



Technical Document

GSM PROTOCOL STACK
MESSAGE SEQUENCE CHARTS
GSMS

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Table of Contents

| | | |
|----------|--|-----------|
| 1.1 | References | 5 |
| 1.2 | Abbreviations | 7 |
| 1.1 | Terms | 10 |
| 2 | Overview | 10 |
| 1.2 | GRR (RLC/MAC) – Radio Link Control/Medium Access Control | 11 |
| 1.3 | LLC – Logical Link Control | 11 |
| 1.4 | GMM – GPRS Mobility Management | 11 |
| 1.5 | SM – Session Management | 11 |
| 1.6 | SNDCP - Subnetwork Dependant Convergence Protocol | 11 |
| 1.7 | GACI – GPRS Application Control Interface | 11 |
| 1.8 | USART - Universal Synchronous Asynchronous Receiver Transmitter Driver | 11 |
| 1.9 | TOM – Tunnelling of Messages | 11 |
| 3 | Introduction | 12 |
| 3.1 | Dynamic Configuration | 12 |
| 3.2 | Timer Modi | 12 |
| 4 | Initialisation | 12 |
| 4.1 | Initial Parameters from the SIM card | 12 |
| 4.2 | Reading SMS from SIM card | 13 |
| 4.3 | Reading SMS from Mobile Memory | 15 |
| 4.4 | Set Mobile Originated Short Message Service | 15 |
| 5 | Flow Control | 16 |
| 5.1 | Availability Indication of GPRS | 16 |
| 6 | Mobile Originated Short Message Service | 16 |
| 6.1 | Establishment Phase | 16 |
| 6.1.1 | Initiation by Man Machine Interface | 16 |
| 6.1.2 | Initiation by Man Machine Interface, GPRS preferred but not registered | 18 |
| 6.1.3 | Sending the MO SM in a UNITDATA REQ | 19 |
| 6.1.4 | Timeout TR1M | 19 |
| 6.1.5 | Multiple Request by Man Machine Interface | 19 |
| 6.1.6 | Confirmation to CP DATA Message | 20 |
| 6.1.7 | Wrong Message received | 21 |
| 6.1.8 | CP Error received | 22 |
| 6.1.9 | Timeout TC1M | 23 |
| 6.1.10 | Timeout TR1M (state GSMS MO WAIT FOR RP ACK) | 24 |
| 6.2 | Active Phase | 25 |
| 6.2.1 | Acknowledge of the Infrastructure | 25 |
| 6.2.2 | Error signalled by the Infrastructure | 26 |
| 6.2.3 | Wrong Message signalled by the Infrastructure (CP layer) | 27 |
| 6.2.4 | Wrong Message signalled by the Infrastructure (RL layer) | 28 |
| 6.2.5 | Timeout TR1M | 29 |
| 6.3 | Mobile Originated Short Message Command | 30 |
| 7 | Mobile Terminated Short Message Service | 33 |

| | | |
|----------|--|-----------|
| 7.1 | Reception of a Short Message | 35 |
| 7.2 | Reception of CP ERROR message | 36 |
| 7.3 | Reception of CP ACK or unknown message | 36 |
| 7.4 | Second Mobile Terminated Connection | 37 |
| 7.5 | Additional Message for Mobile Terminated Connection | 38 |
| 7.6 | Display Message..... | 39 |
| 7.7 | Store Message in ME memory | 40 |
| 7.7.1 | No Storage available on ME memory, no other opportunities | 42 |
| 7.8 | Store Message in SIM memory | 43 |
| 7.8.1 | Storage on SIM available, writing successfull | 43 |
| 7.8.2 | Storage on SIM available, writing not successfull | 44 |
| 7.8.3 | No Storage on SIM available | 45 |
| 7.8.4 | No Storage available on SIM memory, no other opportunities | 46 |
| 7.9 | Replace Short Message..... | 47 |
| 7.9.1 | Replace in Mobile Station Memory | 47 |
| 7.10 | Mobile Terminated Short Message Status | 48 |
| 7.11 | SIM Toolkit Data Download..... | 49 |
| 7.12 | SMS - Depersonalisation | 50 |
| 8 | Short Message Service Procedures..... | 50 |
| 9 | Data Formats | 50 |
| | Appendices..... | 52 |
| A. | Acronyms | 52 |
| B. | Glossary..... | 52 |

List of Figures and Tables

List of References

- | | |
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PPP in HDLC-like Framing
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PPP LCP Extensions
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PPP Link Quality Monitoring
- [19] RFC 1332 May 1992
The PPP Internet Protocol Control Protocol (IPCP)
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PPP IPCP Extensions for Name Server Addresses
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PPP Vendor Extensions
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1.2 Abbreviations

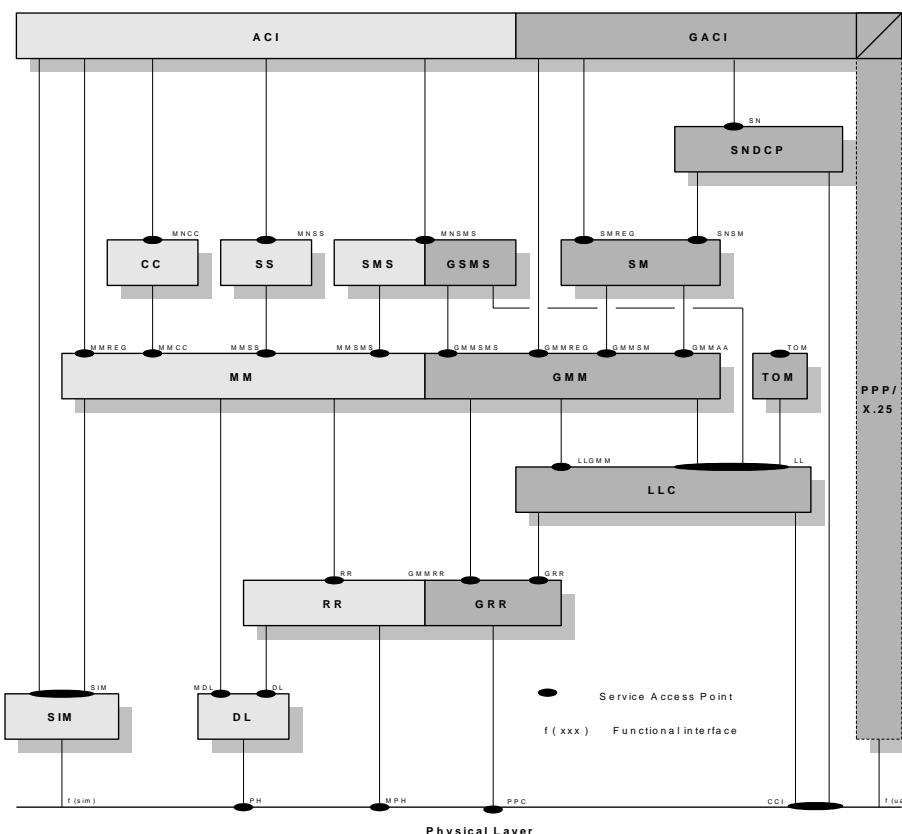
| | |
|-------|--|
| ACI | Application Control Interface |
| AGCH | Access Grant Channel |
| AT | Attention sequence "AT" to indicate valid commands of the ACI |
| BCCH | Broadcast Control Channel |
| BS | Base Station |
| BSIC | Base Station Identification Code |
| C/R | Command/Response |
| C1 | Path Loss Criterion |
| C2 | Reselection Criterion |
| CBCH | Cell Broadcast Channel |
| CBQ | Cell Bar Qualify |
| CC | Call Control |
| CCCH | Common Control Channel |
| CCD | Condat Coder Decoder |
| CCI | Compression and Ciphering Interface |
| CHAP | Challenge Handshake Authentication Protocol |
| CKSN | Ciphering Key Sequence Number |
| CRC | Cyclic Redundancy Check |
| DCCH | Dedicated Control Channel |
| DCOMP | Identifier of the user data compression algorithm used for the N-DPU |
| DISC | Disconnect Frame |
| DL | Data Link Layer |
| DM | Disconnected Mode Frame |
| DTX | Discontinuous Transmission |
| E | Extension bit |
| EA | Extension Bit Address Field |
| EL | Extension Bit Length Field |
| EMMI | Electrical Man Machine Interface |
| F | Final Bit |
| FACCH | Fast Associated Control Channel |
| FHO | Forced Handover |
| GACI | GPRS Application Control Interface |
| GMM | GPRS Mobility Management |
| GP | Guard Period |
| GRR | GPRS RR |
| GSM | Global System for Mobile Communication |
| HDLC | High-level Data Link Control |
| HISR | High level Interrupt Service Routine |
| HPLMN | Home Public Land Mobile Network |
| I | Information Frame |
| IMEI | International Mobile Equipment Identity |
| IMSI | International Mobile Subscriber Identity |
| IP | Internet Protocol |
| IPCP | Internet Protocol Control Protocol |
| ITU | International Telecommunication Union |
| IWF | Interworking Function |
| Kc | Ciphering Key |
| L | Length Indicator |
| LAI | Location Area Information |
| LCP | Link Control Protocol |
| LISR | Low level Interrupt Service Routine |

| | |
|-------|---|
| LLC | Logical Link Control |
| LPD | Link Protocol Discriminator |
| LQM | Link Quality Monitoring |
| M | More bit used to indicate the last segment of N-DPU |
| MAC | Medium Access Control |
| MCC | Mobile Country Code |
| MM | Mobility Management |
| MMI | Man Machine Interface |
| MNC | Mobile Network Code |
| MS | Mobile Station |
| MT | Mobile Termination |
| N(R) | Receive Number |
| N(S) | Send Number |
| NC | Network Control |
| NCC | National Colour Code |
| NCP | Network Control Protocol |
| NECI | New Establishment Causes included |
| N-PDU | Network Protocol Data Unit |
| NSAPI | Network Layer Service Access Point Identifier |
| OTD | Observed Time Difference |
| P | Poll Bit |
| P/F | Poll/Final Bit |
| PACCH | Packet Associated Control Channel |
| PAP | Password Authentication Protocol |
| PBCCH | Packet BCCH |
| PCCCH | Packet CCCH |
| PCOMP | Identifier of the protocol control information compression algorithm used for the N-DPU |
| PDCH | Packet Data Channel |
| PDP | Packet Data Protocol e.g. IP or X.25 |
| PDTCH | Packet Data Traffic Channel |
| PRACH | Packet RACH |
| PSI | Packet System Information |
| PCH | Paging Channel |
| PCO | Point of Control and Observation |
| PDU | Protocol Data Unit |
| PL | Physical Layer |
| PLMN | Public Land Mobile Network |
| PPC | Packet Physical Convergence |
| PPP | Point-to-Point Protocol |
| PTP | Point to Point |
| QoS | Quality of Service |
| RACH | Random Access Channel |
| REJ | Reject Frame |
| RLC | Radio Link Control |
| RNR | Receive Not Ready Frame |
| RR | Radio Resource Management |
| RR | Receive Ready Frame |
| RTD | Real Time Difference |
| RTOS | Real Time Operating System |
| SABM | Set Asynchronous Balanced Mode |
| SACCH | Slow Associated Control Channel |
| SAP | Service Access Point |
| SAPI | Service Access Point Identifier |
| SDCCH | Stand alone Dedicated Control Channel |
| SDU | Service Data Unit |
| SGSN | Serving GPRS Support Node |

| | |
|-------|---|
| SIM | Subscriber Identity Module |
| SM | Session Management |
| SMS | Short Message Service |
| SMSCB | Short Message Service Cell Broadcast |
| SNDCP | Subnetwork Dependant Convergence Protocol |
| SNSM | SNDCP-SM |
| SS | Supplementary Services |
| TAP | Test Application Program |
| TBF | Temporary Block Flow |
| TCH | Traffic Channel |
| TCH/F | Traffic Channel Full Rate |
| TCH/H | Traffic Channel Half Rate |
| TCP | Transmission Control Protocol |
| TDMA | Time Division Multiple Access |
| TE | Terminal Equipment - e. g. a PC |
| TFI | Temporary Flow Identifier |
| TLLI | Temporary Logical Link Identifier |
| TMSI | Temporary Mobile Subscriber Identity |
| TOM | Tunnelling of Messages |
| TQI | Temporary Queuing Identifier |
| UA | Unnumbered Acknowledgement Frame |
| UART | Universal Asynchronous Receiver Transmitter |
| UI | Unnumbered Information Frame |
| USF | Uplink State Flag |
| V(A) | Acknowledgement State Variable |
| V(R) | Receive State Variable |
| V(S) | Send State Variable |
| VPLMN | Visited Public Land Mobile Network |

| | |
|----------------------|--|
| Entity: | Program which executes the functions of a layer |
| Message: | A message is a data unit which is transferred between the entities of the same layer (peer-to-peer) of the mobile and infrastructure side. Message is used as a synonym to protocol data unit (PDU). A message may contain several information elements. |
| Primitive: | A primitive is a data unit which is transferred between layers on one component (mobile station or infrastructure). The primitive has an operation code which identifies the primitive and its parameters. |
| Service Access Point | A Service Access Point is a data interface between two layers on one component (mobile station or infrastructure). |

The protocol stack for GPRS consists of several entities. Each entity has one or more service access points, over which the entity provides a service for the upper entity.



The entities of the GPRS protocol stack are:

1.2 GRR (RLC/MAC) – Radio Link Control/Medium Access Control

This layer contains two functions: The Radio Link Control function provides a radio-solution-dependent reliable link. The Medium Access Control function controls the access signalling (request and grant) procedures for the radio channel, and the mapping of LLC frames onto the GSM physical channel.

1.3 LLC – Logical Link Control

The LLC entity provides multiple highly reliable logical links for asynchronous data transfer between the MS and the network. It supports variable-length information frames, acknowledged and unacknowledged data transfer, flow and sequence control, error detection and recovery, notification of unrecoverable errors, user identity confidentiality, and ciphering of user and signaling data.

1.4 GMM – GPRS Mobility Management

The GMM entity provides procedures for the mobility of the MS, such as informing the network of its present location, and user identity confidentiality. It manages the GMM context (attach, detach, routing area updating), supports security functions such as authentication of user and MS, controls ciphering of data, and initiates the response to paging messages.

1.5 SM – Session Management

The main function of the session management (SM) is to support PDP context handling of the user terminal. Session Management activates, modifies and deletes the contexts for packet data protocols (PDP). 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.

1.6 SNDCP - Subnetwork Dependant Convergence Protocol

SNDCP carries out all functions related to transfer of Network layer Protocol Data Units (N-PDUs) over GPRS in a transparent way. SNDCP helps to improve channel efficiency by means of compression techniques. The set of protocol entities above SNDCP consists of commonly used network protocols. They all use the same SNDCP entity, which then performs multiplexing of data coming from different sources to be sent using the service provided by the LLC layer.

1.7 GACI – GPRS Application Control Interface

The GACI is the GPRS extension of the ACI. It is specified in GSM 07.07 and 07.60. It is responsible for processing of the GPRS related AT Commands to setup, activate and deactivate the PDP context parameter. It also provides functionality for the interworking between GMM/SM/SNDCP and a packet oriented protocol like PPP.

1.8 USART - Universal Synchronous Asynchronous Receiver Transmitter Driver

The USART is a hardware component that facilitates a connection between the mobile station and terminal equipment (e.g. a PC). This interface uses some of the circuits described in V.24.

The data exchange provided by this unit is serial and asynchronous (synchronous communication is not in the scope of this document). A driver that uses interrupts to manage a circular buffer for the sending and receiving direction is necessary in order to use this component in the GPRS. The driver has to be able to perform flow control.

1.9 TOM – Tunnelling of Messages

The TOM entity is present if and only if HS136 is supported (the feature flag FF_HS136 is enabled).

The main function of TOM is to tunnel non-GSM signalling messages between the MS and the SGSN. The only non-GSM signalling which is currently supported by TOM is for the EGPRS-136 system (according to TIA/EIA-136-376). Data transfer

in both uplink and downlink direction is possible. Two different priorities (high, low) of signalling data transfer are supported. TOM uses the unacknowledged mode of LLC and the acknowledged mode of GRR (RLC/MAC).

3 Introduction

3.1 Dynamic Configuration

For short message service (SMS) a lot of dynamic configurations are defined. That means it is possible at run-time to change in behaviour of SMS by sending of a string from a test device to SMS.

SMS uses a keyword table to interpretate the strings. The strings have the following general format:

<keyword> = (parameter 1, parameter 2, ...)

Keywords without parameters are defines only by using the keyword. For keywords with one parameter the bracket aren't necessary.

The following table is an overview of the possible configurations:

| keyword | Parameter |
|-----------------|-----------------|
| TIMER_SET | name value unit |
| TIMER_RESET | name |
| TIMER_SPEED_UP | name factor |
| TIMER_SLOW_DOWN | name factor |
| TIMER_SUPPRESS | name |

If mobility management is used in a multi instances system the dynamic configurations have the parameter instance.

The keywords **TIMER_SET**, **TIMER_RESET**, **TIMER_SPEED_UP**, **TIMER_SLOW_DOWN** and **TIMER_SUPPRESS** are used for manipulating timers. The different timers are identified by their names. The time used by next starting of the timer is manipulated by the dynamic configurations.

3.2 Timer Modi

For each timer of SMS it is possible to define a mode by a dynamic configuration. If a timer is started by SMS the given start value is manipulated according to the timer mode.

The timer mode **TIMER_SET** defines a new timer value instead of the origin start value.

The default timer mode is **TIMER_RESET** which makes no manipulation of the start value.

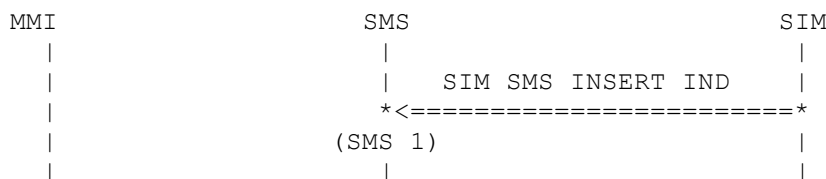
TIMER_SPEED_UP is used to speed up a timer by the given factor. The start value is divided by the factor. The minimum time is one unit.

The opposite mode is **TIMER_SLOW_DOWN**. The start value is multiplied by the given factor.

TIMER_SUPPRESS is used to suppress the timer start.

4 Initialisation

4.1 Initial Parameters from the SIM card



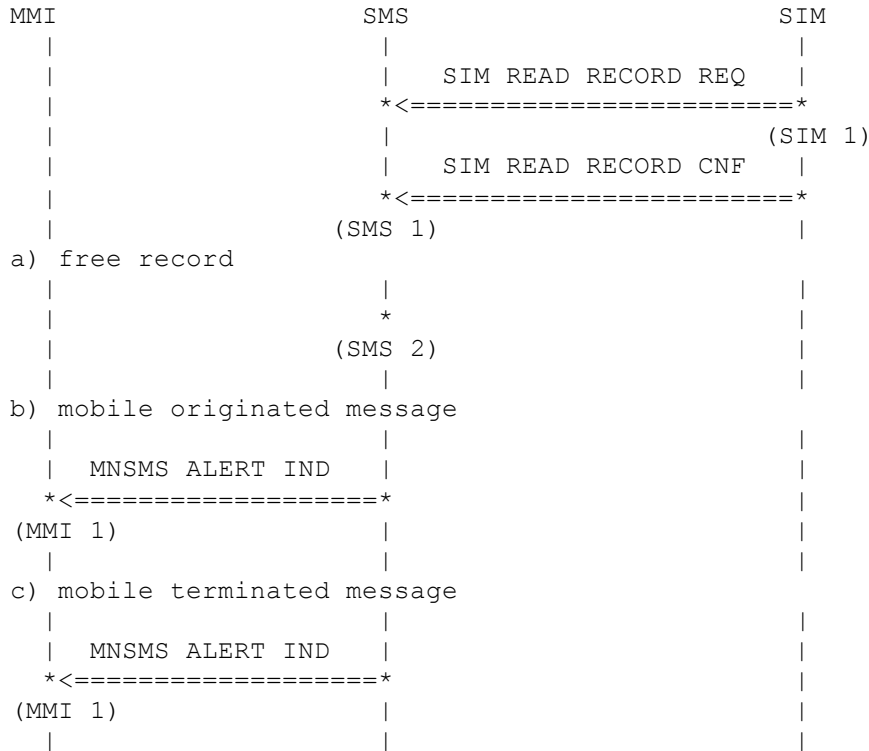
(SMS 1)

The SIM application sends to SMS the initial parameter from the SIM card. This are the SMS status informations whether short message storage capacity is available on the SIM card, the last used message reference for mobile originated short

message service and the SMS download flag. The SMS download flag defines whether data download via SMS for SIM toolkit is possible or not.

The SMS initialisation procedure starts now reading the SMS messages from the SIM card and the mobile memory.

4.2 Reading SMS from SIM card



(SIM 1)

Starting with record 1 all SMS records are read. If the answer from the SIM application indicates that all records are read this procedure is finished.

(SMS 1)

The SIM application has read the requested record of the SIM card.

(SMS 2)

If it is a free record the status of the SMS message is stored.

(MMI 1)

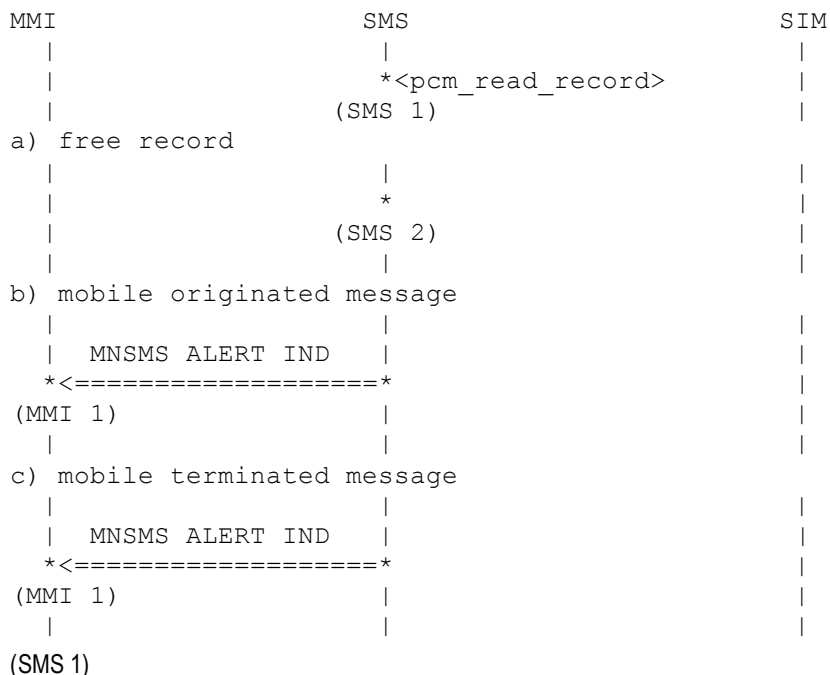
If it is a mobile originated message, the status and the protocol identifier are stored from the SMS message. An indication is send to the MMI.

(MMI 1)

If it is a mobile terminated message, the status and the protocol identifier are stored from the SMS message. An indication is send to the MMI.

The status and protocol identifier backup for all SMS messages is used by SMS for faster access to the SIM card.

4.3 Reading SMS from Mobile Memory



Starting with record 1 all SMS records are read from the permanent configuration memory. If the answer from the permanent configuration memory indicates that all records are read this procedure is finished.

(SMS 2)

If it is a free record the status of the SMS message is stored.

(MMI 1)

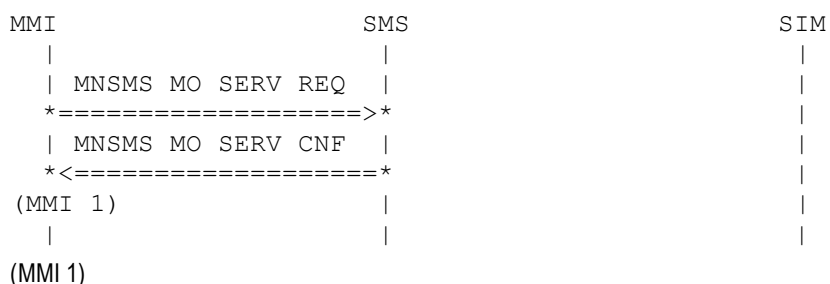
If it is a mobile originated message, the status and the protocol identifier are stored from the SMS message. An indication is send to the MMI.

(MMI 2)

If it is a mobile terminated message, the status and the protocol identifier are stored from the SMS message. An indication is send to the MMI.

The status and protocol identifier backup for all SMS messages is used by SMS for faster access to the permanent configuration memory.

4.4 Set Mobile Originated Short Message Service

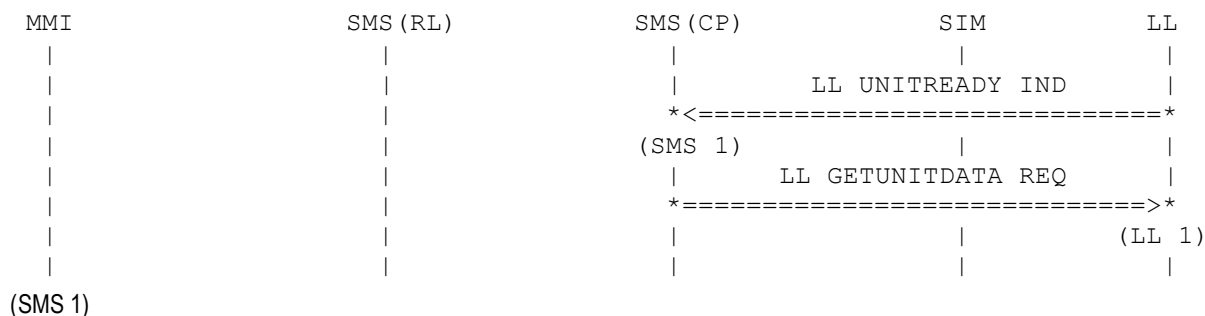


The MMI configures the preferred messages service (GPRS or normal CCT) for mobile originated messages. Possible choices are: use GPRS only, prefer using GPRS, prefer using CCT and use CCT only.

5 Flow Control

The flow control between the (G)SMS entity and the LL sublayer is managed in the following way: LL indicates towards SMS its availability to send one data unit by sending a LL UNITREADY IND. SMS indicates that it is ready to receive a unitdata indication by sending a LL GETUNITDATA REQ.

5.1 Availability Indication of GPRS



The SMS entity assumes that GPRS is not available on startup. It is notified that GPRS is ready to send data units when it receives a LL UNITREADY IND by the GPRS LL.

(LL 1)

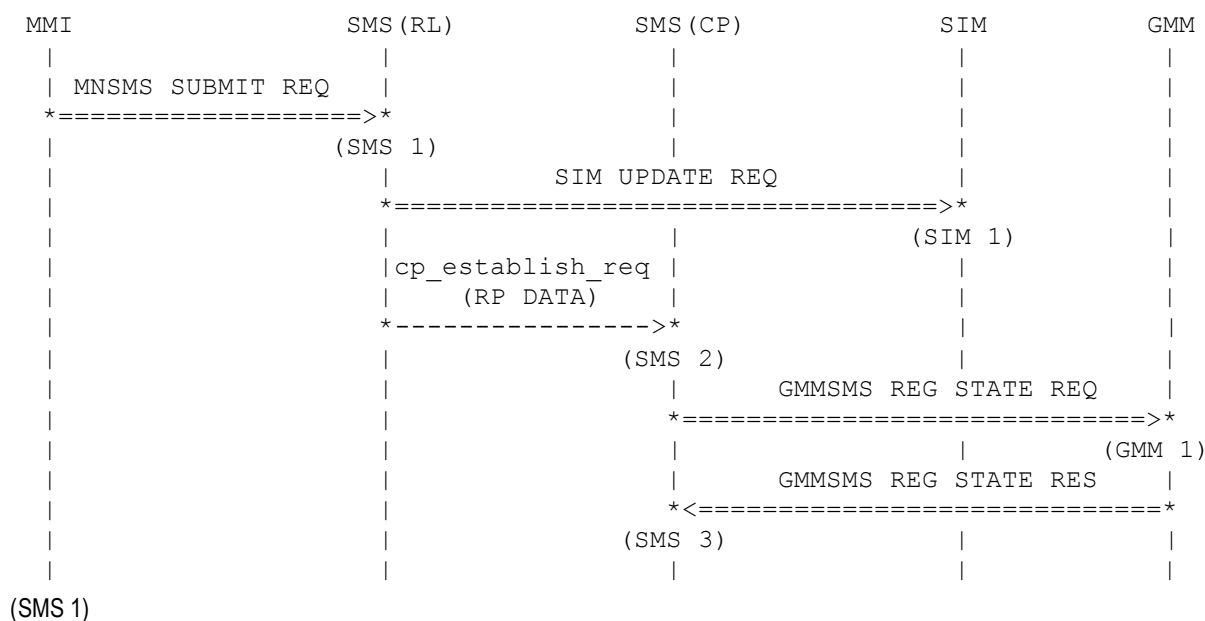
The SMS entity informs LL that it is ready to receive data unit indications.

6 Mobile Originated Short Message Service

The mobile originated short message service enables the user to send a text message to the infrastructure. The receiving side is the so called service center (SC), which handles sending of the message to the destination address. In the following it is assumed that SMS is configured to prefer using GPRS or to use GPRS only for mobile originated short messages. (see 4.4)

6.1 Establishment Phase

6.1.1 Initiation by Man Machine Interface



The user starts sending of a short message.

(SIM 1)

Each short message contains a message reference. This number is used to identify this short message for later transactions. The message reference is stored on the SIM card, if it is a phase 2/2+ SIM card.

(SMS 2)

The RP DATA message is created and forwarded to the Control Protocol layer. The timer TR1M is started.

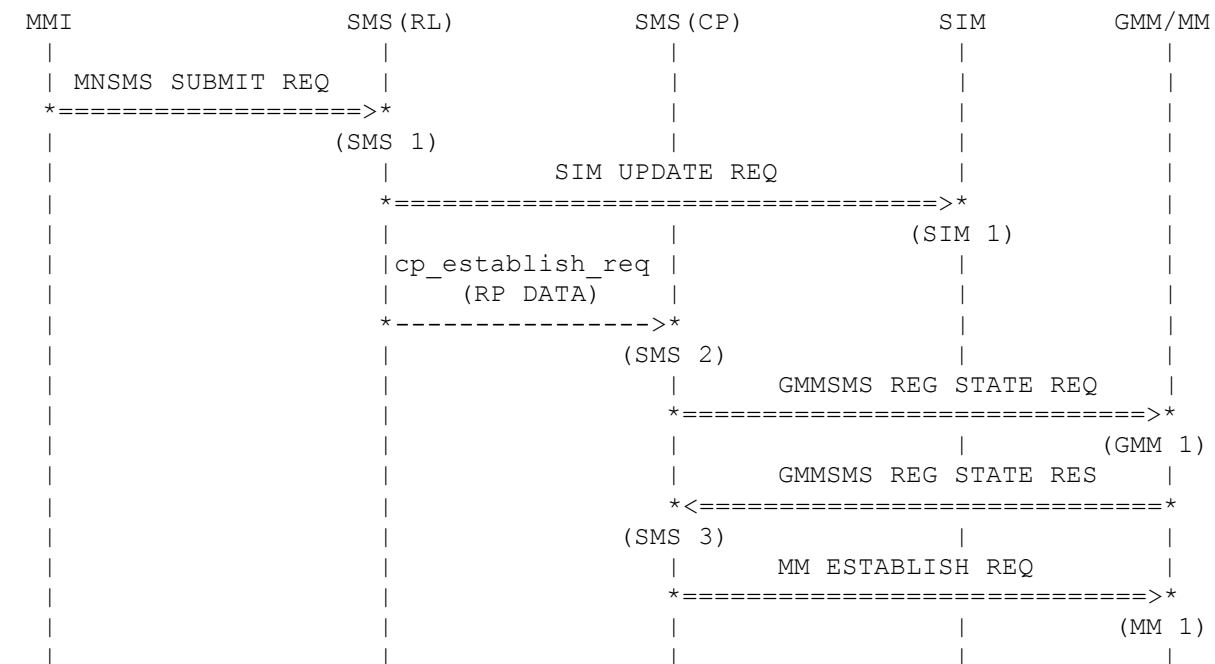
(GMM 1)

The RP DATA message is stored and a registration request is issued in order to check if GPRS is registered and therefore still able to send data units. This is necessary since it might have been a long while since the last UNITREADY IND was received and GPRS might not be registered anymore.

(SMS 3)

Only if a positive registration information is received by the CP layer (meaning that GPRS is still registered and able to send data units) the SMS continues to use GPRS as shown in 6.1.3. If a negative registration information is received and the user has configured to prefer GPRS for MO SM, the SMS entity switches to use CCT (see 6.1.2 for more information). If the user has configured to use only GPRS for MO SM and GPRS is not registered, no information is sent out and another attempt to use GPRS is made when TR1M expires. In this case the user is informed about the negative end of the procedure when the timer TR1M times out and the maximum number of RP layer retransmissions is reached.

6.1.2 Initiation by Man Machine Interface, GPRS preferred but not registered



(SMS 1)

The user starts sending of a short message. (Previously the SMS entity was configured to prefer using GPRS for mobile originated messages and to use circuit switched service if GPRS is not available.)

(SIM 1)

Each short message contains a message reference. This number is used to identify this short message for later transactions. The message reference is stored on the SIM card, if it is a phase 2/2+ SIM card.

(SMS 2)

The RP DATA message is created and forwarded to the Control Protocol layer. The timer TR1M is started.

(GMM 1)

The RP DATA message is stored and a registration request is issued in order to check if GPRS is registered and therefore still able to send data units. This is necessary since it might have been a long while since the last UNITREADY IND was received and GPRS might not be registered anymore.

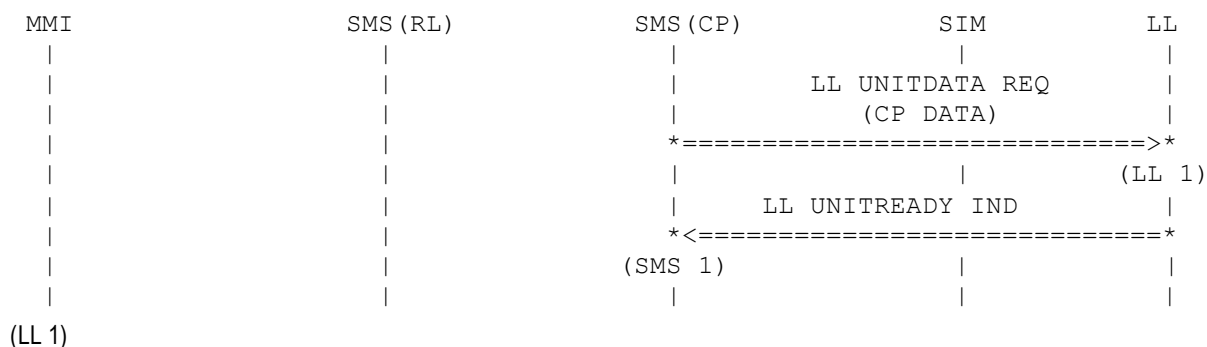
(SMS 3)

GPRS is not registered anymore and a negative registration information is received from GMM.

(MM 1)

The SMS entity falls back to using normal circuit switched short message service and sends an establish request to MM. From this point on the procedure continues as described in the message sequence chart document for normal circuit switched SMS.

6.1.3 Sending the MO SM in a UNITDATA REQ

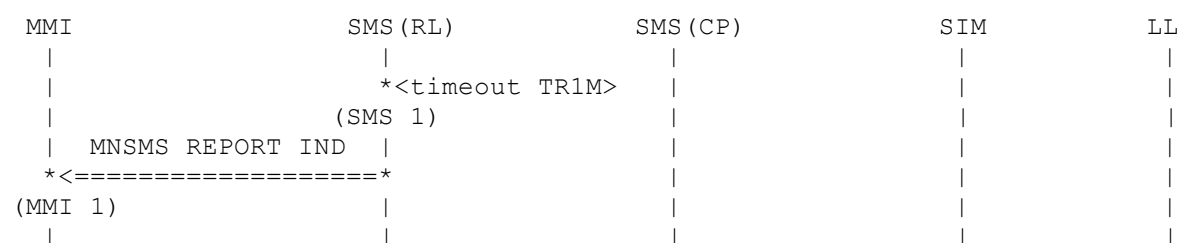


The mobile originated SM is sent via LL.

(SMS 1)

The LL layer confirms that it is ready to receive another data unit by the SMS entity.

6.1.4 Timeout TR1M



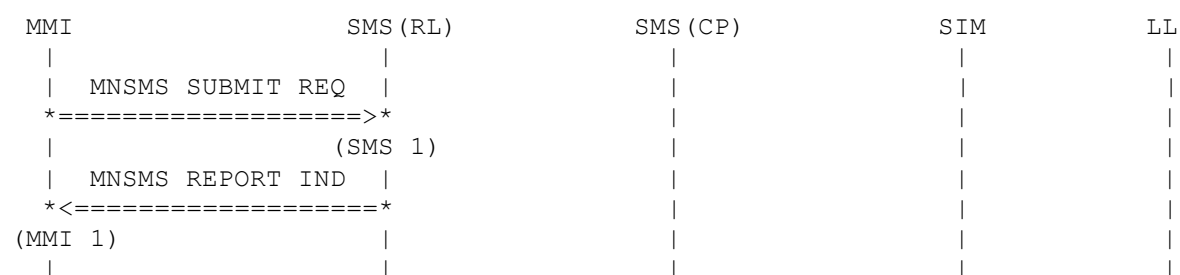
(SMS 1)

In the relay layer the timer TR1M times-out. That means that no answer has received from the infrastructure.

(MMI 1)

The user is informed about the abort of the mobile originated short message service.

6.1.5 Multiple Request by Man Machine Interface



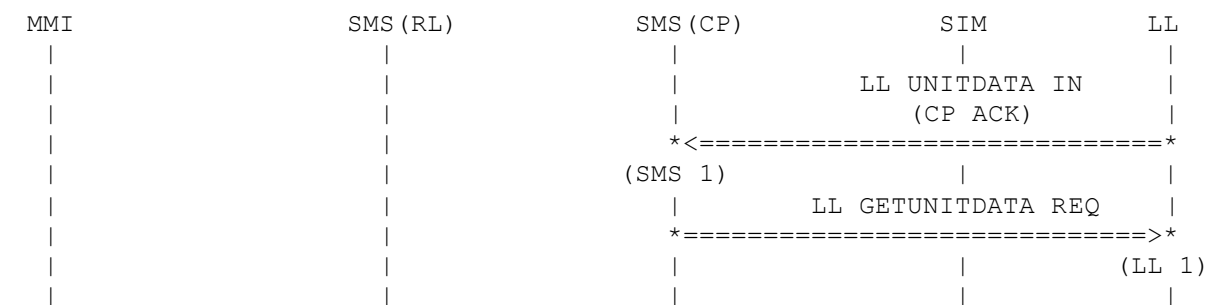
(SMS 1)

The user tries to send an additional mobile originated short message although the current transaction has not finished. At one time only one transaction is allowed.

(MMI 1)

The user is informed about rejection of the mobile originated short message request.

6.1.6 Confirmation to CP DATA Message



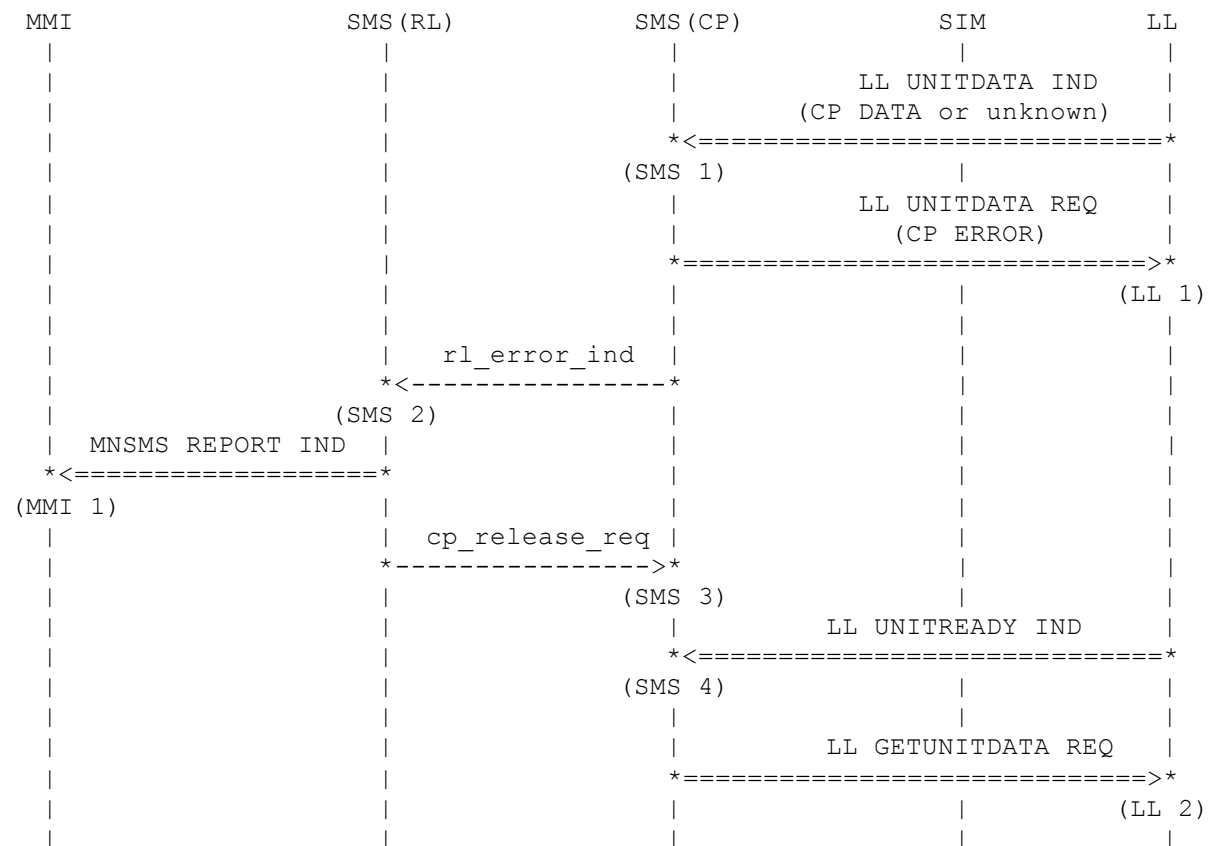
(SMS 1)

Control Protocol is in the state GSMS MO Wait for CP ACK. That means it waits for the acknowledgement of the previous CP-DATA message. This acknowledgement is received. The timer T1CM is stopped and Control Protocol enters the state GSMS MO Wait for RP ACK where it waits for the arrival of the RP layer acknowledgement in a CP-DATA message.

(LL 1)

The SMS entity indicates that it is ready to receive another data unit

6.1.7 Wrong Message received



(SMS 1)

Control Protocol expects a CP ACK message as response to its own CP DATA message. Instead of this a CP DATA or unknown message receives. The timer T1CM is stopped.

(LL 1)

Control Protocol answers with a CP ERROR message and the cause #98 for a CP DATA message or #97 for an unknown message.

(SMS 2)

Relay Layer is informed about the error.

(MMI 1)

The user is informed about the error.

(SMS 3)

The control protocol is informed about the release of the connection.

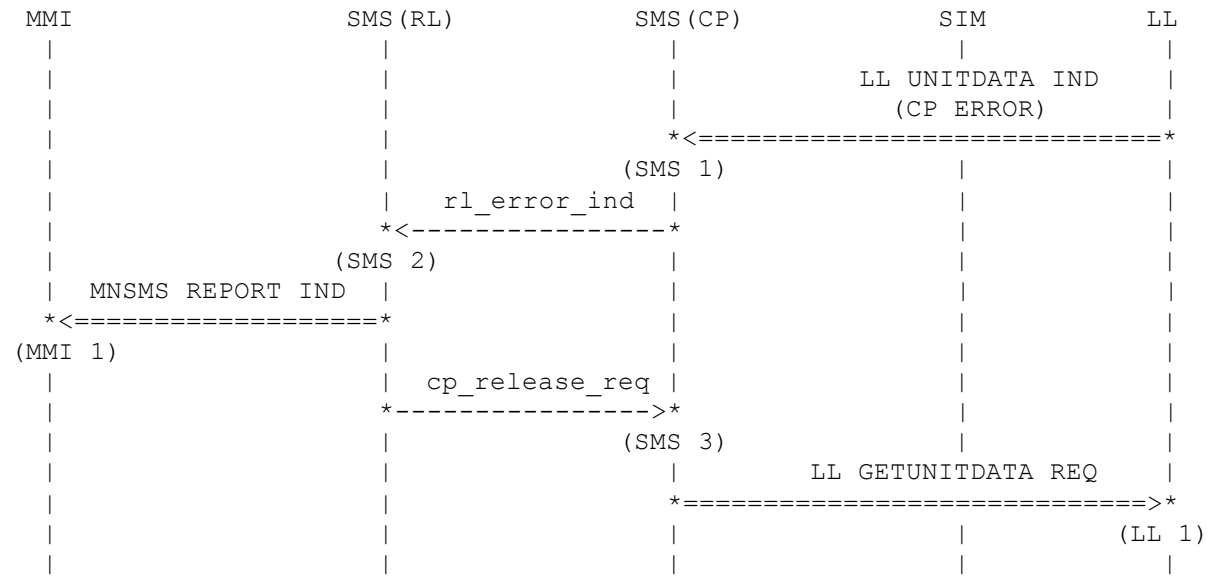
(SMS 4)

LL indicates it is ready to accept another data unit

(LL 2)

LL is informed that SMS is ready to handle the next data unit

6.1.8 CP Error received



(SMS 1)

Control Protocol expects a CP ACK message as response of its own previous CP DATA message. Instead a CP ERROR message receives. The timer T1CM is stopped.

(SMS 2)

The error cause is forwarded to the relay layer.

(MMI 1)

The user is informed about the error.

(SMS 3)

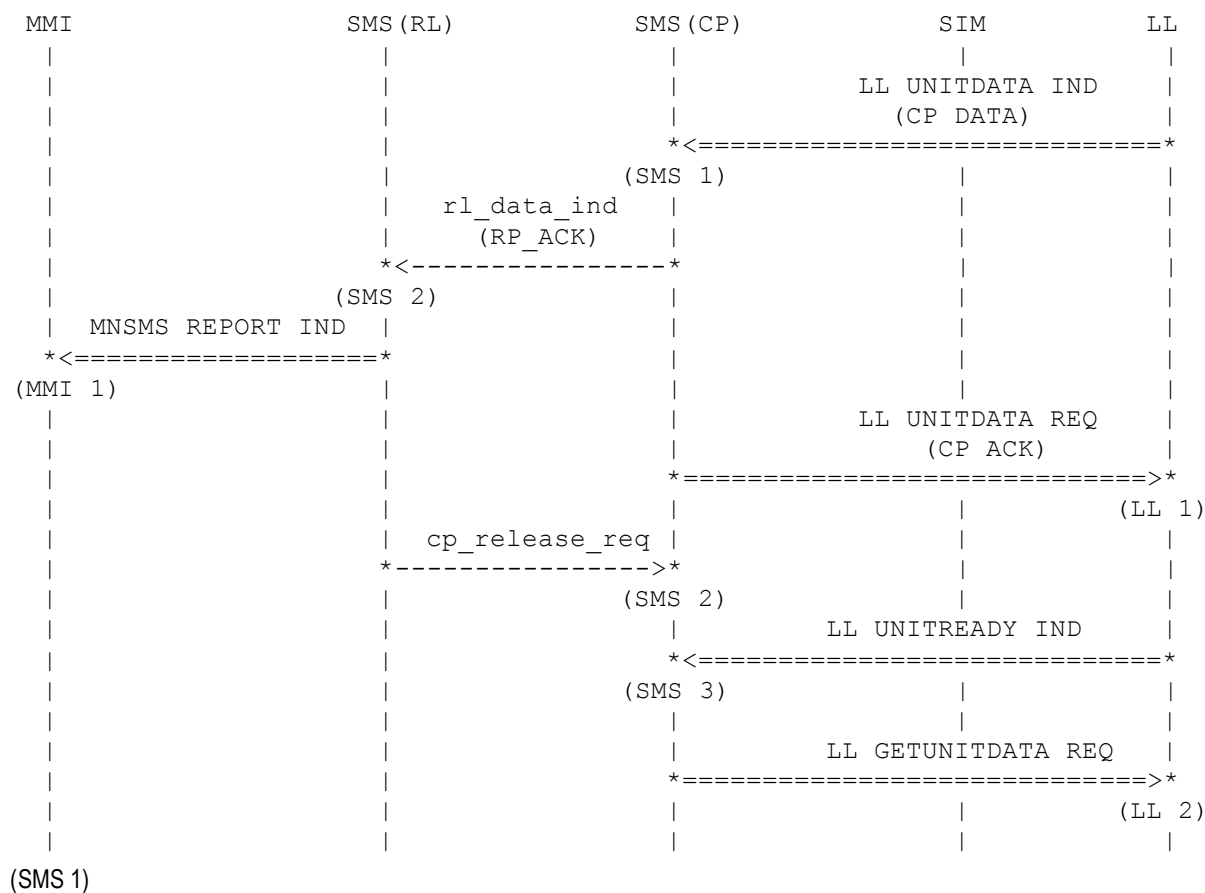
The release of the CP SMS connection is requested.

(LL 1)

LL is notified that SMS is ready to handle the next primitive.

6.2 Active Phase

6.2.1 Acknowledge of the Infrastructure



The SMS entity is in state GSMS MO WAIT FOR RP ACK and the response of the network receives. It is a CP DATA message containing a RP ACK message.

(SMS 2)

The RP ACK message is forwarded to the relay layer.

(MMI 1)

The user is informed about the positive end of procedure.

(MM 1)

After reception of the CP DATA message control protocol sends a CP ACK message as response to the infrastructure.

(SMS 2)

Relay Layer releases the SMS CP connection.

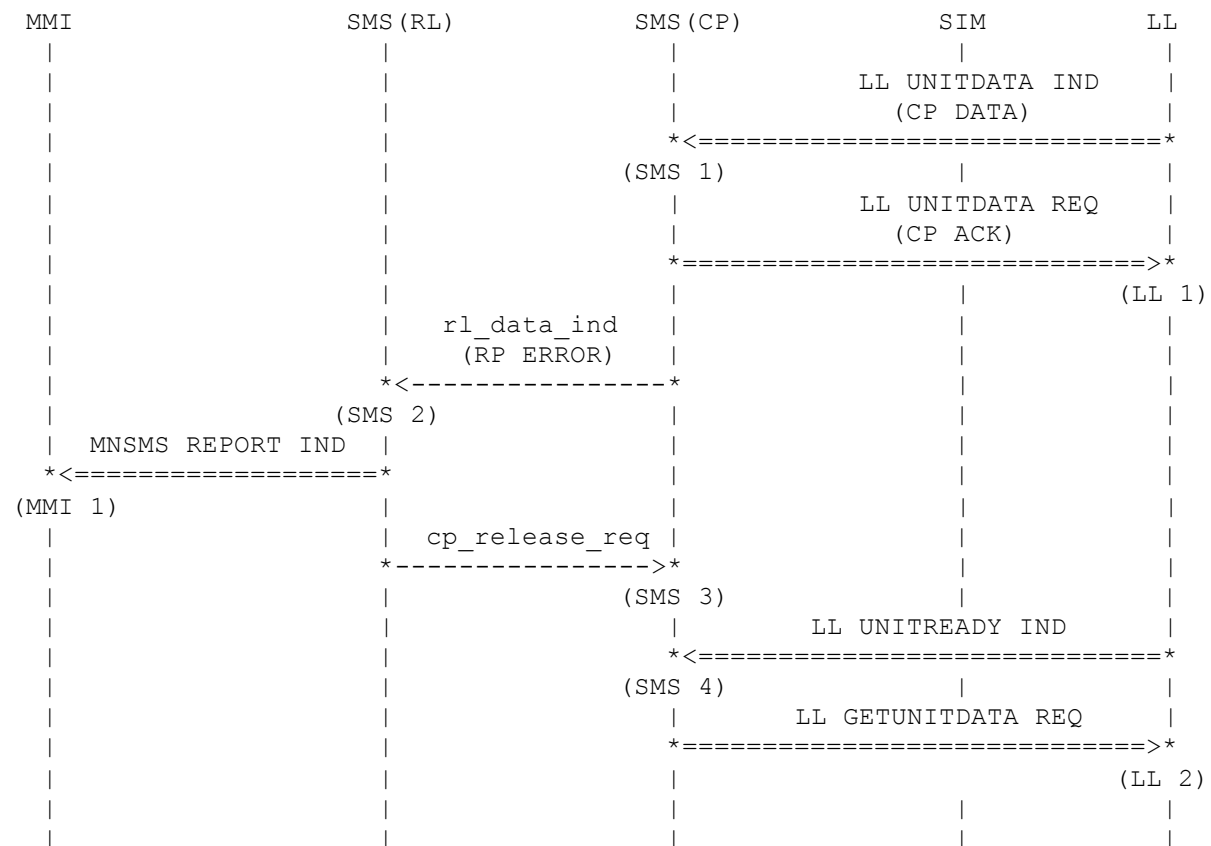
(SMS 3)

LL informs the SMS entity that it is ready to handle another unitdata request.

(LL 2)

SMS informs LL that it is able to accept another unitdata indication.

6.2.2 Error signalled by the Infrastructure



(SMS 1)

A SMS connection is established and the response of the network receives. It is a CP DATA message containing a RP ERROR message.

(LL 1)

The CP DATA message containing the RP ERROR message is acknowledged by the CP layer.

(SMS 2)

The RP ERROR message is forwarded to the relay layer.

(MMI 1)

The user is informed about the negative end of procedure.

(SMS 3)

Relay Layer releases the SMS connection.

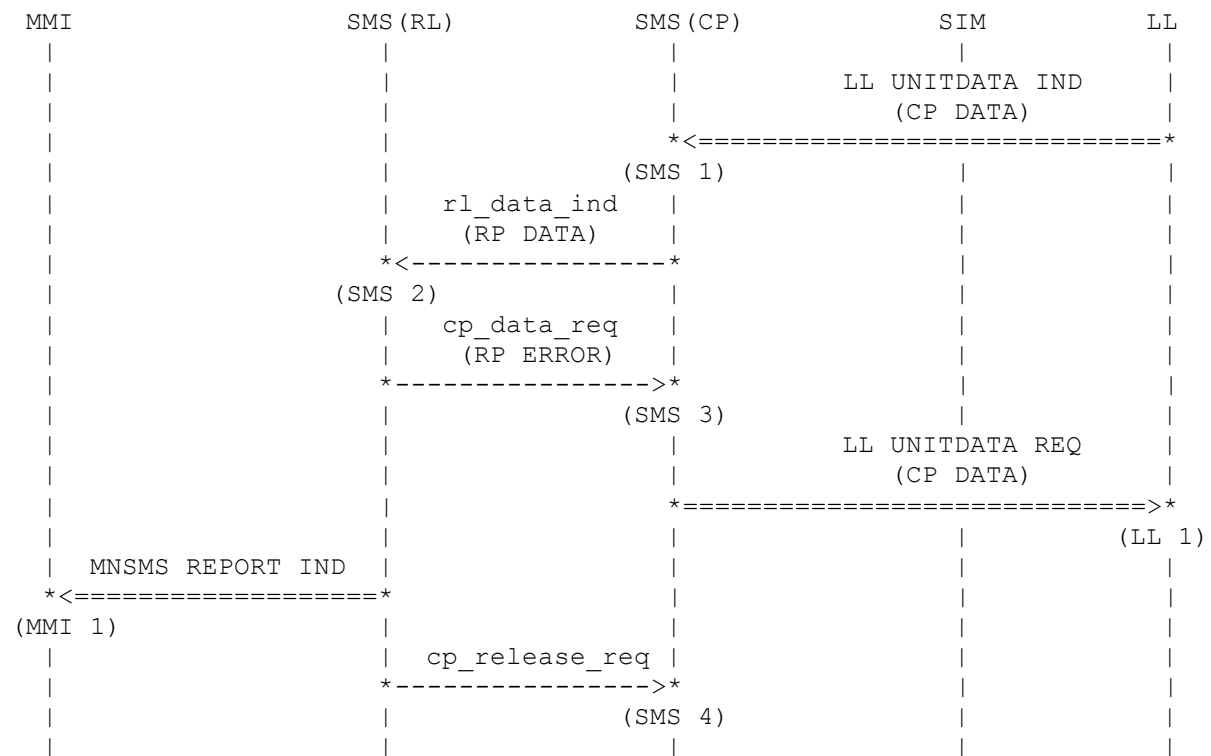
(SMS 4)

The SMS CP layer receives the notification that LL is ready to receive the next data request

(LL 2)

Since now the SMS entity is also ready to receive the next data indication by LL, positive flow control is signalled to LL.

6.2.4 Wrong Message signalled by the Infrastructure (RL layer)



(SMS 1)

A response of the infrastructure is expected. Control Protocol receives a CP DATA message.

(SMS 2)

This CP DATA message contains a RP DATA message instead of the expected RP ACK message.

(SMS 3)

Relay Layer builds a RP ERROR message and forwards it to the control protocol.

(LL 1)

The RP ERROR message is included into a CP DATA message and send to the infrastructure.

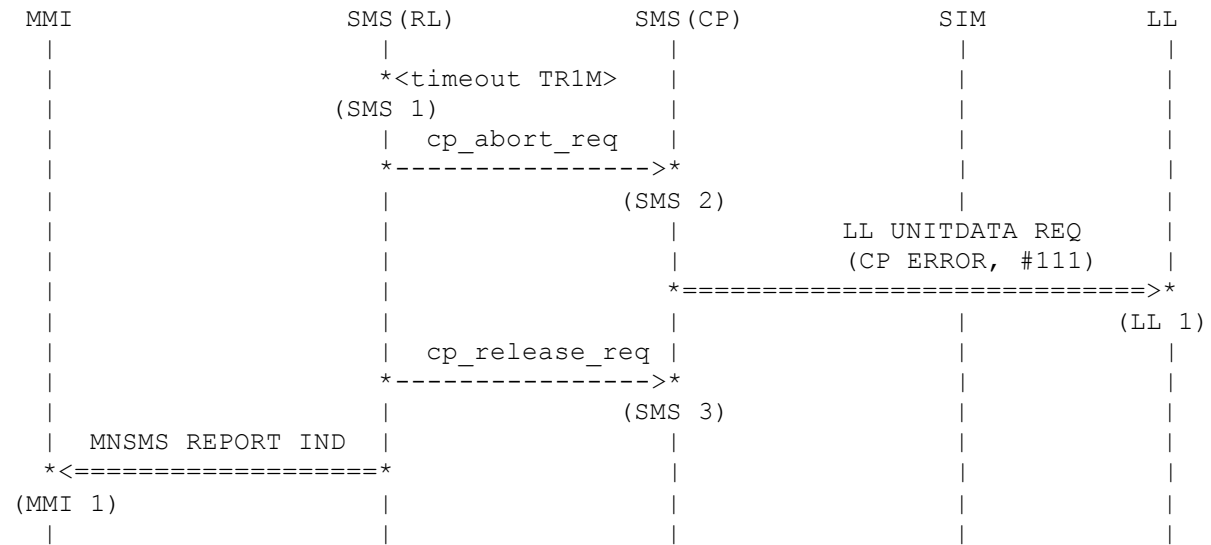
(MMI 1)

The error is reported to the user.

(SMS 4)

Relay Layer requests the release of the SMS connection.

6.2.5 Timeout TR1M



(SMS 1)

SMS expects a response of the infrastructure. In the relay layer the timer TR1M timesout

(SMS 2)

The abort of the SMS connection is requested to the control protocol.

(LL 1)

A CP ERROR message with the cause #111 is send to the infrastructure.

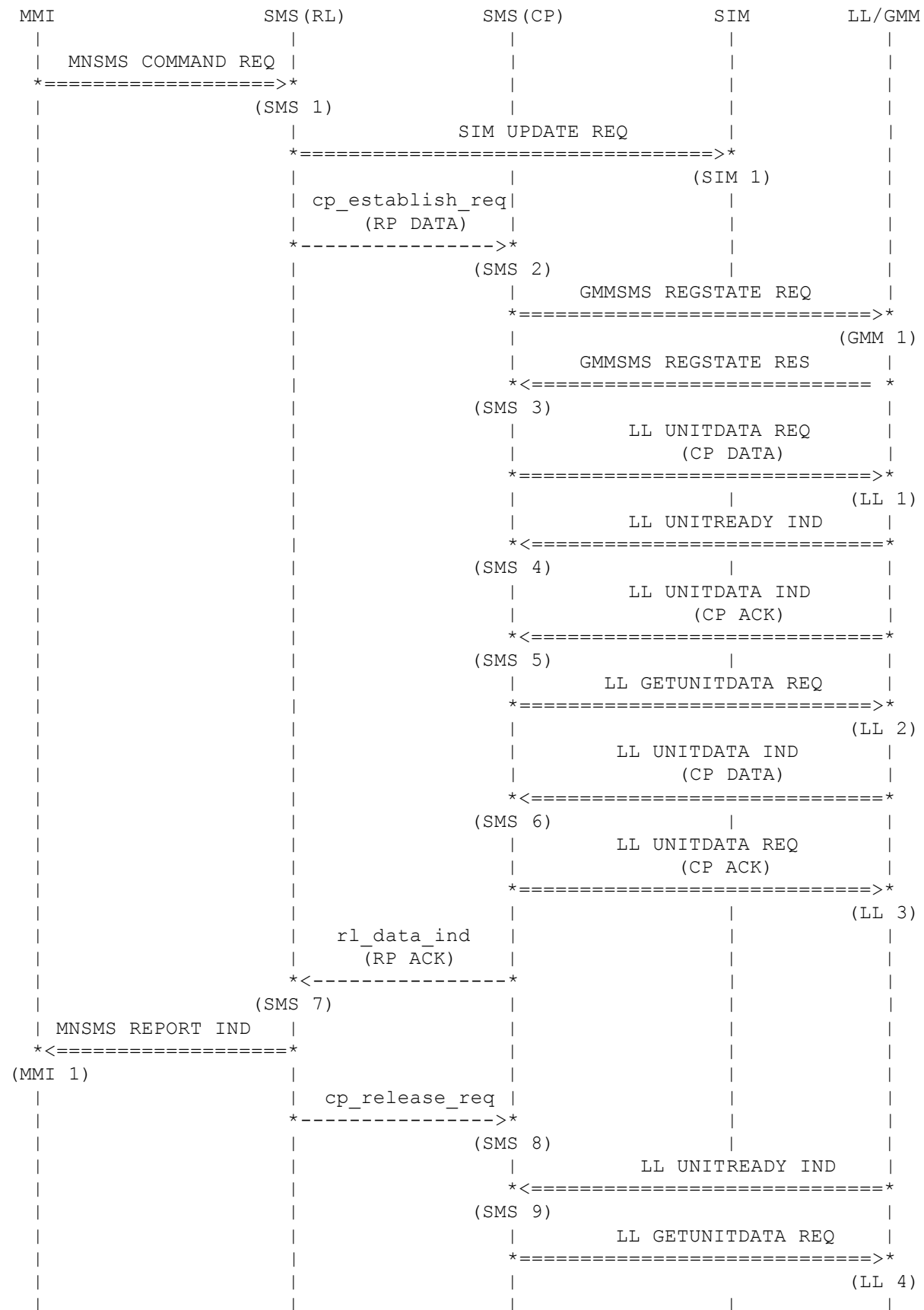
(SMS 3)

The SMS connection is not longer necessary.

(MMI 1)

The user is informed about the error.

6.3 Mobile Originated Short Message Command



(SMS 1)

The mobile originated short message command procedure is used to send commands to the service center for previous sent short message. The procedure differs from a mobile originated short message service procedure only in the different initial primitive.

The mobile station starts sending of a short message command. The following commands are available:

Status request for a short message

Delete of status report request for a short message and

Delete of a short message.

The named short message is identified by the message reference used for the short message

(SIM 1)

Each short message command has its own message reference. This number is used if other short message commands are related to this short message command. The message reference is incremented by one. If a phase 2 SIM is available the message reference is stored on the SIM card.

(SMS 2)

The relay layer builds a RP DATA message containing the short message command. The message is forwarded to the control protocol. The timer TR1M is started to supervise the response of the infrastructure.

(GMM 1)

Control Protocol requests the GPRS registration status.

(SMS 3)

GMM confirms positive registration status of GPRS.

(LL 1)

The CP DATA message containing the RP DATA message of the relay layer is send to the infrastructure. The timer T1CM is started to supervise response of the infrastructure.

(SMS 4)

Positive flow control by LL.

(SMS 5)

Control Protocol receives the response of the infrastructure. It is a CP ACK message. It now waits for the response of the peer's relay layer.

(LL 2)

SMS entity is ready to process the next unit data indication.

(SMS 6)

A CP DATA message is received. The content for the relay layer is decoded.

(LL 3)

The SMS CP layer acknowledges the CP DATA message.

(SMS 7)

The content of the message is a RP ACK message which is indicated to SMS RP layer.

(MMI 1)

The user is informed about the positive end of procedure.

(SMS 8)

The connection release is requested.

(SMS 9)

Positive flow control by LL.

(LL 4)

Transaction is completed and SMS entity is ready to process next unitdata indication. Therefore a getunitdata request is sent to LL.

7 Mobile Terminated Short Message Service

With the mobile terminated short message service it is possible to send a textual message from the infrastructure to the mobile station. This message contains the data coding scheme describing the message class.

Additionally it is possible to configure the preferred memory (SIM or mobile equipment (ME) memory) and the used mode (MT = 0 .. 3) according the AT command +CNMI. If nothing is configured SMS prefers SIM card memory and MT is set to 4.

The following tables shows the handling in the relay layer of short message service with the following meanings:

- DISPLAY forward directly to MMI
- MEM_ME store in ME memory
- MEM_SIM store in SIM memory
- NOTHING do nothing

SMS differs between the following data coding schemes:

- NO CLASS
- CLASS 0
- CLASS 1
- CLASS 2
- CLASS 3
- DISCARD Mail-Waiting Indicator, discard message
- STORE Mail-Waiting Indicator, store message

The first action if the preferred memory is ME memory is carried out according the following table:

| MT | NO CLASS | CLASS 0 | CLASS 1 | CLASS 2 | CLASS 3 | DISCARD | STORE |
|-------------|----------|---------|---------|---------|---------|---------|--------|
| 0 | MEM_ME | DISPLAY | MEM_ME | MEM_SM | MEM_ME | DISPLAY | MEM_ME |
| 1 | MEM_ME | DISPLAY | MEM_ME | MEM_SM | MEM_ME | DISPLAY | MEM_ME |
| 2 | DISPLAY | DISPLAY | DISPLAY | MEM_SM | DISPLAY | DISPLAY | MEM_ME |
| 3 | MEM_ME | DISPLAY | MEM_ME | MEM_SM | DISPLAY | DISPLAY | MEM_ME |
| 4 (default) | MEM_SM | DISPLAY | MEM_ME | MEM_SM | MEM_SM | DISPLAY | MEM_SM |

The second action if the preferred memory is ME memory is carried out according the following table:

| MT | NO CLASS | CLASS 0 | CLASS 1 | CLASS 2 | CLASS 3 | DISCARD | STORE |
|-------------|----------|---------|---------|---------|---------|---------|---------|
| 0 | NOTHING | NOTHING | MEM_SM | MEM_ME | MEM_SM | NOTHING | NOTHING |
| 1 | NOTHING | NOTHING | MEM_SM | MEM_ME | MEM_SM | NOTHING | NOTHING |
| 2 | NOTHING | NOTHING | NOTHING | MEM_ME | NOTHING | NOTHING | NOTHING |
| 3 | NOTHING | NOTHING | MEM_SM | MEM_ME | NOTHING | NOTHING | NOTHING |
| 4 (default) | NOTHING | NOTHING | MEM_SM | MEM_ME | MEM_ME | NOTHING | NOTHING |

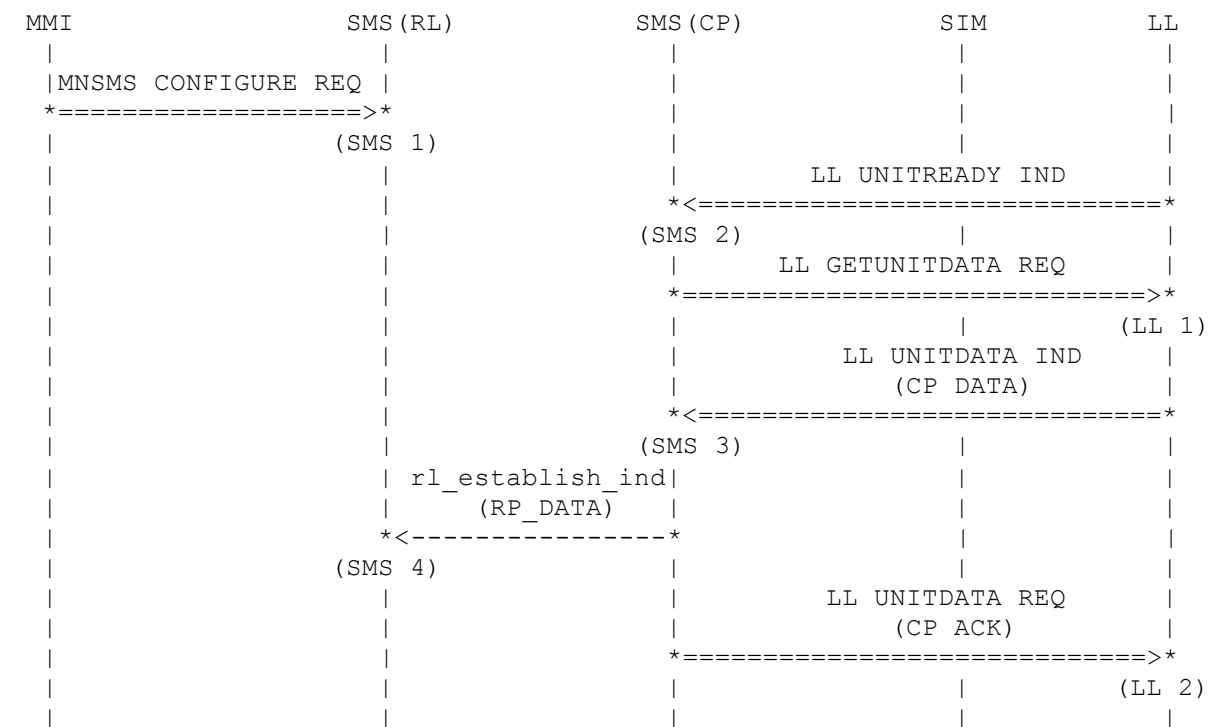
The first action if the preferred memory is SIM memory is carried out according the following table:

| MT | NO CLASS | CLASS 0 | CLASS 1 | CLASS 2 | CLASS 3 | DISCARD | STORE |
|-------------|----------|---------|---------|---------|---------|---------|--------|
| 0 | MEM_SM | DISPLAY | MEM_SM | MEM_SM | MEM_SM | DISPLAY | MEM_SM |
| 1 | MEM_SM | DISPLAY | MEM_SM | MEM_SM | MEM_SM | DISPLAY | MEM_SM |
| 2 | DISPLAY | DISPLAY | DISPLAY | MEM_SM | DISPLAY | DISPLAY | MEM_SM |
| 3 | MEM_SM | DISPLAY | MEM_SM | MEM_SM | DISPLAY | DISPLAY | MEM_SM |
| 4 (default) | MEM_SM | DISPLAY | MEM_ME | MEM_SM | MEM_SM | DISPLAY | MEM_SM |

The second action if the preferred memory is SIM memory is carried out according the following table:

| MT | NO CLASS | CLASS 0 | CLASS 1 | CLASS 2 | CLASS 3 | DISCARD | STORE |
|-------------|----------|---------|---------|---------|---------|---------|---------|
| 0 | NOTHING | NOTHING | MEM_ME | MEM_ME | MEM_ME | NOTHING | NOTHING |
| 1 | NOTHING | NOTHING | MEM_ME | MEM_ME | MEM_ME | NOTHING | NOTHING |
| 2 | NOTHING | NOTHING | NOTHING | MEM_ME | NOTHING | NOTHING | NOTHING |
| 3 | NOTHING | NOTHING | MEM_ME | MEM_ME | NOTHING | NOTHING | NOTHING |
| 4 (default) | NOTHING | NOTHING | MEM_SM | MEM_ME | MEM_ME | NOTHING | NOTHING |

7.1 Reception of a Short Message



(SMS 1)

MMI configures the reception modes for mobile terminated short messages.

(SMS 2)

Availability of LL is indicated. (see section 5.1)

(LL 1)

SMS indicates that it is ready to receive a data unit.

(SMS 3)

A CP DATA message is received.

(SMS 4)

The content of the CP DATA message is a RP DATA message which is forwarded to the Relay Layer.

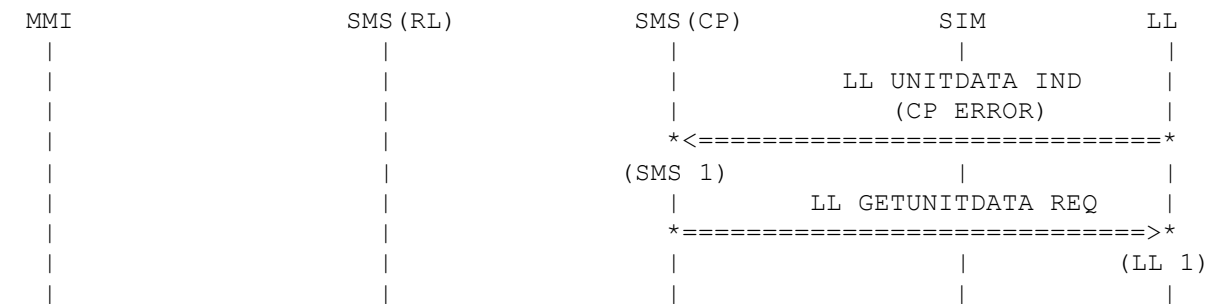
(LL 2)

Control Protocol sends a CP ACK message as acknowledgement to the infrastructure.

(SMS 5)

The following handling of the mobile terminated short message depends on the protocol identifier and the data coding scheme of the message and of the configured mode by MMI.

7.2 Reception of CP ERROR message



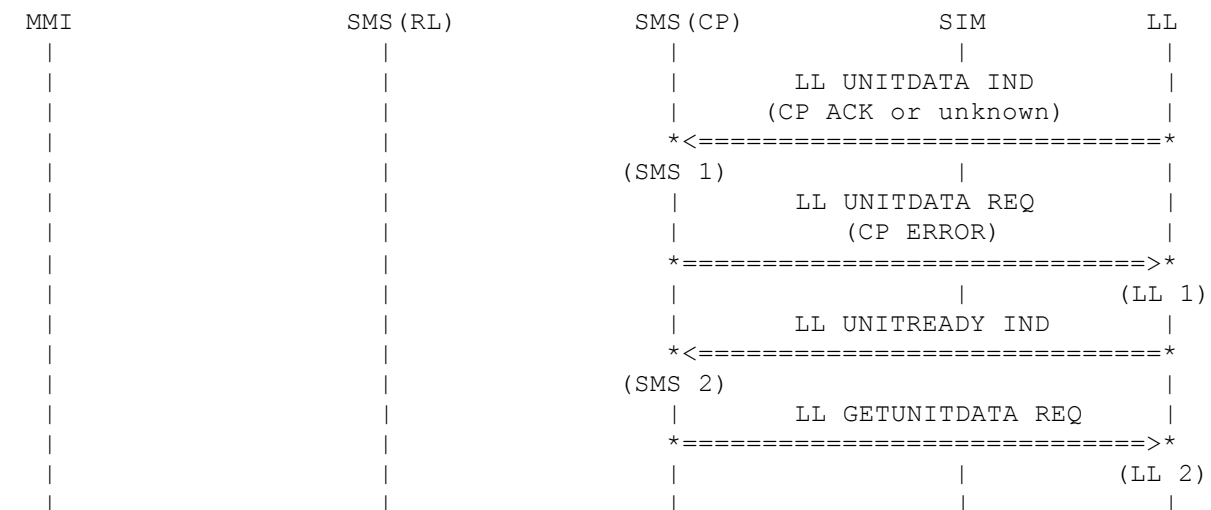
(SMS 1)

LL indicates a data unit. The incoming message is a CP ERROR message. The message is ignored.

(LL 1)

SMS is ready to process the next data unit by LL.

7.3 Reception of CP ACK or unknown message



(SMS 1)

LL indicates a data unit. The incoming message is CP ACK or unknown.

(LL 1)

Control Protocol builds a CP ERROR message with cause #97 for an unknown message and #98 for a CP ACK message.

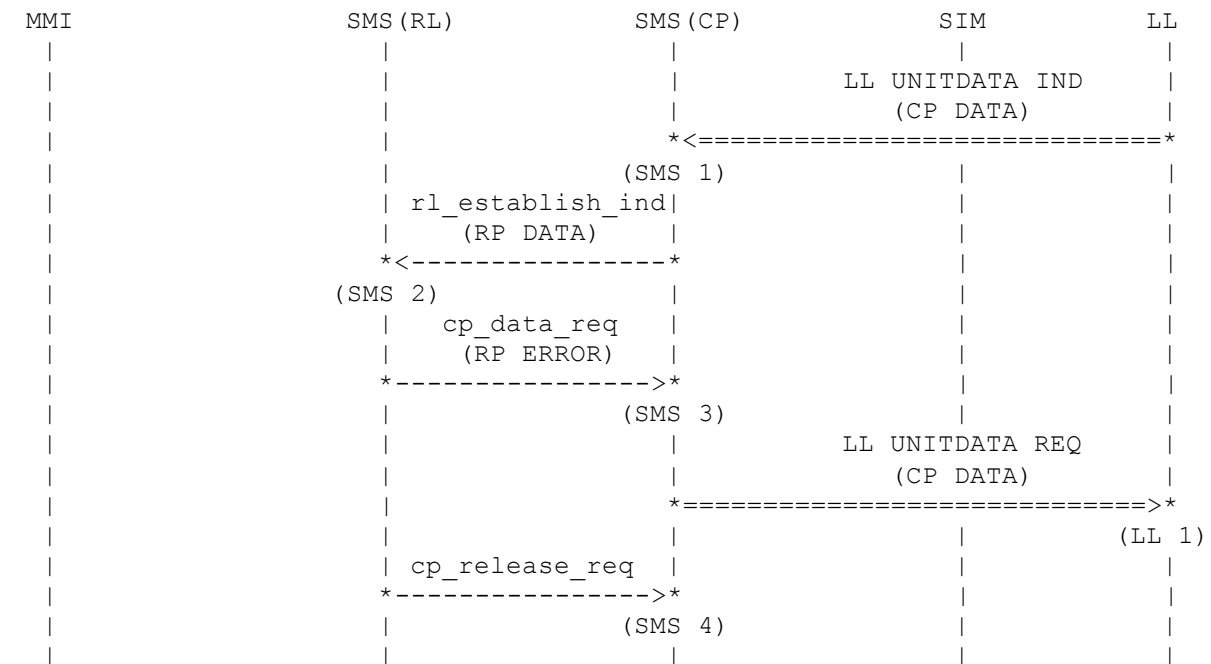
(SMS 2)

LL indicates availability.

(LL 2)

SMS is ready to process the next data unit.

7.4 Second Mobile Terminated Connection



(SMS 1)

LL indicates a second mobile terminated short message connection with a CP DATA message.

(SMS 2)

The content of the CP DATA message is forwarded to the Relay Layer.

(SMS 3)

Only one terminated transaction is allowed in parallel. So a RP ERROR message is build by the Relay Layer and forwarded to the Control Protocol.

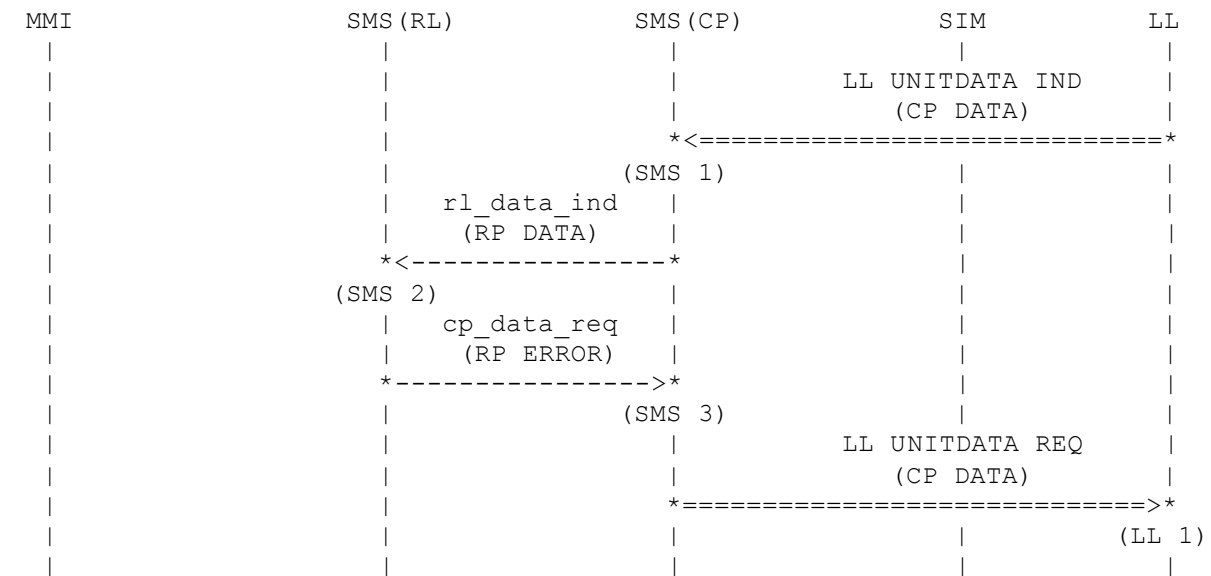
(LL 1)

The message is included into a CP DATA message and sent to the infrastructure.

(SMS 4)

The SMS connection is released by the Relay Layer.

7.5 Additional Message for Mobile Terminated Connection



(SMS 1)

Control Protocol receives additional CP DATA messages for an existing transaction.

(SMS 2)

The content of this CP DATA message is a RP DATA message. It is forwarded to the Relay Layer.

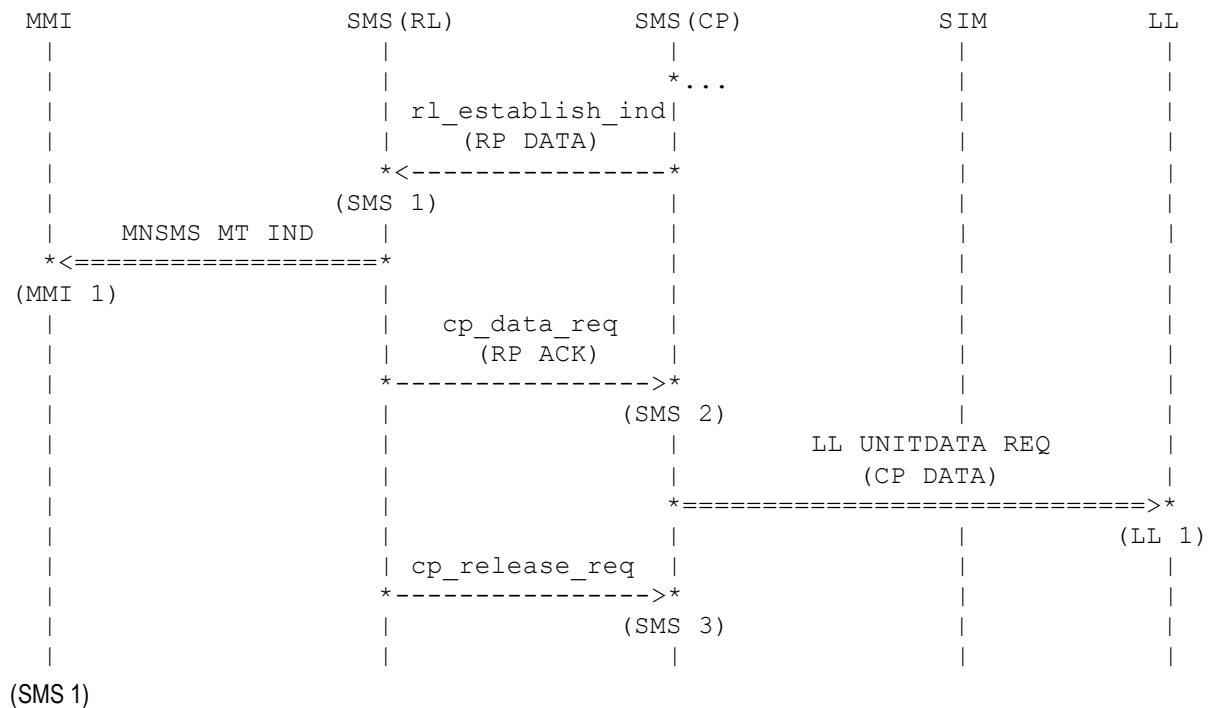
(SMS 3)

The relay layer build a RP ERROR message and sends it back to the Control Protocol.

(LL 1)

This message is part of a CP DATA message which is forwarded to the infrastructure.

7.6 Display Message



(SMS 1)

The incoming mobile terminated short message is received by the Relay Layer. Depending on the protocol identifier, the data coding scheme and the configured modi SMS decides that the message shall be displayed immediately and not stored.

(MMI 1)

The message is displayed to the user.

(SMS 2)

Relay Layer builds a RP ACK message and sent it to Control Protocol.

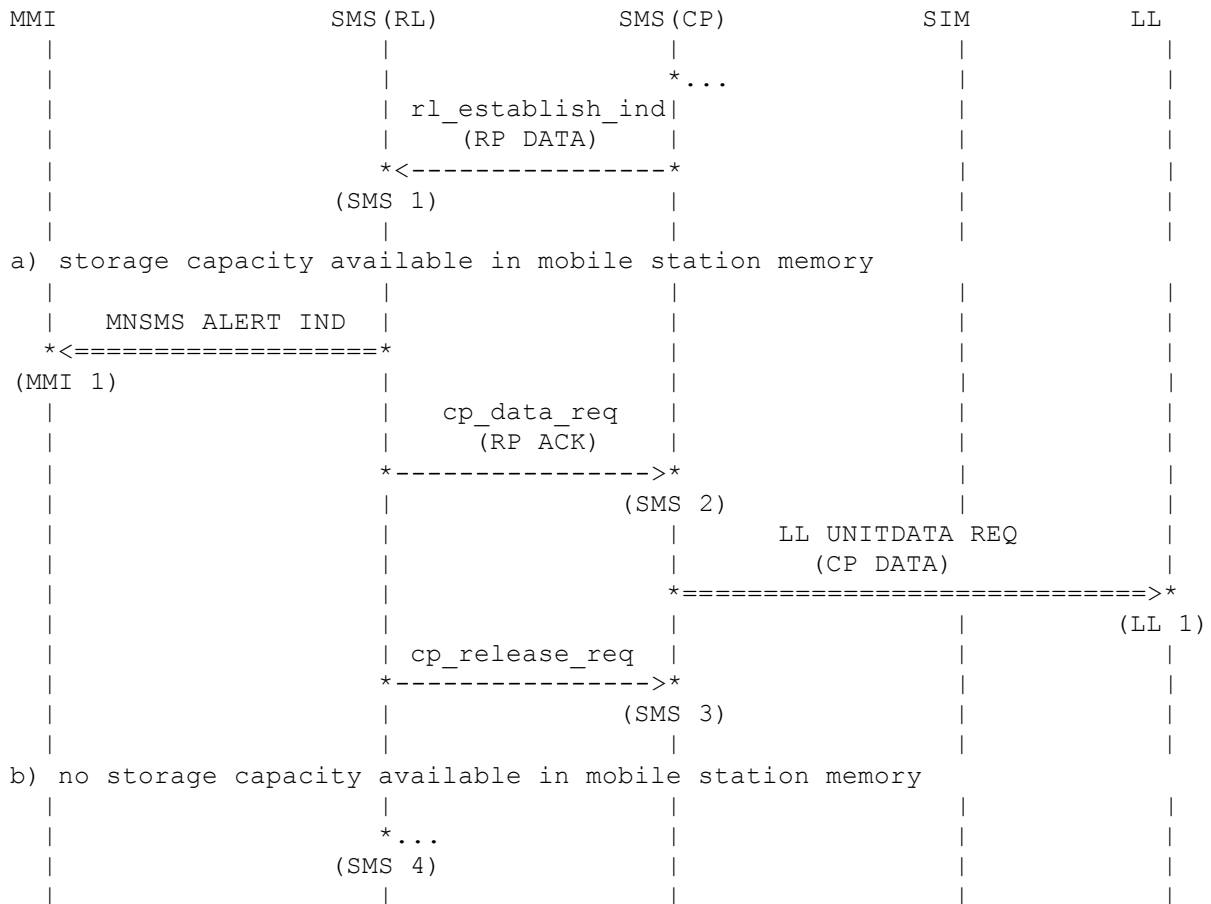
(LL 1)

The message is part of a CP DATA message which is build by Control Protocol. The message is sent to the infrastructure.

(SMS 3)

The SMS connection is released by the Relay Layer.

7.7 Store Message in ME memory



(SMS 1)

The incoming mobile terminated short message is received by the Relay Layer. Depending on the protocol identifier, the data coding scheme and the configured mode SMS decides that the message shall be stored in the ME memory.

(MMI 1)

The message is stored in the memory of the mobile station. An indication is sent to the user. The message can be read by the user with the SMS read procedure.

(SMS 2)

Relay Layer codes a RP ACK message and forwards it to the Control Protocol.

(LL 1)

The RP ACK message is part of the CP DATA message which is sent to the infrastructure.

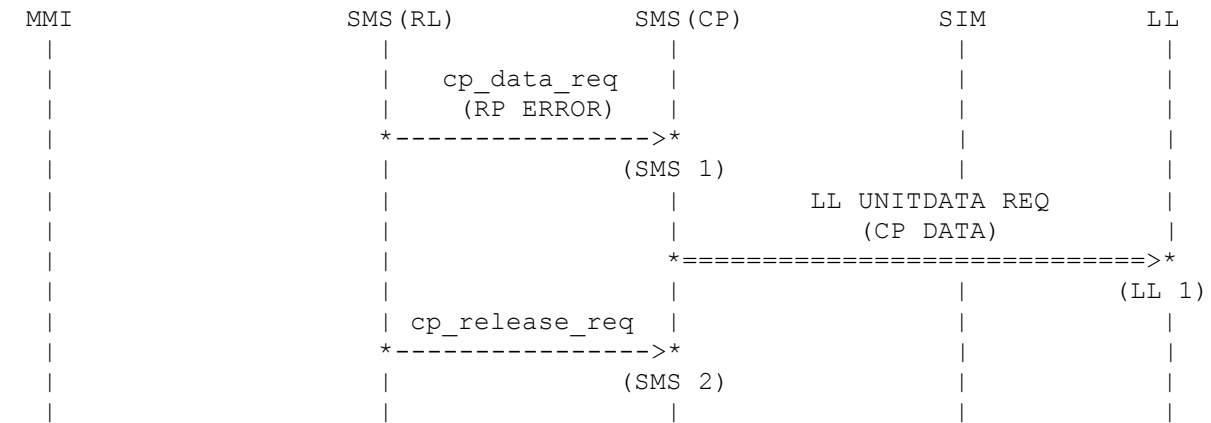
(SMS 3)

The existing SMS-Connection is no longer necessary. The release is requested by the Relay Layer.

(SMS 4)

If no free entry is available in the mobile station memory, the relay layer starts the second action defined for this type of message or sends an error indication to the network as described in the next chapter.

7.7.1 No Storage available on ME memory, no other opportunities



(SMS 1)

The error, that no memory is available is coded in a RP ERROR message and forwarded to the CP layer.

(LL 1)

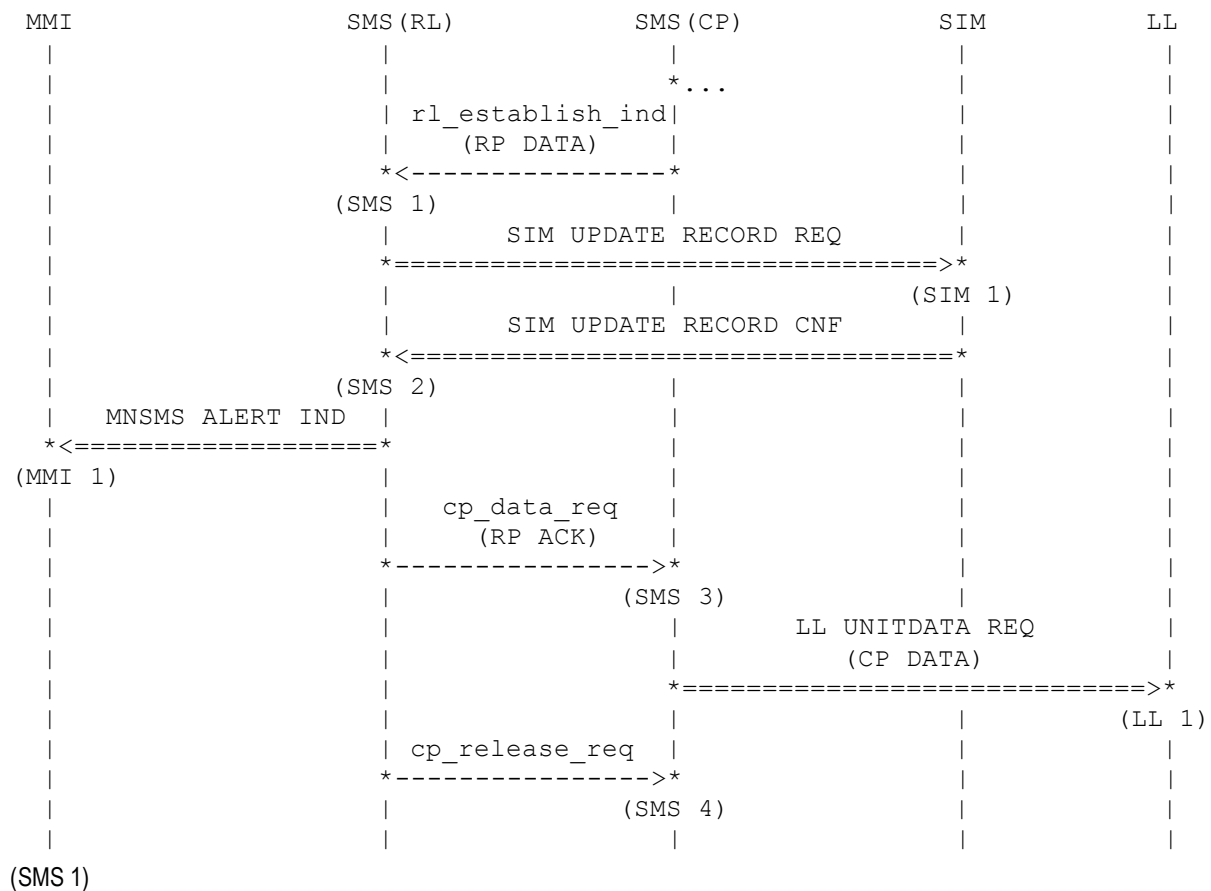
The RP ERROR message is filled in a CP DATA message and forwarded to the infrastructure.

(SMS 2)

The SMS connection will be released by RL layer.

7.8 Store Message in SIM memory

7.8.1 Storage on SIM available, writing successful



(SMS 1)

The incoming mobile terminated short message is received by the Relay Layer. Depending on the protocol identifier, the data coding scheme and the configured modi SMS decides that the message shall be stored in the SIM memory. Using the backup of SMS status bytes from the SIM card a free record is found.

(SIM 1)

The SMS message is written to this record.

(SMS 2)

SMS receives the confirmation of writing the SMS message to the SIM memory.

(MMI 1)

An indication is sent to the user. The message can be read by the user with the SMS read procedure.

(SMS 3)

Relay Layer codes a RP ACK message and forwards it to the Control Protocol.

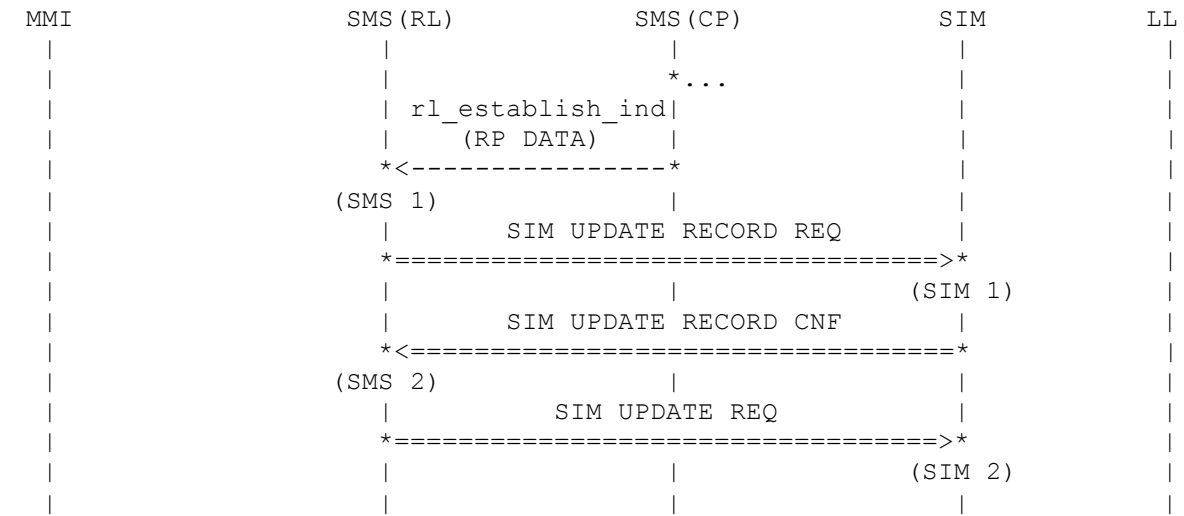
(LL 1)

The RP ACK message is part of the CP DATA message which is sent to the infrastructure.

(SMS 4)

The existing SMS-Connection is no longer necessary. The release is requested by the Relay Layer.

7.8.2 Storage on SIM available, writing not successful



(SMS 1)

The incoming mobile terminated short message is received by the Relay Layer. Depending on the protocol identifier, the data coding scheme and the configured modi SMS decides that the message shall be stored in the SIM memory. Using the backup of SMS status bytes from the SIM card a free record is found.

(SIM 1)

The SMS message is written to this record.

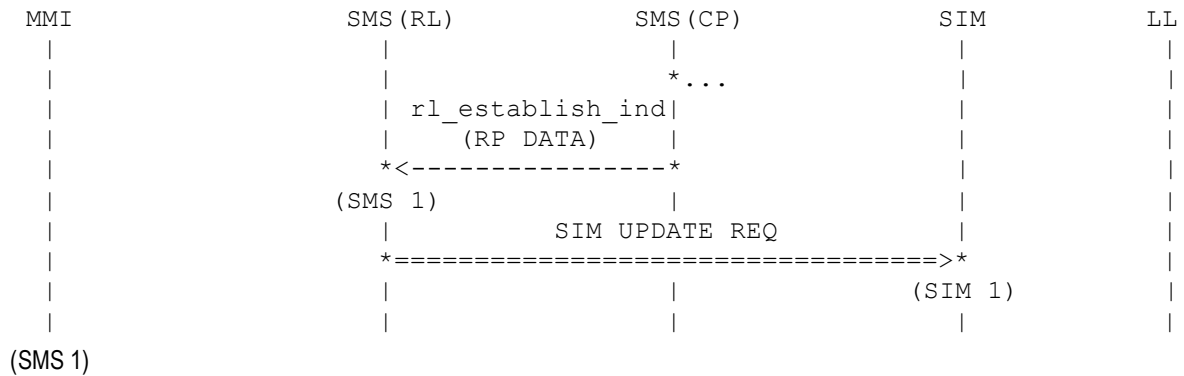
(SMS 2)

SMS indicates a write error during updating the record.

(SIM 2)

A memory capacity exceeded message will be send to the infrastructure to indicate that the SIM memory is not accessible. Therefore the message number in this mobile originated short message attempt is incremented.

7.8.3 No Storage on SIM available



The incoming mobile terminated short message is received by the Relay Layer. Depending on the protocol identifier, the data coding scheme and the configured modi SMS decides that the message shall be stored in the SIM memory. Using the backup of SMS status bytes from the SIM card SMS finds no free entry.

(SIM 1)

A memory capacity exceeded message will be sent to the infrastructure to indicate that the SIM memory is not accessible. Therefore the message number in this mobile originated short message attempt is incremented.

7.8.4 No Storage available on SIM memory, no other opportunities



(SMS 1)

The error, that no memory is available is coded in a RP ERROR message and forwarded to the CP layer.

(LL 1)

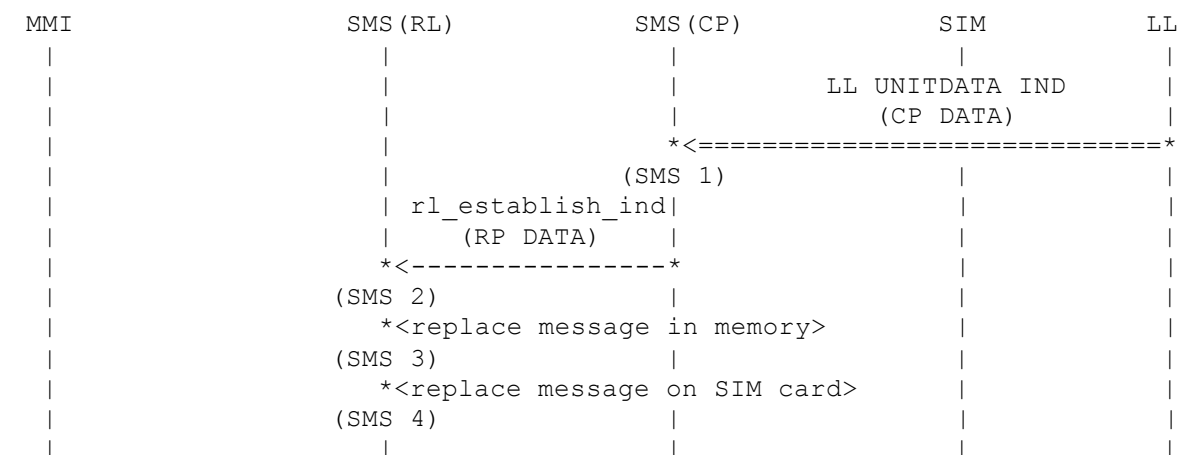
The RP ERROR message is filled in a CP DATA message and forwarded to the infrastructure.

(SMS 2)

The SMS connection will be released by the Relay Layer.

7.9 Replace Short Message

7.9.1 Replace in Mobile Station Memory



(SMS 1)

LL indicates the reception of a mobile terminated short message.

(SMS 2)

The protocol identifier of the incoming short message indicates that it is a replace short message. That means it shall replace a short message which is already stored in the mobile station.

(SMS 3)

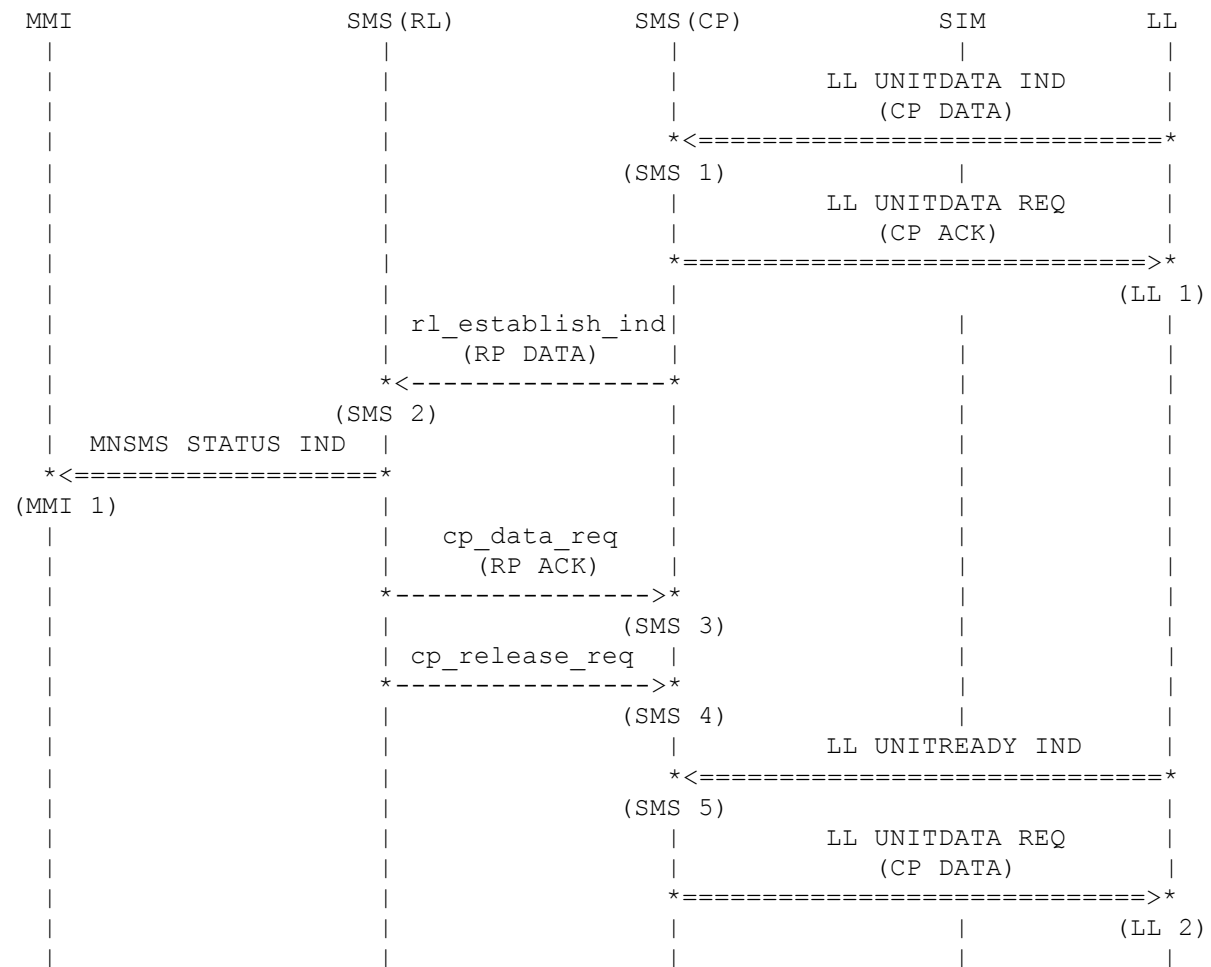
Using the ME backup of status and protocol identifier of all SMS messages in the ME memory a candidate is selected by SMS for replacing. This SMS message must be mobile terminated and must have the same protocol identifier. If such a SMS message is available, SMS reads the whole message from the permanent configuration memory and compares originator address and service center address. If all matches the new message is stored in the mobile memory replacing the old one.

(SMS 4)

If replacing in the mobile memory has failed, the same is carried out for the SIM card memory. A pre-selection of candidates is carried out using the stored status and protocol identifier of the SMS messages stored on the SIM card. Then a possible record is read from the SIM card and the originator address and the service center address are checked. If these parameters are also matching with the received message the SMS record on the SIM card is replaced.

If both checks have failed, normal storing of the incoming message is carried out.

7.10 Mobile Terminated Short Message Status



(SMS 1)

LL indicates the reception of a mobile terminated short message.

(LL 1)

The CP DATA message is acknowledged.

(SMS 2)

The received CP DATA message is a SMS STATUS message and indicated to the Relay Layer.

(MMI 1)

The content of the SMS STATUS message is forwarded to MMI.

(SMS 3)

The reception of the RP DATA message is acknowledged by the RP ACK message. Since until now no positive flow control was received, this RP DATA message cannot be forwarded to LL now. It is temporarily stored.

(SMS 4)

The SMS connection is released by RL layer.

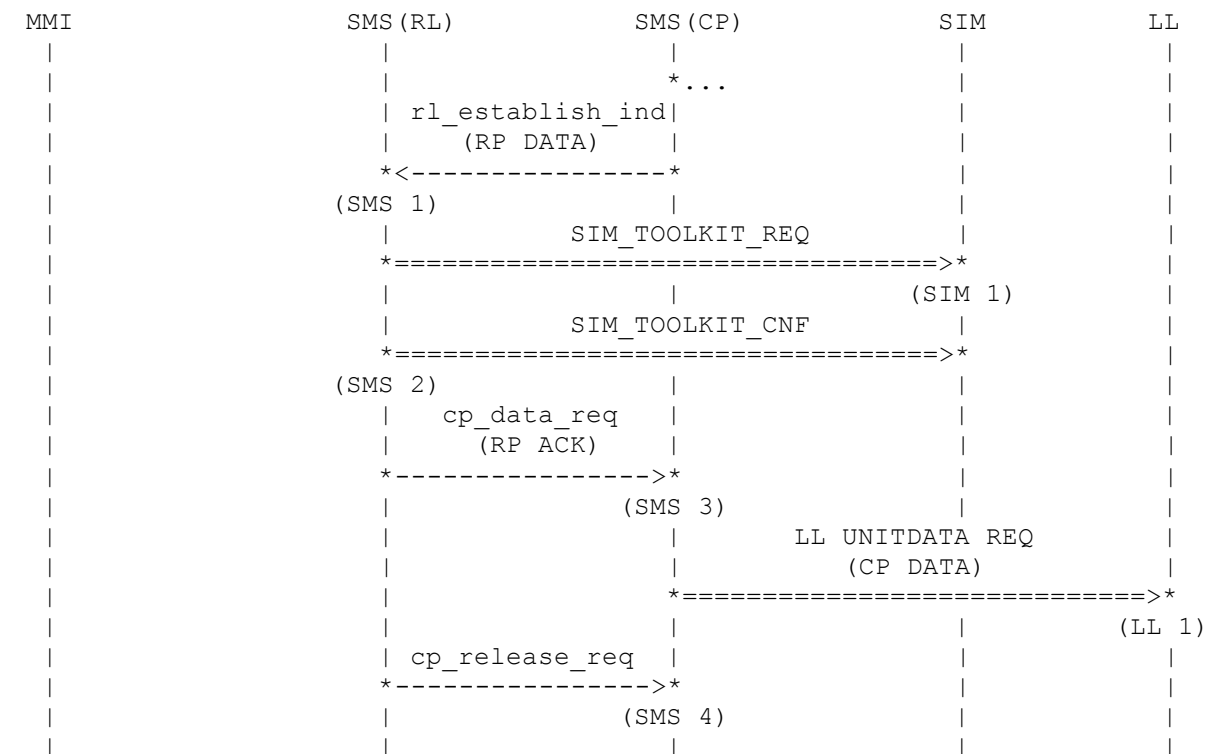
(SMS 5)

Availability is indicated by LL.

(LL 2)

A CP DATA message is sent by the Control Layer which contains the temporarily stored RP DATA message.

7.11 SIM Toolkit Data Download



(SMS 1)

The incoming mobile terminated short message is received in the Relay Layer. The protocol identifier indicates SIM Data Download.

(SIM 1)

If the sms download flag indicates support of this feature, the message content is forwarded to the SIM application.

(SMS 2)

The SIM application response is received.

(SMS 3)

Relay Layer builds a RP ACK message which may contain response data from the SIM application and sent it to Control Protocol.

(LL 1)

The message is part of a CP DATA message which is build by Control Protocol. The message is sent to the infrastructure.

(SMS 4)

The SMS connection will be released by the Relay Layer.

| MMI | SMS (RL) | SMS (CP) | SIM | LL |
|-----------------------|------------------|----------|-----------------|--------|
| | | | | |
| | | *... | | |
| | rl_establish_ind | | | |
| | (RP DATA) | | | |
| | *<-----* | | | |
| | (SMS 1) | | | |
| MNSMS_MT_IND | | | | |
| *<=====* | | | | |
| (MMI 1) | | | | |
| MNSMS_DELIVER_REP_REQ | | | | |
| *=====>* | | | | |
| | (SMS 2) | | | |
| | cp_data_req | | | |
| | (RP ACK) | | | |
| | *----->* | | | |
| | | (SMS 3) | | |
| | | | LL UNITDATA REQ | |
| | | | (CP DATA) | |
| | | *=====>* | | |
| | | | | (LL 1) |
| | cp_release_req | | | |
| | *----->* | | | |
| | | (SMS 4) | | |
| | | | | |

The incoming mobile terminated short message is received in the Relay Layer. The protocol identifier indicates SMS De-personalisation.

The SMS message is forwarded to MMI.

MMI sends the response to SMS.

Relay Layer builds a RP ACK message containing the the DELIVER REPORT from MMI and sent it to Control Protocol.

The message is part of a CP DATA message which is build by Control Protocol. The message is sent to the infrastructure.

The SMS connection will be released by the Relay Layer.

The release of SMS connection is forwarded to MM.

Since the handling of short message service procedures does not depend on the kind of underlying message delivery service (GPRS or normal circuit switched) these procedures are the same as those described in the message charts for normal SMS. In order to avoid problems with updating redundant information, the appropriate section will not be repeated here - please refer to the SMS message sequence charts, document no. 6147.202.98.101, section 7, instead.

Since the short message data format does not depend on the kind of underlying message delivery service (GPRS or normal circuit switched) these procedures are the same as those described in the message charts for normal SMS. In order to avoid

problems with updating redundant information, the appropriate section will not be repeated here - please refer to the SMS message sequence charts, document no. 6147.202.98.101, section 8, instead.

Appendices

A. Acronyms

DS-WCDMA Direct Sequence/Spread Wideband Code Division Multiple Access

B. Glossary

International Mobile Telecommunication 2000 (IMT-2000/ITU-2000) Formerly referred to as FPLMTS (Future Public Land-Mobile Telephone System), this is the ITU's specification/family of standards for 3G. This initiative provides a global infrastructure through both satellite and terrestrial systems, for fixed and mobile phone users. The family of standards is a framework comprising a mix/blend of systems providing global roaming. <URL: <http://www.imt-2000.org/>>