Technical Document - Confidential

GSM GENERAL PACKET RADIO SERVICES

MESSAGE SEQUENCE CHARTS

TOM

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Table of Contents

1.1 References 5
1.2 Abbreviations 7
1.3 Terms 10
2.1 GRR (RLC/MAC) – Radio Link Control/Medium Access Control 11
2.2 LLC – Logical Link Control 11
2.3 GMM – GPRS Mobility Management 12
2.4 SM – Session Management 12
2.5 SNDCP - Subnetwork Dependant Convergence Protocol 12
2.6 GACI – GPRS Application Control Interface 12
2.7 USART - Universal Synchronous Asynchronous Receiver Transmitter Driver 12
2.8 TOM – Tunnelling of Messages 12
3.1 TOM PDU Formats 12
4.1 Uplink data transmission 13
4.1.1 Normal scenarios 13
4.1.2 Error scenarios 14
4.2 Downlink data reception 16
4.2.1 Normal scenarios 16
4.2.2 Error scenarios 17
4.3 XID related scenarios 19
4.3.1 Reset XID indication 19
4.3.2 XID indication 19
A. Acronyms 20
B. Glossary 20

List of Figures and Tables

List of References

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[19] RFC 1332 May 1992
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[20] RFC 1877 December 1995
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[23] RFC 1994 August 1996
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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

1.3 Terms

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).

2 Overview

The Protocol Stacks are used to define the functionality of the GSM protocols for interfaces. The GSM specifications are normative when used to describe the functionality of interfaces, but the stacks and the subdivision of protocol layers does not imply or restrict any implementation.

The protocol stack for fax and data transmission consists of several entities. Each entity has one ore more service access points, over which the entity provides a service for the upper entity. The entity, which is described in this document, is coloured grey in the following figure :

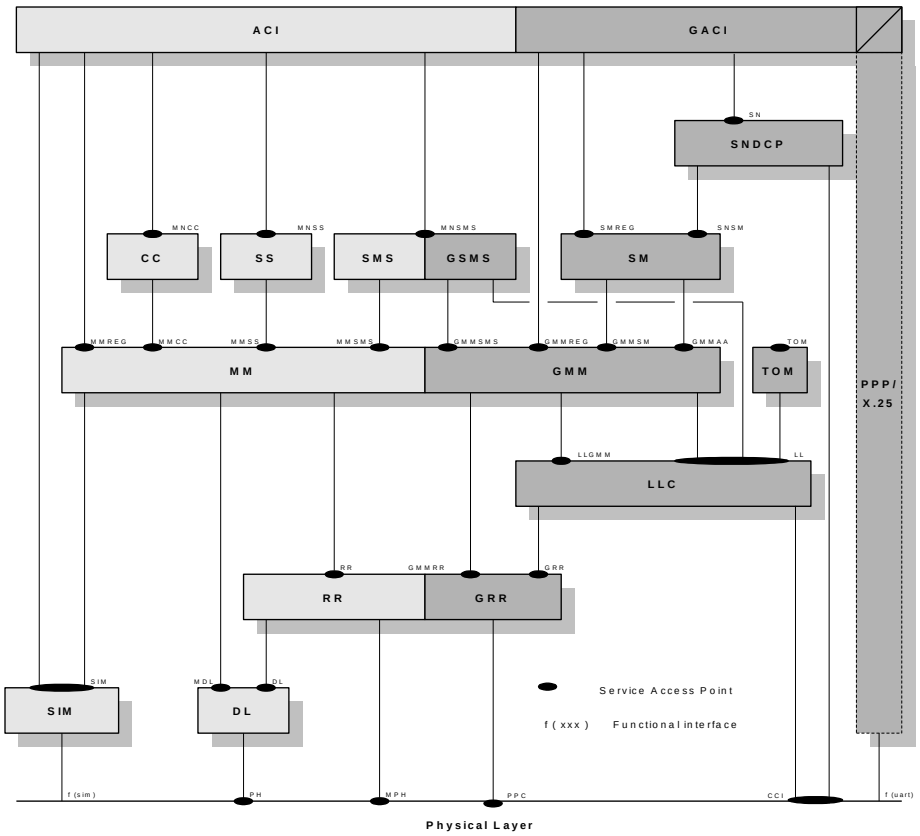


Figure 2-1: Architecture of the GSM/GPRS protocol stack

The information units passed via the SAPs are called primitives and consists of an operation code and several parameters. See the Users Guide for details.

The entities of the GPRS protocol stack are:

2.1 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.

2.2 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.

2.3 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.

2.4 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.

2.5 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.

2.6 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.

2.7 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.

2.8 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 TOM PDU Formats

For a description of the TOM PDU formats, i.e. the TOM Protocol Envelope, please refer to GSM 04.64.

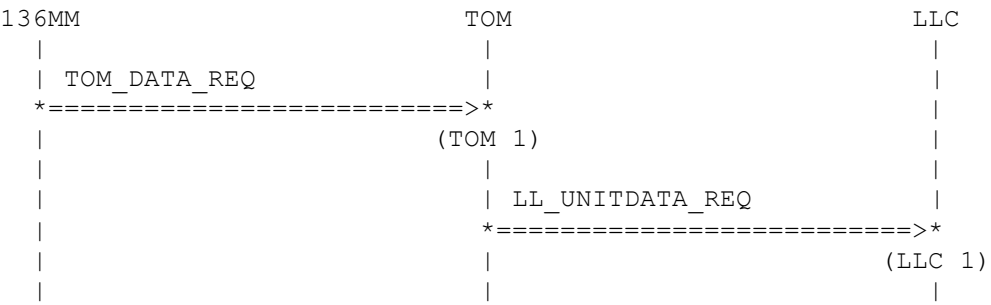
For information on the Message Capsule contents in case of 136MM as service user of TOM, please refer to TIA/EIA-136-376.

4 Protocol

4.1 Uplink data transmission

4.1.1 Normal scenarios

4.1.1.1 Normal, successful case with high priority and ciphering



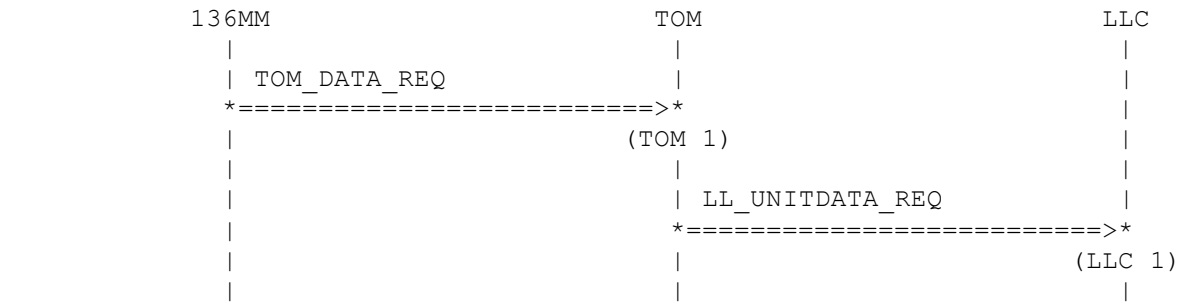
(TOM 1)
136MM — as service user of TOM — requests data transmission from TOM. The request specifies in this example via the parameter

- service access point identifier that 136MM is the source of the request
- tunnel priority that high priority transmission is requested
- cipher mode that ciphering shall be applied.

The parameter service data unit was encoded by 136MM to carry the Remaining Length of TOM Protocol Header, optionally Remaining Octets of TOM Protocol Header and the Message Capsule.

(LLC 1)
TOM fills in the TOM Protocol Header field within the service data unit and determines that the service access point identifier TOM2 of LLC is to be used as 136MM requested the high tunnel priority and that ciphering being enabled is to be requested from LLC. TOM uses the unacknowledged but protected mode transmission of LLC and requests data transmission at the LL-SAP with the highest radio priority (Note that this is always the case, independent of the tunnel priority). QoS values of attributes other than reliability class are set to the “subscribed” values. The QoS attribute reliability class indicates acknowledged RLC mode.

4.1.1.2 Normal, successful case with low priority and no ciphering



(TOM 1)
136MM — as service user of TOM — requests data transmission from TOM. The request specifies in this example via the parameter

- service access point identifier that 136MM is the source of the request
- tunnel priority that low priority transmission is requested
- cipher mode that ciphering shall not be performed.

The parameter service data unit was encoded by 136MM to carry the Remaining Length of TOM Protocol Header, optionally Remaining Octets of TOM Protocol Header and the Message Capsule.

(LLC 1)
TOM fills in the TOM Protocol Header field within the service data unit and determines that the service access point identifier TOM8 of LLC is to be used as 136MM requested the low tunnel priority and that ciphering being disabled is to be requested from LLC. TOM uses the unacknowledged but protected mode transmission of LLC and requests data transmission at the LL-SAP with the highest radio priority (Note that this is always the case, independent of the tunnel priority). QoS values of attributes other than reliability class are set to the “subscribed” values. The QoS attribute reliability class indicates acknowledged RLC mode.

4.1.1.3 Normal, successful case with high priority and no ciphering

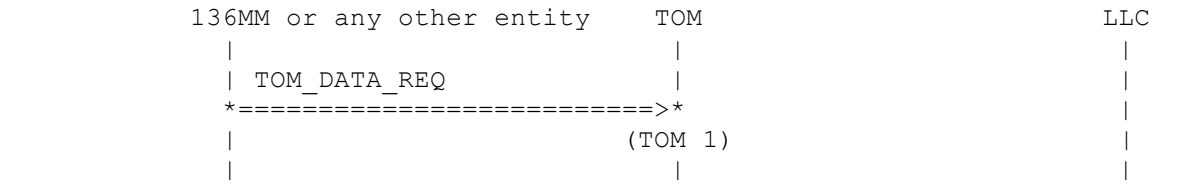
This scenario is analogous to the scenarios in section 4.1.1.1 or 4.1.1.2.

4.1.1.4 Normal, successful case with low priority and ciphering

This scenario is analogous to the scenarios in section 4.1.1.1 or 4.1.1.2.

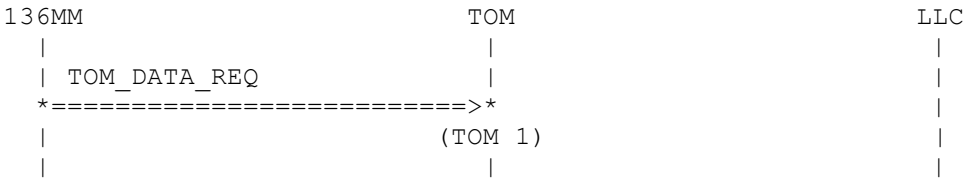
4.1.2 Error scenarios

4.1.2.1 SAPI other than 136MM



(TOM 1)
As service user of TOM requests data transmission from TOM. The parameter service access point indicates something other than 136MM. As the only service user currently supported is 136MM, this primitive will be discarded by TOM without any further action except for potential writing of diagnostic information.

4.1.2.2 Inconsistent value of Remaining Length of TOM Protocol Header



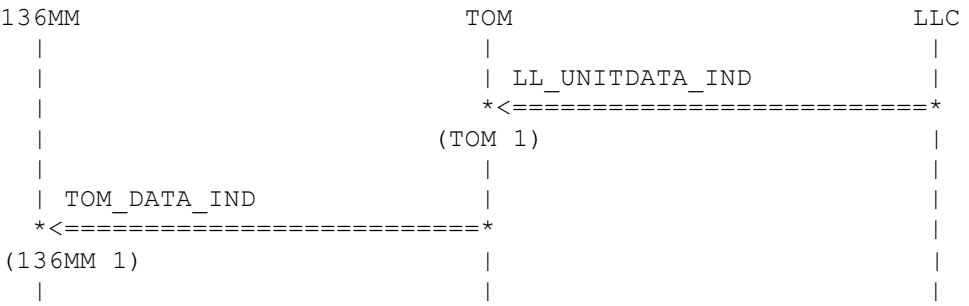
(TOM 1)

A TOM_DATA_REQ carrying an SDU with a value of Remaining Length of TOM Protocol Header which is inconsistent with the rest of the TOM Protocol Envelope is discarded without further action except for potential writing of diagnostic information. An example for such an inconsistent value is if the value is 10 but the entire TOM Protocol Envelope has a size of 11 or less octets (one octet for the TOM Protocol Discriminator and the Remaining Length of TOM Protocol Header, 10 octets Remaining Octets of Protocol Header and 1 octet at least for the Message Capsule $\geq$ 12 octets).

4.2 Downlink data reception

4.2.1 Normal scenarios

4.2.1.1 Normal, successful case with ciphering and receipt on TOM2



(TOM 1)
LLC indicates to TOM the reception of data in unacknowledged mode. The indication specifies in this example via the parameter

- service access point identifier that the SAP TOM2 is used
- ciphering indicator that ciphering was applied (before LLC deciphered).

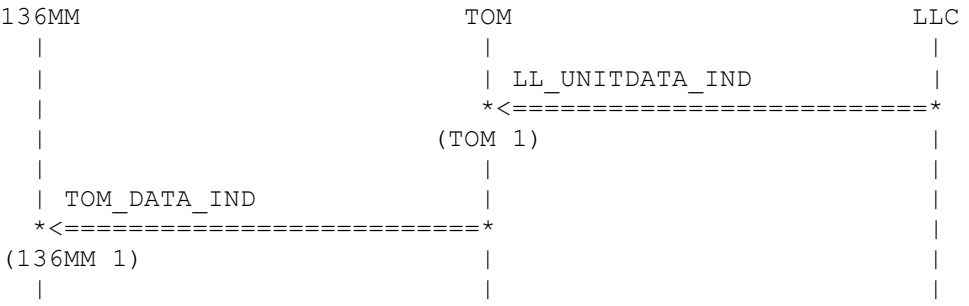
The parameter service data unit carries the TOM Protocol Envelope.

(136MM 1)
TOM checks the received data (rudimentary) for consistency (only TOM protocol related) and forwards the data to 136MM if the consistency check passes. The TOM Protocol Discriminator of the TOM Protocol Envelope carried in LL_UNITDATA_IND has in this scenario here the value TIA/EIA-136. TOM indicates in this example via the parameter

- tunnel priority that high priority transmission was used
- cipher mode that ciphering was applied (before LLC deciphered).

The parameter service data unit carries the Remaining Length of TOM Protocol Header, optionally Remaining Octets of TOM Protocol Header and the Message Capsule.

4.2.1.2 Normal, successful case without ciphering and receipt on TOM8



(TOM 1)
LLC indicates to TOM the reception of data in unacknowledged mode. The indication specifies in this example via the parameter

- service access point identifier that the SAP TOM8 is used
- ciphering indicator that ciphering was not applied.

The parameter service data unit carries the TOM Protocol Envelope.

(136MM 1)

TOM checks the received data (rudimentary) for consistency (only TOM protocol related) and forwards the data to 136MM if the consistency check passes. The TOM Protocol Discriminator of the TOM Protocol Envelope carried in LL_UNITDATA_IND has in this scenario here the value TIA/EIA-136. TOM indicates in this example via the parameter

- tunnel priority that low priority transmission was used
- cipher mode that ciphering was not applied.

The parameter service data unit carries the Remaining Length of TOM Protocol Header, optionally Remaining Octets of TOM Protocol Header and the Message Capsule.

4.2.1.3 Normal, successful case without ciphering and receipt on TOM2

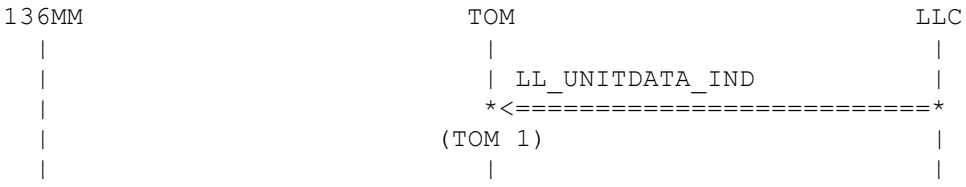
This scenario is analogous to the scenarios in section 4.2.1.1 or 4.2.1.2.

4.2.1.4 Normal, successful case with ciphering and receipt on TOM8

This scenario is analogous to the scenarios in section 4.2.1.1 or 4.2.1.2.

4.2.2 Error scenarios

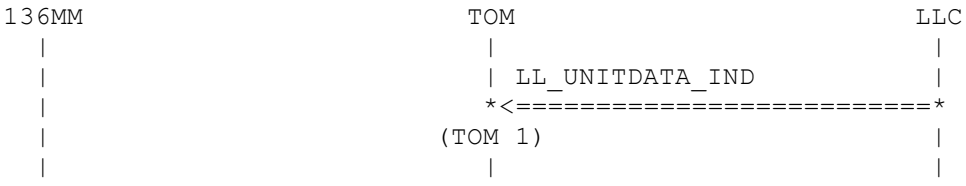
4.2.2.1 TOM Protocol Discriminator other than TIA/EIA-136



(TOM 1)

A TOM Protocol Envelope received with a TOM Protocol Discriminator indicating not TIA/EAI-136 is discarded without further action.

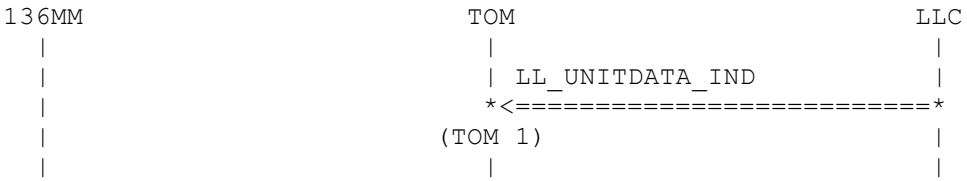
4.2.2.2 TOM Protocol Envelope smaller than 2 octets



(TOM 1)

A TOM Protocol Envelope smaller than 2 octets is discarded without further action except for potential writing of diagnostic information.

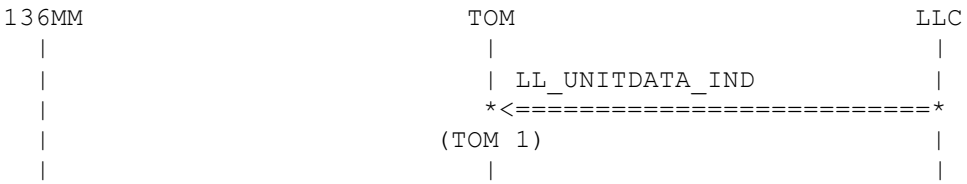
4.2.2.3 Reserved value of Remaining Length of TOM Protocol Header



(TOM 1)

A TOM Protocol Envelope received with a reserved value of Remaining Length of TOM Protocol Header is discarded without further action.

4.2.2.4 Inconsistent value of Remaining Length of TOM Protocol Header

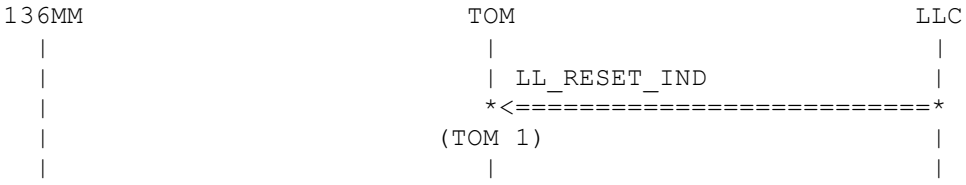


(TOM 1)

A TOM Protocol Envelope received from the network with a value of Remaining Length of TOM Protocol Header which is inconsistent with the rest of the TOM Protocol Envelope is discarded without further action except for potential writing of diagnostic information. An example for such an inconsistent value is if the value is 10 but the entire TOM Protocol Envelope has a size of 11 or less octets (one octet for the TOM Protocol Discriminator and the Remaining Length of TOM Protocol Header, 10 octets Remaining Octets of Protocol Header and 1 octet at least for the Message Capsule ≥ 12 octets).

4.3 XID related scenarios

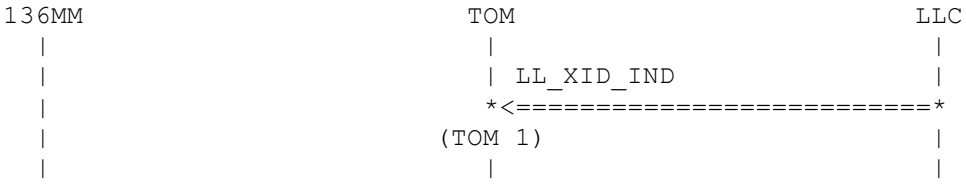
4.3.1 Reset XID indication



(TOM 1)

LLC informs TOM that the Reset XID parameter has been received from the SGSN and the LLC parameters are reset to their default values. This information will not be forwarded to TOM service users but will be discarded without further action except for potential writing of diagnostic information.

4.3.2 XID indication



(TOM 1)

LLC indicates to TOM that the SGSN LLC entity performed an XID negotiation. This information will not be forwarded to TOM service users but will be discarded without further action except for writing of diagnostic information as it is assumed that XID negotiation does not apply to the SAPIs TOM2

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/>