI, N-PDU	6.7.2.16
LL-STATUS-IND	TLLI, cause	6.7.2.17

6.7.2.1 LL-ESTABLISH-REQ

A LLC SABM frame will be sent to establish the LLC ABM mode

6.7.2.2 LL-ESTABLISH-CNF

A LLC UA frame is received, the LLC ABM mode has been established

6.7.2.3 LL-ESTABLISH-IND

A LLC SABM frame is received

6.7.2.4 LL-ESTABLISH-RSP

A LLC UA frame will be sent, the ABM mode is established

6.7.2.5 LL-RELEASE-REQ

A LLC DISC frame will be sent to change to LLC ADM mode

6.7.2.6 LL-RELEASE-CNF

The LLC link has been disconnected, LLC is in ADM mode

6.7.2.7 LL-RELEASE-IND

LLC is in idle mode

6.7.2.8 LL-XID-REQ

An LLC XID frame will be sent

6.7.2.9 LL-XID-IND

An LLC XID frame has been received

6.7.2.10 LL-XID-RSP

An LLC XID frame will be sent as a response to a received XID frame

6.7.2.11 LL-XID-CNF

An LLC XID frame has been received as a response to a sent XID frame

6.7.2.12 LL-DATA-REQ

An LLC I frame will be sent to the peer entity

6.7.2.13 LL-DATA-CNF

Successful reception of an LLC I frame has been acknowledged by the peer entity

6.7.2.14 LL-DATA-IND

An LLC I frame has been received from the peer entity

6.7.2.15 LL-UNITDATA-REQ

An LLC UI frame will be sent to the peer entity

6.7.2.16 LL-UNITDATA-IND

An LLC UI frame has been received from the peer entity

6.7.2.17 LL-STATUS-IND

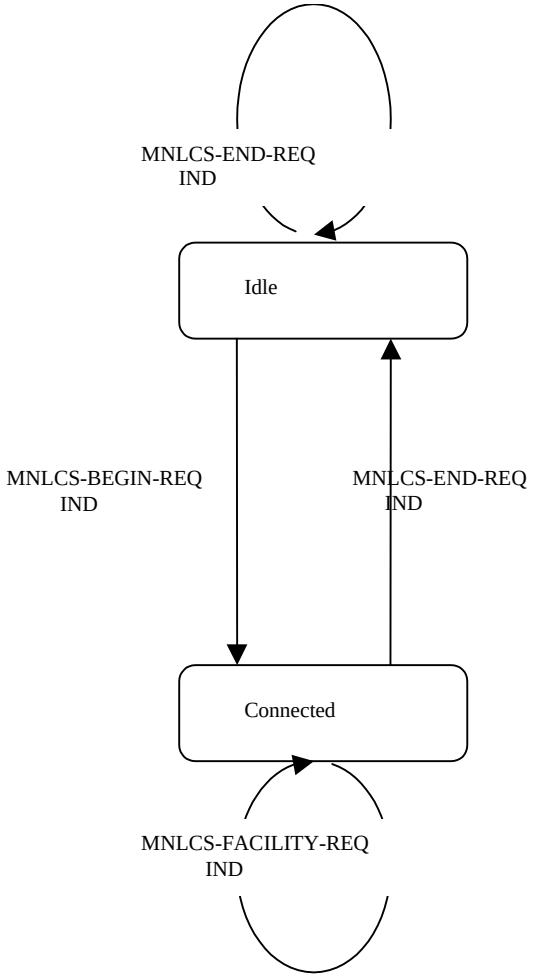
Indication used by LLC to transfer LLC failures to the SNDCP sublayer. The failure may also be caused due to errors at the RLC/MAC layer.

6.8 Location services at the MS side

The location services (initiation of positioning measurements at the MS are provided at the service access point MNLCS-SAP. The service provided by the CM sublayer to support the location services is defined in GSM 04.71.

6.8.1 Service state diagram

The positioning services provided at the service access point MNLCS-SAP are illustrated in the state diagram of figure 6.8.



STATES:

IDLE - No LCS signalling transaction pending

CONN - LCS signalling transaction established

Figure 6.8: Service graph of the Location Services Support entity - MS side

6.8.2 Service primitives

Table 6.8: Primitives and Parameters at MNLCS-SAP - MS side

PRIMITIVES	PARAMETERS (Info elements of message)	REFERENCE
MNLCS_BEGIN_REQ	REGISTER	6.8.2.1
MNLCS_BEGIN_IND	REGISTER	6.8.2.2
MNLCS_FACILITY_REQ	FACILITY	6.8.2.3
MNLCS_FACILITY_IND	FACILITY	6.8.2.4
MNLCS_END_REQ	RELEASE COMPLETE	6.8.2.5
MNLCS_END_IND	RELEASE COMPLETE	6.8.2.6

6.8.2.1 MNLCS_BEGIN_REQ

Request to send a REGISTER message in order to establish a signalling transaction for the provision of location services. The request for transfer of a location service facility may be included

6.8.2.2 MNLCS_BEGIN_IND

Receipt of a REGISTER message, a signalling transaction is established for the provision of location services after receipt of a REGISTER message. The indication of a location service facility may be included.

6.8.2.3 MNLCS_FACILITY_REQ

Request to send a FACILITY message for the provision of a location service invocation. The request for transfer of a location service facility may be included

6.8.2.4 MNLCS_FACILITY_IND

Receipt of a FACILITY message, a location service facility has been requested

6.8.2.5 MNLCS_END_REQ

Request to send a RELEASE COMPLETE message in order to release the signalling transaction. The request for transfer of a location service facility may be included.

6.8.2.6 MNLCS_END_IND

Receipt of a RELEASE COMPLETE message, the signalling transaction has been released. The indication of a location service facility may be included.

7 Services provided by signalling layer 3 on the Network side

In this clause, the services provided by signalling layer 3 on the network side are described which belong to the CM sub-layer functional blocks of CC, SMS, and SS. The services corresponding to further functional blocks of the CM sublayer are not further described in this clause.

7.1 Call control services

The Call Control services are provided by multiple CC entities at the service access point MNCC-SAP.

The Call Control service class consists of the following services:

- call establishment;
- call maintaining;
- call termination;
- call related Supplementary Services Support.

7.1.1 Service state diagram

The Call Control services provided at the service access point MNCC-SAP are illustrated in figure 7.1.

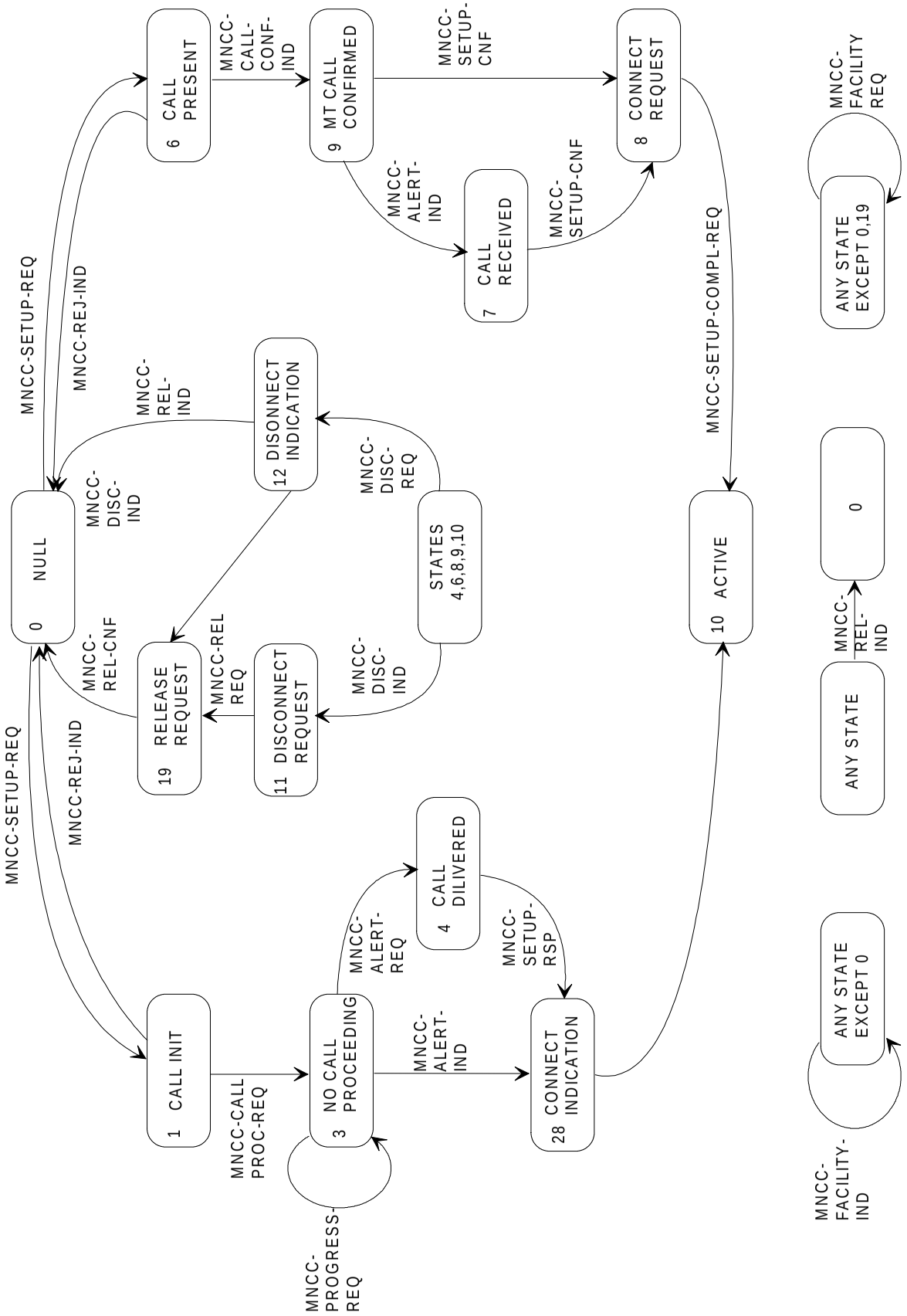


Figure 7.1: (page 1 of 2) Service graph of Call Control entity - Network side

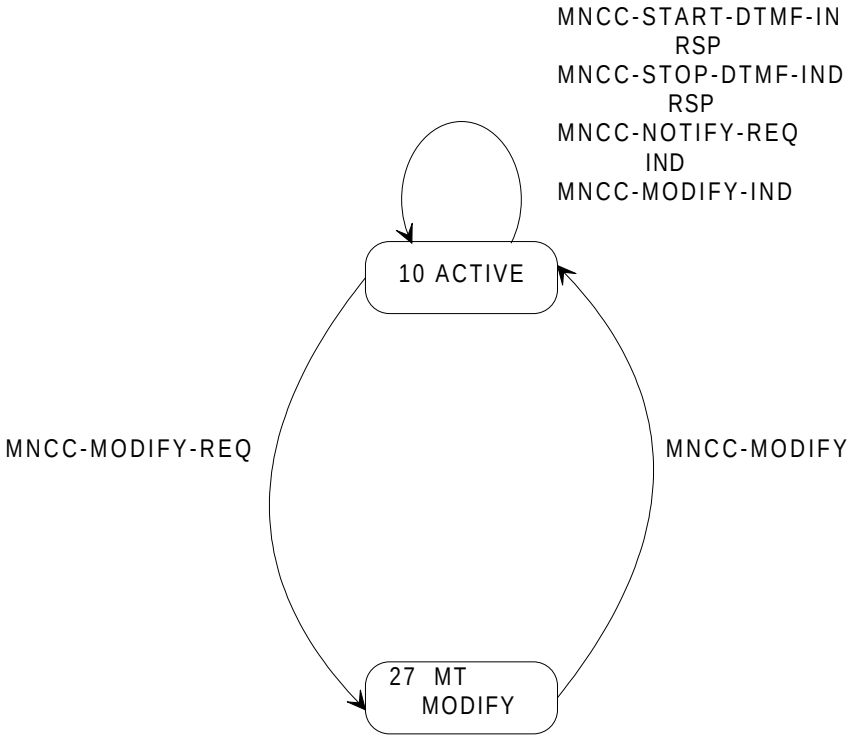


Figure 7.1: (page 2 of 2) Service graph of Call Control entity - Network side

7.1.2 Service primitives

Table 7.1: Primitives and Parameters at MNCC-SAP - Network side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
MNCC_SETUP_REQ	SETUP incl. Mobile ID or EMERGENCY SETUP	7.1.2.1
MNCC_SETUP_IND	SETUP	7.1.2.2
MNCC_SETUP_RSP	CONNECT	7.1.2.3
MNCC_SETUP_CNF	CONNECT	7.1.2.4
MNCC_SETUP_COMPL_REQ	CONNECT ACKNOWLEDGE	7.1.2.5
MNCC_SETUP_COMPL_IND	CONNECT ACKNOWLEDGE	7.1.2.6
MNCC_REJ_REQ	RELEASE COMPLETE	7.1.2.7
MNCC_REJ_IND	cause	7.1.2.8
MNCC_CALL_CONF_IND	CALL CONFIRMED	7.1.2.9
MNCC_CALL PROC_REQ	CALL PROCEEDING	7.1.2.10
MNCC_PROGRESS_REQ	PROGRESS	7.1.2.11
MNCC_ALERT_REQ	ALERTING	7.1.2.12
MNCC_ALERT_IND	ALERTING	7.1.2.13
MNCC_NOTIFY_REQ	NOTIFY	7.1.2.14
MNCC_NOTIFY_IND	NOTIFY	7.1.2.15
MNCC_DISC_REQ	DISCONNECT	7.1.2.16
MNCC_DISC_IND	DISCONNECT	7.1.2.17
MNCC_REL_REQ	RELEASE or DISCONNECT	7.1.2.18
MNCC_REL_IND	RELEASE	7.1.2.19
MNCC_REL_CNF	RELEASE or RELEASE COMPLETE	7.1.2.20
MNCC_FACILITY_REQ	facility	7.1.2.21
MNCC_FACILITY_IND	facility	7.1.2.22
MNCC_START_DTMF_IND	START DTMF	7.1.2.23
MNCC_START_DTMF_RSP	START DTMF ACK or START DTMF REJ	7.1.2.24
MNCC_STOP_DTMF_IND	STOP DTMF	7.1.2.25
MNCC_STOP_DTMF_RSP	STOP DTMF ACK	7.1.2.26
MNCC_MODIFY_REQ	MODIFY or BC-parameter	7.1.2.27
MNCC_MODIFY_IND	BC-parameter	7.1.2.28
MNCC_MODIFY RES	MODIFY COMPLETE	7.1.2.29
MNCC_MODIFY_CNF	BC-parameter	7.1.2.30

7.1.2.1 MNCC_SETUP_REQ

Request to send a SETUP message to initiate Mobile terminated establishment.

7.1.2.2 MNCC_SETUP_IND

Receipt of a SETUP or EMERGENCY SETUP message, the Mobile originating call establishment has been initiated.

7.1.2.3 MNCC_SETUP_RSP

Response to send a CONNECT message to indicate call acceptance by the remote user.

7.1.2.4 MNCC_SETUP_CNF

Receipt of a CONNECT message, the Mobile terminated call has been accepted.

7.1.2.5 MNCC_SETUP_COMPL_REQ

Request to send a CONNECT ACKNOWLEDGE message, the Mobile terminated call establishment has been completed.

7.1.2.6 MNCC_SETUP_COMPL_IND

Indication of the receipt of a CONNECT ACKNOWLEDGE message, the Mobile originating call establishment has been completed.

7.1.2.7 MNCC_REJ_REQ

Reject the Mobile originated call establishment if the call cannot be accepted.

7.1.2.8 MNCC_REJ_IND

A Mobile terminated call was rejected by the MS, e.g. because of missing compatibility.

7.1.2.9 MNCC_CALL_CONF_IND

Receipt of a CALL CONFIRMED message, the Mobile terminated call has been confirmed. A bearer capability different from that given in MNCC_SETUP_REQ may be offered to the remote calling user.

7.1.2.10 MNCC_CALL_PROC_REQ

Request to send a CALL PROCEEDING message to indicate to the Mobile originating user that call establishment has been initiated in the Network and no more call establishment information will be accepted.

7.1.2.11 MNCC_PROGRESS_REQ

Request to send a PROGRESS message or to piggy-back a progress IE in a suitable CC message in order to give the Mobile user information about the call , e.g., that the call is progressing in the PLMN/ISDN environment, or that the call has left the PLMN/ISDN environment, or that in-band tones/announcement are available.

7.1.2.12 MNCC_ALERT_REQ

Request to send an ALERTING message to indicate to the Mobile originating user that remote called user alerting has been initiated.

7.1.2.13 MNCC_ALERT_IND

Receipt of an ALERTING message from the Mobile terminated user to be sent to the remote calling user to indicate that user alerting has been initiated.

7.1.2.14 MNCC_NOTIFY_REQ

Request to send information pertaining to a call, such as user suspended, to the Mobile originating or the Mobile terminated user.

7.1.2.15 MNCC_NOTIFY_IND

Indication from the Mobile originating or Mobile terminated user of information pertaining to a call, such as remote user suspended.

7.1.2.16 MNCC_DISC_REQ

Request to send a DISCONNECT message to the MS in order to clear the end-to-end connection.

7.1.2.17 MNCC_DISC_IND

Receipt of a DISCONNECT message, the MS indicates that the end-to-end connection is cleared.

7.1.2.18 MNCC_REL_REQ

Request to send a RELEASE message to inform the MS that the network intends to release the MM connection and the correspondent call reference.

7.1.2.19 MNCC_REL_IND

Receipt of a RELEASE message, the MS intends to release its MM connection and call reference. The Network is requested to release its call reference and MM connection.

7.1.2.20 MNCC_REL_CNF

The RELEASE COMPLETE message has been received, the MM connection in the MS has been released, the Network itself shall release its MM connection and the corresponding call reference.

7.1.2.21 MNCC_FACILITY_REQ

Request to transport a *facility* IE for call related supplementary service invocations.

7.1.2.22 MNCC_FACILITY_IND

Indication that a *facility* IE for call related supplementary service invocations has been received.

7.1.2.23 MNCC_START_DTMF_IND

Indicate the receipt of a START DTMF message in order to start a DTMF control operation.

7.1.2.24 MNCC_START_DTMF_RSP

Request to send a START DTMF ACKNOWLEDGE or START DTMF REJECT message in order to acknowledge or reject the start of a DTMF control operation.

7.1.2.25 MNCC_STOP_DTMF_IND

Indicate the receipt of a STOP DTMF message in order to stop a DTMF control operation.

7.1.2.26 MNCC_STOP_DTMF_RSP

Request to send a STOP DTMF ACKNOWLEDGE message in order to acknowledge the completion of a DTMF control operation.

7.1.2.27 MNCC_MODIFY_REQ

Request to start the Mobile terminating in-call modification.

7.1.2.28 MNCC_MODIFY_IND

Receipt of a MODIFY message, the Mobile originating in-call modification has been initiated.

7.1.2.29 MNCC_MODIFY_RES

Response to send a MODIFY COMPLETE to indicate to the Mobile user that the mobile originating in-call modification procedure has been completed.

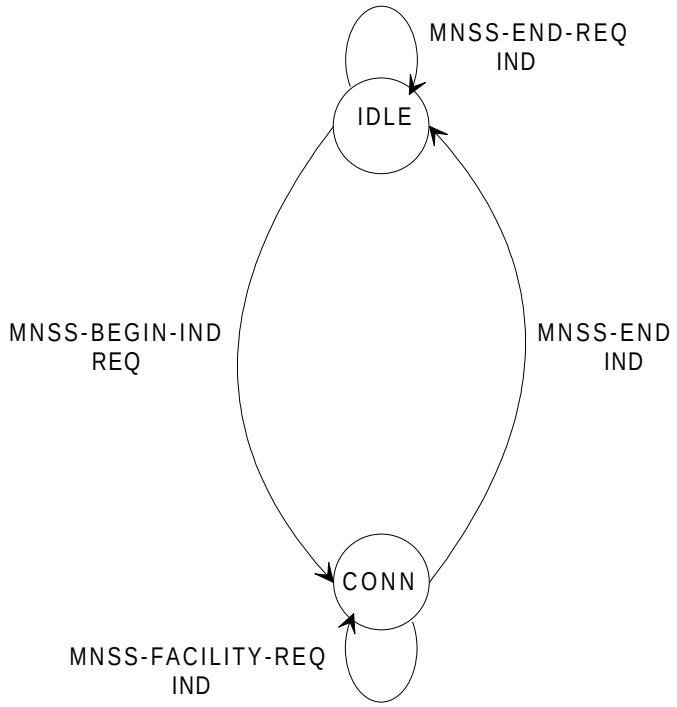
7.1.2.30 MNCC_MODIFY_CNF

Confirmation that the Mobile terminating in-call modification has been completed.

7.2 Call independent Supplementary Services Support

7.2.1 Service state diagram

The primitives provided by the call independent Supplementary Services Support entity and the transitions between permitted states are shown in the service graph of figure 7.2 below.



STATES:

IDLE - No SS signalling transaction pending

CONN - SS signalling transaction established

Figure 7.2: Service graph of the call independent Supplementary Services Support entity - Network side

7.2.2 Service primitives

Table 7.2: Primitives and Parameters at MNSS-SAP - Network side

PRIMITIVES	PARAMETERS (Info elements of message)	REFERENCE
MNSS_BEGIN_REQ	REGISTER	7.2.2.1
MNSS_BEGIN_IND	REGISTER	7.2.2.2
MNSS_FACILITY_REQ	FACILITY	7.2.2.3
MNSS_FACILITY_IND	FACILITY	7.2.2.4
MNSS_END_REQ	RELEASE COMPLETE	7.2.2.5
MNSS_END_IND	RELEASE COMPLETE	7.2.2.6

7.2.2.1 MNSS_BEGIN_REQ

Request to send a REGISTER message in order to establish a signalling transaction for the provision of call independent supplementary services. The request for a supplementary service invocation may be included.

7.2.2.2 MNSS_BEGIN_IND

Receipt of a REGISTER message, a signalling transaction is established for the provision of call independent supplementary services. The indication of a supplementary service invocation may be included.

7.2.2.3 MNSS_FACILITY_REQ

Request to send a FACILITY message for the provision of a call independent supplementary service facility.

7.2.2.4 MNSS_FACILITY_IND

Receipt of a FACILITY message, a supplementary service facility has been requested.

7.2.2.5 MNSS_END_REQ

Request to send a RELEASE COMPLETE message in order to release the signalling transaction by sending a RELEASE COMPLETE message. The request for transfer of a supplementary service facility may be included.

7.2.2.6 MNSS_END_IND

Indication that the signalling transaction has been released after receipt of a RELEASE COMPLETE message. The indication of a supplementary service facility may be included.

7.3 Short Message Services Support

The service provided by the CM sublayer to support the short message service are defined in GSM 04.11.

7.4 Services provided to SNDCP and SMS entities by GPRS Logical Link Control services

This section is informative, the service primitives are defined in GSM 04.64 [11]. They are included here to provide a complete overview of the radio interface protocol architecture.

On the network side, Logical Link Control services are provided at the QoS1-SAP - QoS4 SAP towards the SNDCP and at the LLSMS-SAP towards SMS

7.4.1 Service state diagram for QoS1-SAP, QoS2-SAP, QoS3-SAP and QoS4-SAP

The service state diagram is identical on the network side is identical to the one shown in figure 6.7 for the mobile side.

7.4.2 Service primitives for QoS1-SAP, QoS2-SAP, QoS3-SAP and QoS4-SAP

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
LL-ESTABLISH-REQ	TLLI, SNDCP requested parameters (XID)	7.4.2.1
LL-ESTABLISH-CNF	TLLI, SNDCP negotiated parameters (XID), N201	7.4.2.2
LL-ESTABLISH-IND	TLLI, SNDCP requested parameters (XID), N201	7.4.2.3
LL-ESTABLISH-RSP	TLLI, SNDCP negotiated parameters (XID)	7.4.2.4
LL-RELEASE-REQ	TLLI	7.4.2.5
LL-RELEASE-CNF	TLLI	7.4.2.6
LL-RELEASE-IND	TLLI	7.4.2.7
LL-XID-REQ	TLLI, SNDCP requested parameters (XID)	7.4.2.8
LL-XID-IND	TLLI, SNDCP requested parameters (XID), N201	7.4.2.9
LL-XID-RSP	TLLI, SNDCP negotiated parameters (XID)	7.4.2.10
LL-XID-CNF	TLLI, SNDCP negotiated parameters (XID), N201	7.4.2.11
LL-DATA-REQ	TLLI, N-PDU, local reference	7.4.2.12
LL-DATASENT-IND	TLLI, local reference, V(S)	7.4.2.13
LL-DATA-CNF	TLLI, local reference	7.4.2.14
LL-DATA-IND	TLLI, N-PDU	7.4.2.15
LL-UNITDATA-REQ	TLLI, N-PDU, protect, cipher	7.4.2.16
LL-UNITDATA-IND	TLLI, N-PDU	7.4.2.17
LL-STATUS-IND	TLLI, cause	7.4.2.18

7.4.2.1 LL-ESTABLISH-REQ

A LLC SABM frame will be sent to establish the LLC ABM mode.

7.4.2.2 LL-ESTABLISH-CNF

A LLC UA frame is received, the LLC ABM mode has been established.

7.4.2.3 LL-ESTABLISH-IND

A LLC SABM frame is received.

7.4.2.4 LL-ESTABLISH-RSP

A LLC UA frame will be sent, the ABM mode is established.

7.4.2.5 LL-RELEASE-REQ

A LLC DISC frame will be sent to change to LLC ADM mode.

7.4.2.6 LL-RELEASE-CNF

The LLC link has been disconnected, LLC is in ADM mode.

7.4.2.7 LL-RELEASE-IND

LLC is in idle mode.

7.4.2.8 LL-XID-REQ

An LLC XID frame will be sent.

7.4.2.9 LL-XID-IND

An LLC XID frame is received.

7.4.2.10 LL-XID-RSP

An LLC XID frame will be sent as a reply to a received XID frame.

7.4.2.11 LL-XID-CNF

An LLC XID frame has been received as a reply to a sent XID frame.

7.4.2.12 LL-DATA-REQ

An LLC I frame will be sent to the peer entity.

7.4.2.13 LL-DATASENT-IND

The sent LLC frame was sent with the V(S) indicated

7.4.2.14 LL-DATA-CNF

Successful reception of an LLC I frame has been acknowledged by the peer entity.

7.4.2.15 LL-DATA-IND

An LLC I frame has been received form the peer entity.

7.4.2.16 LL-UNITDATA-REQ

An LLC UI frame will be sent to the peer entity.

7.4.2.17 LL-UNITDATA-IND

An LLC UI frame has been received from the peer entity.

7.4.2.18 LL-STATUS-IND

Indication used by LLC to transfer LLC failures to the SNDCP sublayer. The failure may also be caused due to errors at the RLC/MAC layer.

7.5 Session Management Services for GPRS

On the network side Session Management Services are provided only at the SNSM-SAP

7.5.1 Session Management Services for SMREG-SAP

Table 7.5.1: Primitives and Parameters at SMREG-SAP - network side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
SMREG-PDP-ACTIVATE-REQ	PDP type, PDP address, QoS, NSAPI, APN, Data mode	7.5.1.1
SMREG-PDP-ACTIVATE-REJ	cause	7.5.1.2
SMREG-PDP-DEACTIVATE-REQ	NSAPI(s)	7.5.1.3
SMREG-PDP-DEACTIVATE-CNF	NSAPI(s)	7.5.1.4
SMREG-PDP-MODIFY-REQ	QoS(s), NSAPI(s)	7.5.1.5
SMREG PDP-MODIFY-CNF	server address, QoS(s), NSAPI(s)	7.5.1.6
SMREG PDP-MODIFY-REJ	server address, QoS(s), NSAPI(s)	7.5.1.7

7.5.1.1 SMREG-PDP-ACTIVATE-REQ

The network initiates a PDP context activation. SM is requested to send the ACTIVATE PDP CONTEXT REQUEST message to the MS. The PDP context is pending activation. The network expects that the MS continues with a normal MS initiated context activation. Therefore at the SMREG-SAP no confirmation is provided.

7.5.1.2 SMREG-PDP-ACTIVATE-REJ

The network initiated PDP context activation failed. Either the ACTIVATE PDP CONTEXT FAILURE message was received from the MS, or lower layer failure or timer expiry caused abortion of the activation procedure.

7.5.1.3 SMREG-PDP-DEACTIVATE-REQ

The network initiates a PDP context deactivation. SM is requested to send a DEACTIVATE PDP CONTEXT REQUEST message. The PDP context is pending deactivation.

7.5.1.4 SMREG-PDP-DEACTIVATE-CNF

The network initiated PDP context activation has been concluded. The MS confirmed he PDP context activation, i.e. the DEACTIVATE PDP CONTEXT ACCEPT message was received. Then SM ordered SNDCP to locally release those LLC links not further needed by other PDP contexts. The PDP context is deactivated.

7.5.1.5 SMREG-PDP-MODIFY-REQ

The network initiates a modification of the PDP context. SM is requested to send a MODIFY PDP CONTEXT REQUEST message to the MS. The PDP context is pending modification.

7.5.1.6 SMREG-PDP-MODIFY-CNF

The PDP context modification has been concluded. The MS confirmed he PDP context modification, i.e. the MODIFY PDP CONTEXT ACCEPT message was received. Then SM ordered SNDCP to adjust LLC links as required. The PDP context is modified.

7.5.1.7 SMREG-PDP-MODIFY-REJ

The PDP context modification has been failed. Due to timer expiry or lower layer failure the modification procedure has been aborted.

7.5.2 Session Management Services for SNSM-SAP

Table 7.5.2: Primitives and Parameters at SNSM-SAP - network side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
SNSM-ACTIVATE-IND	TLLI, NSAPI, QoS, SAPI	7.5.2.1
SNSMM-ACTIVATE-RSP	TLLI,	7.5.2.2
SNSM-DEACTIVATE-IND	TLLI, NSAPI	7.5.2.3
SNSM-DEACTIVATE-RSP	TLLI	7.5.2.4
SNSM-MODIFY-IND	TLLI, NSAPI, QoS, SAPI	7.5.2.5
SNSM-MODIFY-RSP	TLLI	7.5.2.6
SNSM-STATUS-REQ	TLLI, NSAPI, Cause	7.5.2.7
SNSM-WINDOW-IND	TLLI, NSAPI + MS's V(R)s	7.5.2.8

7.5.2.1 SNSM-ACTIVATE-IND

Indication used by the SM entity to inform the SNDCP entity that an NSAPI has been activated for data transfer. It also informs the SNDCP entity about the negotiated QoS profile and the SAPI assigned for this NSAPI. The request is sent by SM towards SNDCP during an ongoing PDP context activation procedure.

7.5.2.2 SNSM-ACTIVATE-RSP

Response used by the SNDCP entity to inform the SM entity that the indicated NSAPI is now in use and that the acknowledged peer-to-peer LLC operation for the indicated SAPI is established, if necessary.

7.5.2.3 SNSM-DEACTIVATE-IND

Indication used by the SM entity to inform the SNDCP entity that an NSAPI has been de-allocated and cannot be used by the SNDCP entity anymore. The request is sent by SM towards SNDCP during an ongoing PDP context activation procedure, or by SM in the old SGSN during an ongoing inter-SGSN routeing area update procedure.

7.5.2.4 SNSM-DEACTIVATE-RSP

Response used by the SNDCP entity to inform the SM entity that the NSAPI indicated is no longer in use and that the acknowledged peer-to-peer LLC operation for the associated SAPI is released, if necessary.

7.5.2.5 SNSM-MODIFY-IND

Indication used by the SM entity to trigger change of the QoS for an NSAPI and indication of the SAPI to be used. It is also used by the SM entity to inform the SNDCP entity that an NSAPI shall be created, together with the (re-)negotiated QoS profile and the SAPI assigned. The former is used during an ongoing PDP context modification procedure. The latter is used in the new SGSN during an ongoing inter-SGSN routeing area update procedure.

7.5.2.6 SNSM-MODIFY-RSP

Response used by the SNDCP entity to inform the SM entity that the indicated NSAPI and QoS profile are now in use and the acknowledged peer-to-peer LLC operations for the appropriate SAPIs are established and/or released, if necessary.

7.5.2.7 SNSM-STATUS-REQ

This primitive is used by the SNDCP entity to inform the SM entity that SNDCP cannot continue its operation due to errors at the LLC layer (as indicated with LL-Release.indication) or at the SNDCP layer. The Cause parameter indicates the cause of the error.

7.5.2.8 SNSM-WINDOW-IND

This primitive is used in case of inter SGSN routing area updating. The LLC frames confirmed by the MS are indicated to the SNDCP sublayer. The SNDCP sublayer will retransmit an N-PDU again if the MS has not confirmed all LLC PDUs that belong to the possibly segmented N-PDU.

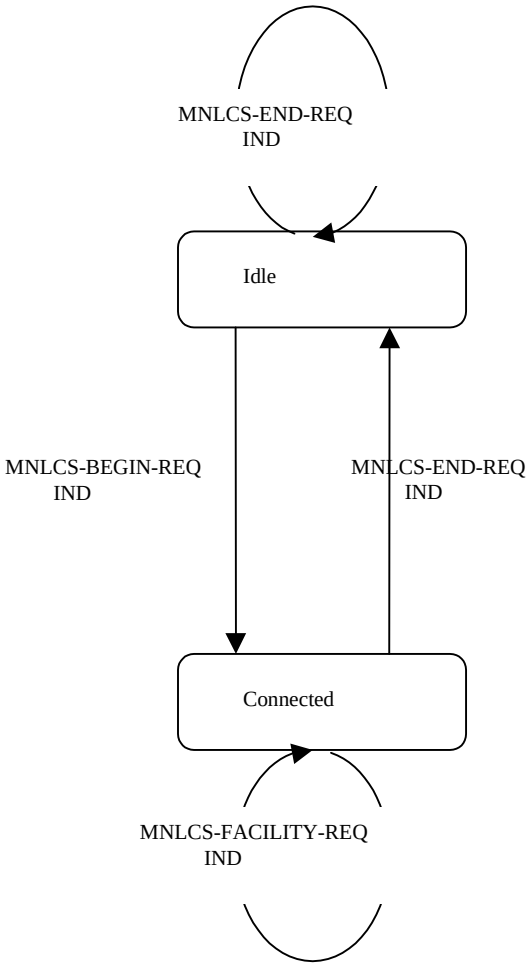
TCP/IP header and V.42bis data compression algorithms shall be reset before N-PDU transmission is resumed.

7.6 Location services at the Network side

The location services (initiation of location measurements at the network) are provided at the service access point MNLCS-SAP. The service provided by the CM sublayer to support the location services is defined in GSM 04.71

7.6.1 Service state diagram

The primitives provided by the call independent Location Services Support entity and the transitions between permitted states are shown in the service graph of figure 7.6 below.



STATES:

IDLE - No LCS signalling transaction pending
CONN - LCS signalling transaction established

Figure 7.6: Service graph of the Location Services Support entity - Network side

7.6.2 Service primitives

Table 7.6: Primitives and Parameters at MNLCS-SAP - Network side

PRIMITIVES	PARAMETERS (Info elements of message)	REFERENCE
MNLCS_BEGIN_REQ	REGISTER	7.6.2.1
MNLCS_BEGIN_IND	REGISTER	7.6.2.2
MNLCS_FACILITY_REQ	FACILITY	7.6.2.3
MNLCS_FACILITY_IND	FACILITY	7.6.2.4
MNLCS_END_REQ	RELEASE COMPLETE	7.6.2.5
MNLCS_END_IND	RELEASE COMPLETE	7.6.2.6

7.6.2.1 MNLCS_BEGIN_REQ

Request to send a REGISTER message in order to establish a signalling transaction for the provision of location services. The request for a location service invocation may be included.

7.6.2.2 MNLCS_BEGIN_IND

Receipt of a REGISTER message, a signalling transaction is established for the provision of location services. The indication of a location service invocation may be included.

7.6.2.3 MNLCS_FACILITY_REQ

Request to send a FACILITY message for the provision of a location service facility.

7.6.2.4 MNLCS_FACILITY_IND

Receipt of a FACILITY message, a location service facility has been requested.

7.6.2.5 MNLCS_END_REQ

Request to send a RELEASE COMPLETE message in order to release the signalling transaction by sending a RELEASE COMPLETE message. The request for transfer of a location service facility may be included.

7.6.2.6 MNLCS_END_IND

Indication that the signalling transaction has been released after receipt of a RELEASE COMPLETE message. The indication of a location service facility may be included.

8 Services assumed from signalling layers 1 and 2

The services provided by layer 2 are defined in detail in GSM 04.05. A short summary is given below.

In addition, layer 1 communicates directly with layer 3 for information transfer related to channel management and to measurement control. See section 8.5 below.

8.1 Priority

Messages from layer 3 can be sent with:

- no priority,

  i.e. the messages are sent in first-in-first-out order;

- priority,

  i.e. a message with this indication is sent as early as possible by layer 2.

8.2 Unacknowledged information transfer

Transfer of unacknowledged information using the primitives DL_UNIT_DATA_ REQUEST/INDICATION.

8.3 Acknowledged information transfer

Transfer of information in multiframe acknowledged mode including:

- establishment of data link connection between L3 entities;
- transfer of information in acknowledged mode;
- release of the data link connection.

The primitives associated with acknowledged information transfer are:

- DL_ESTABLISH_REQUEST/INDICATION/CONFIRM for establishment of acknowledged mode;
- DL_DATA_REQUEST/INDICATION for requesting the transmission of a message unit and for indicating the reception of a message unit;
- DL_SUSPEND_REQUEST/DL_RELEASE_CONFIRM for requesting and confirming the suspension of the acknowledged information transfer in the MS upon channel change;
- DL_RESUME_REQUEST/DL_ESTABLISH_CONFIRM for requesting and confirming the resumption of the acknowledged information transfer in the MS after suspension at channel change;
- DL_RELEASE_REQUEST/INDICATION/CONFIRM for the termination of acknowledged mode operation;
- DL_RECONNECT_REQUEST for requesting the re-establishment of acknowledged information transfer in the MS on the old channel after channel change failure.

8.4 Random access

The transmission/reception of a random access burst is controlled by the primitives DL_RANDOM_ACCESS_REQUEST/INDICATION/CONFIRM.

8.5 Channel management and measurements

The management of channels, i.e. their activation, deactivation, configuration, deconfiguration, through-connection and disconnection is controlled by the RR sublayer in layer 3. The measurements performed by the physical layer are also controlled by the RR sublayer of layer 3 and they are reported to layer 3.

These functions use the primitives MPH_INFORMATION_REQUEST/INDICATION/CONFIRMATION.

9 Interlayer service interfaces on the MS side

In addition to the services described in this clause, the RR entity and MM entity also provide services to CM entities which don't belong to the functional blocks of CC, SMS, and SS. (For example, the RR entity provides service to Group Call and Broadcast Call entities.) These services are not further described in this clause.

9.1 Services provided by the Radio Resource Management entity

The Radio Resource Management (RR) sublayer provides a service to the Mobility Management entity (MM).

The RR services are used for:

- establishing control channel connections;
- releasing control channel connections;
- control-data transfer.

The Radio Resource Management services are represented by the RR-service primitives.

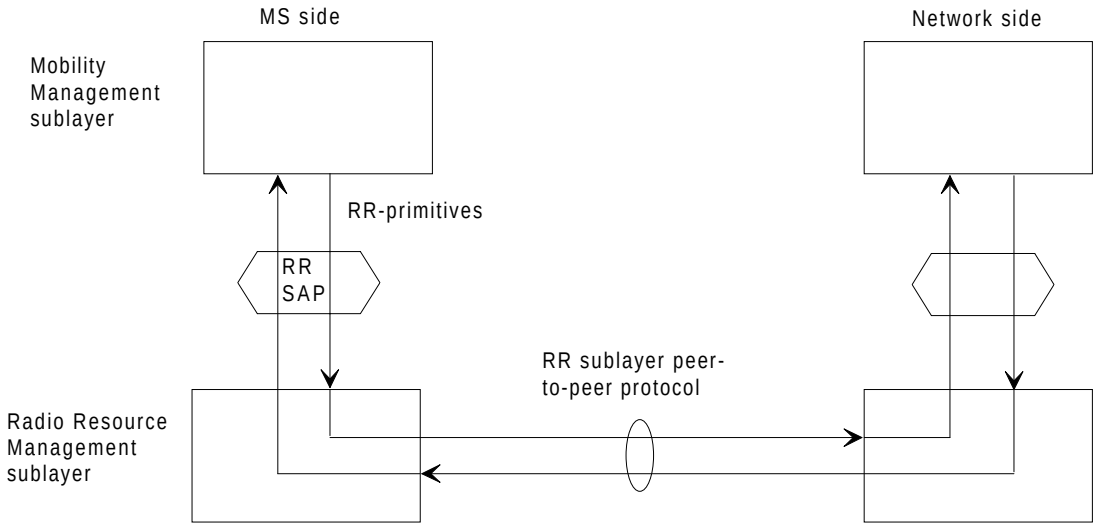


Figure 9.1: Services provided at RR-SAP - MS side

9.1.1 Service state diagram

The primitives provided by the Radio Resource Management entity and the transition between permitted states are shown in figure 9.2.

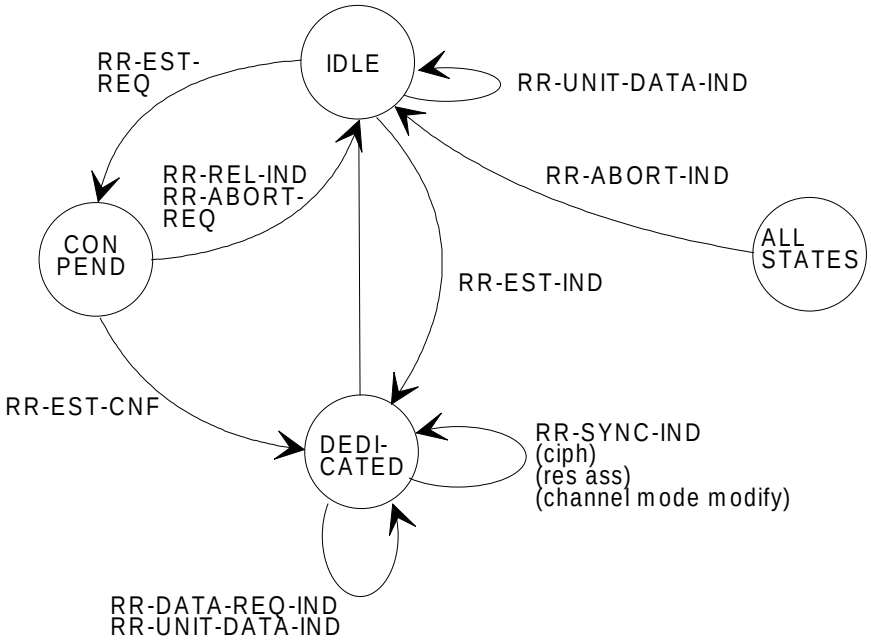


Figure 9.2: Service graph of the Radio Resource Management - MS side

9.1.2 Service primitives

Table 9.1: Primitives and parameters at the RR-SAP - MS side

PRIMITIVES	PARAMETERS	REFERENCE
RR_EST_REQ	Layer 3 message transferred in the SABM frame	9.1.2.1
RR_EST_IND	-	9.1.2.2
RR_EST_CNF	-	9.1.2.3
RR_REL_IND	cause	9.1.2.4
RR_SYNC_IND	cause (ciphering, res. ass., channel mode modify)	9.1.2.5
RR_DATA_REQ	Layer 3 message	9.1.2.6
RR_DATA_IND	Layer 3 message	9.1.2.7
RR_UNIT DATA_IND	Layer 3 message	9.1.2.8
RR_ABORT_REQ	cause	9.1.2.9
RR_ABORT_IND	cause	9.1.2.10
RR_ACT_REQ	reselection mode	9.1.2.11

9.1.2.1 RR_EST_REQ

Is used by the Mobility Management entity to request establishment of a Mobile originated RR connection. The request shall be given only in the IDLE state when the MS listens to the CCCH and the previously selected BCCH.

9.1.2.2 RR_EST_IND

Indicates to the Mobility Management entity the establishment of a Mobile terminated RR connection. By this indication MM is informed that a transparent connection exists and RR is in the dedicated mode.

9.1.2.3 RR_EST_CNF

Is used by RR to indicate the successful completion of a Mobile originated RR connection establishment. RR connection exists and RR is in the dedicated mode.

9.1.2.4 RR_REL_IND

Is used by RR to indicate to the Mobility Management entity the release of a RR connection when RR has received a CHANNEL RELEASE from the Network and has triggered a normal release of the data link layer. It is also used to indicate that a requested RR connection cannot be established. In both cases, RR returns to IDLE mode.

9.1.2.5 RR_SYNC_IND

Is used for synchronizing RR and the Mobility Management entity after the establishment of a Mobile originated or Mobile terminated RR connection. This indication is provided to MM in the following cases:

- ciphering has been started (ciphering);
- a traffic channel has been assigned (res. ass. = "resource assigned");
- the channel mode has been modified (channel mode modify).

9.1.2.6 RR_DATA_REQ

Is used by the Mobility Management entity to send control data to its peer entity on the Network side via an existing RR connection.

9.1.2.7 RR_DATA_IND

Is used by RR to indicate control-data, which has been received from its peer entity on the Network side via an existing RR connection.

9.1.2.8 RR_UNIT_DATA_IND

Is used by RR to provide MM with system info. The system info is received on the current BCCH if RR is in the IDLE state. If a RR connection has been established, the system info is received on the SACCH.

9.1.2.9 RR_ABORT_REQ

Request to abort an existing RR connection or a RR connection in progress. The data link, if already established, shall be released by a normal release procedure (DISC/UA) initiated by the MS. This is the only way the MS can trigger the release of a RR connection in case of exceptional conditions. The RR returns to the IDLE state.

9.1.2.10 RR_ABORT_IND

Indication that the RR connection has been aborted by a lower layer failure and RR has returned to the IDLE state.

9.1.3 Services provided by the Radio Resource Management entity for CTS

Inside the RR sub-layer, the CTS Radio Resource Management (CTS-RR) sublayer provides services to the CTS Mobility Management (CTS-MM) entity.

The CTS-RR services are used for:

- alive check.

The CTS Radio Resource Management services are represented by the CTS-RR-service primitives.

Table 9.1.3: Primitives and parameters at the RR-SAP - MS side for CTS

PRIMITIVES	PARAMETERS	REFERENCE
CTS_RR_ALIVE_CHECK_IND	-	9.1.3.1

9.1.3.1 CTS_RR_ALIVE_CHECK_IND

Indicates to the CTS Mobility Management entity that an alive check request has been received from the fixed part.

9.2 Services provided by the Mobility Management entity

The Mobility Management (MM) sublayer provides services to the Call Control (CC) entity, the Supplementary Services Support (SS) entity, the Location Services (LCS) entity(only for type A LMU) and the Short Message Service Support (SMS) entity.

The Mobility Management services primitives are discriminated by the MMCC, MMSS, MMLCS and MMSMS prefix.

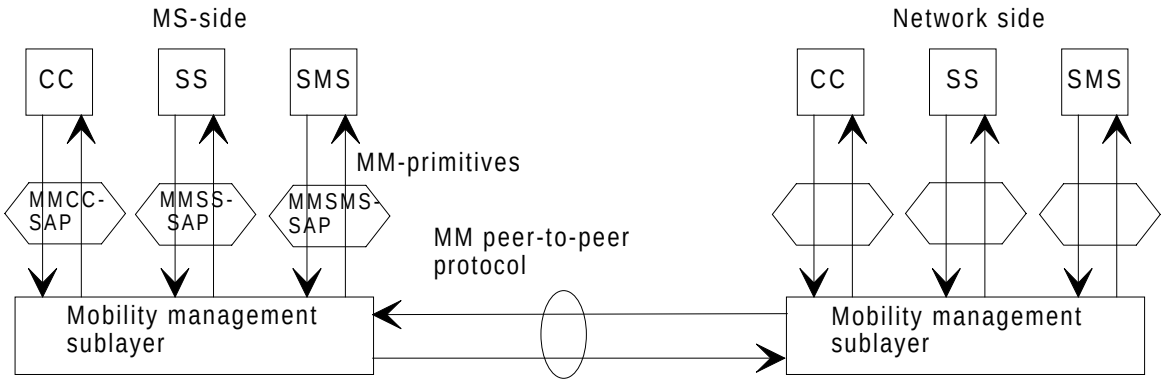
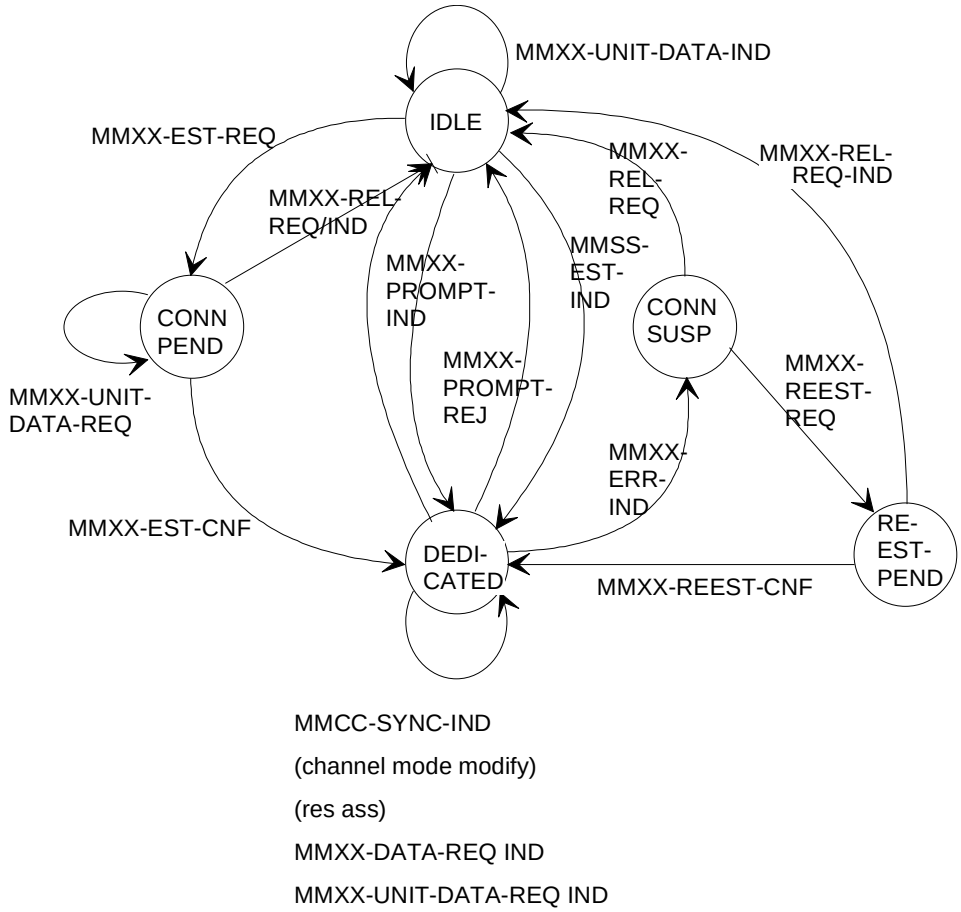


Figure 9.3: Services provided at the MMCC-SAP, MMSS-SAP, MMLCS-SAP, MMSMS-SAP - MS side

(Note: Figure 9.3 shall be updated to include the LCS PD in the same manner as the other PDs are shown)

9.2.1 Service state diagram

The primitives provided by the Mobility Management entity towards Call Control, call independent Supplementary Service Support, Location Services Support for type A LMU and towards Short Messages Service Support and the transition between permitted states are illustrated in figure 9.4.



NOTE 1: MMCC-primitives only at MMCC-SAP.
NOTE 2: The prefix MMXX is used for substitution of MMCC, MMSS, MMLCS or MMSMS.

Figure 9.4: Service graph of the Mobility Management entity - MS side

9.2.2 Service primitives

Table 9.2: Primitives and Parameters at MMCC-SAP, MMSS-SAP, MMLCS-SAP (for type A LMU) or MMSMS-SAP - MS side

PRIMITIVES	PARAMETERS	REFERENCE
MMXX_EST_REQ (see note 1)	Parameters for the appropriate CM SERVICE REQUEST (if any)	9.2.2.1
MMXX_EST_IND (see note 1)	First CM message	9.2.2.2
MMXX_EST_CNF (see note 1)	-	9.2.2.3
MMXX_REL_REQ (see note 1)	cause	9.2.2.4
MMXX_REL_IND (see note 1)	cause	9.2.2.5
MMXX_DATA_REQ (see note 1)	Layer 3 message	9.2.2.6
MMXX_DATA_IND (see note 1)	Layer 3 message	9.2.2.7
MMXX_UNIT_DATA_REQ (see note 1)	Layer 3 message	9.2.2.8
MMXX_UNIT_DATA_IND (see note 1)	Layer 3 message	9.2.2.9
MMCC_SYNC_IND (see note 2)	cause: res.ass	9.2.2.10
MMXX_REEST_REQ (see note 1)		9.2.2.11
MMXX_REEST_CNF (see note 1)		9.2.2.12
MMXX_ERR_IND (see note 1)	cause	9.2.2.13
MMXX_PROMPT_IND (see note 1)	-	9.2.2.14
MMXX_PROMPT_REJ (see note 1)	-	9.2.2.15
NOTE 1: MMXX is used as substitution for MMCC, MMSS, MMLCS or MMSMS NOTE 2: Only at MMCC-SAP		

9.2.2.1 MMXX_EST_REQ

Request used by CC, SS, LCS (for type A LMU) and SMS respectively, to request establishment of a MM connection. Several MM connections may be provided in parallel to the requesting entities. The primitive may contain parameters which are relevant for the CM SERVICE REQUEST message, e.g. to distinguish a basic call from an emergency call.

9.2.2.2 MMXX_EST_IND

Indication to CC, SS, LCS (for type A LMU) or SMS that a Mobile terminated MM connection has been established and the first message has been received from the respective peer entity. Several MM connections may be provided in parallel. If a MM connection already exists, a new MM connection using the same RR connection is indicated by this primitive if MM detects a message with a new combination of Protocol Discriminator (PD) and Transaction Identifier (TI).

9.2.2.3 MMXX_EST_CNF

Successful confirmation of the MM connection establishment by the MM sublayer to be given to the appropriate entity which has requested the service.

9.2.2.4 MMXX_REL_REQ

Used by CC, SS, LCS (for type A LMU) or SMS respectively, to request release of the MM connection. The corresponding PD/TI will be released and may be used for a new MM connection.

9.2.2.5 MMXX_REL_IND

Indication of the release of an existing MM connection or a MM connection in progress. This primitive is used in exceptional cases to indicate that the MM connection cannot be established or kept any longer and PD/TI have been released.

9.2.2.6 MMXX_DATA_REQ

Request used by the CC, SS or SMS entities for acknowledged control-data transmission.

9.2.2.7 MMXX_DATA_IND

Indication used by MM to transfer the received acknowledged control-data to the CC, SS, LCS (for type A LMU) or SMS entities.

9.2.2.8 MMXX_UNIT_DATA_REQ

Request used by the CC, SS, LCS (for type A LMU) or SMS entities for unacknowledged control-data transmission.

9.2.2.9 MMXX_UNIT_DATA_IND

Indication used by MM to transfer the received unacknowledged control-data to the CC, SS, LCS or SMS entities.

9.2.2.10 MMCC_SYNC_IND

Indication that a dedicated channel assignment has been performed and/or the channel mode has been changed (only towards the CC entity).

9.2.2.11 MMXX_REEST_REQ

Request to establish a MM connection which has been interrupted by a lower layer failure. The interruption must have been indicated by MMXX_ERR_IND.

9.2.2.12 MMXX_REEST_CNF

Confirmation of the successful re-establishment of the MM connection. The MM connection will continue with PD/TI as it had before.

9.2.2.13 MMXX_ERR_IND

Indication of a lower layer failure interrupting the MM connection. The PD/TI are still kept by MM. In case of parallel transactions this indication is passed to all CM entities for which a MM connection has been established. It is left to the decision of the appropriate CM entity to either request the re-establishment of the MM connection by MMXX_REEST_REQ or to release it by MMXX_REL_REQ.

9.2.2.14 MMXX_PROMPT_IND

Indication given by MM to inform of the completion of the MM connection to the CC, SS, LCS (for type A LMU) or SMS entities for a mobile station which supports “Network Initiated MO CM Connection Request”.

9.2.2.15 MMXX_PROMPT_REJ

Response to the MMXX_PROMPT_IND indication to the MM entity in a mobile station which supports “Network Initiated MO CM Connection Request” in case when it is impossible to establish the prompted CM connection e.g. due to lack of free transaction identifiers.

9.3 Services provided by radio resource management entity for GPRS services

This subclause is informative, the service primitives are defined in GSM 04.60 [10]. They are included here to provide a complete overview of the radio interface protocol architecture.

9.3.1 Service primitives for GRR-SAP

Table 9.3.1: Primitives and parameters at GRR-SAP

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
GRR-DATA-REQ	LLC PDU, Priority, Cause	9.3.1.1
GRR-DATA-IND	LLC PDU	9.3.1.2
GRR-UNITDATA-REQ	LLC PDU, Priority	9.3.1.3
GRR-UNITDATA-IND	LLC PDU	9.3.1.4
GRR-STATUS-IND	cause	9.3.1.5

9.3.1.1 GRR-DATA-REQ

Request used by the LL sublayer for acknowledged data transmission with a certain priority. Cause indicates if the GRR-DATA-REQ was triggered as an implicit page response.

9.3.1.2 GRR-DATA-IND

Indication used by RR to transfer received data to the LL sublayer.

9.3.1.3 GRR-UNITDATA-REQ

Request used by the LL sublayer for unacknowledged data transmission with a certain priority.

9.3.1.4 GRR-UNITDATA-IND

Indication used by RR to transfer received data to the LL sublayer.

9.3.1.5 GRR-STATUS-IND

Indication used by RR to transfer RLC/MAC failures to the LL sublayer.

9.3.2 Service primitives for GMMRR-SAP

Table 9.3.2: Primitives and Parameters at GMMRR-SAP - MS side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
GMMRR-ASSIGN-REQ	newTLLI	9.3.2.1
GMMRR-PAGE-IND	TLLI	9.3.2.2

9.3.2.1 GMMRR-ASSIGN-REQ

A new TLLI is assigned to the RR sublayer.

9.3.2.2 GMMRR-PAGE-IND

A RR-paging message has been received by the RR sublayer.

9.4 Services provided by the LLC entity for GPRS services

This subclause is informative, the service primitives are defined in GSM 04.64 [11]. They are included here to provide a complete overview of the radio interface protocol architecture.

9.4.1 Service primitives for LLGMM-SAP

Table 9.4.1: Primitives and parameters at LLGMM-SAP - MS side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
LLGMM-ASSIGN-REQ	oldTLLI, newTLLI, Kc, RAND, Ciphering Algorithm	9.4.1.1
LLGMM-TRIGGER-REQ	Cause	9.4.1.2
LLGMM-TRIGGER-IND	-	9.4.1.3
LLGMM-SUSPEND-REQ	TLLI	9.4.1.4
LLGMM-RESUME-REQ	TLLI	9.4.1.5
LLGMM-WINDOW-REQ	TLLI, old SGSN's V(R) per SAPI	9.4.1.6
LLGMM-WINDOW-CNF	TLLI, actual MS's LLC's V(R) per SAPI	9.4.1.7
LL-UNITDATA-REQ	TLLI, GMM-PDU, protect, cipher	9.4.1.8
LL-UNITDATA-IND	TLLI, GMM-PDU, cipher	9.4.1.9
LLGMM-STATUS-IND	TLLI, cause	9.4.1.10

9.4.1.1 LLGMM-ASSIGN-REQ

A new TLLI and/or a ciphering key and/or a ciphering algorithm is assigned to the LLC sublayer.

9.4.1.2 LLGMM-TRIGGER-REQ

Request to send an LLC PDU to the network. Cause indicates if the primitive is sent to trigger an implicit page response.

9.4.1.3 LLGMM-TRIGGER-IND

An LLC frame has been transmitted to the network.

9.4.1.4 LLGMM-SUSPEND-REQ

All LLC links in ABM mode will cease sending PDUs. GMM messages can still be sent and received.

9.4.1.5 LLGMM-RESUME-REQ

Normal LLC frame sending and reception is possible again.

9.4.1.6 LLGMM-WINDOW-REQ

Request for the MS's actual LLC's V(R)s.

9.4.1.7 LLGMM-WINDOW-CNF

The actual LLC's V(R)s for each LLC link in ABM mode are transferred to GMM.

9.4.1.8 LL-UNITDATA-REQ

Request to send a GMM message in unacknowledged mode to the peer entity.

9.4.1.9 LL-UNITDATA-IND

A GMM message in unacknowledged mode has been received from the peer entity.

9.4.1.10 LLGMM-STATUS-IND

Indication used by LLC to transfer LLC failures to the GMM sublayer. The failure may also be caused due to errors at the RLC/MAC layer.

9.4.2 Service primitives for LLSMS-SAP

Table 9.4.2: Service primitives and parameters at LLSMS-SAP - MS side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
LL-UNITDATA-REQ	TLLI, SMS-CP-PDU, protect, cipher	9.4.2.1
LL-UNITDATA-IND	TLLI, SMS-CP-PDU,	9.4.2.2

9.4.2.1 LL-UNITDATA-REQ

An LLC UI frame will be sent to the peer entity

9.4.2.2 LL-UNITDATA-IND

An LLC UI frame has been received from the peer entity

9.5 Registration Services provided for GPRS Services

9.5.1 Service primitives for GMMSM-SAP

Session management services for non-anonymous may request GPRS service registration before activating a PDP context.

Table 9.5.1: Primitives and parameters at GMMSM-SAP - MS side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
GMMSM-ESTABLISH-REQ	-	9.5.1.1
GMMSM-ESTABLISH-CNF	-	9.5.1.2
GMMSM-ESTABLISH-REJ	cause	9.5.1.3
GMMSM-RELEASE-IND	-	9.5.1.4
GMMSM-UNITDATA-REQ	SM-PDU	9.5.1.5
GMMSM-UNITDATA-IND	SM-PDU	9.5.1.6

9.5.1.1 GMMSM-ESTABLISH-REQ

Request from Session Management to send an ATTACH REQUEST message to the network to setup a GMM connection. The request is only performed in case the MS is not already attached. The GPRS attach is then indirectly caused by a requested non-anonymous PDP context activation.

9.5.1.2 GMMSM-ESTABLISH-CNF

The network has send the ATTACH ACCEPT message to the MS, the indirect attach was successful. Now session management can proceed with PDP context activation.

9.5.1.3 GMMSM-ESTABLISH-REJ

The network has rejected the attach. The MS has received the ATTACH REJECT message.

9.5.1.4 GMMSM-RELEASE-IND

The GPRS mobility management informs the session management that the MS has been GPRS detached, e.g. by timer expiry, and therefore the PDP contexts are not valid anymore.

9.5.1.5 GMMSM-UNITDATA-REQ

The GMM is requested to forward a SM PDU to LLC in order to send it in unacknowledged more to the peer entity.

9.5.1.6 GMMSM-UNITDATA-IND

The GMM forwards a SM PDU, which has been received in unacknowledged mode via LLC from the peer entity.

9.5.2 Service primitives for GMMAA-SAP

Session management services for an anonymous PDP require a mobility management entity which does not perform Routing Area Updating, but which requests the termination of the anonymous access in case of change of the RA.

Table 9.5.2: Primitives and parameters at GMMAA-SAP - MS side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
GMMAA-ESTABLISH-REQ	-	9.5.2.1
GMMAA-RELEASE-IND	-	9.5.2.2
GMMAA-ETSABLISH-REJ	-	9.5.2.3

9.5.2.1 GMMAA-ESTABLISH-REQ

Request from Session Management to perform timer supervision (standby timer set to zero) and to disable routing area updating for anonymous PDP context(s).

9.5.2.2 GMMAA-RELEASE-IND

The GPRS mobility management informs the session management that the anonymous PDP contexts are deactivated.

9.5.2.3 GMMAA-ESTABLISH-REJ

The GPRS mobility management informs the session management that the anonymous PDP contexts activation was rejected.

9.5.3 Service primitives for GMMSMS-SAP

The Short Message entity may request from the GMM entity the GMM IMSI registration state before an MO SMS transmission is initiated.

Table 9.5.3: Primitives and parameters at GMMSMS-SAP - MS side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
GMMSMS-REG-STATE-REQ	-	9.5.3.1
GMMSM- REG-STATE -RSP	Registration state	9.5.3.2

9.5.3.1 GMMSMS-REG-STATE-REQ

Request for the current IMSI registration state from the Short Message entity.

9.5.3.2 GMMSM- REG-STATE -RSP

The current IMSI registration state is sent to the Short Message entity.

10 Interlayer service interfaces on the Network side

In addition to the services described in this clause, the RR entity and MM entity also provide services to CM entities which don't belong to the functional blocks of CC, SMS, and SS. (For example, the RR entity provides service to Group Call Control and Broadcast Call Control entities.) These services are not further described in this clause.

10.1 Services provided by the Radio Resource Management entity

The Radio Resource Management (RR) sublayer provides services to the Mobility Management entity (MM).

The RR services are used for:

- establishing control channel connections;
- establishing traffic channel connections;
- ciphering mode indication;
- releasing control channel connections;
- control-data transfer.

The Radio Resource Management services are represented by the RR service primitives.

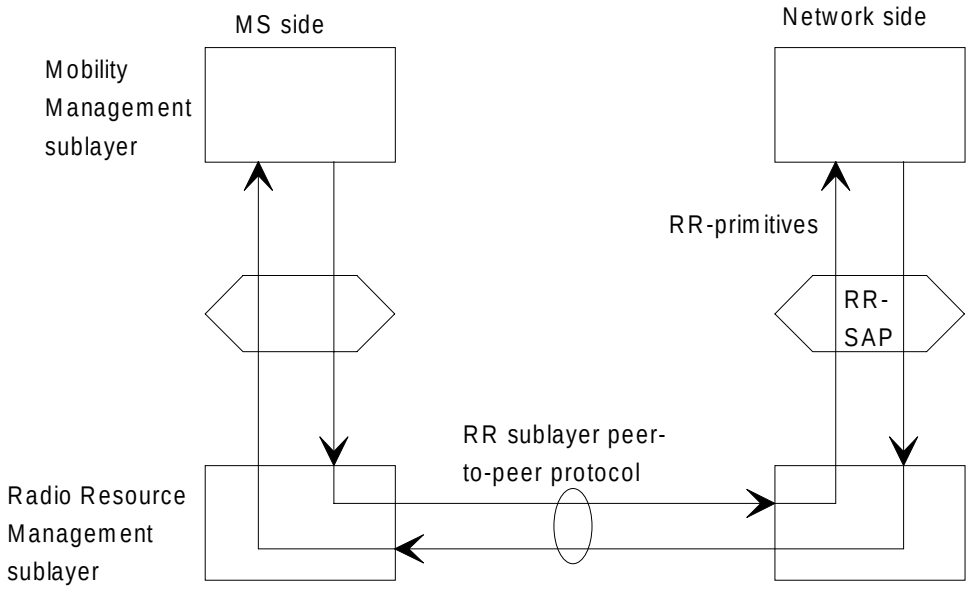
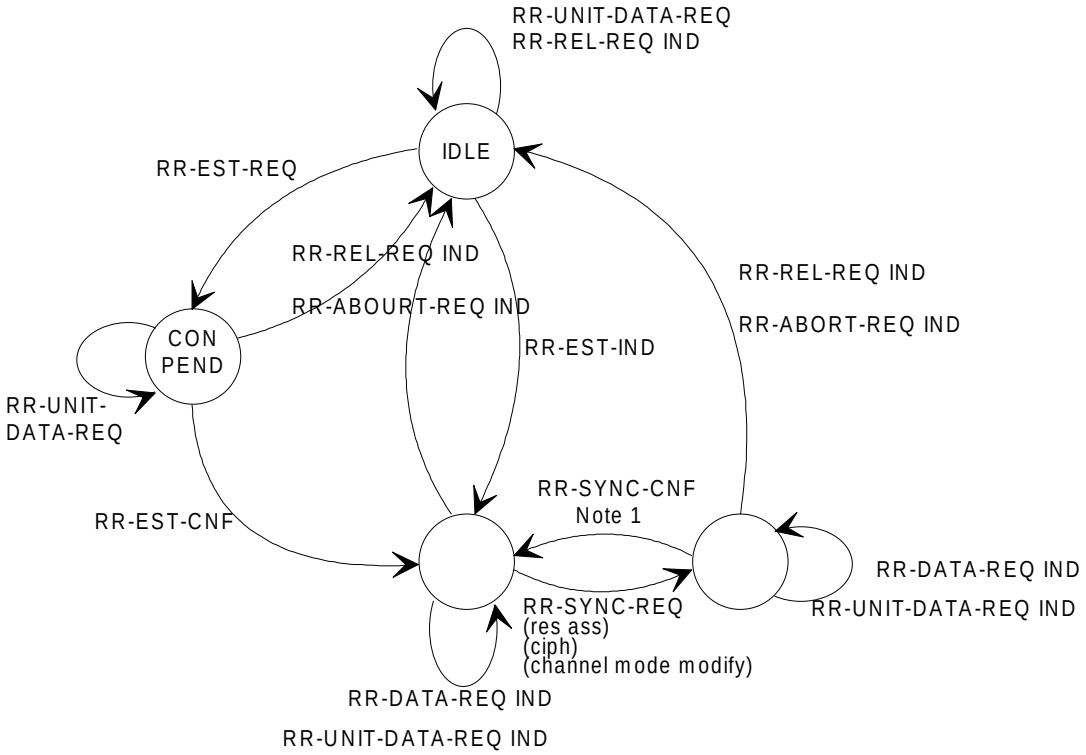


Figure 10.1: Services provided at RR-SAP - Network side

10.1.1 Service state diagram

The primitives provided by the Radio Resource Management entity and the transition between permitted states are shown in figure 10.2.



STATES:

IDLE - No dedicated channel established.
CONPEND - Connection pending.
DT1 - Data transfer 1, dedicated channel established.
DT2 - Data transfer 2, dedicated channel established, ciphering mode set.

Figure 10.2: Service graph of the Radio Resource Management entity - Network side

10.1.2 Service primitives

Table 10.1: Primitives and Parameters at the RR-SAP - Network side

PRIMITIVES	PARAMETERS	REFERENCE
RR_EST_REQ	Parameters for the Initial layer 3 message	10.1.2.1
RR_EST_IND	Initial layer 3 message	10.1.2.2
RR_EST_CNF	-	10.1.2.3
RR_REL_REQ	cause	10.1.2.4
RR_REL_IND	cause	10.1.2.5
RR_SYNC_REQ	cause (resource assign, ciphering)	10.1.2.6
RR_SYNC_CNF	cause (resource assign, ciphering)	10.1.2.7
RR_DATA_REQ	Layer 3 message	10.1.2.8
RR_DATA_IND	Layer 3 message	10.1.2.9
RR_UNIT_DATA_REQ	Layer 3 message	10.1.2.10
RR_UNIT_DATA_IND	Layer 3 message	10.1.2.11
RR_ABORT_REQ	cause	10.1.2.12
RR_ABORT_IND	cause	10.1.2.13

10.1.2.1 RR_EST_REQ

Request used by the Mobility Management entity to request establishment of control channel connections.

10.1.2.2 RR_EST_IND

Indication to the Mobility Management entity that the establishment of control channel connections has been done.

10.1.2.3 RR_EST_CNF

Confirmation used by RR to confirm the establishment of a requested control channel connection.

10.1.2.4 RR_REL_REQ

Request used by the Mobility Management to release a control channel connection.

10.1.2.5 RR_REL_IND

Indication from RR to MM that the main signalling link has been released.

10.1.2.6 RR_SYNC_REQ

Request used by the Mobility Management entity for synchronization with the RR protocol.

10.1.2.7 RR_SYNC_CNF

Confirmation used by RR that the requested synchronization is done.

10.1.2.8 RR_DATA_REQ

Request used by the Mobility Management entity for acknowledged control-data transmission.

10.1.2.9 RR_DATA_IND

Indication used by RR to transfer received control-data, which should be acknowledged, to the Mobility Management entity.

10.1.2.10 RR_UNIT_DATA_REQ

Request used by the Mobility Management entity for unacknowledged control-data transmission.

10.1.2.11 RR_UNIT_DATA_IND

Indication used by RR to transfer received control-data, which should not be acknowledged, to the Mobility Management entity.

10.1.2.12 RR_ABORT_REQ

Request of the abandon of the RR connection.

10.1.2.13 RR_ABORT_IND

Indication that a radio link failure has occurred.

10.2 Services provided by the Mobility Management entity

The Mobility Management (MM) sublayer provides services to the Call Control (CC) entity, the Supplementary Service Support (SS) entity, the Location Services (LCS) (for type A LMU) and the Short Message Service Support (SMS) entity.

The Mobility Management services primitives are recognized by the MMCC, MMSS, MMLCS and MMSMS prefix.

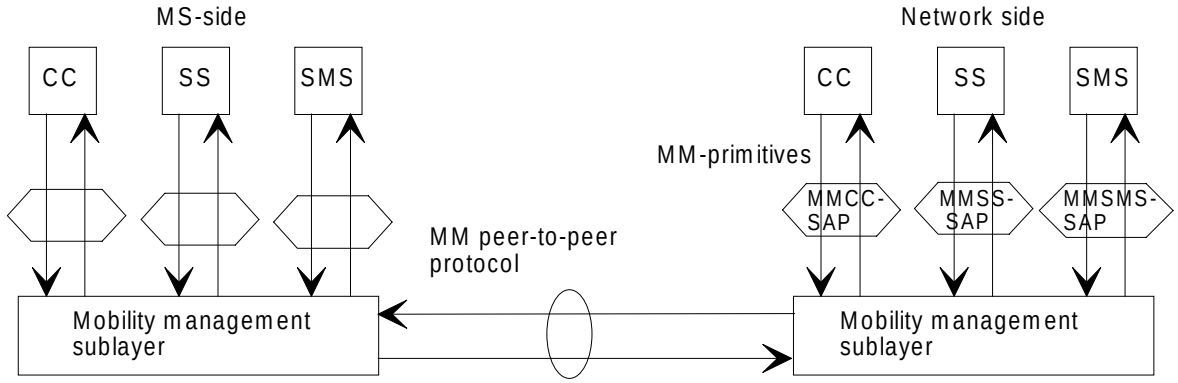
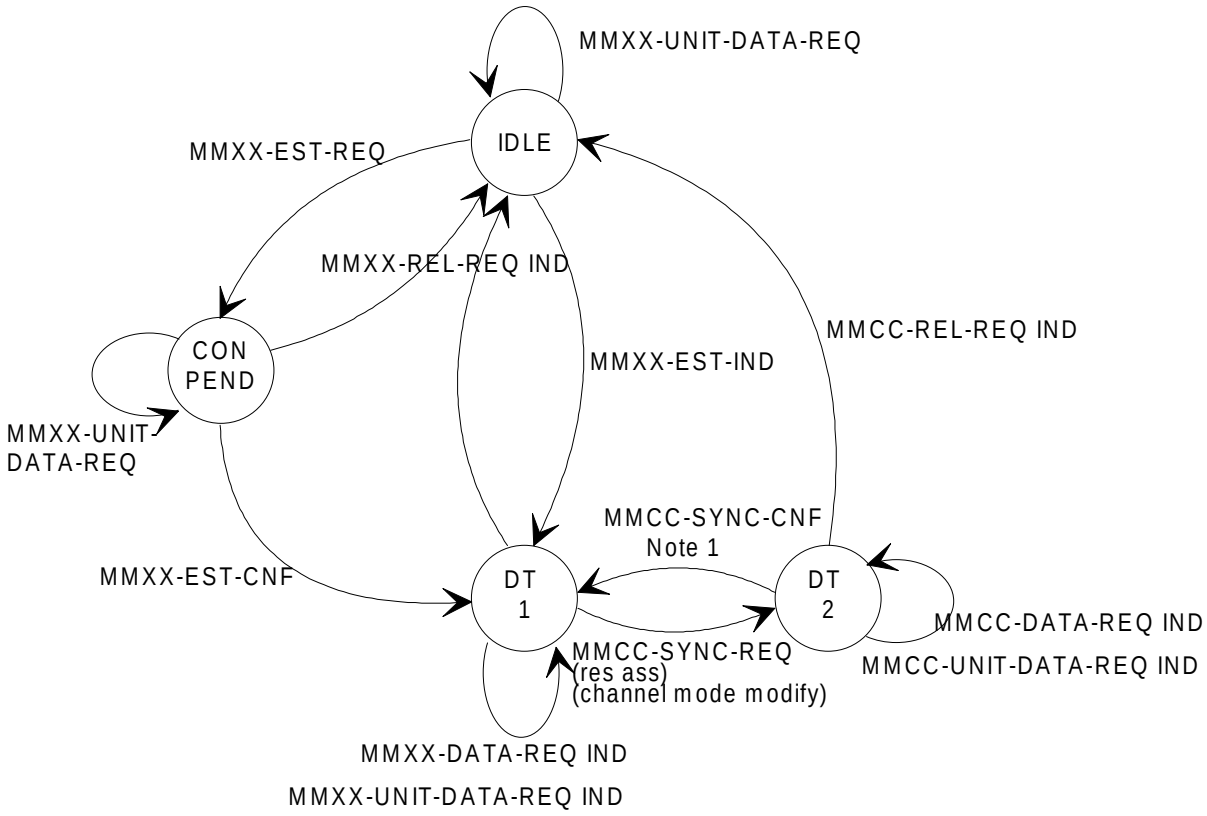


Figure 10.3: Services provided at MMCC-SAP, MMSS-SAP, MMLCS-SAP, MMSMS-SAP - Network side

(Note: Figure 10.3 shall be updated to include the new LCS PD in the same manner as for the other PDs)

10.2.1 Service state diagram

The primitives provided by the Mobility Management entity towards Call Control, Short Messages Service Support Location Services and call independent Supplementary Services Support (for type A LMU) as well as the transition between permitted states are illustrated in figure 10.4.



NOTE 1: the parameters in RR_SYNC_CNF must correspond to the parameter in RR_SYNC_REQ.
NOTE 2: MMCC-primitives only at MMCC-SAP.
NOTE 3: The prefix MMXX is used for substitution of MMCC, MMSS, MMLCS (for type A LMU) or MMSMS.

Figure 10.4: Service graph of the Mobility Management entity, towards Call Control - Network side

10.2.2 Service primitives

Table 10.2: Primitives and Parameters at MMCC-SAP, MMSS-SAP, MMSMS-SAP - Network side

PRIMITIVES	PARAMETERS	REFERENCE
MMXX_EST_REQ (see note 1)	Mobile ID	10.2.2.1
MMXX_EST_IND (see note 1)	First CM message	10.2.2.2
MMXX_EST_CNF (see note 1)	-	10.2.2.3
MMXX_REL_REQ (see note 1)	cause	10.2.2.4
MMXX_REL_IND (see note 1)	cause	10.2.2.5
MMXX_DATA_REQ (see note 1)	Layer 3 message	10.2.2.6
MMXX_DATA_IND (see note 1)	Layer 3 message	10.2.2.7
MMXX_UNIT_DATA_REQ (see note 1)	Layer 3 message	10.2.2.8
MMXX_UNIT_DATA_IND (see note 1)	Layer 3 message	10.2.2.9
MMCC_SYNC_REQ (see note 2)	cause (resource assign)	10.2.2.10
MMCC_SYNC_CNF (see note 2)	cause (resource assign)	10.2.2.11
NOTE 1: MMXX is used as substitution for MMCC, MMSS, MMLCS (for type A LMU) or MMSMS. NOTE 2: Only at MMCC-SAP.		

10.2.2.1 MMXX_EST_REQ

Request by CC, SS, LCS (for type A LMU) and SMS respectively, for the establishment of a MM connection.

10.2.2.2 MMXX_EST_IND

Indication by the MM sublayer that a MM connection is established.

10.2.2.3 MMXX_EST_CNF

Confirmation of the MM connection establishment by the MM sublayer.

10.2.2.4 MMXX_REL_REQ

Request by CC, SS, LCS (for type A LMU) or SMS respectively, for the release of the MM connection.

10.2.2.5 MMXX_REL_IND

Indication by the MM sublayer that a MM connection has been released.

10.2.2.6 MMXX_DATA_REQ

Request by the CC, SS, LCS (for type A LMU) or SMS entities for acknowledged control-data transmission.

10.2.2.7 MMXX_DATA_IND

Indication used by MM to transfer the received acknowledged control-data to the CC, SS, LCS (for type A LMU) or SMS entities.

10.2.2.8 MMXX_UNIT_DATA_REQ

Request used by the CC, SS, LCS (for type A LMU) or SMS entities for unacknowledged control-data transmission.

10.2.2.9 MMXX_UNIT_DATA_IND

Indication used by MM to transfer the received unacknowledged control-data to the CC, SS, LCS (for type A LMU) or SMS entities.

10.2.2.10 MMCC_SYNC_REQ

Request used by the CC entity to synchronize with the MM entity (resource assign).

10.2.2.11 MMCC_SYNC_CNF

Confirmation used by the MM to inform the CC entity that synchronization is completed (resource assign).

10.3 Services provided by radio resource management entity for GPRS services

This section is informative, the service primitives are defined in GSM 04.60 [10]. They are included here to provide a complete overview of the radio interface protocol architecture.

10.3.1 Service primitives for GRR-SAP

Table 10.3.1 Primitives and Parameters at GRR-SAP - network side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
GRR-DATA-REQ	LLC PDU, TLLI, CI, DRX, MS CLM, QoS, Priority	10.3.1.1
GRR-DATA-IND	LLC PDU, TLLI, CI	10.3.1.2
GRR-UNITDATA-REQ	LLC PDU, TLLI, CI, DRX, MS CLM, QoS, Priority	10.3.1.3
GRR-UNITDATA-IND	LLC PDU, TLLI, CI	10.3.1.4
GRR-STATUS-IND	TLLI, cause	10.3.1.5

10.3.1.1 GRR-DATA-REQ

Request used by the LLC layer for acknowledged data transmission with a certain priority.

10.3.1.2 GRR-DATA-IND

Indication used by RR to transfer received data, which shall be acknowledged, to the LLC layer.

10.3.1.3 GRR-UNITDATA-REQ

Request used by the LLC layer for unacknowledged data transmission with a certain priority.

10.3.1.4 GRR-UNITDATA-IND

Indication used by RR to transfer received data, which shall not be acknowledged, to the LLC layer

10.3.1.5 GRR-STATUS-IND

Indication to upper layers that an error has occurred on the radio interface. The cause for the failure is indicated

10.3.2 Service primitives for GMMRR-SAP

Table 10.3.2 Primitives and Parameters at GMMRR-SAP - network side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
GMMRR-PAGE-REQ	TLLI, IMSI, CI or CI-list or RAI, priority	10.3.2.1

10.3.2.1 GMMRR-PAGE-REQ

Request by GMM to send a RR-paging message to the mobile station.

10.4 Services provided by the LLC entity for GPRS services

10.4.1 Service primitives for LLGMM-SAP

Table 10.4.1 Primitives and Parameters at GRR-SAP - network side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
LLGMM-ASSIGN-REQ	newTLLI, oldTLLI, Kc, Algorithm	10.4.1.1
LLGMM-TRIGGER-IND	TLLI	10.4.1.2
LLGMM-SUSPEND-REQ	TLLI, page	10.4.1.3
LLGMM-RESUME-REQ	TLLI	10.4.1.4
LLGMM-PAGE-IND	TLLI	10.4.1.5
LLGMM-PAGE-RESP-IND	TLLI	10.4.1.6
LLGMM-WINDOW-REQ	TLLI	10.4.1.7
LLGMM-WINDOW-CNF	actual LLC's N(R) per SAP	10.4.1.8
LL-UNITDATA-REQ	TLLI, SMM-PDU, protect, cipher	10.4.1.9
LL-UNITDATA-IND	TLLI, SMM-PDU, cipher	10.4.1.10
LLGMM-STATUS-IND	TLLI, cause	10.4.1.11

10.4.1.1 LLGMM-ASSIGN-REQ

A new TLLI and/or a ciphering key and/or a ciphering algorithm is assigned to the LL sublayer. Also an old TLLI can be unassigned.

10.4.1.2 LLGMM-TRIGGER-IND

An LLC frame has been received from the mobile station.

10.4.1.3 LLGMM-SUSPEND-REQ

All LLC links will cease sending PDUs. The parameter page indicates that data shall be sent if available and therefore paging shall be needed. Or the cause indicates that data shall not be sent until a RESUME-REQ is received.

10.4.1.4 LLGMM-RESUME-REQ

Normal LLC frame sending and reception is possible again.

10.4.1.5 LLGMM-WINDOW-REQ

Request for the actual LLC's N(R)s.

10.4.1.6 LLGMM-WINDOW-CNF

The actual LLC's V(R)s for each LLC link in ABM mode are transferred to SMM.

10.4.1.7 LLGMM-PAGE-IND

Requires to send a paging message to the mobile station.

10.4.1.8 LLGMM-PAGE-RESP-IND

A paging response has been received from the mobile

10.4.1.9 LL-UNITDATA-REQ

Request to send a SMM message in unacknowledged mode to the peer entity.

10.4.1.10 LL-UNITDATA-IND

A SMM message in unacknowledged mode has been received from the peer entity.

10.4.1.11 LLGMM-STATUS-IND

Indication used by LLC to transfer lower layer failures to the GMM sublayer.

10.4.2 Service primitives for LLSMS-SAP

Table 10.4.2; Primitives and Parameters at LLSMS-SAP - network side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
LL-UNITDATA-REQ	TLLI, SMS-CP-PDU, protect, cipher	10.4.2.1
LL-UNITDATA-IND	TLLI, SMS-CP-PDU	10.4.2.2

10.4.2.1 LL-UNITDATA-REQ

An LLC UI frame will be sent to the peer entity.

10.4.2.2 LL-UNITDATA-IND

An LLC UI frame has been received from the peer entity.

10.5 Services provided by the GMM for GPRS services

10.5.1 Service primitives for GMMSM-SAP

Table 10.5.1: Primitives and Parameters at GMMSM-SAP - network side

PRIMITIVE	PARAMETER (message, info elements of message, other parameters)	REFERENCE
GMMSM-RELEASE-IND	-	10.5.1.1
GMMSM-UNITDATA-REQ	SM-PDU	10.5.1.2
GMMSM-UNITDATA-IND	SM-PDU	10.5.1.3

10.5.1.1 GMMSM-RELEASE-IND

The GPRS mobility management informs the session management that the MS has been GPRS detached, e.g. by timer expiry, and therefore the PDP contexts are not valid anymore.

10.5.1.2 GMMSM-UNITDATA-REQ

The GMM is requested to forward a SM PDU to LLC in order to send it in unacknowledged more to the peer entity.

10.5.1.3 GMMSM-UNITDATA-IND

The GMM forwards a SM PDU, which has been received in unacknowledged mode via LLC from the peer entity.

10.6 Services provided by the Radio Resource Management entity for CTS on the fixed part

In addition to services described in 10.1, the CTS Radio Resource Management (CTS-RR) inside the RR sublayer provides services to the CTS Mobility Management entity (CTS-MM).

The CTS-RR services are used for:

- alive check;
- hunting;
- group alerting.

The CTS Radio Resource Management services are represented by the CTS-RR service primitives.

10.6.1 Service primitives

Table 10.6: Primitives and Parameters at the RR-SAP – Fixed part side

PRIMITIVES	PARAMETERS	REFERENCE
RR_CTS_ALIVE_CHECK_REQ	CTSMSI	10.6.1.1
RR_ CTS_ALIVE_CHECK_IND	Cause	10.6.1.2
RR_ CTS_HUNTING_REQ	-	10.6.1.3
RR_ CTS_GROUP_ALERTING_REQ	CTSMSI, display	10.6.1.4

10.6.1.1 RR_ CTS_ALIVE_CHECK_REQ

Request used by the CTS Mobility Management entity to request an alive check.

10.6.1.2 RR_ CTS_ALIVE_CHECK_IND

Indication to the CTS Mobility Management entity on the results of the alive check.

10.6.1.3 RR_ CTS_HUNTING_REQ

Request to hunt the mobiles.

10.6.1.4 RR_ CTS_GROUP_ALERTING_REQ

Request to alert a group of mobiles.

11 L3 Messages

This clause specifies the generic methods used in the layer 3 protocol specifications to describe messages. It define in particular a generic message structure, that of the "standard L3 messages". Not all messages in layer 3 protocols follow this structure, but many do, and this section specifies how to interpret the standard description.

This clause also addresses basic aspects of the handling of messages received but not compliant with the allowed structure. In most cases, only the conditions that lead to the diagnosis of an error are described. The reaction of an entity receiving a message leading to such a diagnosis is in general specified for each protocol in the relevant protocol specification.

11.1 General

11.1.1 Messages

For all concerned protocols, concrete messages are bit strings of variable length, formally a succession of a finite, possibly null, number of bits (i.e., elements of the set {"0", "1"}), with a beginning and an end.

The services provided by lower layers includes the transmission of such bit strings.

Considered as messages, these bit strings follow some structure (the syntax), enabling to organise bits in information pieces of a different meaning level.

The term *message* is used as well for a concrete message (i.e., a bit-string, as defined by the giving of all its bits, in practice appearing at one point of time in a concrete dialog), as for a class of concrete messages sharing a common structure. A concrete message is an instance of the corresponding class of messages. Message classes can be described as sets of potential bit strings, and of a common structure, enabling in particular to identify parts meaningful for the co-operation functions the protocol supports.

In general, in the rest of the clause as in the protocol specifications, the term *message* will be used to refer to the class. It may be used, when the context prevents ambiguity, to refer to a message instance (e.g., a received is usually a message instance). In the rest of this clause, the term *message instance* will be used when needed to refer unambiguously to specific concrete message, i.e., to a specific bit string.

A message (message class) can be described directly as a set of bit strings, using the formal notation described in Annex B.

A message can also be described as a standard L3 message, in which case the interpretation of the message description in term of a set of bit strings is specified in the next sub-clauses.

In all cases, structuring messages is based on the underlying bit string. Thus, the following terms are used :

a *part* of a message instance is a sub-string of the corresponding string ; a part of a message (as a class) is described by a definition applicable to all instances; a part of a message then is both a structural attribute of the message as a class, and a set of sub-strings, composed of the sub-strings obtained by applying the definition to each possible instance ; for instance, « the first octet » of a message instance is defined from the moment its length is greater than 8, and is the sub-string composed of the first 8 bits of the message instance; the « first octet » of a message as a class is the structural definition given above, and the set of all 8-bit octet strings that can be obtained as the first octet of one instance of the class.

'part A *follows* part B' means that in the message the sub-string corresponding to part B is concatenated with the sub-string of part B ;

the *length* of a message instance, or of part of message instance, is the number of bits of the corresponding sub string ; rigorously speaking, a message as a class (or a part seen as a class) has a length only if all the corresponding instances have the same length ; by extension, sentences such as « a message as a length in the range so and so » means that the length of an instances of the class always fall in the range ;

11.1.2 Octets

In many places, a message is described as a succession of octets. An octet is generally a succession of 8 bits. Unless otherwise indicated, the term octet is used more restrictively to refer to a part of message, defined when considering a message as a succession of octets, e.g., the first 8 bits of a message, or the 17th to the 23rd, form an octet, but not the second bit to the 9th.

Unless specified otherwise, the numbering conventions are the following :

Octets in a message or in a part are numbered from 1 onward, starting at the beginning of the bit string. This numbering can be strictly applied only for message instances, and for the first part of a message structurally identical for all instances.

Bits in octets are numbered from 8 down to 1, starting at the beginning of the octet.

When represented as tables showing the different bit positions, octets are presented in the natural occidental order, i.e., from the top of a page downward. Bits in octets are presented with the first bit on the left of the page.

11.1.3 Integer

In many places, message parts are described as encoding integers. Two generic encoding are defined in this sub-clause.

11.1.3.1 Binary

A message part is said to encode in binary an integer to indicate that concrete strings are mapped, for some usage, on the set of non signed integers with the following rule :

Let k denote the length of the bit string, and let b(i) denote an integer of value 0 if the ith bit in the string is "0", and 1 otherwise. The encoded integer n respects the equation :

$$n = \sum_{i=1 to k} b(i) 2^{k-i-1}$$

11.1.3.2 2-complement binary

A message part is said to encode in 2-complement binary an integer to indicate that concrete strings are mapped, for some usage, on the set of signed integers with the following rule :

Let k denote the length of the bit string, and let b(i) denote an integer of value 0 if the ith bit in the string is "0", and 1 otherwise. The encoded integer n respects the equation :

$$\text{if } b(1) = 0 \text{ then } n = \sum_{i=1 to k} b(i)2^{k-i-1}$$

$$\text{else } n = \sum_{i=1 to k} b(i)2^{k-i-1} - 2^k$$

11.1.4 Spare parts

In some cases the specification is that which message instances can be accepted by a receiver comprise more that the legal message instances that can be sent. One example of this is the notion of spare bit. A spare bit has to send as the value indicated in the specification (typically 0), but can be accepted as a 0 or a 1 by the receiver without error diagnosis. A spare field is a field composed entirely of spare bits.

11.2 Standard L3 messages

11.2.1 Components of a standard L3 message

A standard L3 message consists of an imperative part, itself composed of a header and the rest of imperative part, followed by a non-imperative part. Both the non-header part of the imperative part and the non-imperative part are composed of successive parts referred as standard information elements.

11.2.1.1 Format of standard information elements

A standard IE may have the following parts, in that order:

- an information element identifier (IEI);
- a length indicator (LI);
- a value part.

A standard IE has one of the formats shown in table 11.1:

Table 11.1: Formats of information elements

Format	Meaning	IEI present	LI present	Value part present
T	Type only	yes	no	no
V	Value only	no	no	yes
TV	Type and Value	yes	no	yes
LV	Length and Value	no	yes	yes
TLV	Type, Length and Value	yes	yes	yes

Some IEs may appear in the structure, but not in all instances of messages. An IE is then said to be present or not present in the message instance. If an IE is not present in a message instance, none of the three parts is present. Otherwise, parts must be present according to the IE format.

In the message structure, an IE that is allowed not to be present in all message instances is said not to be mandatory. Other IEs are said to be mandatory.

11.2.1.1.1 Information element type and value part

Every standard IE has an information element type which determines the values possible for the value part of the IE, and the basic meaning of the information. The information element type describes only the value part. Standard IEs of the same information element type may appear with different formats. The format used for a given standard IE in a given message is specified within the description of the message.

The value part of a standard IE either consists of a half octet or one or more octets; the value part of a standard IE with format LV or TLV consists of an integral number of octets, between 0 and 255 inclusive ; it then may be empty, i.e.,

consist of zero octets; if it consists of a half octet and has format TV, its IEI consists of a half octet, too. The value part of a standard IE may be further structured into parts, called fields.

11.2.1.1.2 Length indicator

When present, the LI of a standard IE consists of one octet. It contains the binary encoding of the number of octets of the IE value part. The length indicator of a standard IE with empty value part indicates 0 octets. Standard IE of an information element type such that the possible values may have different values must be formatted with a length field, i.e., LV or TLV.

11.2.1.1.3 Information element identifier

When present, the IEI of a standard IE consists of a half octet or one octet. A standard IE with IEI consisting of a half octet has format TV, and its value part consists of a half octet. The value of the IEI depends on the standard IE, not on its information element type. The IEI, if any, of a given standard IE in a given message is specified within the description of the message. In some protocol specifications, default IEI values can be indicated. They are to be used if not indicated in the message specification. Non mandatory standard IE in a given message, i.e., IE which may be not be present (formally, for which the null string is acceptable in the message), must be formatted with an IEI, i.e., with format T, TV or TLV.

11.2.1.1.4 Categories of IEs; order of occurrence of IEI, LI, and value part

Totally four categories of standard information elements are defined:

- information elements of format V or TV with value part consisting of 1/2 octet (type 1);
- information elements of format T with value part consisting of 0 octets (type 2);
- information elements of format V or TV with value part that has fixed length of at least one octet (type 3);
- information elements of format TLV or LV with value part consisting of zero, one or more octets (type 4);

Type 1 standard information elements of format V provide the value in bit positions 8, 7, 6, 5 of an octet (see figure 11.1) or bits 4, 3, 2, 1 of an octet (see figure 11.2).

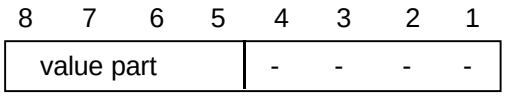


Figure 11.1: Type 1 IE of format V

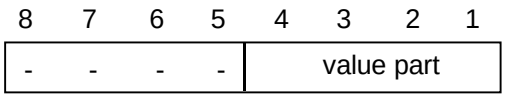


Figure 11.2: Type 1 IE of format V

Type 1 standard information elements of format TV have an IEI of a half octet length; they provide the IEI in bit positions 8, 7, 6, 5 of an octet and the value part in bit positions 4, 3, 2, 1 of the same octet, see figure 11.3.

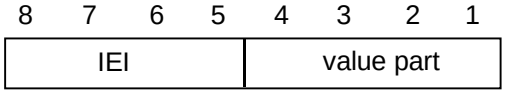


Figure 11.3: Type 1 IE of format TV

A type 2 standard IE has format T; its IEI consists of one octet, its value part is empty, see figure 11.4.

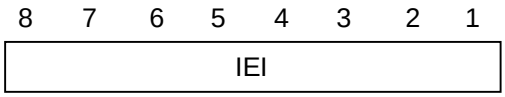


Figure 11.4: Type 2 IE

A type 3 standard information element has format V or TV; if it has format TV, its IEI consists of one octet and proceeds the value part in the IE. The value part consists of at least one octet. See figure 11.5 and figure 11.6.

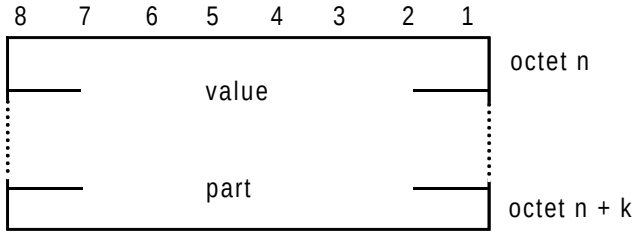


Figure 11.5: Type 3 IE of format V (k = 0, 1, 2, ...)

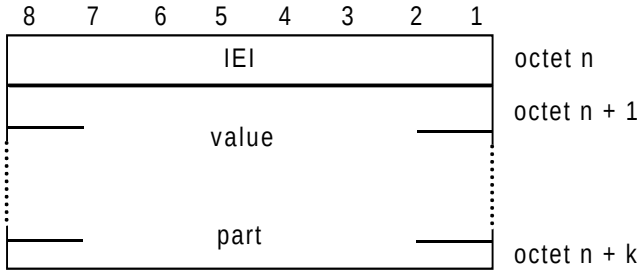


Figure 11.6: Type 3 IE of format TV (k = 1, 2, ...)

A type 4 standard information element has format LV or TLV. Its LI precedes the value part, which consists of zero, one, or more octets; if present, its IEI has one octet length and precedes the LI. See figure 11.7 and figure 11.8.

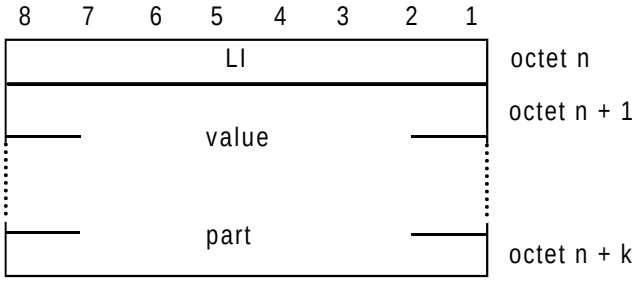


Figure 11.7: Type 4 IE of format LV (k = 0, 1, 2, ...)

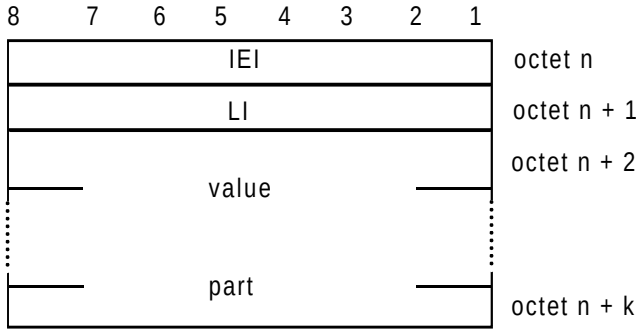


Figure 11.8: Type 4 IE of format TLV (k = 1, 2, ...)

11.2.2 Description methods for IE structure

Standard IEs can be further structured in parts called fields. Two description methods are recommended and described hereafter.

11.2.2.1 Tables

According to this description method, the IE is presented in its maximum format, i.e., T, TV or TLV, in a picture representing the bits in a table, each line representing an octet. Bits appear in the occidental order, i.e., from left of the page to right of the page, and from top of the page to bottom of the page.

Boxes so delimited contains typically the field name, possibly an indication of which bits in the field are in the box, and possibly a value (e.g., for spare bits).

A specific method can be used in the IE description to describe a branching structure, i.e., a structure variable according to the value of particular fields in the IE. This design is unusual outside type 4 IEs, and as, a design rule, should be used only in type 4 IEs.

a) The octet number of an octet within the IE is defined typically in the table. It consists of a positive integer, possibly of an additional letter, and possibly of an additional asterisk, see clause f). The positive integer identifies one octet or a group of octets.

b) Each octet group is a self contained entity. The internal structure of an octet group may be defined in alternative ways.

c) An octet group is formed by using some extension mechanism. The preferred extension mechanism is to extend an octet (N) through the next octet(s) (Na, Nb, etc.) by using bit 8 in each octet as an extension bit.

   The bit value "0" indicates that the octet group continues through to the next octet. The bit value "1" indicates that this octet is the last octet of the group. If one octet (Nb) is present, the preceding octets (N and Na) shall also be present.

   In the format descriptions appearing in section 10.5.1 to 10.5.4, bit 8 is marked "0/1 ext" if another octet follows. Bit 8 is marked "1 ext" if this is the last octet in the extension domain.

   Additional octets may be defined in later versions of the protocols ("1 ext" changed to "0/1 ext") and equipments shall be prepared to receive such additional octets; the contents of these octets shall be ignored. However the length indicated in sections 9 and 10 only takes into account this version of the protocols.

d) In addition to the extension mechanism defined above, an octet (N) may be extended through the next octet(s) (N+1, N+2 etc.) by indications in bits 7-1 (of octet N).

e) The mechanisms in c) and d) may be combined.

f) Optional octets are marked with asterisks (*). As a design rule, the presence of absence of an optional octet should be determinable from information in the IE and preceding the optional octet. Care should be taken not to introduce ambiguities with optional octets.

11.2.2.1.1 Compact notation

The compact notation described in Annex B can be used to describe the value part of a standard IE. This method is recommended for complex structures, or for a branching structure not respecting octet boundaries.

11.2.3 Imperative part of a standard L3 message

The imperative part of a standard L3 message is composed a header possibly followed by mandatory standard IEs having the format V or LV.

11.2.3.1 Header

The header of a standard L3 message is composed of two octets, and structured in three main parts, the protocol discriminator (1/2 octet), a message type octet, and a half octet used in some cases as a Transaction Identifier, in some other cases as a sub-protocol discriminator, and called skip indicator otherwise.

11.2.3.1.1 Protocol discriminator

Bits 1 to 4 of the first octet of a standard L3 message contain the protocol discriminator (PD) information element. The PD identifies the L3 protocol to which the standard layer 3 message belongs. The correspondence between L3 protocols and PDs is one-to-one.

For future evolution an extension mechanism is foreseen which allows the use of protocol discriminators with one octet length, where bits 4 to one are coded as 1 1 1 0. Messages of such protocols may not be standard L3 messages. In particular, the rest of the header may not respect the structure described in this sub-clause.

The PD can take the following values:

Table 11.2: Protocol discriminator values

bits 4 3 2 1	
0 0 0 0	group call control
0 0 0 1	broadcast call control
0 0 1 0	PDSS1
0 0 1 1	call control; call related SS messages
0 1 0 0	PDSS2
0 1 0 1	mobility management messages
0 1 1 0	radio resources management messages
1 0 0 0	GPRS mobility management messages
1 0 0 1	SMS messages
1 0 1 0	GPRS session management messages
1 0 1 1	non call related SS messages
1 1 0 0	Location services
1 1 1 0	reserved for extension of the PD to one octet length
1 1 1 1	reserved for tests procedures described in GSM 11.10

If the network receives, on a SAP where it expects standard L3 messages, a message with a protocol discriminator different from those specified in table 11.2, the network may ignore the message or initiate the channel release procedure defined in GSM 04.08.

If the Mobile Station receives, on a SAP where it expects standard L3 messages, a standard L3 message with a protocol discriminator different from those specified in table 11.2, or for a protocol that it does not support, the Mobile Station shall ignore the message.

11.2.3.1.2 Skip indicator

Bits 5 to 8 of octet 1 of a standard L3 message may be used differently, depending on the protocol and the SAP. The use of this half-octet is consistent for a given PD and SAP. One possibility is that this half-octet contains the skip indicator. Unless otherwise specified in the protocol, the skip indicator IE is a spare field.

11.2.3.1.3 Transaction identifier

A L3 protocol may define that bits 5 to 8 of octet 1 of a standard L3 message of the protocol contains the transaction identifier (TI). The TI allows to distinguish up to 16 different bi-directional messages flows for a given PD and a given SAP. Such a message flow is called a transaction.

The TI IE is coded as shown in figure 11.9 and table 11.3. It is composed of the TI value and the TI flag.

The TI value and the TI flag occupy bits 5 - 7 and bit 8 of the first octet respectively.

Transactions are dynamically created, and their TI value is assigned at creation time. TI values are assigned by the side of the interface initiating a transaction. At the beginning of a transaction a free TI value (i.e., a value not yet used for the

given PD, the given SAP, and with the given initiator) is chosen and assigned to this transaction. It then remains fixed for the lifetime of the transaction. After a transaction ends, the associated TI value is free and may be reassigned to a later transaction.

Two identical TI values may be used when each value pertains to a transaction initiated by the different sides of the interface. In this case the TI flag shall avoid ambiguity. The transaction identifier flag can take the values "0" or "1". The TI flag is used to identify which side of the interface initiated the transaction. A message has a TI flag set to "0" when it belongs to transaction initiated by its sender, and to "1" otherwise.

Hence the TI flag identifies who allocated the TI value for this transaction and the only purpose of the TI flag is to resolve simultaneous attempts to allocate the same TI value.

The TI may in future evolutions of the L3 protocols be extended by using a combination of bits in the TI value field that is specified as "reserved for future extension" in table 11.3. In the present version, messages received on a SAP where standard L3 messages are expected and with a TI of TI value 111 may be ignored.

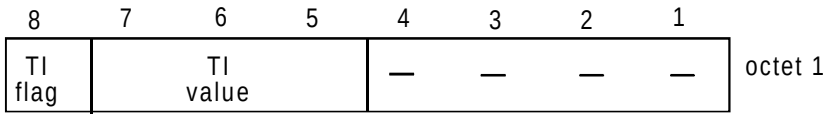


Figure 11.9: Transaction identifier

Table 11.3. Transaction identifier

TI flag (octet 1)	
Bit	
8	
0	The message is sent from the side that originates the TI
1	The message is sent to the side that originates the TI
TI value (octet 1)	
Bits	
7 6 5	
0 0 0	TI value 0
0 0 1	- - 1
0 1 0	- - 2
0 1 1	- - 3
1 0 0	- - 4
1 0 1	- - 5
1 1 0	- - 6
1 1 1	Reserved for future extension.

11.2.3.1.4 Sub-protocol discriminator

A L3 protocol may define that bits 5 to 8 of octet 1 of a standard L3 message of the protocol contains the sub-protocol discriminator (SPD). The SPD allows to distinguish between different protocols inside one sublayer.

Table 11.4: Sub-Protocol discriminator values

bits 8 7 6 5	
0 0 0 0	Value used by the Skip Indicator (see 11.2.3.1.2)
0 0 0 1	CTS sub-protocol
0 0 1 0	\
To	} all other values are reserved
1 1 1 1	/

11.2.3.2 Message type octet

The message type octet is the second in a standard L3 message.

When a standard L3 message is expected, and a message is received that is less than 16 bit long, that message shall be ignored.

The message type IE is coded as shown in figure 11.10.

Bit 8 is encoded as "0"; value "1" is reserved for possible future use as an extension bit. A protocol entity expecting a standard L3 message, and receiving a message containing bit 8 of octet 2 encoded as "1" shall diagnose a " message not defined for the PD" error and treat the message accordingly.

In messages sent using the transmission functionality provided by the RR layer to upper layers, and sent from the mobile station to the network , bit 7 of octet 2 is used by the RR protocol.

In all other standard layer 3 messages bit 7 is set to 0 A protocol entity expecting a standard L3 message, and not using the transmission functionality provided by the RR layer, and receiving a message containing bit 7 of octet 2 encoded as 1 shall diagnose a "message not defined for the PD" error and treat the message accordingly.

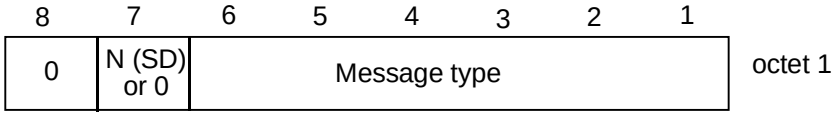


Figure 11.10: Message type IE

Bit 1 to 6 of octet 2 of standard L3 messages contain the message type.

The message type determines the function of a message within a protocol in a given direction and for a given lower layer SAP. The meaning of the message type is therefore dependent on the protocol (the same value may have different meanings in different protocols), the direction (the same value may have different meanings in the same protocol, when sent from the Mobile Station to the network and when sent from the network to the Mobile Station) and the lower layer SAP (the same value may have different meanings, e.g., whether the message was sent on the SACCH or on the main DCCH).

Each protocol defines a list of allowed message types for each relevant SAP. A message received analysed as a standard L3 message, and with a message type not in the corresponding list leads to the diagnosis "message not defined for the PD". Some message types may correspond to a function not implemented by the receiver. They are then said to be non implemented by the receiver.

The reaction of a protocol entity expecting a standard L3 message and receiving a message with message type not defined for the PD or not implemented by the receiver and the reception conditions is defined in the relevant protocol specification. As a general rule, a protocol specification should not force the receiver to analyse the message further.

11.2.3.3 Standard information elements of the imperative part

The message type octet of a standard L3 message may be followed by mandatory standard IEs having the format V or LV as specified in the message description in the relevant protocol specification.

As a design rule, octet boundaries must be respected. This implies that half-octet standard IEs (i.e., V formatted type 1 standard IEs) must appear by pair.

If message is received as a standard L3 message, and that is too short to contain the complete imperative part as specified in the relevant protocol specification, an imperative message part error is diagnosed. (The same error may be diagnosed at detection of certain contents of the imperative part of a message; this is defined in the relevant protocol specification.) The treatment of an imperative message part error is defined in the relevant protocol specification.

11.2.4 Non-imperative part of a standard L3 message

The imperative part of a standard L3 message is followed by the (possibly empty) non-imperative part. The relevant protocol specification defines where the imperative part of a standard L3 message ends. The non-imperative part of a standard L3 message is composed of (zero, one, or several) standard IEs having the format T, TV, or TLV. The receiver

of a standard L3 message shall analyse the non imperative part as a succession of standard IEs each containing an IEI, and shall be prepared for the non-imperative part of the message to contain standard IEs that are not specified in the relevant protocol specification.

An IEI may be known in a message or unknown in a message. Each protocol specification lists, for each message (i.e., according to the message type, the direction and the lower layer SAP), the known standard IEs in the non-imperative part.

An IEI that is known in a message designates the IE type of the IE the first part of which the IEI is, as well as the use of the information. Which IE type it designates is specified in the relevant protocol specification. Within a message, different IEIs may designate the same IE type if that is defined in the relevant protocol specification.

Whether the second part of an IE with IEI known in a message is the length or not (in other words, whether the IEI is the first part of an IE formatted as TLV or not) is specified in the relevant protocol specification.

Unless otherwise specified in the protocol specification, the receiver shall assume that IE with unknown IEI are TV formatted type 1, T formatted type 2 or TLV formatted type 4 standard IEs. The IEI of unknown IEs together with, when applicable, the length indicator, enable the receiver to determine the total length of the IE, and then to skip unknown IEs. The receiver shall assume the following rule for IEs with unknown IEI :

> Bit 8 of the IEI octet is set to "1" indicates a TV formatted type 1 standard IE or a T formatted type 2 IEs, and to "0" indicates a TLV formatted type 4 IE. Hence, a 1 valued bit 8 indicates that the whole IE is one octet long, and a 0 valued bit 8 indicates that the following octet is a length octet.

As a design rule, it is recommended that IEIs of any TV formatted type 1, T formatted type 2 or TLV formatted type 4 IE follow the rule, even if assumed to be known by all potential receivers.

A message may contain two or more IEs with equal IEI. Two IEs with the same IEI in a same message must have the same format, and, when of type 3, the same length. More generally, care should be taken not to introduce ambiguities by using an IEI for two purposes. Ambiguities appear in particular when two IEs potentially immediately successive have the same IEI but different meanings and when both are non-mandatory. As a recommended design rule, messages should contain a single IE of a given IEI.

Each protocol specification may put specific rules for the order of IEs in the non-imperative part. An IE known in the message, but at a position non compliant with these rules is said to be out of sequence. An out of sequence IE is decoded according to the format, and, when of type 3 the length, as defined in the message for its IEI.

11.2.5 Presence requirements of information elements

The relevant protocol specification may define three different presence requirements (M, C, or O) for a standard IE within a given standard L3 message:

- M ("Mandatory") means that the IE shall be included by the sending side, and that the receiver diagnoses a "missing mandatory IE" error when detecting that the IE is not present. An IE belonging to the imperative part of a message has presence requirement M. An IE belonging to the non-imperative part of a message may have presence requirement M;

- C ("Conditional") means:

  * that inclusion of the IE by the sender depends on conditions specified in the relevant protocol specification;

  * that there are conditions for the receiver to expect that the IE is present and/or conditions for the receiver to expect that the IE is not present in a received message of a given PD, SAP and message type; these conditions depend only on the content of the message itself, and not for instance on the state in which the message was received, or on the receiver characteristics; they are known as static conditions;

  * that the receiver detecting that the IE is not present when sufficient static conditions are fulfilled for its presence, shall diagnose a "missing conditional IE" error;

  * that the receiver detecting that the IE is present when sufficient static conditions are fulfilled for its non-presence, shall diagnose an "unexpected conditional IE" error.

  Only IEs belonging to the non-imperative part of a message may have presence requirement C;

- O ("Optional") means that the receiver shall never diagnose a "missing mandatory IE" error, a "missing conditional IE" error, or an "unexpected conditional IE" error because it detects that the IE is present or that the IE is not present. (There may however be conditions depending on the states, resources, etc. of the receiver to diagnose other errors.) Only IEs belonging to the non-imperative part of a message may have presence requirement O.

Unless otherwise specified the presence of a IE of unknown IEI or of an out of sequence IE shall not lead by itself to an error. An alternative specification is the ‘comprehension required’ scheme . An IE is encoded as ‘comprehension required’ if bits 5, 6, 7 and 8 of its IEI are set to zero.. The comprehension required scheme is to be applied if explicitly indicated in the protocol specification. The reaction on the reception of an unknown or out of sequence IE coded as ‘comprehension required’ is specified in the relevant protocol specification.

11.2.6 Description of standard L3 messages

This sub-clause describes a generic description method for standard L3 messages, the tabular description. Protocol specification may follow other methods.

A standard L3 message is described by a table listing the header elements and the standard IEs in the message. For each element is given

- if applicable the IEI, in hexadecimal representation (one digit followed by and hyphen for TV formatted type 1, and two digits for the other cases);
- The name of the IE (this is used in particular for the description of conditional presence rules);
- The type of the information element, with a reference of where the internal structure of the value part is specified;
- The format of the standard IE (T, V, TV, LV or TLV); and
- The length, or the range of lengths, of the whole standard IE, including when applicable the T and L parts.

The list of elements is given in the table in the order they appear in the resulting bit string, with the exception of half-octet elements in the imperative part : half octets in a pair are inverted. This applies in particular for the two first header elements : the protocol discriminator appears first in a table describing a standard L3 message.

11.3 Non standard L3 messages

In some protocols, the structure of part or all of the messages might not always follow the standard L3 message structure. As a design rule, this should be consistent for a given protocol, direction and lower layer SAP.

A possibility is to describe the message with the compact notation described in Annex B.

A few consistent structures are found in the present protocol specifications, and are described hereafter.

Other structures can be described directly in the protocol specifications.

11.3.1 Case A : BCCH and AGCH/PCH messages

In these cases, the SAP capability is for fixed length messages. The messages are structured as standard L3 messages plus one octet in front, the L2 pseudo length octet, and a rest octet part at the end.

11.3.1.1 L2 Pseudo Length octet

This octet, the L2 pseudo length indicator octet, indicates the length in octets of the subsequent octet string that can be analysed as a standard L3 message .

The octet is structured as follows :

Bits 3 to 8 encodes in binary the L2 pseudo length, i.e., the length of the part to be analysed as a standard L3 message ;

Bit 2 is set to "0" ;

Bit 1 is set to "1".

A receiver expecting a message so structured and receiving a message with bit 1 of octet 1 (i.e., the 8th bit of the message) set to "1" and bit 2 of octet 1 (i.e., the 7th bit of the message) different from "0", shall abandon the analysis of the message.

A receiver expecting a message so structured and receiving a message with an L2 pseudo length indicator encoding 0 or 1 shall skip the indicated number of octets and not try to analyse the standard L3 message part.

A receiver expecting a message so structured and receiving a L2 pseudo length indicator bigger than what is compatible with the SAP capability shall abandon the analysis of the message.

11.3.1.2 Rest Octets

The part after the part structured as a standard L3 message, and up to the end of the message as constrained by lower layers, is presented as a non standard IE of variable length (sometime indicated as of type 5), the ‘rest octets’ IE.

The rest octets element may be described by table description, or, preferably, using the compact notation described in Annex B of this document.

11.3.1.3 Description of a modified standard L3 message

The description can be provided in the same way as a standard L3 message, with in the case of a tabular description one non standard IE at the beginning (of type L2 pseudo length), and one non standard IE at the end.

11.3.2 Case B : SACCH messages sent in unacknowledged mode

The messages are structured either as standard L3 messages, or in the so-called short header format. The value of the 8th bit (bit 1 of octet 1) of the link layer PDU distinguishes the two cases. In the case of the short header, the L3 message is the same bit string as the link layer PDU, and has a fixed length. The following description includes the 2-bit link layer header.

11.3.2.1 The first octet

Bits 1 and 2 are the link layer header. Bit 2 of octet 1 is set to "0", and bit 1 is reserved for the link layer.

A protocol discriminator is the first part of the message (starting bit 8 of octet 1). The protocol discriminator field may have different lengths. The following protocol discriminator is defined :

0 RR

All additional PD defined for this structure shall start by 1. The reception of a message with bit 8 of octet 1 set to 1 when expecting a message structured as defined by this clause shall be diagnosed as an unknown PD, and the message ignored.

As a design rule, a message type field should follow the PD, and of a length such that the PD and the message type fit in the 6 first bits of the message.

11.3.2.2 The rest of the message

The rest of the structure is not more constrained.

The preferred description method is the one described in Annex B.

11.3.3 Design guidelines for non standard parts

The guidelines in this sub-clause apply to non standard parts, such as rest octets, short header broadcast message or fully non standard L3 messages.

11.3.3.1 General

The structure should be as far as possible be such that the analysis can be conducted from beginning to end. In other terms, the conditions determining the syntactic analysis of a part (e.g., tags, lengths) should appear before that part.

The part should be structured as a succession of information elements, each carrying an elementary semantic information. An information element should be composed of (possibly) a tag, than (possibly) a length indicator, then a value part.

Tags can be of fixed or variable length, their extent being analysable from beginning to end. A typical tagging is the one bit tagging, which should preferably used as follows : value "0" indicates that the IE is no more than the tag bit, and "1" indicates that the IE continues at least with the next bit.

Variable length tagging should be used to distinguish between several possible formats of the element. Tag lengths are then chosen according to packing efficiency criteria.

The T field of standard IEs can be presented as a variable tagging with only two lengths : 4 and 8 bits.

The length indicator can be of fixed or variable length, their extent being analysable from beginning to end. It should preferably be presented as encoding the length in bits of the value part.

The L field of standard IEs can be presented as a fixed length (one octet) length indicator which can encode only lengths multiple of 8 bits.

The value part can be described as further structured, in a similar way. This can be used to help the reading, and to cover some presence dependence.

11.4 Handling of superfluous information

All equipment should be able to ignore any extra information present in an L3 message, which is not required for the proper operation of that equipment. For example, a mobile station may ignore the calling party BCD number if that number is of no interest to the Mobile Station when a SETUP message is received.

11.4.1 Information elements that are unnecessary in a message

The relevant protocol specification may define certain IEs to be under some conditions unnecessary in a L3 message. A protocol entity detecting an unnecessary IE in a received L3 message shall ignore the contents of that IE for treating the message; it is not obliged to check whether the contents of the IE are syntactically correct.

11.4.2 Other syntactic errors

This section applies to the analysis of the value part of an information element. It defines the following terminology:

- An IE is defined to be syntactically incorrect in a message if it contains at least one value defined as "reserved", or if its value part violates syntactic rules given in the specification of the value part. However it is not a syntactical error that a type 4 standard IE specifies in its length indicator a greater length than possible according to the value part specification : extra bits are ignored.

- A message is defined to have semantically incorrect contents if it contains information which, possibly dependant on the state of the receiver, is in contradiction to the resources of the receiver and/or to the procedural part.

Annex A (informative): MN-Services arrow diagram

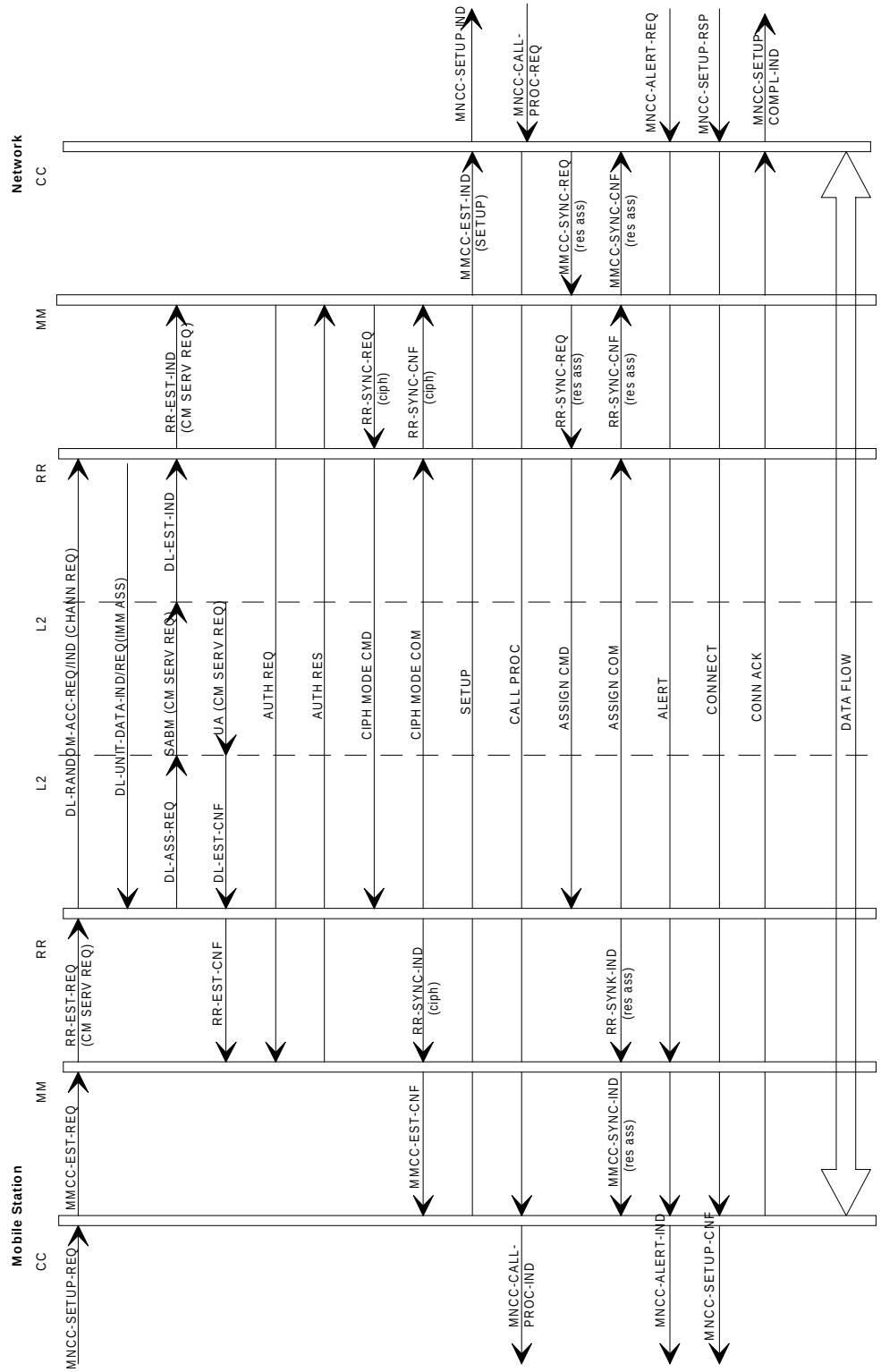


Figure A.1: Mobile originated Call Setup. Successful case

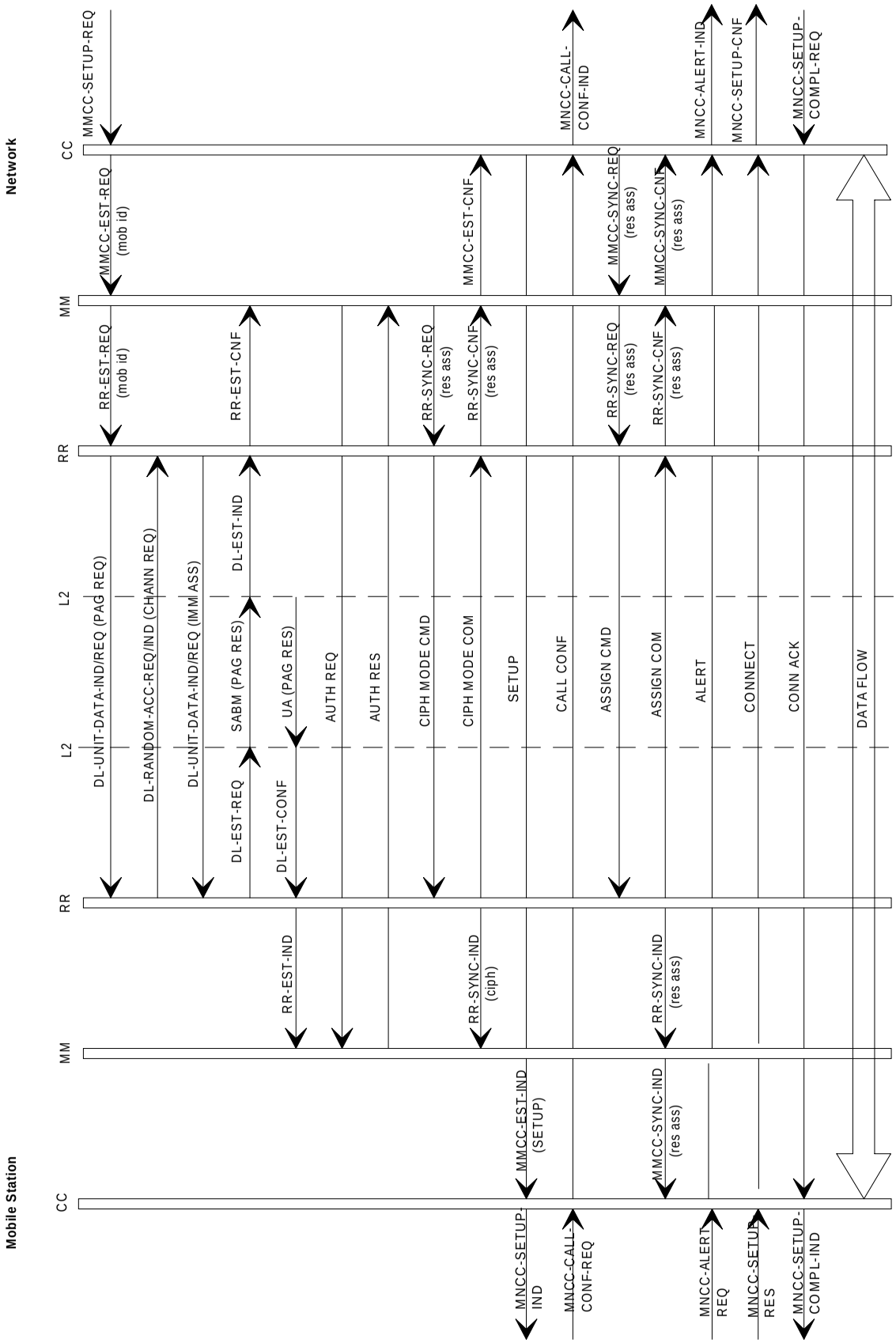


Figure A.2: Mobile terminated Call Setup. Successful case

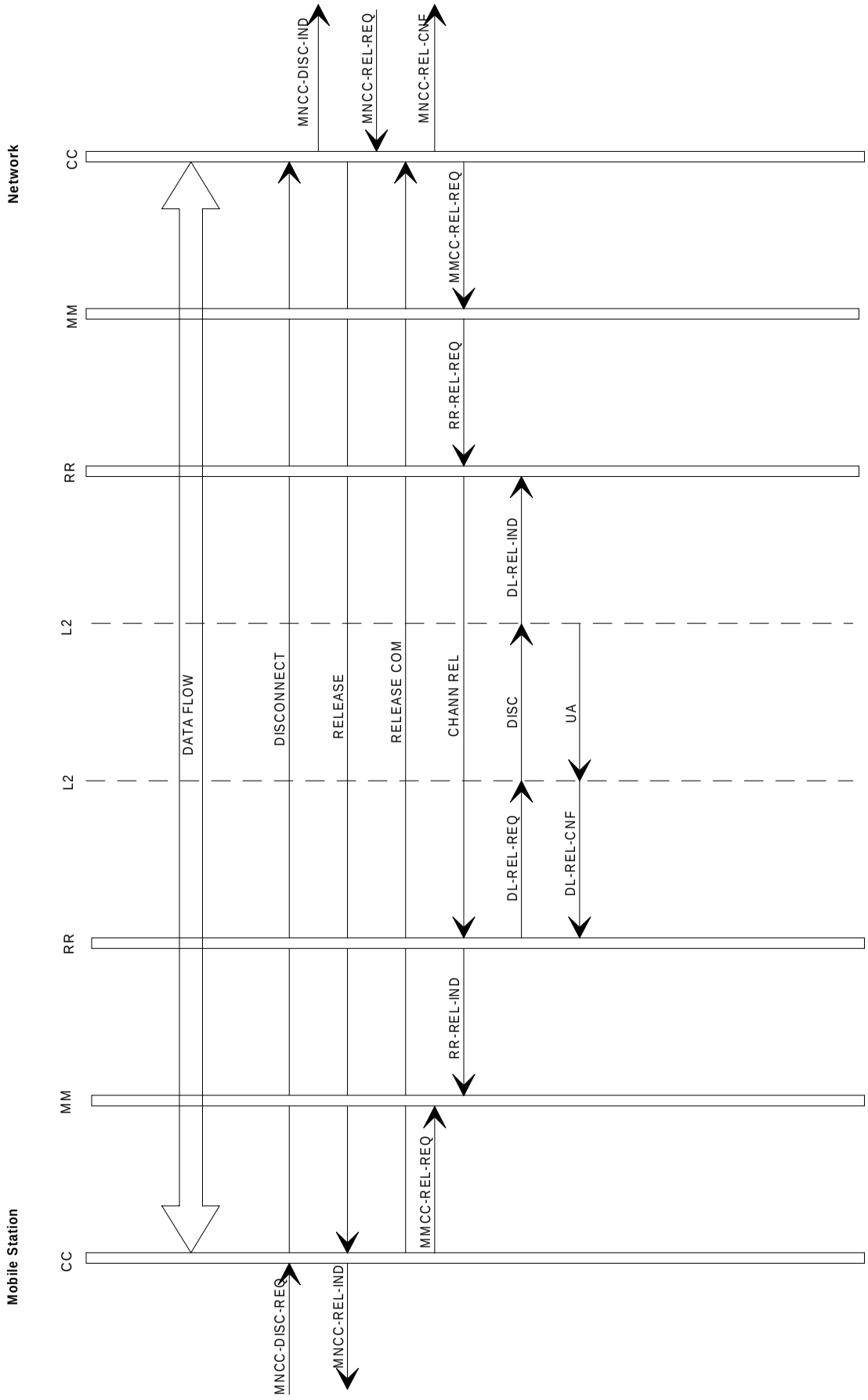


Figure A.3: Mobile originated, Call Release and Channel Release. Successful case

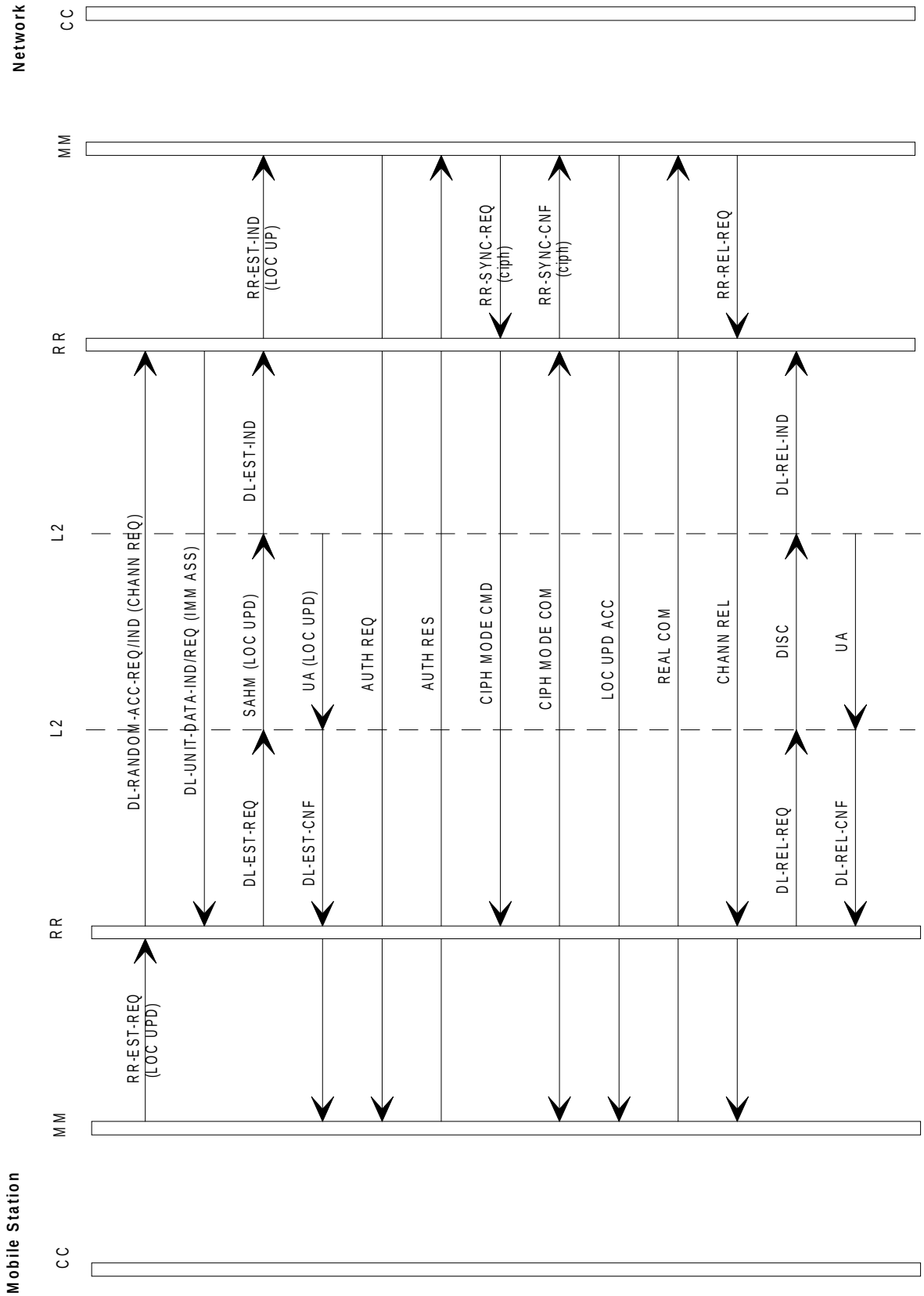


Figure A.4: Location updating. Successful case

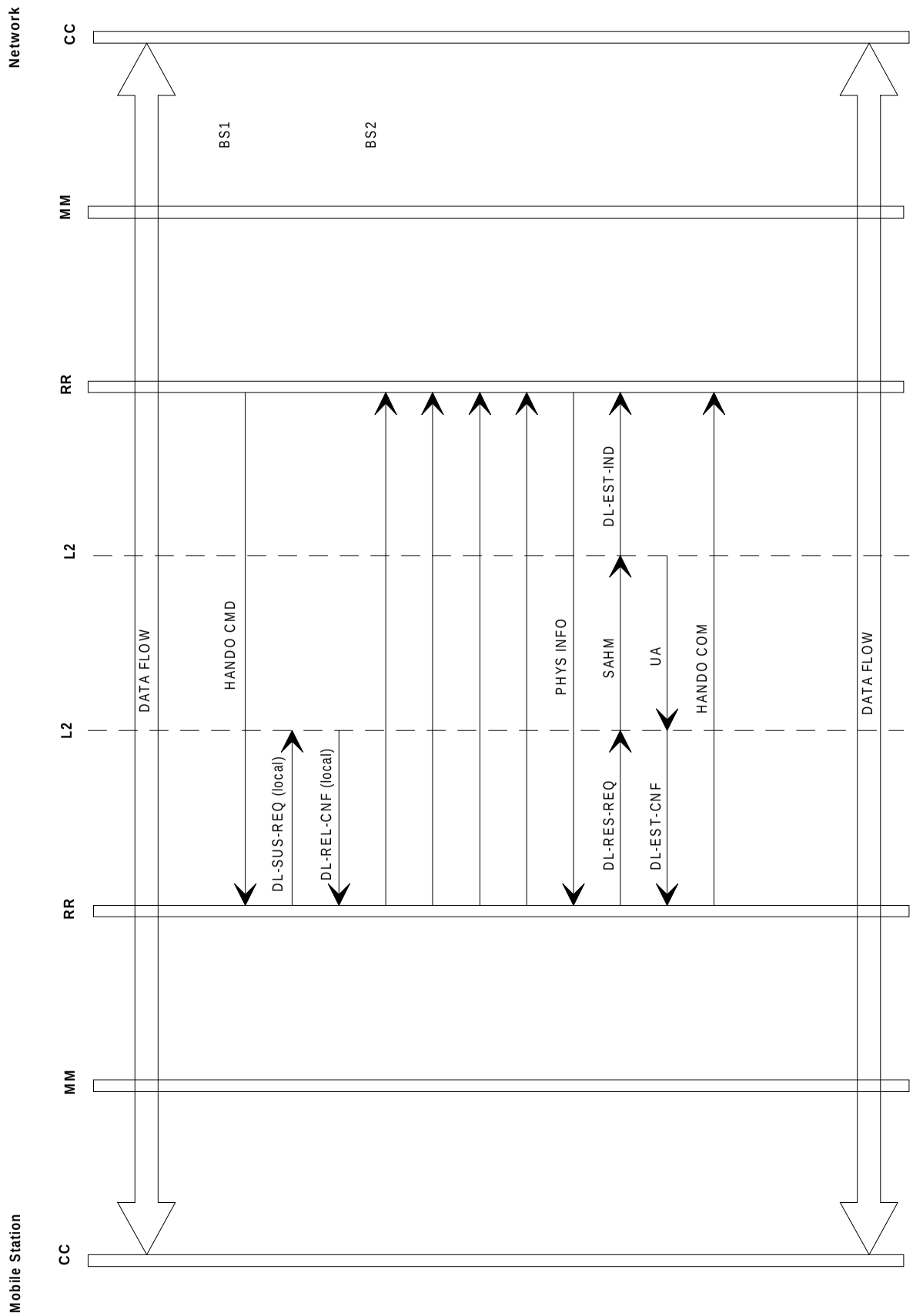


Figure A.5: Handover. Successful case

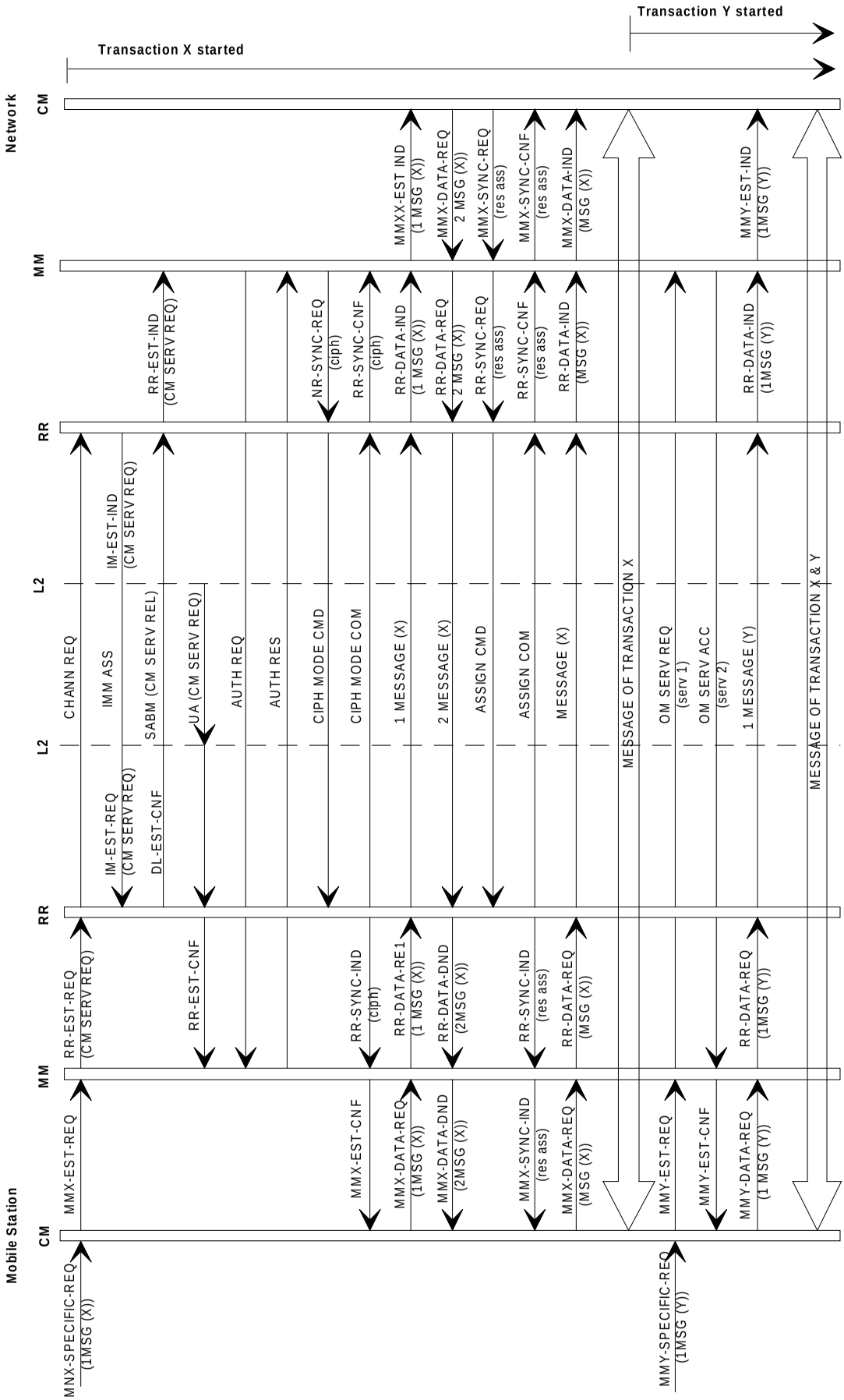


Figure A.6: Establishment of parallel transactions (General view)

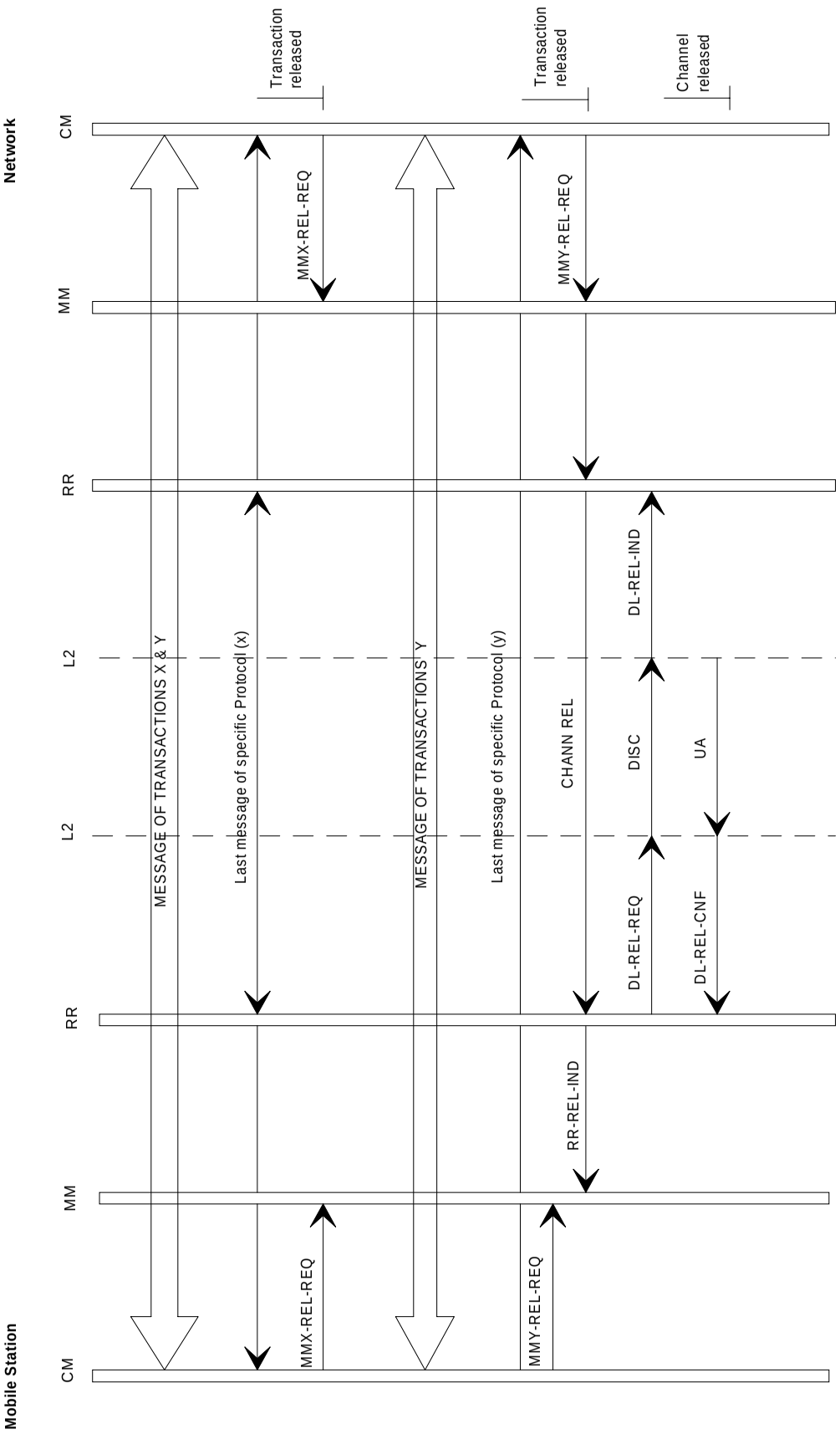


Figure A.7: Release of parallel transactions (General view)

Annex B (informative): Description of CSN.1

The goal of the notation described hereafter is to describe the structure of the syntactically correct messages for a given signalling protocol, or of part of such messages. The notation addresses the cases where the concrete messages are binary strings. The notation allows to describe *sets* of strings : the structure of a message defined a protocol defines a set of allowable bit strings. It also allows to put labels on parts of strings that follow a given structure.

One aspect of the specification of message set is to define the set of strings that are acceptable as when received. All the strings that cannot be recognised as syntactically correct messages are to be rejected for syntactical reasons. In many cases, only a subset of this set are allowed to be sent. The notation allows also to distinguish the set of the strings that can be sent and the set of strings that are recognised as syntactically correct.

Another aspect of the specification of messages is the splitting of an acceptable string in a number of sub-strings that will be use to derive the exact significance of the message. The notation provides this function by labelling sub-strings. These labels can then in turn be used in textual or formal semantic descriptions which are not covered in this document.

The notation described here could be enhanced in the future, with the addition of new rules.

B.1 The Basic Rules

The following rules (B1 to B6) form the core part of the notation, more or less directly inherited from BNF. Rules B7 to B8 add what is needed in addition to encode the rest octet parts of fixed length messages as defined in GSM 04.08.

Rule A1 is not needed to describe sets of strings at this stage. It is the one allowing to label parts of messages.

B.1.1 Core Rules

B.1.1.1 Rule B1 : Bits

A "bit string" is an ordered sequence of symbols, each belonging to a two-value set.

The character "0" and "1" are used to indicate one bit, respectively of one or the other value.

Formally, the notations « 0 » and « 1 » denote each a set composed of a single bit string of a single bit, of different values.

In addition the word “bit” denotes the set of the two 1-bit long strings, namely 0 and 1.

B.1.1.2 Rule B2 : Null String

Where needed, the word "null" call be used to indicate the null string, i.e., the string of no symbols.

Formally, the notation « null » denote the set composed of a single bit string, the empty string.

B.1.1.3 Rule B3 : Concatenation

A succession of two string descriptions describe the concatenation of the strings.

More formally : a succession of two string descriptions describes the strings obtained by concatenation of one string taken in the subset described by the first string description and then one string taken in the subset described by the second string description. The rule extends to any number of string descriptions.

For instance

```
00
```

This denotes the set composed of the single bit string of length 2 composed of two zeros.

B.1.1.4 Rule B4 : Choice

A list of choices is noted using as separator the character "|". An alternative notation uses instead the word "or" (this is not used in this document).

NOTE: An idea is to allow not to used strange characters, by giving in each case a verbose equivalent. This is not done systematically yet in this document.

Formally : the notation A | B, where A and B are string set descriptions, describes the set of the strings which are in the set described by A or in the set described by B, that is the union of sets described by A and B.

The concatenation has a higher precedence than the choice.

Examples:

```
00 | 01
```

This indicates that bit strings 00 and 01 are part of the set (10 and 11 are not).

```
0 | 1
```

denotes the same set as “bit”.

The characters "{" and "}" are used for delimiting a string set description from what follows and/or precedes.

```
0 {0|1}
```

This indicates the same set of bit strings as in the previous case.

Precedence example :

```
10 | 11
1 0|1
```

Because of the priority rule, the two descriptions are not equivalent, the second noting the set (10, 1).

It is allowed that the different sets in a choice have non null intersections. To allow message decoding, a rule must then be given to choose the branch. The rule is that any matching set can be chosen (the concatenation is a true set union).

In practice, it is preferable to have non intersecting choice sets. Moreover, the ability to select the branch to take rapidly is important for obtaining simple message decoders. Except for strong reasons, a design should only include choice construction that can be rewritten using only constructions matching the pattern {*a*1 *s*1 |*a*2 *s*2} where *a*1 and *a*2 are non-intersecting sets of strings of the same non-null length. A tolerable derogation is to use intersecting *a*n.

Examples:

{100 xx | 001 zz} is acceptable.

{00 xx | 010 yy | 011 zz} is acceptable, since it can be rewritten {00 xx | 01 {0 yy | 1 zz}}.

{{00|01|10} xx | {00|11} yy} is not recommended (the start 00 is ambiguous).

In practice this covers fixed length tagging (like tagging by an IEI, or 1-bit tagging in rest octets), and also non-intersecting variable length tagging as used for instance in the frequency list IE (tag list such as 0, 100, 101, 110, 11100, 11101, 11110, 11111, where no tag is the start of another one).

B.1.1.5 Rule B5 : Naming

The characters "<" and ">" are used to delimit a *reference* to the description of a string set. This can be used inside a string set description, to refer to a string set described elsewhere.

For compilability, the name must be used somewhere else to define the corresponding string set. For a simple description, the description of the reference could be done by normal text.

The name, that is the part sequence of characters between "<" and ">" must not be empty, and is constituted freely of characters, with the exception of "<" and ">". Case is not significant, nor are heading or tailing spaces. Any succession of space characters is treated as a single character. To avoid difficulties with more advanced rules, the use of the characters ":", "=", "(" and ")" should be avoided. More generally, it is not recommended to use many other characters, such as "<" for instance. The space character can (and should!) be used, to allow a good legibility for human beings.

Example :

```
<bit pair>
```

B.1.1.6 Rule B6 : Definition

A reference followed by the character sequence "::=" followed by a string set description is used to associate the description with the reference, terminated when needed to separate it from a following definition and when compilability is looked for, by a semi-colon ‘ ;.

Recursive definition is allowed, e.g., the reference can appears on the right hand side of the "::=". To avoid too much difficulties for would-be-compilers, only tail recursivity should be used, i.e., a recursive term should appear only as the last term of a definition.

Examples:

```
<bit pair> ::= 00 | 01 | 10 | 11 ;
```

This could have been noted as well :

```
<bit pair> ::= {00 | 01 | 10 | 11} ;
```

or

```
<bit pair> ::= {0|1} {0|1} ;
```

Recursive example :

```
<all bit strings> ::= null | { {0 | 1} <all bit strings>} ;
```

Another recursive, but not tail-recursive (and then not recommended) example :

```
<all bit strings> ::= null |  {<all bit strings> {0 | 1}} ;
```

B.1.2 Spare parts

For the purpose of message description it is in many cases needed to specify differently the set of bit strings that are acceptable when received and the corresponding set of bit strings which may be sent. The second set is included in the first. A first example are the spare parts.

Notations related to spare parts are different in nature from the bit string set description seen so far. They define two sets as the same time, the sent set and the received set. A construction rule of general application will be defined in advanced rules. For the moment, only two ad-hoc constructions are described.

B.1.2.1 Rule B7 : Spare bits

The following construction

```
<spare bit>
```

describes a 0 when emitted and a bit (0 or 1) in reception.

B.1.2.2 Rule B8 : Padding bits

An issue specific to the GSM radio interface protocols is that in some cases the messages cannot take arbitrary lengths. Padding is then necessary to fill up the message up to the desired length. Moreover, the padding uses a particular sequence of bits, of fixed position, i.e., the value of a padding bit depends on its position relative to the start of the message. The padding sequence is protocol-specific. In most cases it is constituted of all 0 values, in which case the following notation is of no use. In the case of GSM 04.08, the padding sequence is the repetition of octet 00101011, starting on an octet boundary.

The special notations "L" and "H" are used to denote the respectively the bit value corresponding to the padding spare bit for that position, and the other value.

The notations "0", "1", "null", "L" and "H" are the only terminals in CSN.1.

Padding spare bits are bits which are set to the indicated value in emission whereas in reception any bit string is acceptable. The following notation

```
<spare L>
```

describes a bit which has a logical value L in emission, and is a bit (0 or 1) in reception

The term <spare padding> denotes the required padding spare bits needed to fill up the message. The construction can be developed only partially from the rules described so far, because the length limitation does not appear in the following description :

```
< spare padding> ::= <spare L> {null | < spare padding>};
```

B.1.3 Predefined sets

The notation allows a modular description of the messages. This means in particular the possibility to build a library of bit string set definitions to be used wherever needed. The following is an example of an elementary library, which could be specified once and can be used in other specifications without being redefined.

```
<bit> ::= 0|1 ;
<bit (1)> ::= <bit>;
<bit (2)> ::= <bit> <bit>;
<bit (3)> ::= <bit (2)> <bit>;
<bit (4)> ::= <bit (3)> <bit>;
<bit (5)> ::= <bit (4)> <bit>;
<bit (6)> ::= <bit (5)> <bit>;
<bit (7)> ::= <bit (6)> <bit>;
<octet> ::= <bit (7)> <bit>;
<half octet> ::= <bit (4)>;
<spare half octet> ::= <spare bit><spare bit><spare bit><spare bit>;
    <spare padding> ::= <spare L> {null | <spare padding>};

<octet string(i)> ::= <octet>(i) ;          -- for any positive or null integer i
<bit(i)> ::= <bit>(i);                      -- for any positive or null integer I
<bit string> ::= bit**;
<octet string> ::= <octet>**;
```

NOTE 1: The definition of generic constructions such as <bit string(i)> is somewhat cumbersome with only the basic rules. More advanced rules would allow a much more compact notation.

NOTE 2: The use of the characters "(" and ")" within a reference is done consistently with potential advanced rules.

NOTE 3: This basic library is not exhaustive and can be extended when the needs arise.

B.1.4 Labelling Parts

B.1.4.1 Rule A1 : Labels

Delimited names as defined by Rule B6 identify sets of sub strings. In many cases this can be used within the context of a message to refer to the specific part of the message. However, this is not of general application, since it may happen that two parts of a message follow the same structure, and economy of notation requires that the structure is described but once.

The general syntax that follows allows to refer to a part inside a description:

```
<name1 : string description>
```

For the definition of string sets, this is equivalent to the string description being used alone.

The name used as a label can be built according to the rules applicable to parenthesed references.

Examples:

```
<Tag : 000 >
<Field : <Field type>>
<Field : octet>
```

The third example shows the use of a non parentheses reference to obtain a more elegant expression than, for instance, the second example. At this stage, labels has no use for describing message syntax, but can be used to refer to the corresponding part of the string, e.g., in the description of the message specifying the relationship between the syntactical content and the semantical contents of the message, or to associate properties with effective sub-strings in effective messages (rather than with sets of sub strings). Syntactical use of the semantical identifier are presented in more advanced rules.

The same name may appear in several places. Designers have to be careful to use non ambiguous names if non-ambiguous reference is desired.

B.1.5 Goodies

B.1.5.1 Rule G1 : Comments

Comments can be added, starting with the term "--" and ended by the end of line. Comments can be used in particular to indicate the section where a particular description can be found.

B.2 Advanced rules

B.2.1 Rule A2 : Exponent notation

An arithmetic expression used as exponent after a delimited string description is used to indicate repetitions.

A numerical expression between parentheses indicates a fixed number of repetitions.

```
<octet> ::= {0 | 1}^(8) ;
```

is equivalent to

```
<octet> ::= {0 | 1} {0 | 1} {0 | 1} {0 | 1} {0 | 1} {0 | 1} {0 | 1} {0 | 1} ;
```

This could also be written :

```
<octet> ::= bit(8) ;
```

When the exponent is negative or equal to 0, the exponentiated construction is equivalent to the null string.
An example of a common construction is the following :

```
<name : bit(5)>
```

Simple arithmetic, using numbers, terms "+", "-", "*" and "/", and parentheses are allowed in expressions..

Example :

```
<octet string(40)> ::= <octet>^(8*(4+1)) ;
```

A star used alone between parentheses, or a double star, indicates a finite, possibly null, but indeterminate, number of repetitions. (The star used as an exponent can be understood also as meaning the union of all the sets obtained by replacing the star by zero or some positive integer.)

```
<all bit strings> ::= {0 |1}(*) ;
<all bit strings> ::= {0 |1}** ;
```

This allows a shorter notation of recursive constructions such as:

```
<all bit strings> ::= {0|1} <all bit strings> | null;
```

A shorter notation is allowed when the expression has a single term, consisting of a star followed by the term:

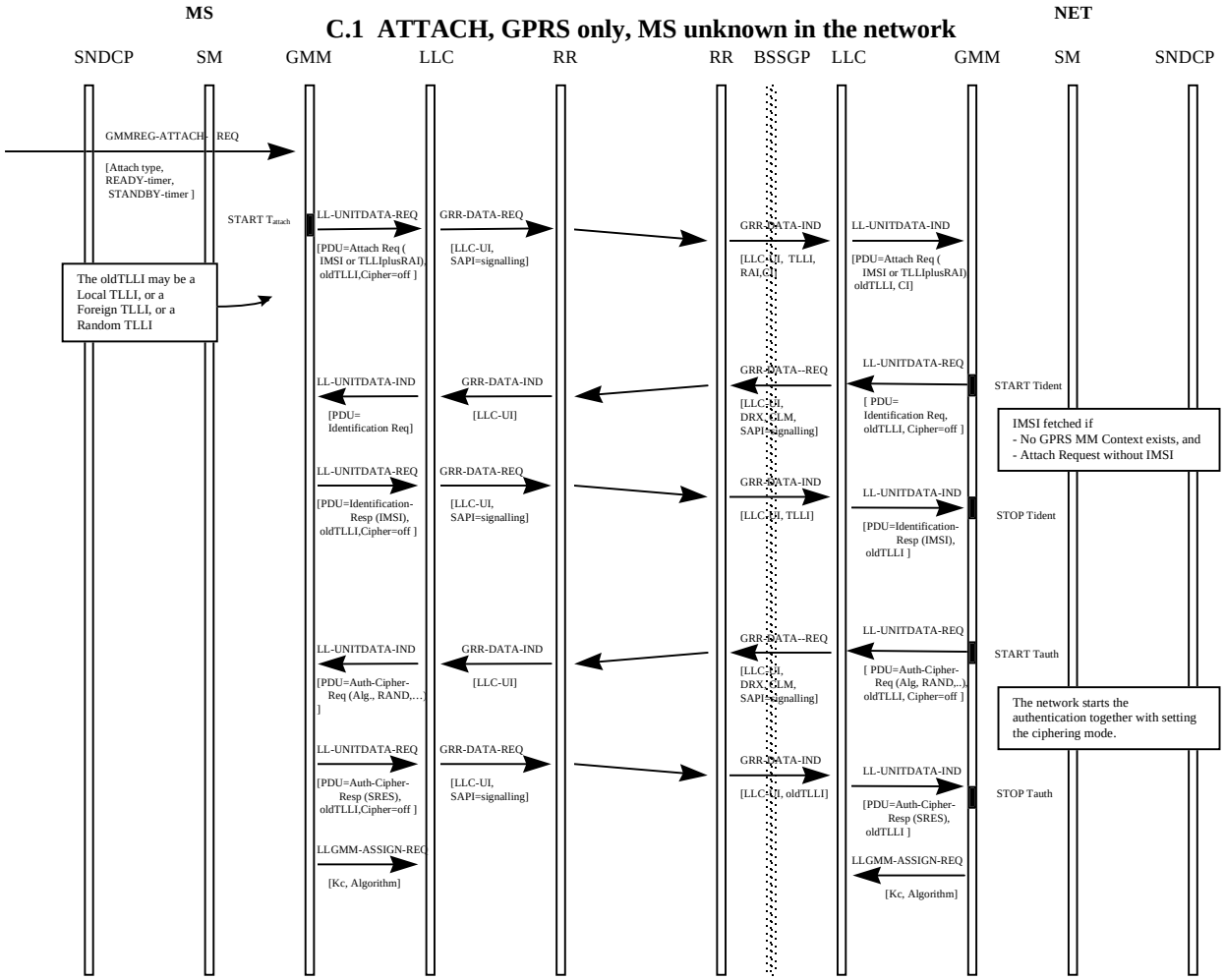
```
<octet> ::= {0 | 1}*8 ;
<octet string(40)> ::= <octet>*(8*(4+1)) ;
<all bit strings> ::= bit**;
```

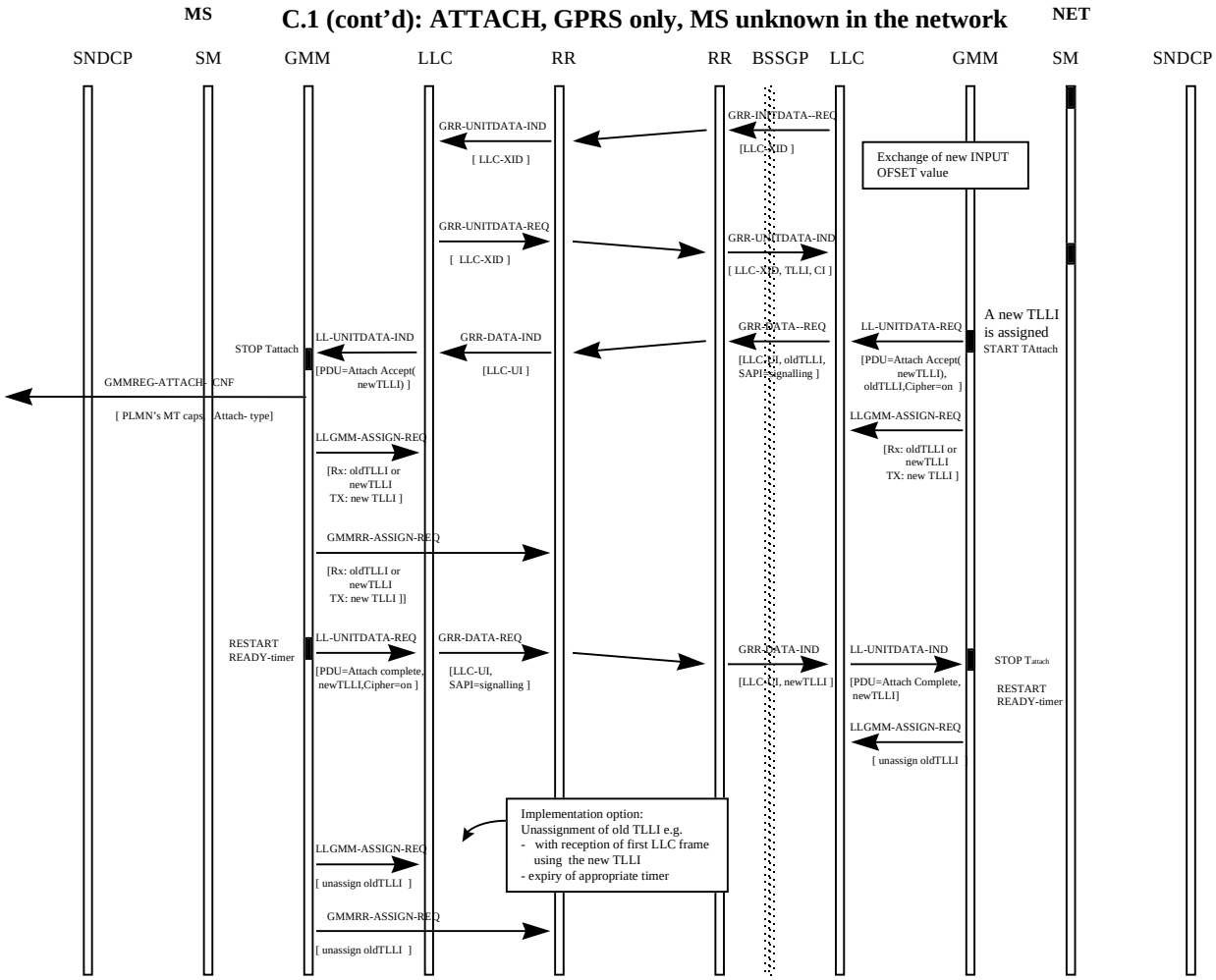
Application note :

The indefinite exponent is usually combined with some mean to indicate to the decoder the end of the repetition. Different techniques exist, such as indicating in a previous field the number of repetitions. Another technique is one-bit tagging, an example of which follows :{1 <item>}** 0

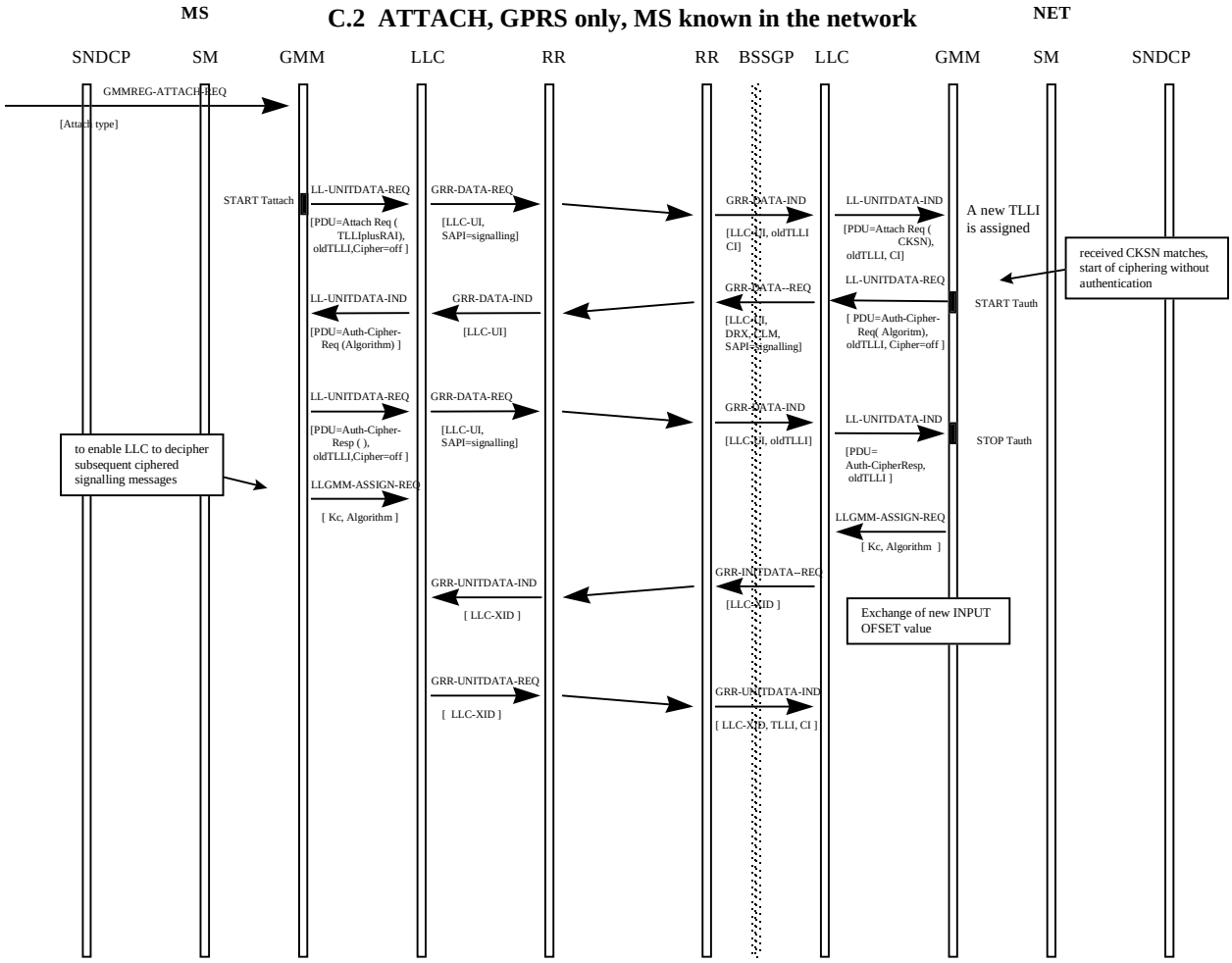
Annex C (informative): GPRS-Services sequence diagram

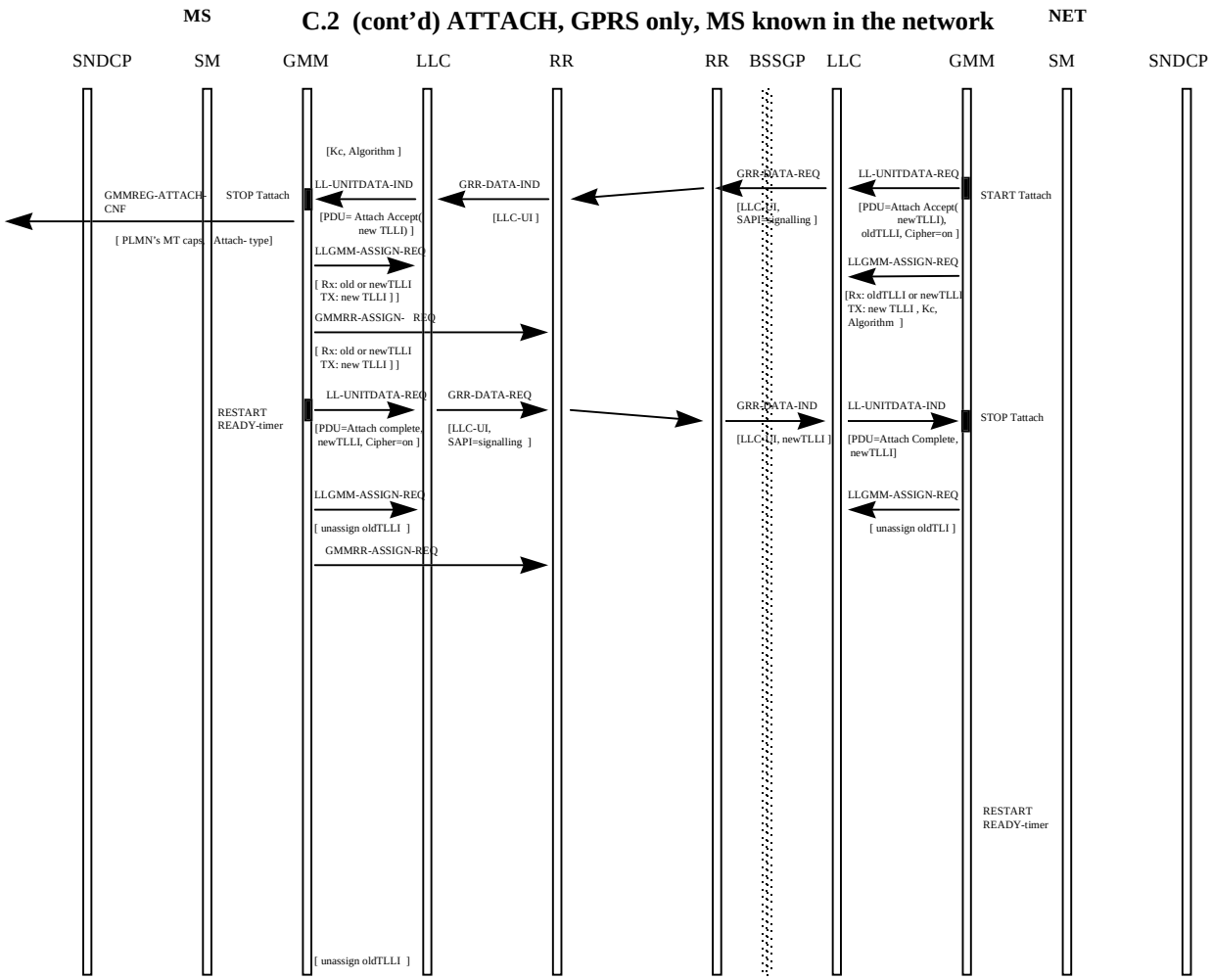
Instead of providing a complete set of all scenarios, the intention of this section is to provide some typical examples. It shall be noted, that within the figures only those parameters of the PDUs and the service primitives are shown, which are needed for a general understanding of the examples. Furthermore during the examples below (except C.17) no cell re-selection takes place.

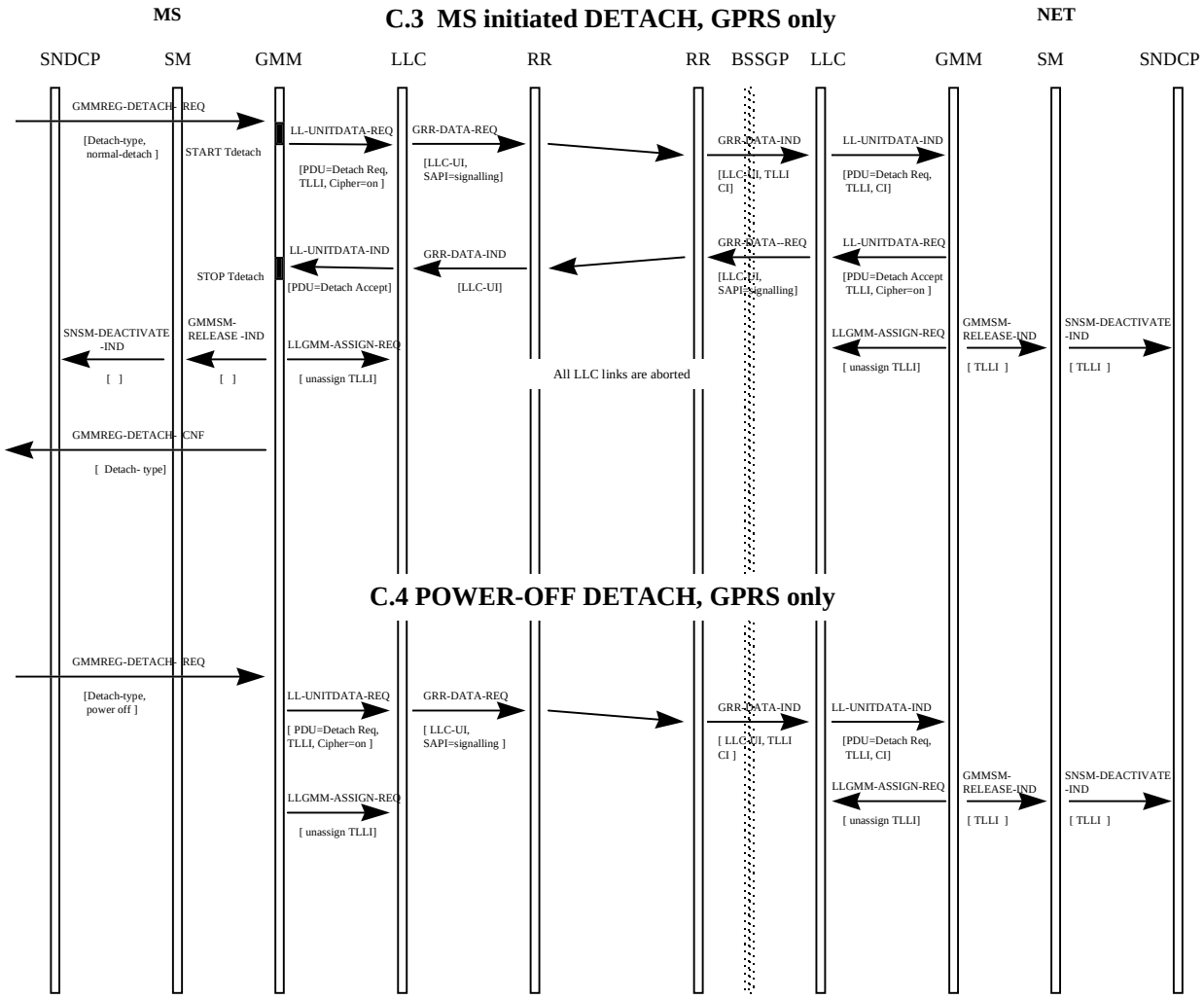



MS
C.1 (cont'd): ATTACH, GPRS only, MS unknown in the network
NET
SNDCP
SM
GMM
LLC
RR
RR
BSSGP
LLC
GMM
SM
SNDCP
GRR-UNITDATA-IND
[LLC-XID]
GRR-UNITDATA--REQ
[LLC-XID]
Exchange of new INPUT OFSET value
GRR-UNITDATA-REQ
[LLC-XID]
GRR-UNITDATA-IND
[LLC-XID, TLLI, CI]
A new TLLI is assigned
START TAttach
STOP Tattach
LL-UNITDATA-IND
[PDU=Attach Accept(newTLLI)]
GRR-DATA-IND
[LLC-UI]
GRR-DATA--REQ
[LLC-UI, oldTLLI, SAPI=signalling]
LL-UNITDATA-REQ
[PDU=Attach Accept(newTLLI), oldTLLI,Cipher=on]
GMMREG-ATTACH- CNF
[PLMN's MT caps , Attach- type]
LLGMM-ASSIGN-REQ
[Rx: oldTLLI or newTLLI
TX: new TLLI]
LLGMM-ASSIGN-REQ
[Rx: oldTLLI or newTLLI
TX: new TLLI]
GMMRR-ASSIGN-REQ
[Rx: oldTLLI or newTLLI
TX: new TLLI]]
RESTART READY-timer
LL-UNITDATA-REQ
[PDU=Attach complete, newTLLI,Cipher=on]
GRR-DATA-REQ
[LLC-UI, SAPI=signalling]
GRR-DATA-IND
[LLC-UI, newTLLI]
LL-UNITDATA-IND
[PDU=Attach Complete, newTLLI]
STOP Tattach
RESTART READY-timer
LLGMM-ASSIGN-REQ
[unassign oldTLLI
Implementation option:
Unassignment of old TLLI e.g.
- with reception of first LLC frame using the new TLLI
- expiry of appropriate timer
LLGMM-ASSIGN-REQ
[unassign oldTLLI]
GMMRR-ASSIGN-REQ
[unassign oldTLLI]

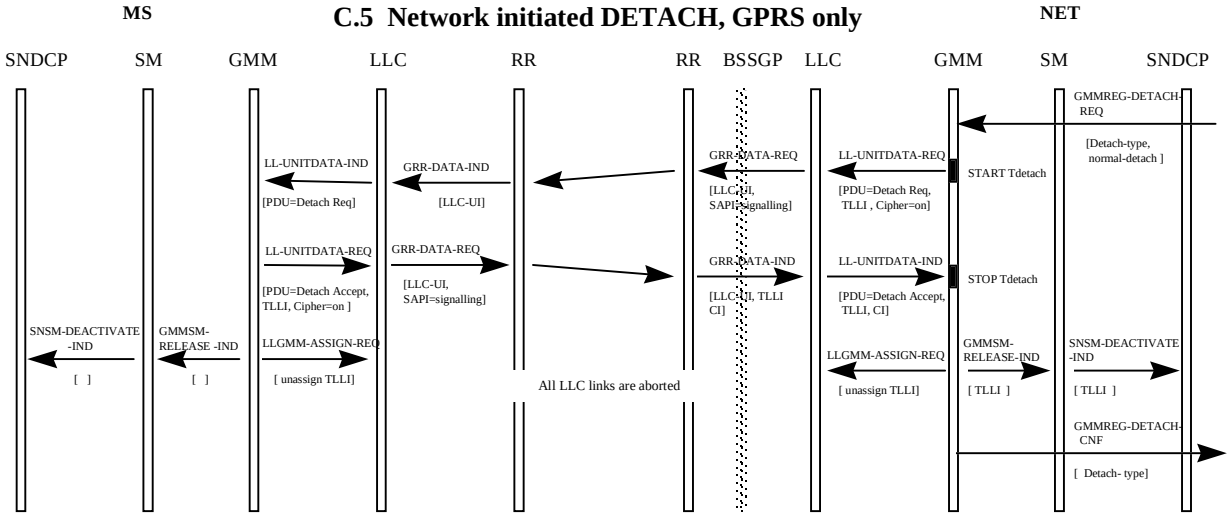
C.2 ATTACH, GPRS only, MS known in the network



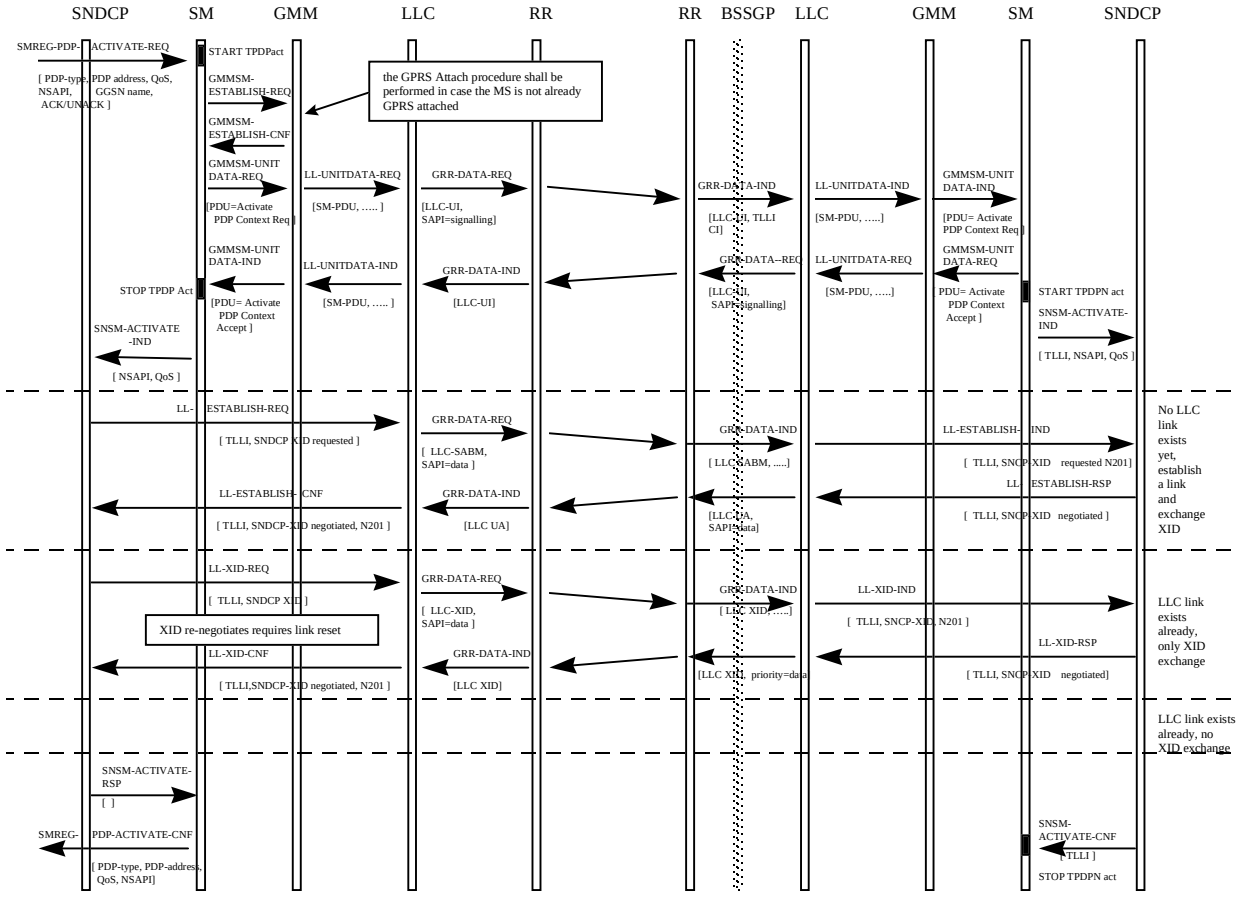

MS
C.2 (cont'd) ATTACH, GPRS only, MS known in the network
NET
SNDCP
SM
GMM
LLC
RR
RR
BSSGP
LLC
GMM
SM
SNDCP
[Kc, Algorithm]
LL-UNITDATA-IND
GRR-DATA-IND
GRR-DATA-REQ
LL-UNITDATA-REQ
START Tattach
GMMREG-ATTACH-CNF
STOP Tattach
[PDU= Attach Accept(new TLLI)]
[LLC-UI]
[LLC-UI, SAPI=signalling]
[PDU=Attach Accept(newTLLI), oldTLLI, Cipher=on]
[PLMN's MT caps Attach- type]
LLGMM-ASSIGN-REQ
LLGMM-ASSIGN-REQ
[Rx: old or newTLLI TX: new TLLI]]
[Rx: oldTLLI or newTLLI TX: new TLLI , Kc, Algorithm]
GMMRR-ASSIGN- REQ
[Rx: old or newTLLI TX: new TLLI]]
LL-UNITDATA-REQ
GRR-DATA-REQ
GRR-DATA-IND
LL-UNITDATA-IND
STOP Tattach
RESTART READY-timer
[PDU=Attach complete, newTLLI, Cipher=on]
[LLC-UI, SAPI=signalling]
[LLC-UI, newTLLI]
[PDU=Attach Complete, newTLLI]
LLGMM-ASSIGN-REQ
LLGMM-ASSIGN-REQ
[unassign oldTLLI]
[unassign oldTLI]
GMMRR-ASSIGN-REQ
RESTART READY-timer
[unassign oldTLLI]


MS
C.3 MS initiated DETACH, GPRS only
NET
SNDCP
SM
GMM
LLC
RR
RR
BSSGP
LLC
GMM
SM
SNDCP
GMMREG-DETACH- REQ
[Detach-type, normal-detach]
START Tdetach
LL-UNITDATA-REQ
[PDU=Detach Req, TLLI, Cipher=on]
GRR-DATA-REQ
[LLC-UI, SAPI=signalling]
GRR-DATA-IND
[LLC-UI, TLLI CI]
LL-UNITDATA-IND
[PDU=Detach Req, TLLI, CI]
LL-UNITDATA-IND
STOP Tdetach
[PDU=Detach Accept]
GRR-DATA-IND
[LLC-UI]
GRR-DATA--REQ
[LLC-UI, SAPI=signalling]
LL-UNITDATA-REQ
[PDU=Detach Accept TLLI, Cipher=on]
SNSM-DEACTIVATE -IND
[ ]
GMMSM- RELEASE -IND
[ ]
LLGMM-ASSIGN-REQ
[unassign TLLI]
All LLC links are aborted
LLGMM-ASSIGN-REQ
[unassign TLLI]
GMMSM- RELEASE-IND
[TLLI]
SNSM-DEACTIVATE -IND
[TLLI]
GMMREG-DETACH- CNF
[Detach- type]
C.4 POWER-OFF DETACH, GPRS only
GMMREG-DETACH- REQ
[Detach-type, power off]
LL-UNITDATA-REQ
[PDU=Detach Req, TLLI, Cipher=on]
GRR-DATA-REQ
[LLC-UI, SAPI=signalling]
GRR-DATA-IND
[LLC-UI, TLLI CI]
LL-UNITDATA-IND
[PDU=Detach Req, TLLI, CI]
LLGMM-ASSIGN-REQ
[unassign TLLI]
GMMSM- RELEASE-IND
[TLLI]
SNSM-DEACTIVATE -IND
[TLLI]
LLGMM-ASSIGN-REQ
[unassign TLLI]

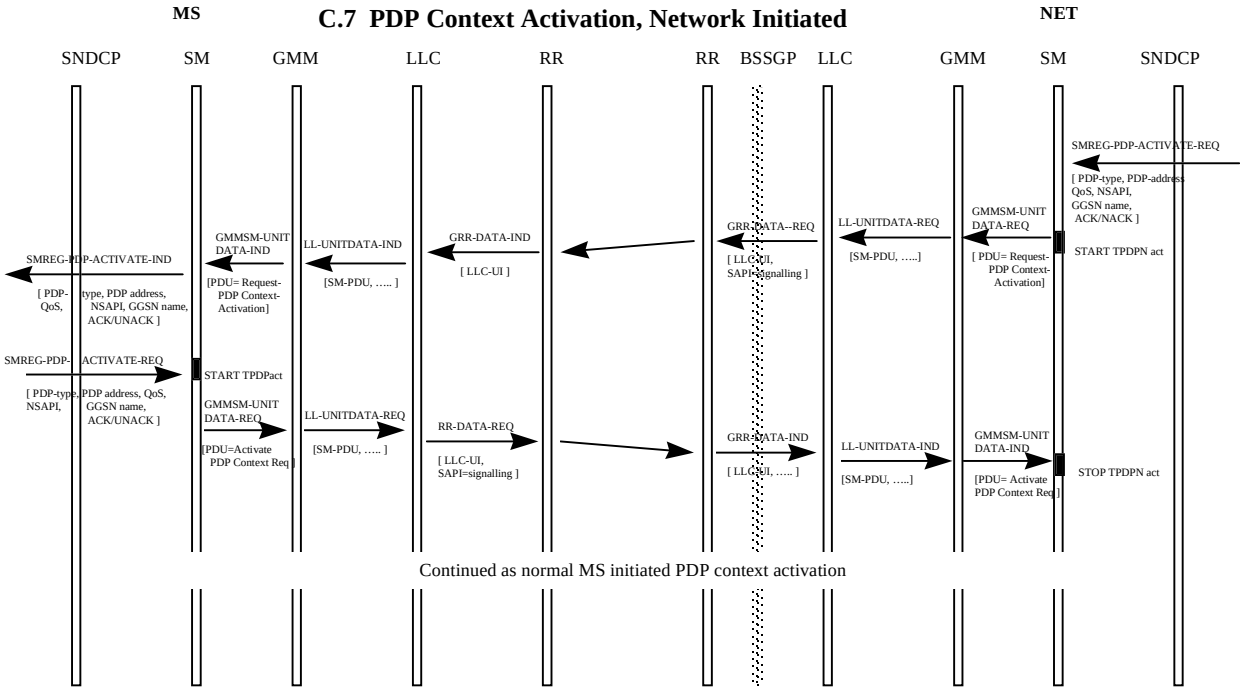
C.5 Network initiated DETACH, GPRS only



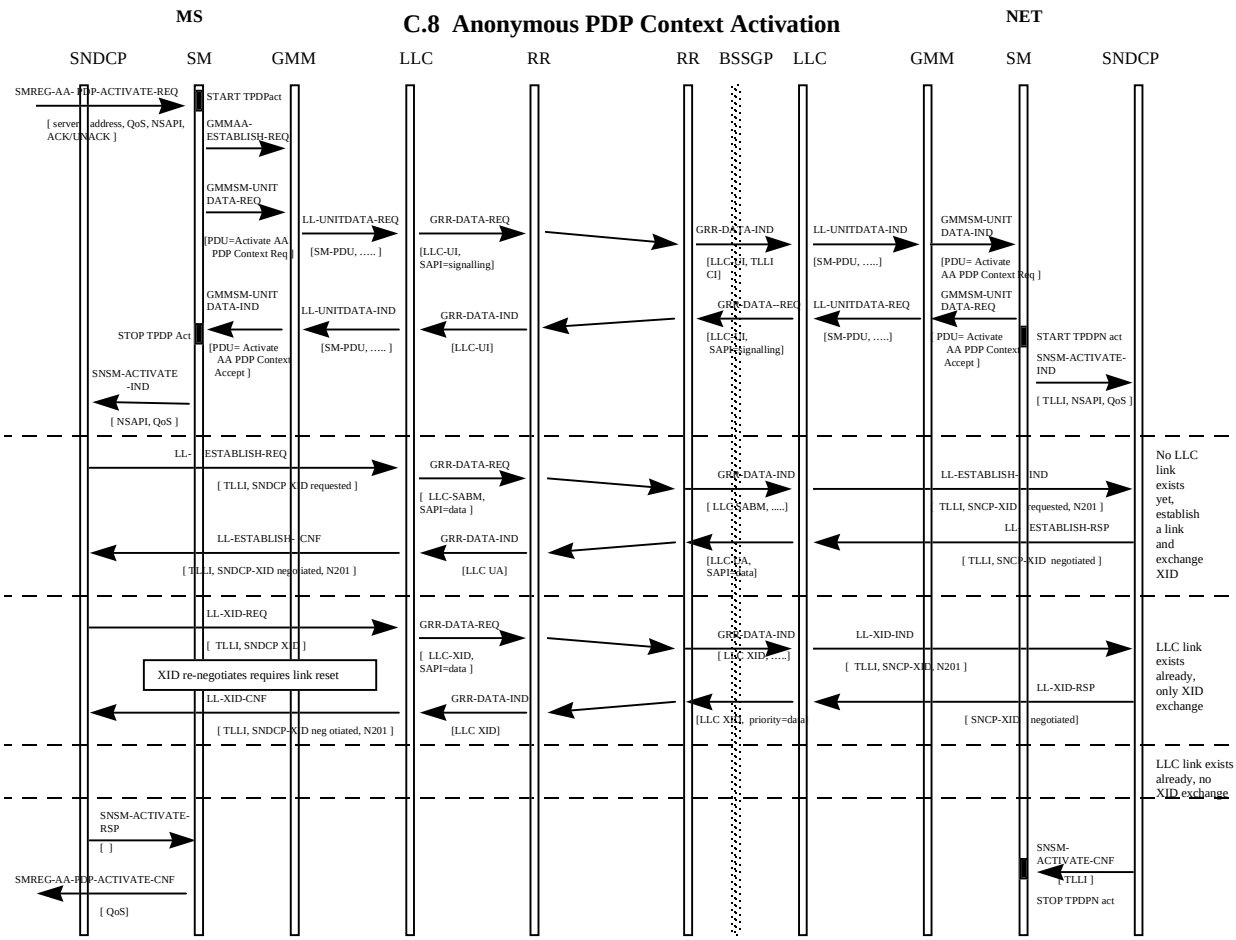
C.6 PDP Context Activation, MS Initiated, MS already attached



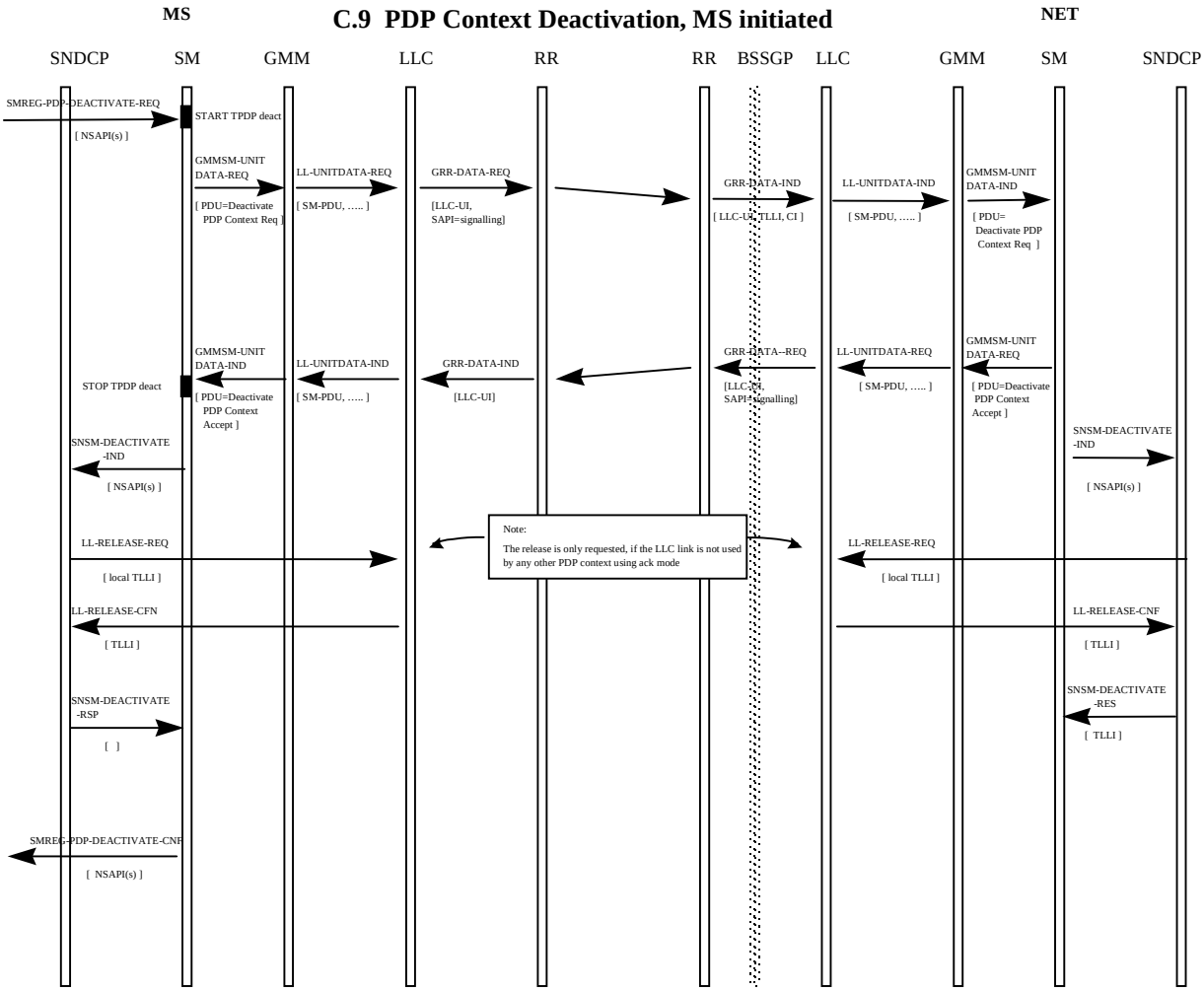
C.7 PDP Context Activation, Network Initiated



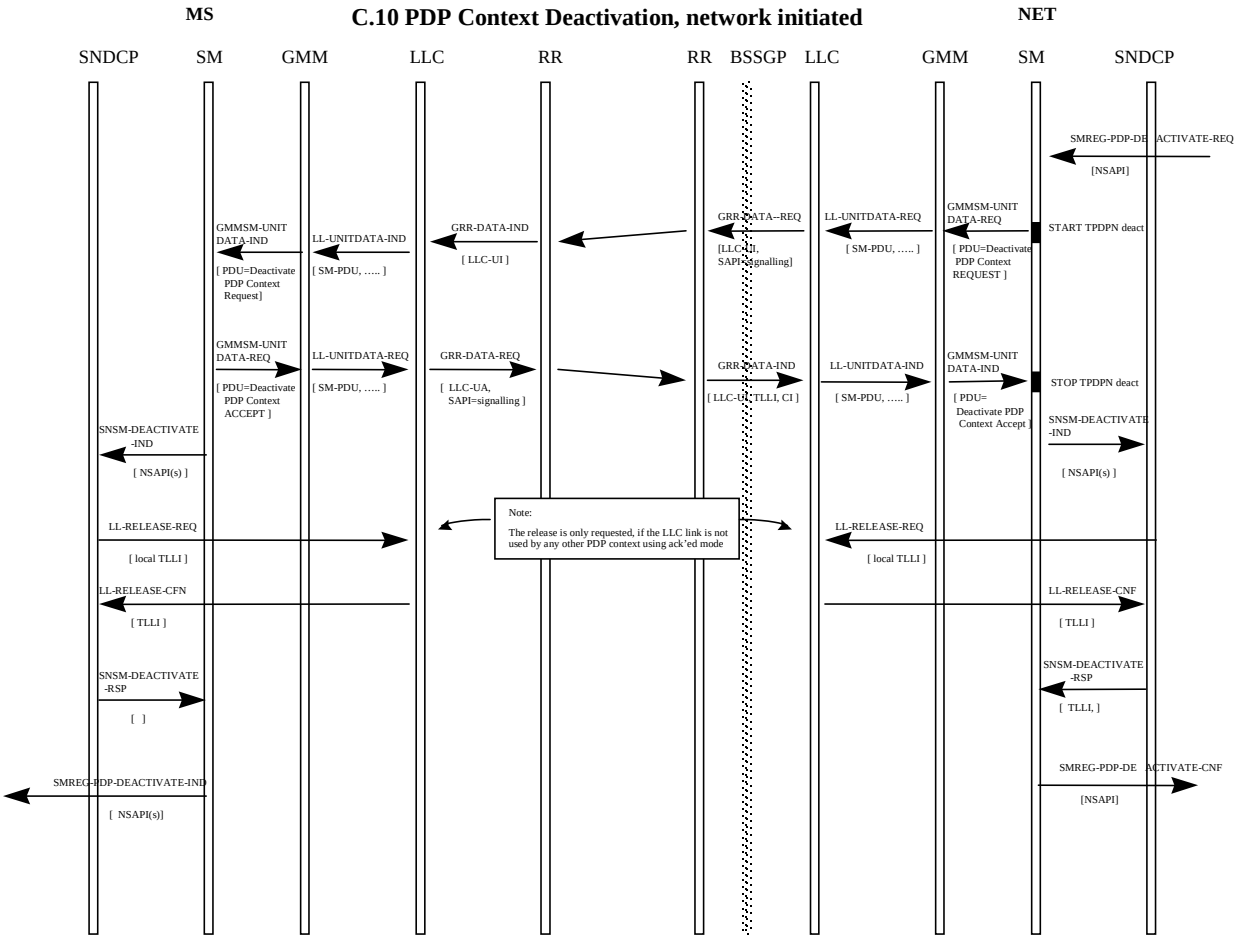
C.8 Anonymous PDP Context Activation

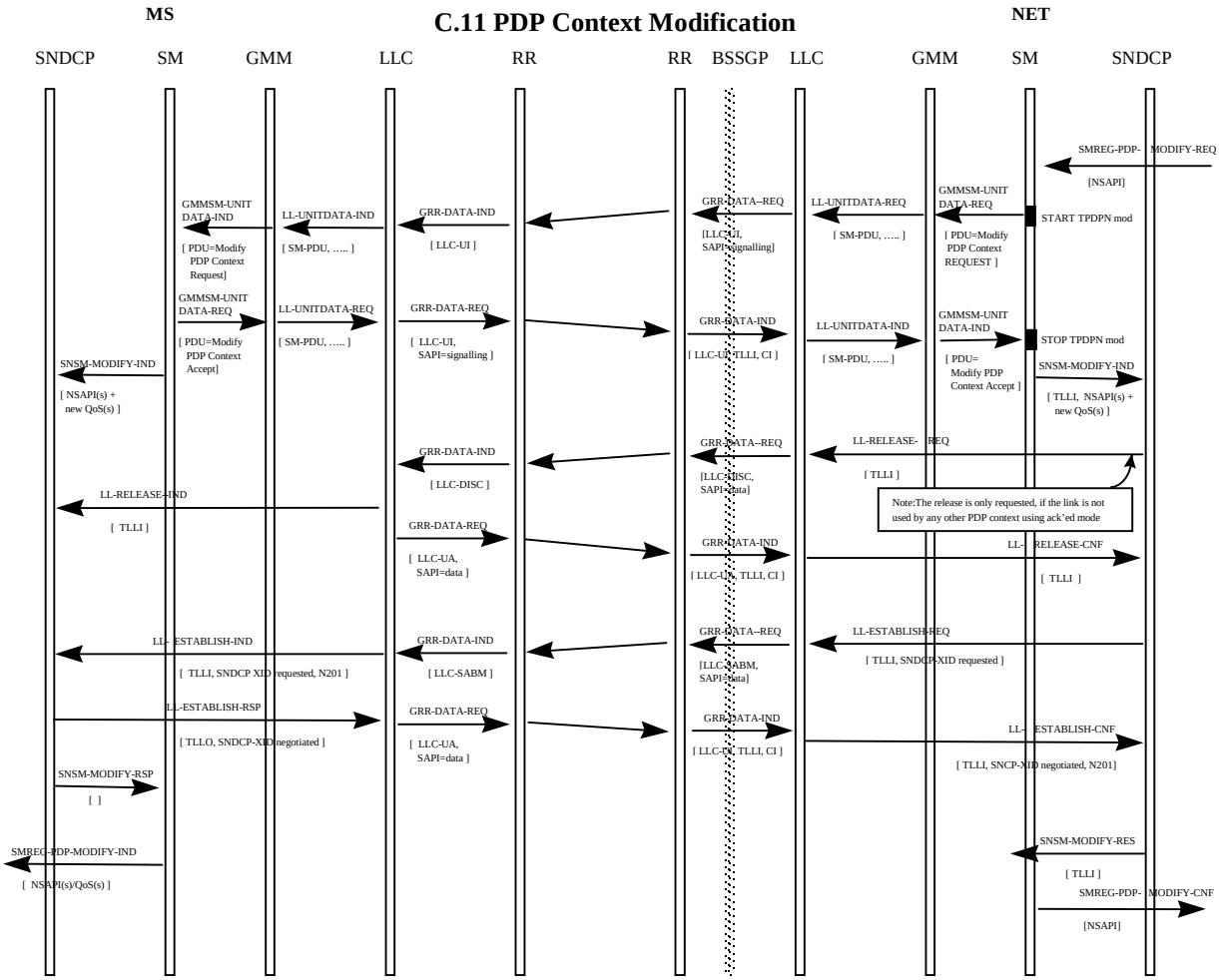


C.9 PDP Context Deactivation, MS initiated



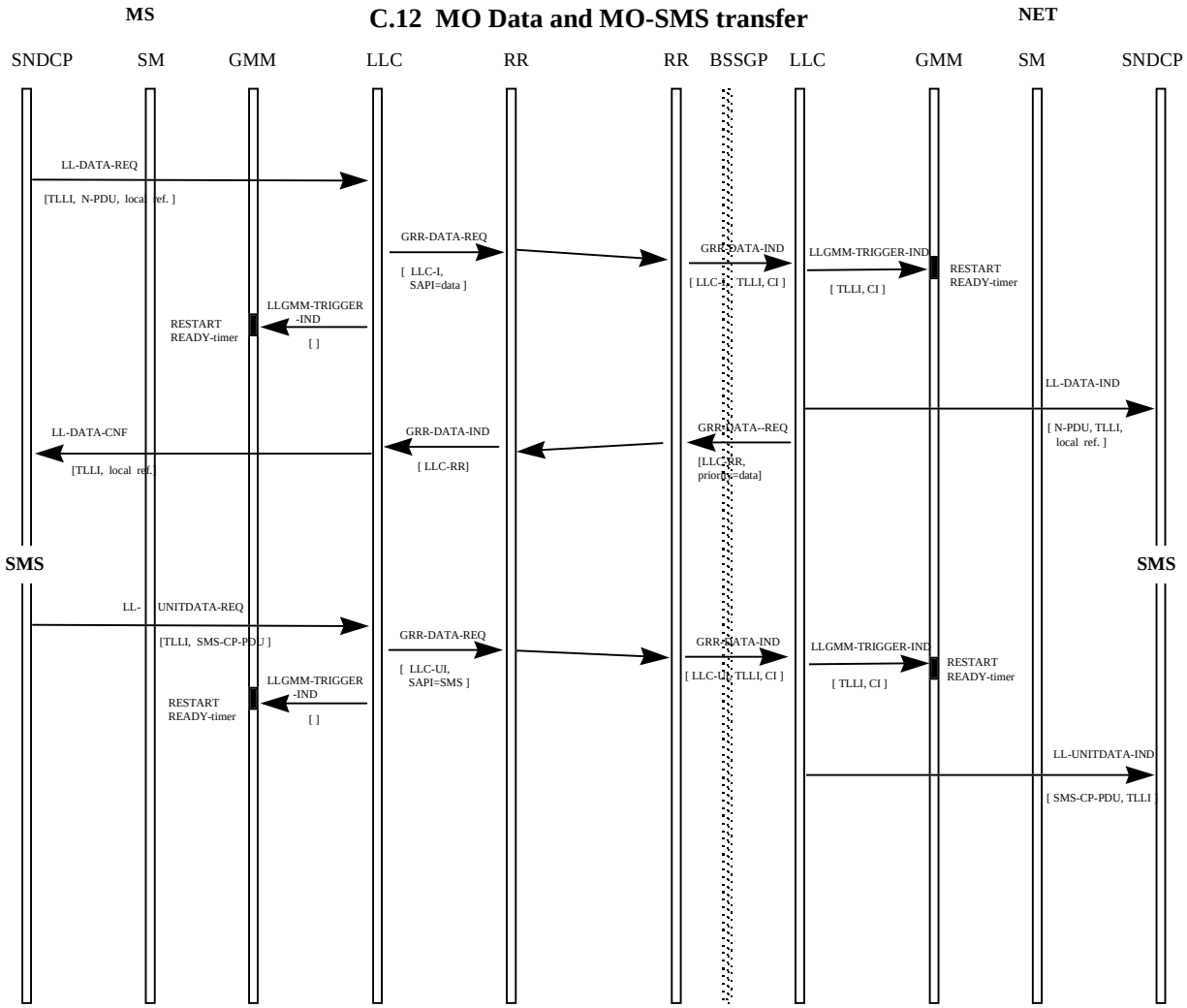
C.10 PDP Context Deactivation, network initiated



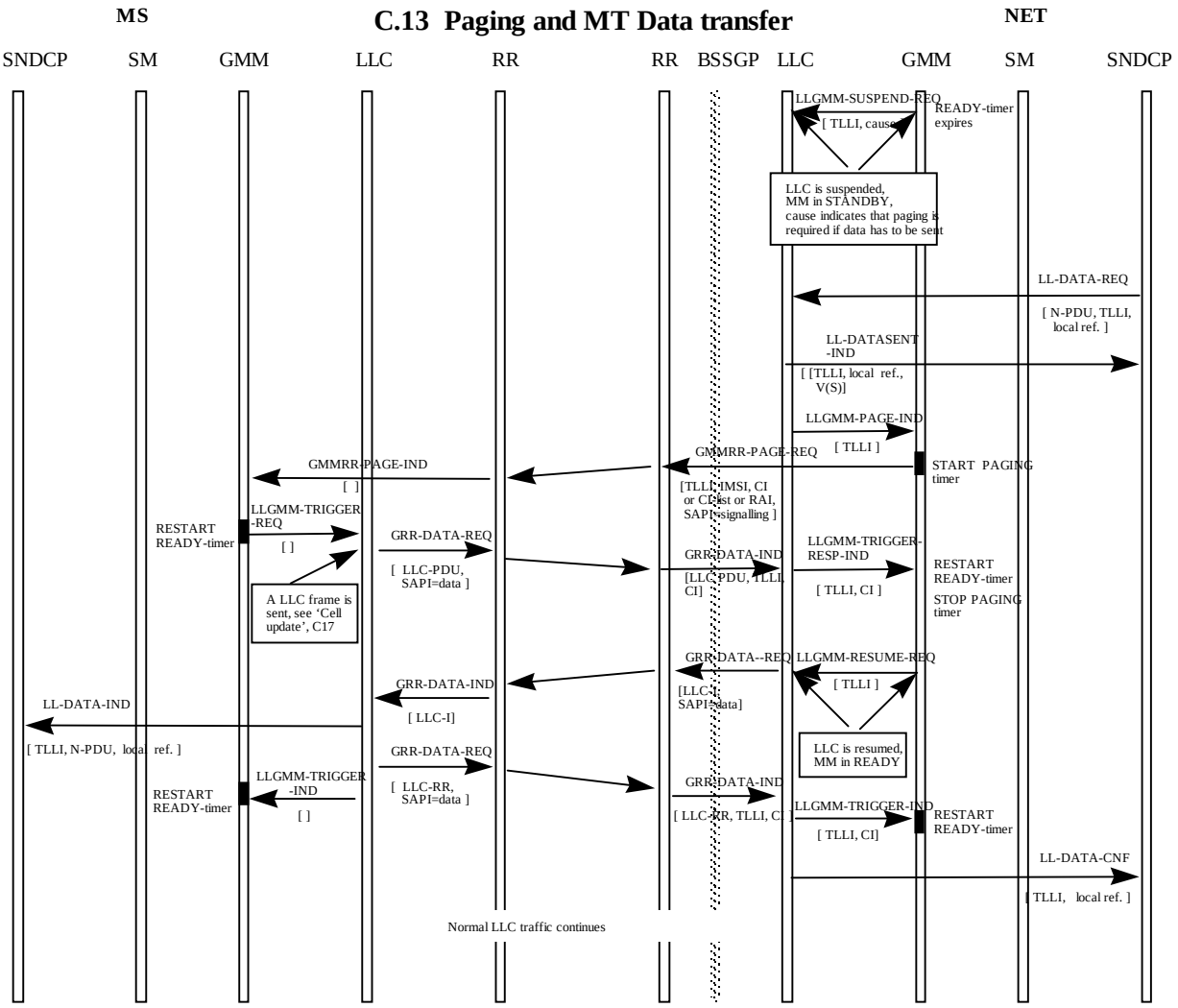


NOTE: The standalone PDP context modification procedure should use graceful disconnection of the LLC link

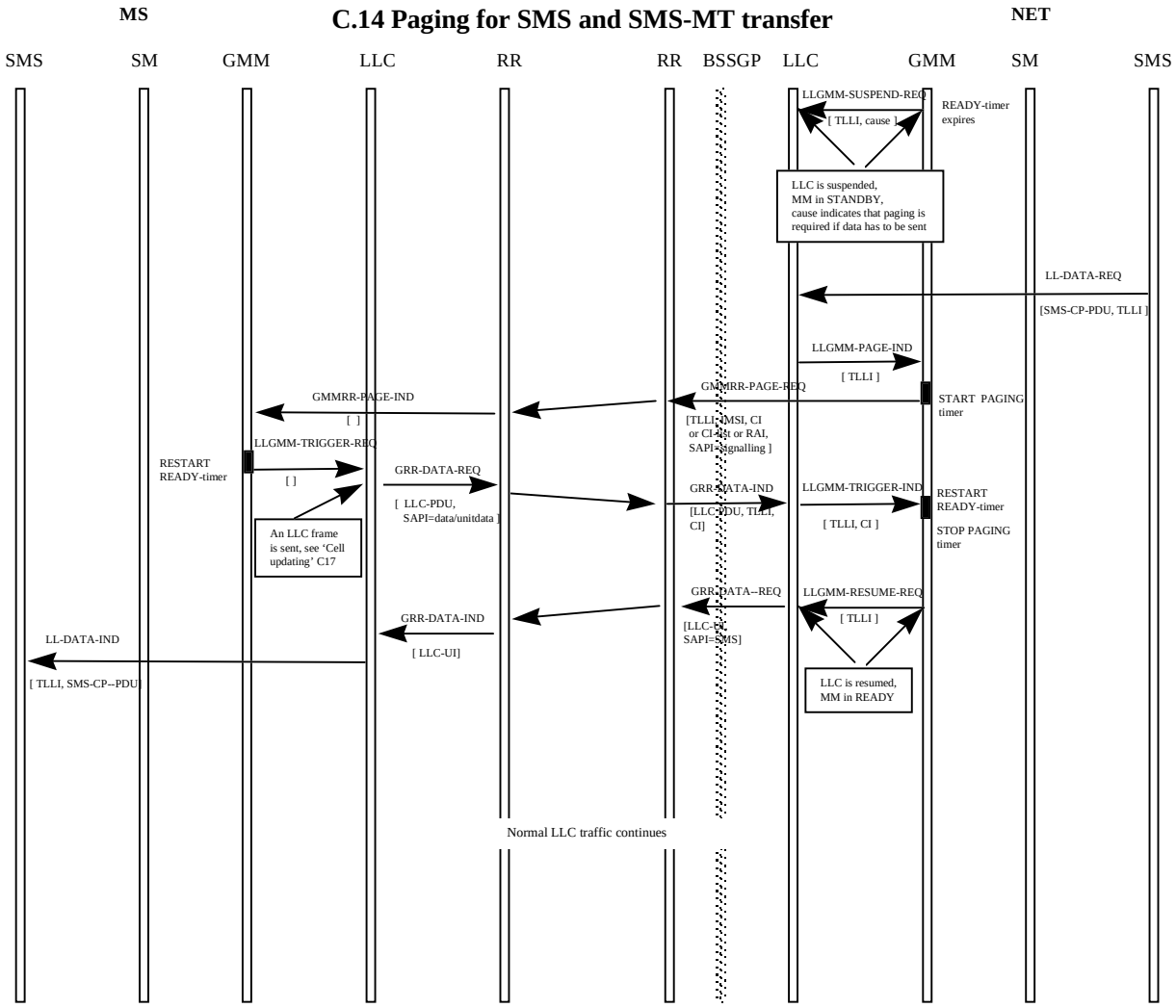
C.12 MO Data and MO-SMS transfer



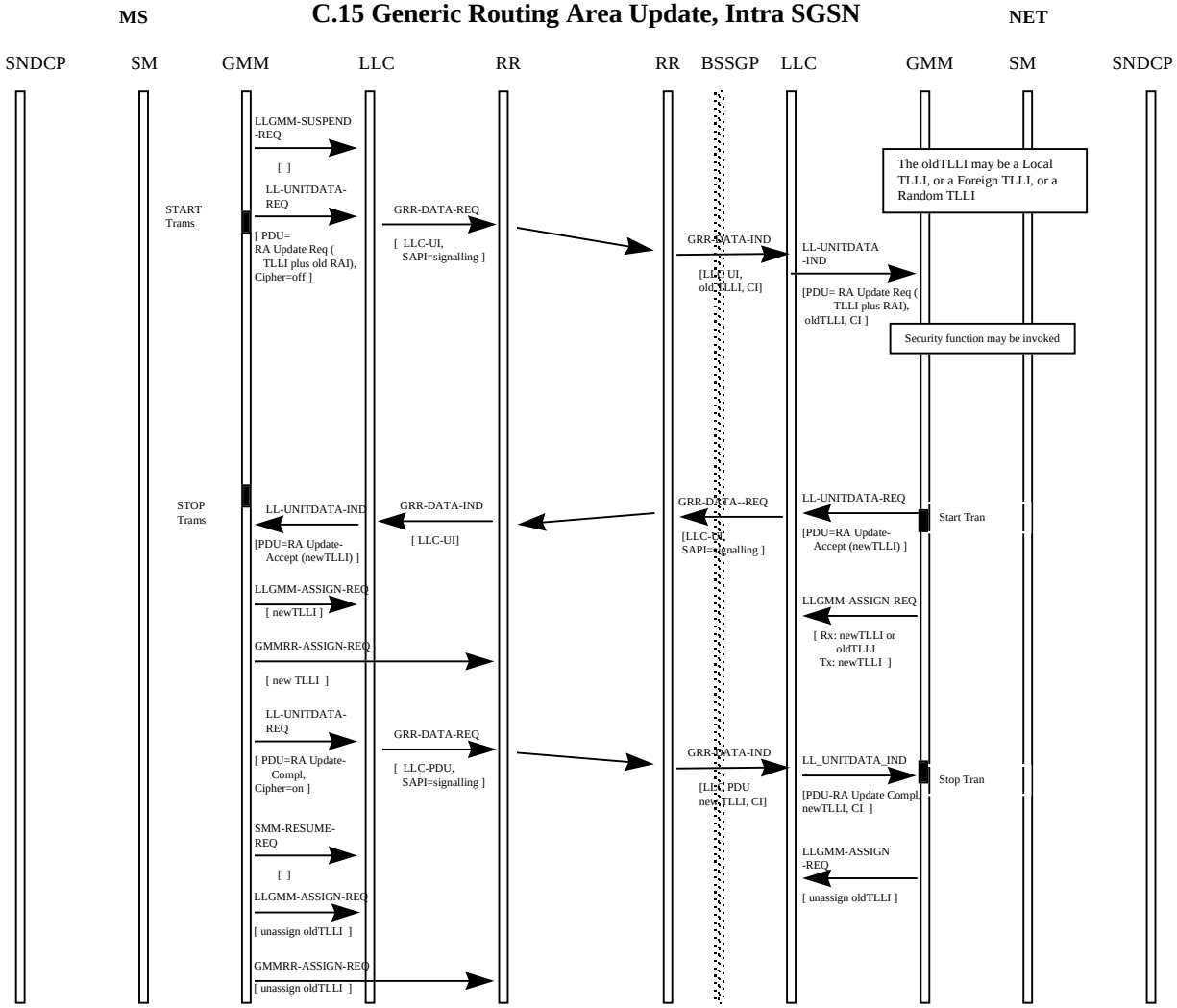
C.13 Paging and MT Data transfer



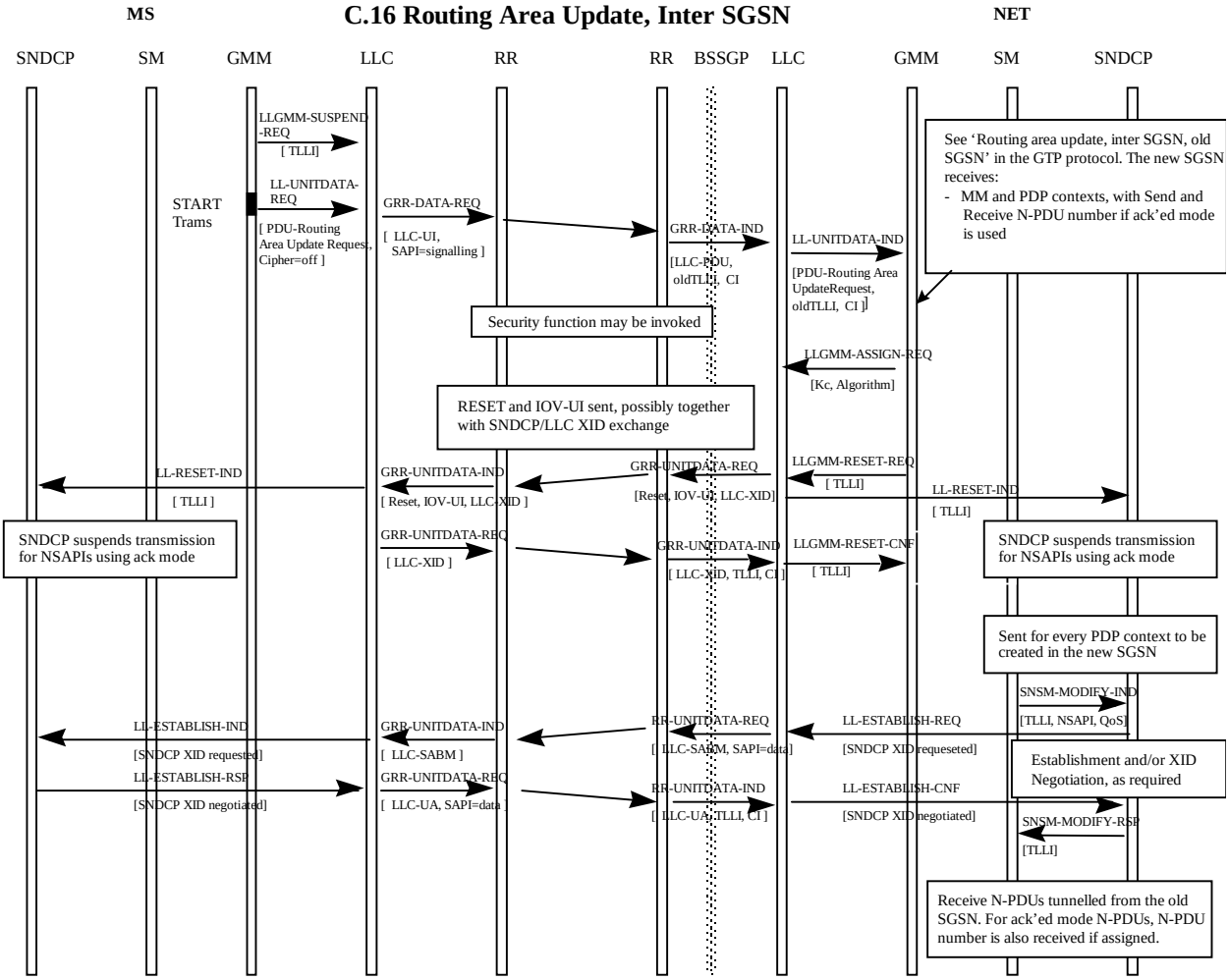
C.14 Paging for SMS and SMS-MT transfer



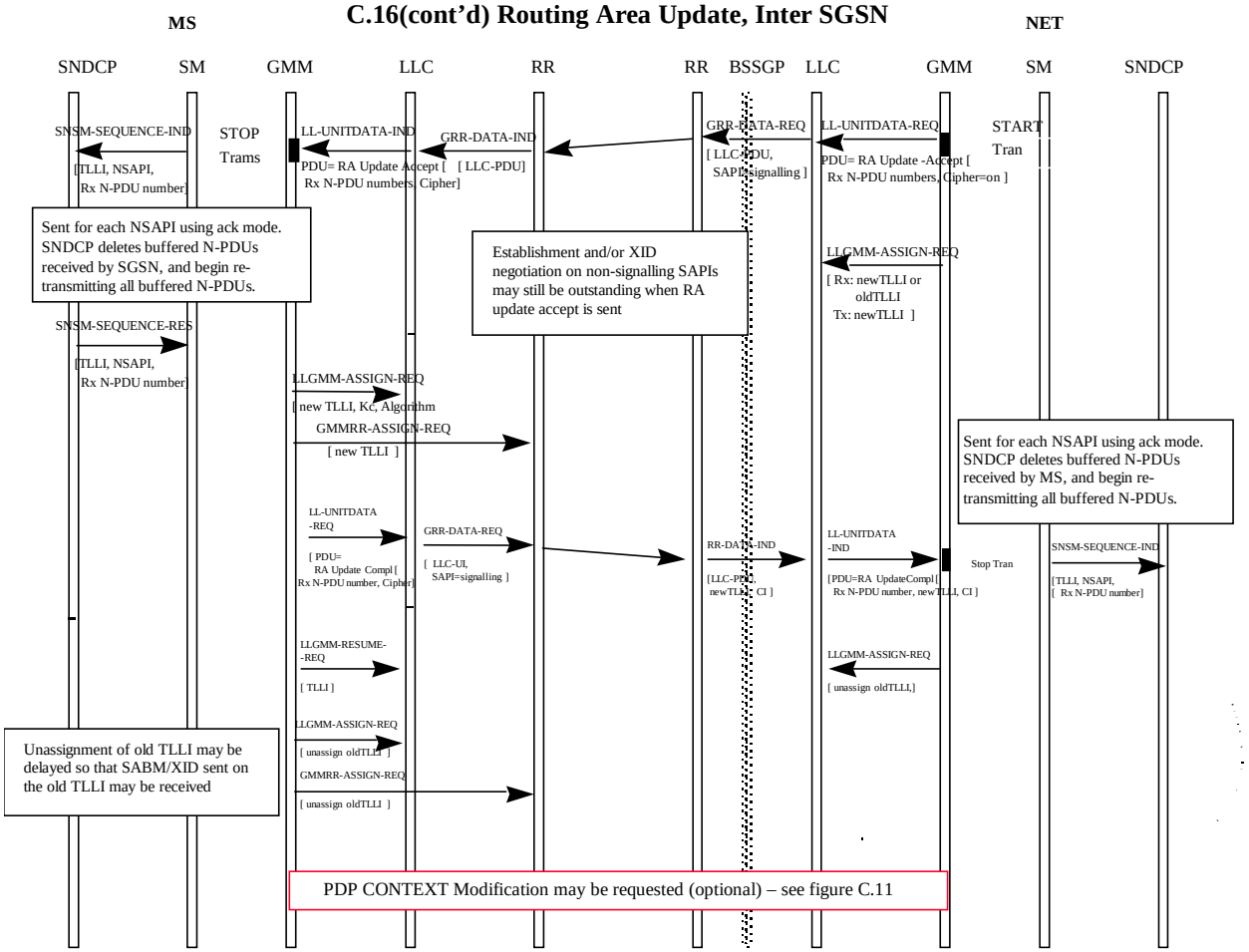
C.15 Generic Routing Area Update, Intra SGSN



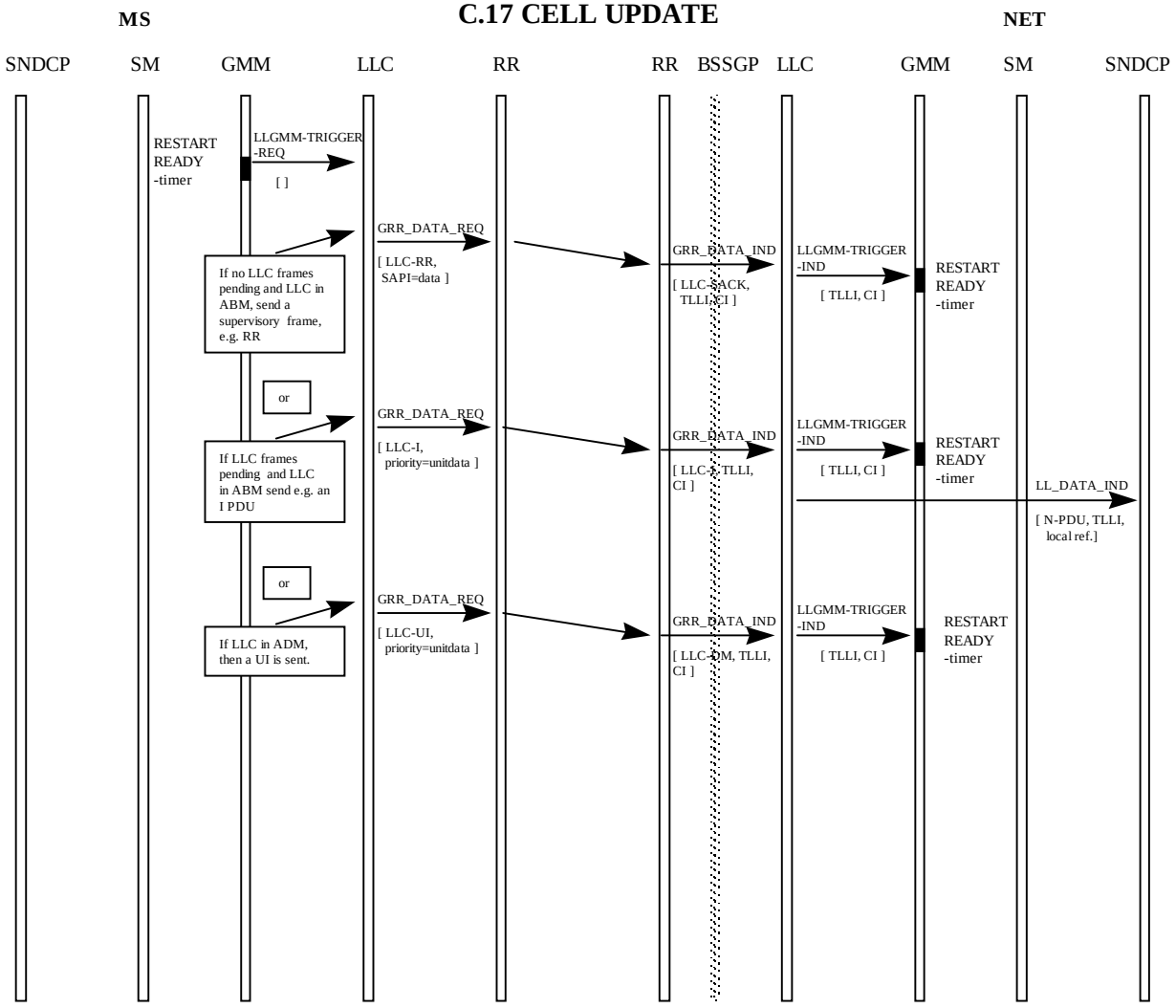
C.16 Routing Area Update, Inter SGSN



C.16(cont'd) Routing Area Update, Inter SGSN



C.17 CELL UPDATE



Annex B (informative): Change history

TSG SA#	Spec	Version	CR	Rev	Rel	New Version	Subject	Comment
Jun 1999	GSM 04.07	7.1.0						Transferred to 3GPP CN
CN#04	24.007					3.0.0		
CN#5	24.007	3.0.0	002	1	R99	3.1.0	Addition of LL-STATUS_IND	

History

Document history		
V3.0.0	August 1999	Transferred to TSG CN at ETSI SMG#29. Under TSG TSG CN Change Control.
V3.1.0	October 99	Published