Technical Document – Confidential

GPRS GENERAL PACKET RADIO SERVICES

MESSAGE SEQUENCE CHARTS

RLC

Document Number:	8441.201.99.005
Version:	0.6
Status:	Draft
Approval Authority:	
Creation Date:	1999-Mar-29
Last changed:	2015-Mar-08 by XGUTTEFE
File Name:	rlc.doc

Important Notice

Change History

Date	Changed by	Approved by	Version	Status	Notes
1999-Mar-29	Can		0.1		1
1999-May-17	Can		0.2		2
1999-Jun-10	ID		0.3		3
1999-Jun-30	ID		0.4		4
1999-Mar-10	ID		0.5		5
2003-May-27	XGUTTEFE		0.6	Draft	

Notes:

1. Initial version
2. Changes in 04.60 Version 6.3.0 included
3. New document header added
4. GRR_DATA_IND and GRR_UNITDATA_IND added
5. Condat AG added and document is ready for S2

Table of Contents

List of Figures and Tables

List of References

[ISO 9000:2000] International Organization for Standardization. Quality management systems - Fundamentals and vocabulary. December 2000

1.1 References

[1] GSM 05.02 version 8.0.0 Release 1999
Digital cellular telecommunications system (Phase 2+);
Multiplexing and multiple access on the radio path

[2] GSM 04.60 version 6.3.0 Release 1997
Digital cellular telecommunications system (Phase 2+);
General Packet Radio Service (GPRS);
Mobile Station (MS) - Base Station System (BSS) interface;
Radio Link Control/ Medium Access Control (RLC/MAC) protocol

[3] GSM 04.08 version 6.3.0 Release 1997
Digital cellular telecommunications system (Phase 2+);
Mobile radio interface layer 3 specification

[4] GSM 03.64 version 6.1.0 Release 1997
Digital cellular telecommunications system (Phase 2+);
General Packet Radio Service (GPRS);
Overall description of the GPRS radio interface; Stage 2

[5] GSM 03.60 version 6.3.1 Release 1997
Digital cellular telecommunications system (Phase 2+);
General Packet Radio Service (GPRS);
Service description; Stage 2

[6] GSM 04.07 version 6.3.0 Release 1997
Digital cellular telecommunications system (Phase 2+);
Mobile radio interface signalling layer 3; General aspects

[7] GSM 04.64 version 6.3.0 Release 1997
Digital cellular telecommunications system (Phase 2+);
General Packet Radio Service (GPRS);
Mobile Station - Serving GPRS Support Node (MS-SGSN)
Logical Link Control (LLC) layer specification

[8] GSM 05.08 version 6.4.0 Release 1997
Digital cellular telecommunications system (Phase 2+);
Radio subsystem link control

[9] GSM 05.10 version 6.3.0 Release 1997
Digital cellular telecommunications system (Phase 2+);
Radio subsystem synchronization

[10] GSM 03.20 TS 100 929: July 1998 (GSM 03.20 version 6.0.1)
Security related network functions, ETSI

[11] Draft GSM 03.22: August 1998 (GSM 03.22 version 6.1.0)
Functions related to Mobile Station (MS) in idle mode and group receive mode, ETSI

[12] GSM 04.65 V6.3.0: Subnetwork Dependant Convergence Protocol
ETSI, March 1999

[13] ITU-T V42bis ITU-T, Recommendation V.42 bis 1990

[14] GSM 09.60 GPRS Tunneling Protocol (GTP) across the Gn and Gp Interface

[15] RFC 1661 IETF STD 51 July 1994
The Point-to-Point Protocol (PPP)

[16] RFC 1662 IETF STD 51 July 1994
PPP in HDLC-like Framing

[17] RFC 1570 January 1994
PPP LCP Extensions

[18] RFC 1989 August 1996
PPP Link Quality Monitoring

[19] RFC 1332 May 1992
The PPP Internet Protocol Control Protocol (IPCP)

[20] RFC 1877 December 1995
PPP IPCP Extensions for Name Server Addresses

[21] RFC 2153 May 1997
PPP Vendor Extensions

[22] RFC 1334 October 1992
PPP Authentication Protocols (for Password Authentication Protocol only)

[23] RFC 1994 August 1996
PPP Challenge Handshake Authentication Protocol (CHAP)

1.2 Abbreviations

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
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 AT Command Interpreter
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
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	Slow 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
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	Visiting 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 :

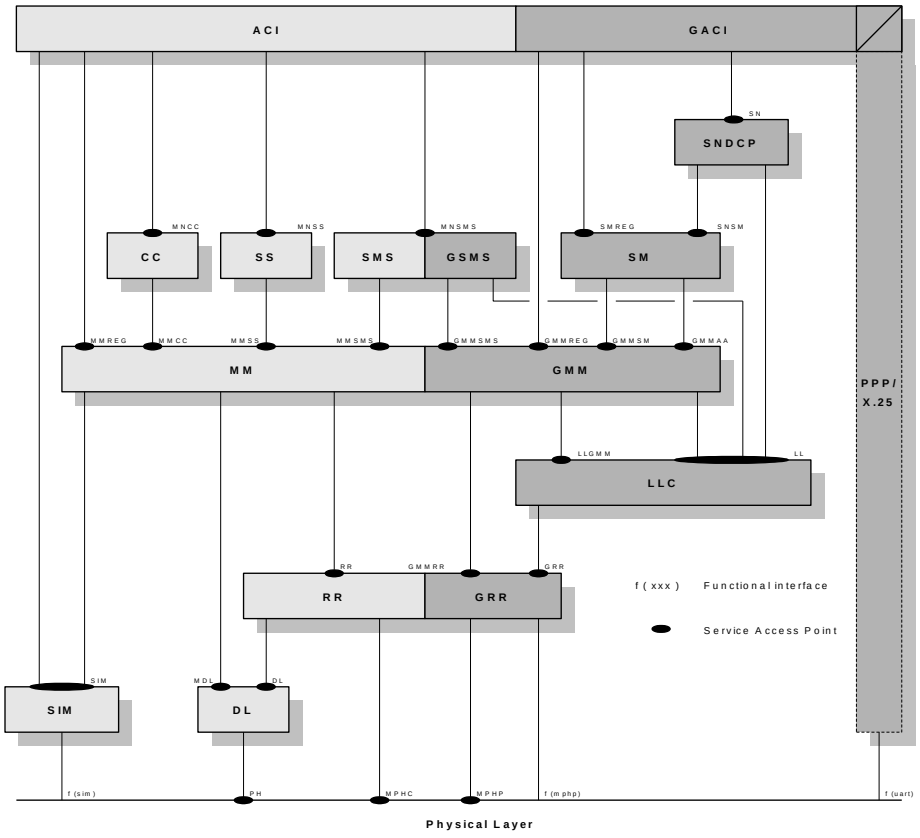


Figure 2-1: Architecture of the GSM/GPRS protocol stack

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 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 user 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 AT Command Interpreter

The ACI is the GPRS extension of the ACI. It is specified in GSM 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 funtionallity for the interworking between GMM/SM/SNDCP and a packet oriented protocol like PPP.

2.7 USART - Universal Synchronous Asynchronous Receiver Transmitter Driver

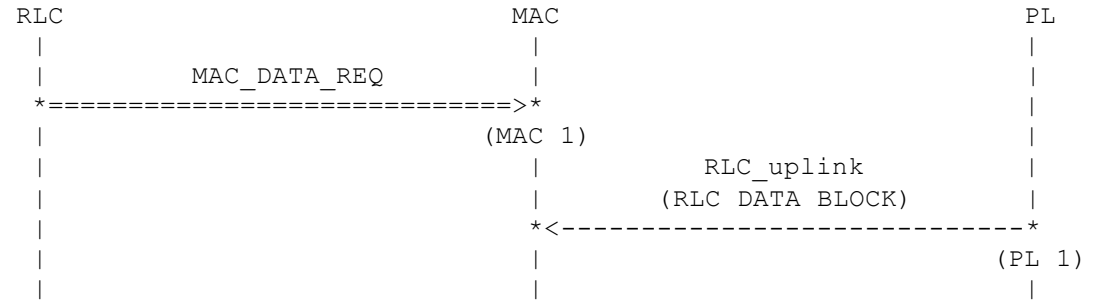
The USART is a hardware component that facilitates a connection between the mobile station and terminal equipment (e.g. a PC). This interface uses some of the circuits described in V.24.

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.

3 Protocol

3.1 RLC Data transfer

3.1.1 Transmission of an uplink RLC Data block.

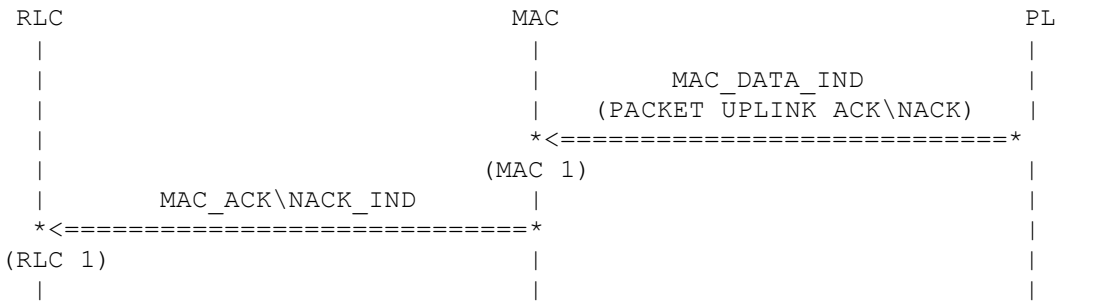


(MAC 1)
RLC sends a RLC data block to MAC.

(PL 1)
MAC forwards the RLC data block to the network side.

Requirements:
<R.RLC.V_SEND.A.00x>, <R.RLC.V_ACK.A.00x>, <R.RLC.V_B.A.00x>, <R.RLC.BSN.A.001>, <R.RLC.WS_K.A.001>, <R.RLC.FILL_OCT.A.001>, <R.RLC.SEG_DATA.A.00x>, <R.RLC.LLC_PRIO.M.001>, <R.RLC.TRA_CTRL.A.00x>, <R.RLC.CNTDOWN.M.00x>, <R.RLC.ACK_MODE.A.001>, <R.RLC.E_UL_TBF.M.001>, <R.RLC.R_UL_TBF.M.001-2>, <R.RLC.UA_MODE.A.001>, <R.RLC.U_UL_TBF.M.001>, <R.RLC.U_UL_TBF.M.011>

3.1.2 Receiving of an Ack\Nack Description for a transmitted uplink RLC Data block.

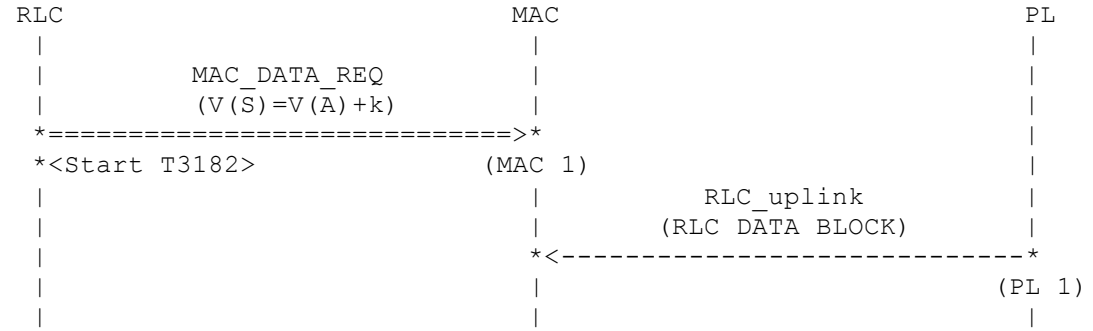


(MAC 1)
MAC receives an RLC control block containing a PACKET UPLINK ACK\NACK message.

(RLC 1)
The Ack\Nack Description is forwarded to RLC.

Requirements:
<R.RLC.SSN_RBB.A.00x>, <R.RLC.R-A_CTRL.M.00x>, <R.RLC.TRA_CTRL.A.00x>, <R.RLC.ACK_MODE.A.001>, <R.RLC.O_UL_TBF.I.002>, <R.RLC.O_UL_TBF.M.005>, <R.RLC.O_UL_TBF.M.007>, <R.RLC.O_UL_TBF.M.010-11>, <R.RLC.R_UL_TBF.M.007>, <R.RLC.U_UL_TBF.I.002>, <R.RLC.U_UL_TBF.M.006>, <R.RLC.U_UL_TBF.M.008-9>

3.1.3 RLC transmit window(k) stall condition is detected



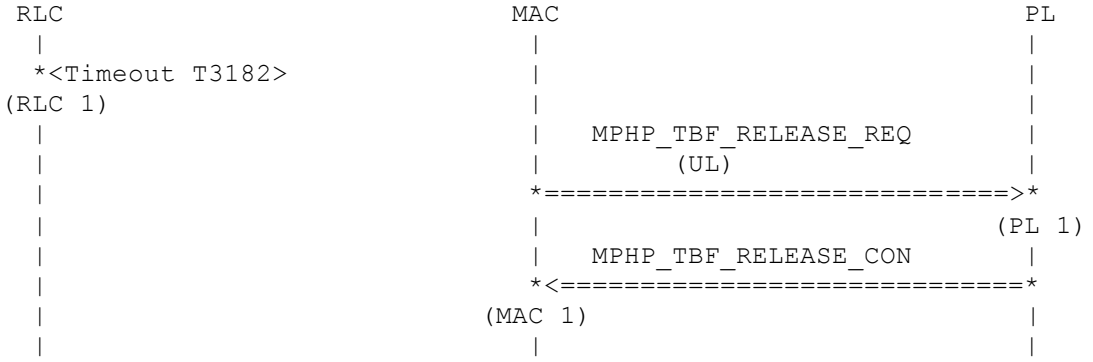
(MAC 1)
RLC sends an RLC data block to MAC. The MS detects a transmit window stall indication(only acknowledged mode). In unacknowledged mode there is no stall condition. In this case there is no restriction for uplink transmission.
Timer T3182 is started in both modes.

(PL 1)

MAC forwards the RLC data block to the network side.

Requirements:
<R.RLC.WS_K.A.001>, <R.RLC.O_UL_TBF.M.003-5>, <R.RLC.U_UL_TBF.M.003-4

3.1.4 Stall condition timeout of timer T3182



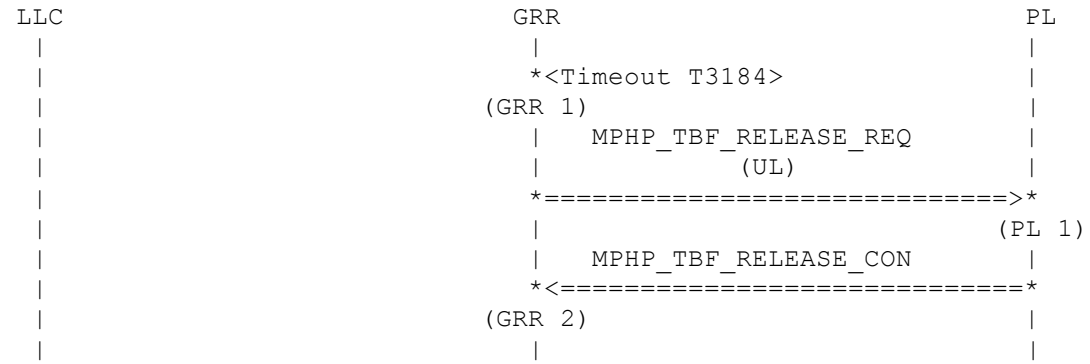
(RLC 1)
Timer T3182 expires.

(PL 1)
PL aborts the UL-TBF procedure

(MAC 1)
Layer confirms the release. In acknowledged mode RR initiates random access. In unacknowledged mode it is considered as an normal release

Requirements:
<R.RLC.O_UL_TBF.M.004>, <R.RLC.O_UL_TBF.M.006>, <R.RLC.O_UL_TBF.M.008-9>, <R.RLC.R_UL_TBF.M.008>, <R.RLC.U_UL_TBF.M.005, <R.RLC.U_UL_TBF.M.017>, <R.RLC.AB_CASES.M.00x>

3.1.5 Timeout of timer T3184



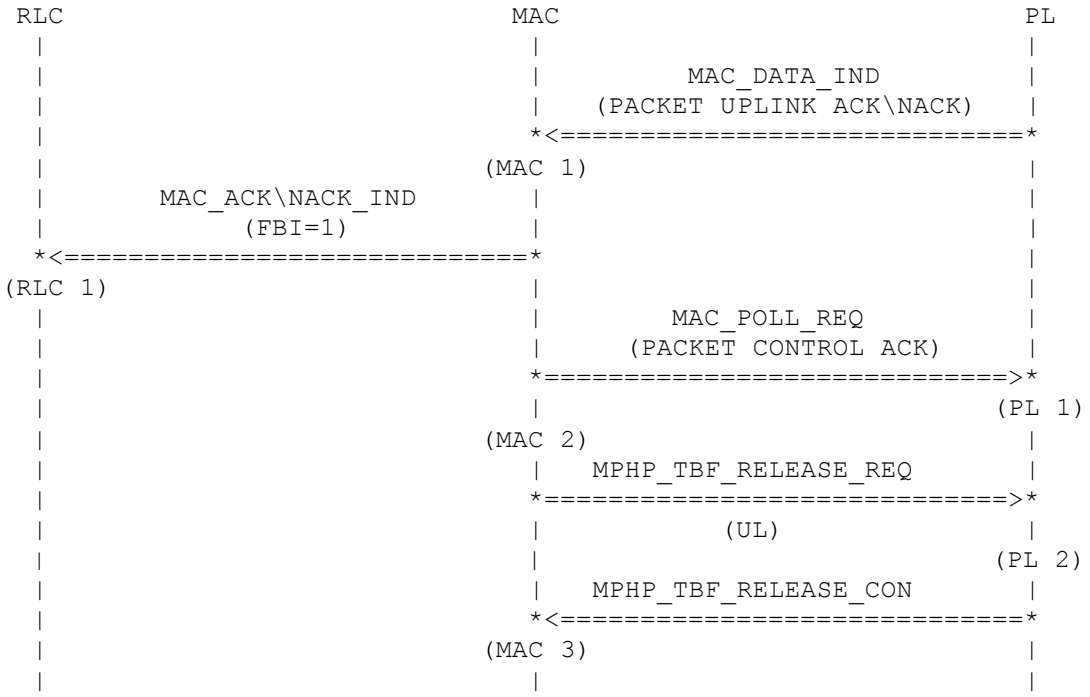
(GRR 1)
Timer T3184 expires.

(PL 1)
PL aborts the UL-TBF procedure

(GRR 2)
Layer confirms the release. RR initiates a new random access.

Requirements:
<R.RLC.O_UL_TBF.M.012>, <R.RLC.U_UL_TBF.M.010>, <R.RLC.AB_CASES.M.001>

3.1.6 Release of uplink TBF



(MAC 1)
MAC receives PACKET UPLINK ACK\NACK message from the network.

(RLC 1)
The Ack\Nack Description is forwarded to RLC, where the final bit indicator is set. This indicates a release of an uplink TBF. All sent RLC data blocks were received successfully.

(PL 1)
The MS sends the PACKET CONTROL ACKNOWLEDGMENT message to the network and releases the TBF. This message is sent by a Single block request. The single block is indicated by RRBP field in the PACKET UPLINK ACK\NACK message

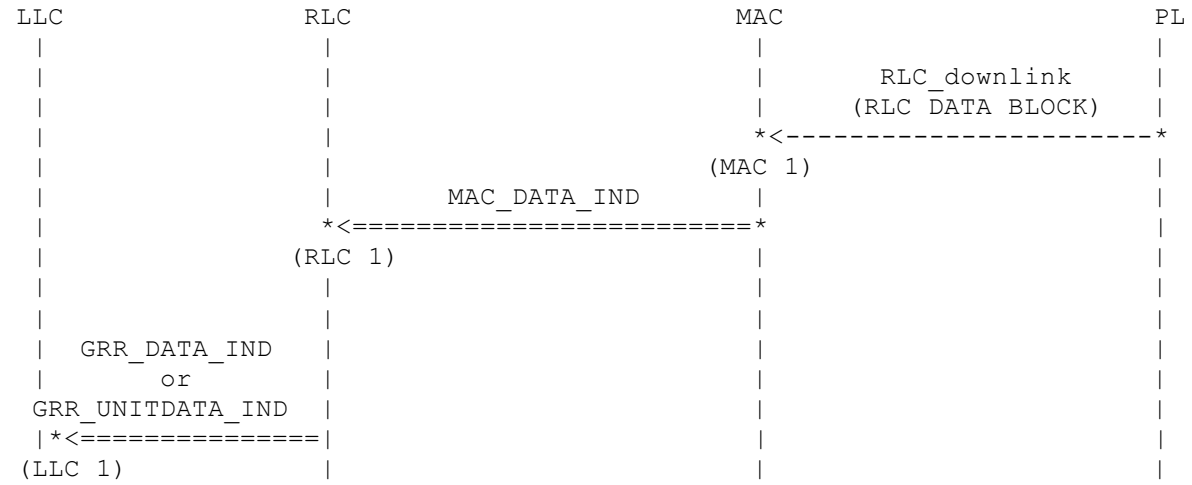
(MAC 2)
Layer 1 confirms the single block request.

(PL 2)
MAC releases the TBF.

(MAC 3)
Layer 1 confirms the release.

Requirements:
<R.RLC.R_UL_TBF.I.003-6>, <R.RLC.U_UL_TBF.I.013-16>

3.1.7 Receiving of a downlink RLC Data block.



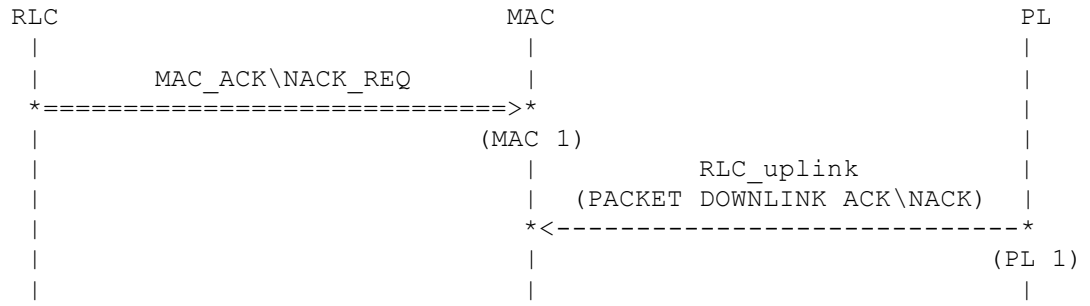
(MAC 1)
MAC receives an RLC data block.

(RLC 1)
The RLC data block is forwarded to RLC.

(LLC 1)
RLC indicates to the LLC that a LLC_PDU was received.

Requirements:
<R.RLC.R-A_DATA.A.00x>, <R.RLC.O_DL_TBF.M.001>, <R.RLC.U_DL_TBF.M.001>, <R.RLC.V_REC.A.00x>, <R.RLC.V_Q.A.00x>, <R.RLC.V_N.A.00x>

3.1.8 Sending of an Ack\Nack Description for an received downlink RLC Data block.

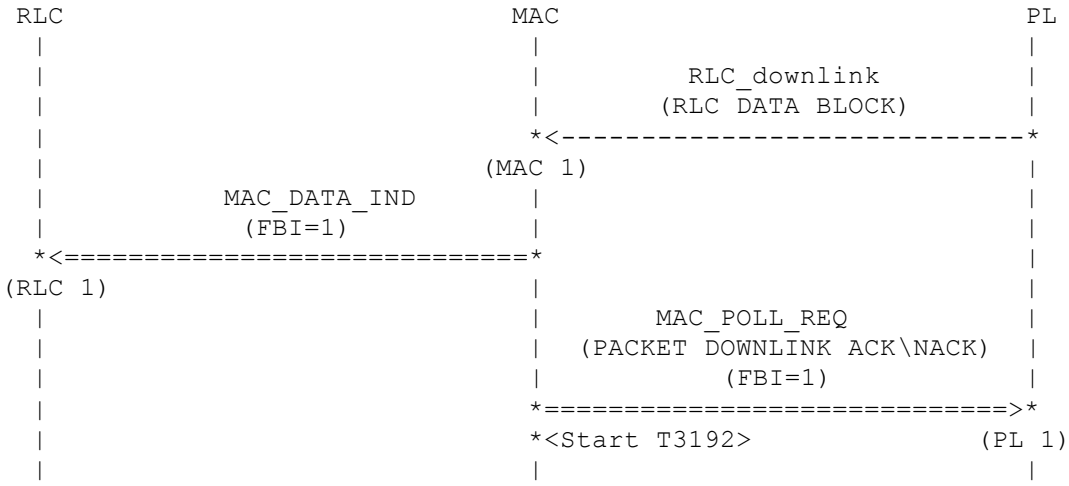


(MAC 1)
RLC sends an ACK\NACK DESCRIPTION to MAC.

(PL 1)
MAC builds the PACKET DOWNLINK ACK\NACK message and sends it to the network side.

Requirements:
<R.RLC.SSN_RBB.A.002-4>, <R.RLC.SSN_RBB.A.009>, <R.RLC.FILL_OCT.A.001>, <R.RLC.SEG_CTRL.M.004>, <R.RLC.TRA_CTRL.A.00x>, <R.RLC.ACK_MODE.A.001>, <R.RLC.R_DL_TBF.M.002>

3.1.9 Release of downlink TBF



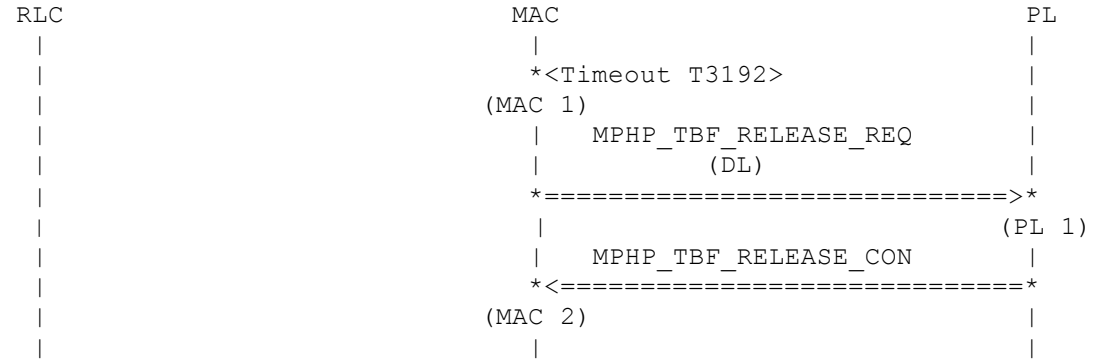
(MAC 1)
MAC receives an RLC DATA BLOCK from the network.

(RLC 1)
The RLC DATA BLOCK is forwarded to RLC, where the final bit indicator is set. This indicates a release of an downlink TBF.

(RLC 1)
The MS sends the PACKET CONTROL ACKNOWLEDGMENT message to the network and releases the TBF. This message is sent by a poll block request. The block is indicated by RRBP field in the RLC DATA BLOCK message

Requirements:
<R.RLC.R_DL_TBF.I.001-5>, <R.RLC.U_DL_TBF.I.002-6>

3.1.10 Timeout of timer T3192



(MAC 1)
Timer T3192 expires.

(PL 1)
Downlink TBF is released. PL stops monitoring its assigned PDCHs.

(MAC 2)
PL confirms the release.

Requirements:
<R.RLC.R_DL_TBF.M.010>, <R.RLC.R_DL_TBF.M.012-13>, <R.RLC.U_DL_TBF.M.009>, <R.RLC.U_DL_TBF.M.011-12>

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/>