Technical Document – Confidential

GSM GENERAL PACKET RADIO SERVICES

MESSAGE SEQUENCE CHARTS

MMGMM

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General Packet Radio Service (GPRS);
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Security related network functions, ETSI

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ETSI, March 1999

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

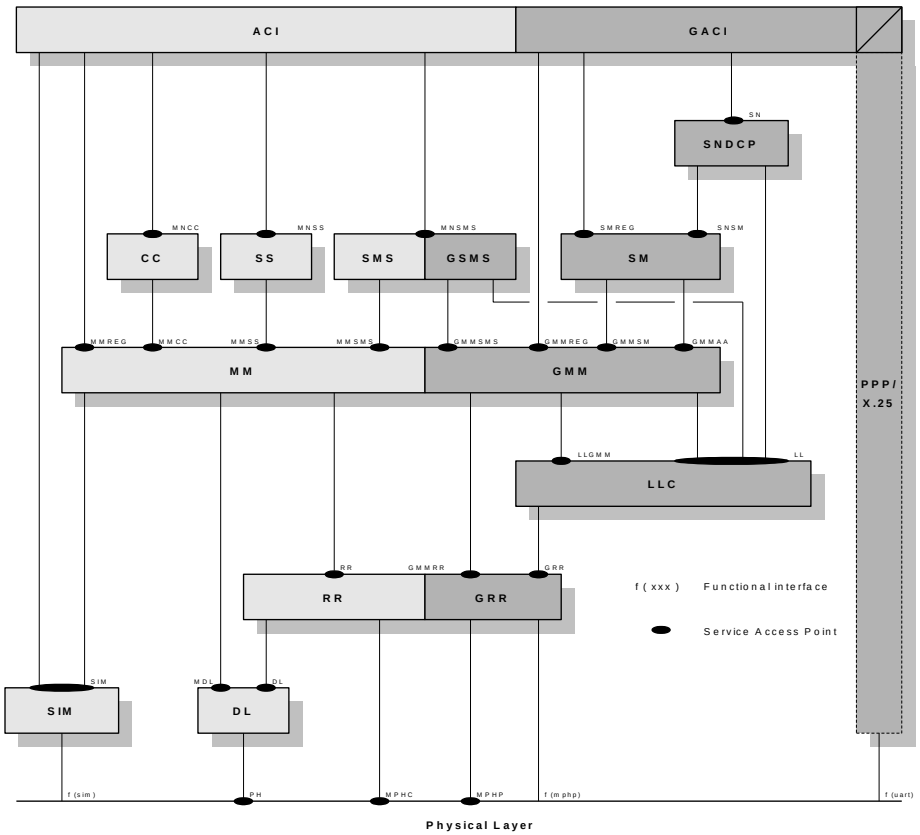


Figure 2-1: Architecture of the GSM/GPRS protocol stack

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 Introduction

4 Protocol

5 Registration

5.1 Power ON

5.1.1 MGM000: Activation of MS as class A, BC, BG, CG mobile

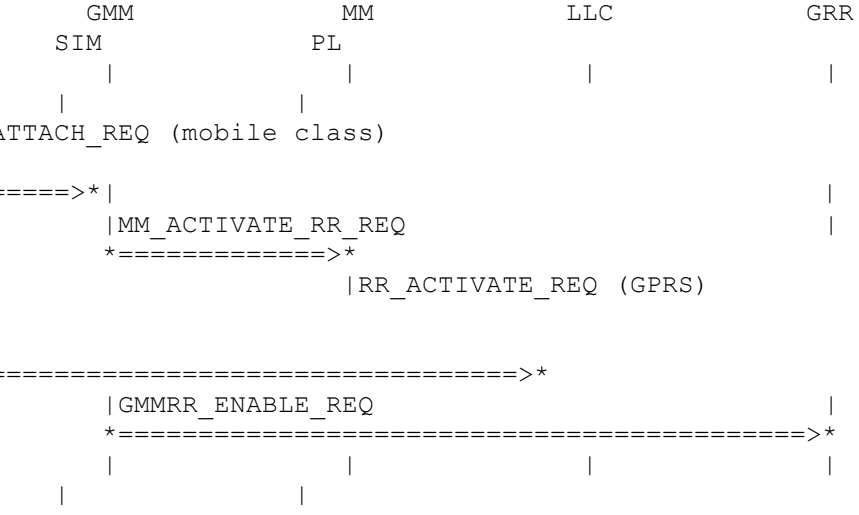
Description:

GMM is in state GMM-NULL.NO-IMSI. MMI activates the MS as an mobile with the appropriate class.

Variant A: mobile class A
Variant B: mobile class BC (class B mobile which reverts to CS in net mode III)
Variant C: mobile class BG (class B mobile which reverts to GPRS in net mode III)
Variant D: mobile class CG (GPRS-only mobile)
Variant E: mobile class CC (CS-only mobile)

Variants:

<A>....<E>



(1) GMMREG_ATTACH_REQ

<A>	mobile_class	GMMREG_AT_CLASS_A
<B>	mobile_class	GMMREG_AT_CLASS_BC
<C>	mobile_class	GMMREG_AT_CLASS_BG
<D>	mobile_class	GMMREG_AT_CLASS_CG
	t3314_ready_val	T3314
	t3312_standby_rau_val	T3312

(2) MM_ACTIVATE_RR_REQ

(3) RR_ACTIVATE_REQ

plmn	PLMN_NO_ID
op	
OP_MODE_NO_SIM_NO_SERV	
cksn	CKSN_RES
kcv	KC_DELETED
accc	ACC_CLASS_0000
imsi	MOB_ID_NO_ID

	tmsi	MOB_ID_NO_ID
	thplmn	THPLMN_FF
	bcch_info	NOT_USED
	gprs	RR_GPRS_ON

(4) GMMRR_ENABLE_REQGMMREG_ATTACH_REQ

<A>	mobile_class	GMMREG_AT_CLASS_A
<B>	mobile_class	GMMREG_AT_CLASS_BC
<C>	mobile_class	GMMREG_AT_CLASS_BG
<D>	mobile_class	GMMREG_AT_CLASS_CG

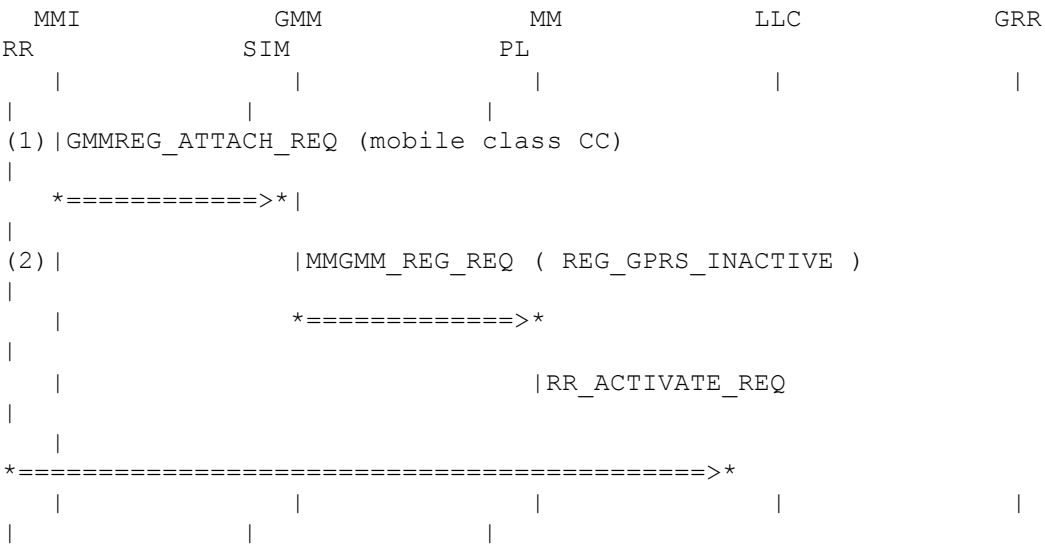
History:

10-Apr-00	ANS	Initial
25-Apr-00	ANS	Class CC removed.

5.1.2 MGM003: Activation of MS as a circuit switched only mobile

Description:

GMM is in state GMM-NULL.NO-IMSI. MMI activates the MS as an CS-only mobile.



(1) GMMREG_ATTACH_REQ

	mobile_class	GMMREG_AT_CLASS_CC
	t3314_ready_val	T3314
	t3312_standby_rau_val	T3312

(2) MM_ACTIVATE_RR_REQ

(3) RR_ACTIVATE_REQ

	plmn	PLMN_NO_ID
	op	
	OP_MODE_NO_SIM_NO_SERV	
	cksn	CKSN_RES
	kcv	KC_DELETED
	accc	ACC_CLASS_0000
	imsi	MOB_ID_NO_ID
	tmsi	MOB_ID_NO_ID
	thplmn	THPLMN_FF
	bcch_info	NOT_USED

(4) GMMRR_ENABLE_REQGMMREG_ATTACH_REQ

	mobile_class	GMMREG_AT_CLASS_CC

History:

25-Apr-00	ANS	Initial

5.1.3 MGM001: Positive End of Registration Attempt (Limited Service)

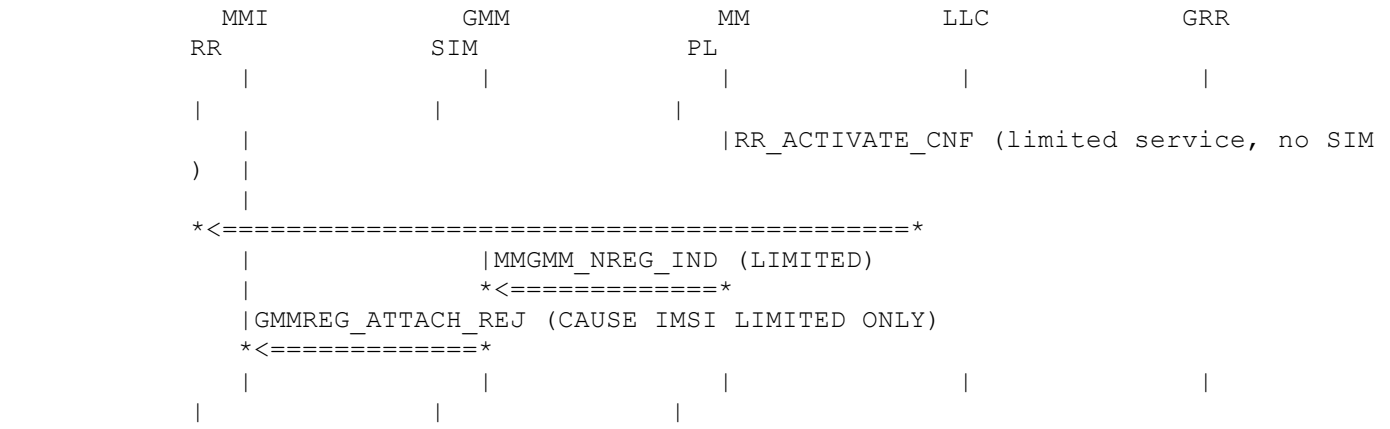
Description:

MS class BG.

MM is informed by means of a RR-ACTIVATE confirmation primitive that the mobile station is synchronous to a cell. The network identification if forwarded to GMM and furter to MMI as part of a GMMREG_ATTACH_REJ indication primitive.

Preamble:

MGM000b



History:

10-Apr-00	ANS	Initial
13-Apr-00	DB	Corrected direction of MM_ACTIVATE_RR_CNF

5.1.4 MGM002: SIM inserted - initiate cell selection

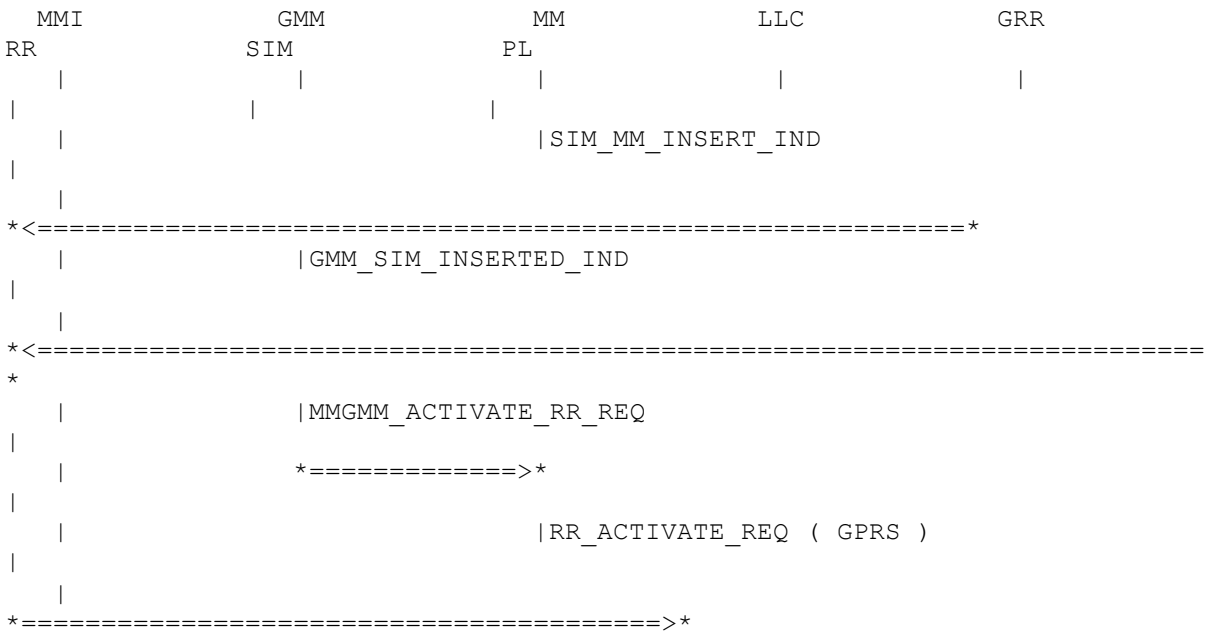
Description:

MS class BG.

GMM is in state GMM-DEREGISTERED.NO-IMSI. GMM receives the indication that a SIM has been inserted and that the SIM is valid. GMM resets the GPRS attach attempt counter. GMM enters state GMM-DEREGISTERED.PLMN-SEARCH. SIM sends the stored temporary data, if any, and the update states to MM and GMM.

Preamble:

MGM001



History:

	10-Apr-00	ANS	Initial

5.2 Cell found – mobile class BG

5.2.1 MGM010: IMSI Cell found

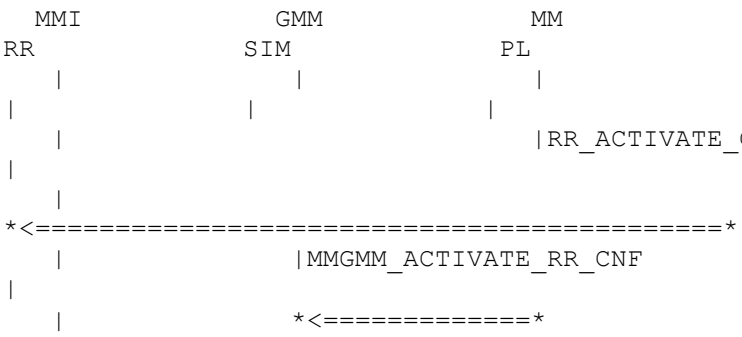
Description:

MS class BG.

Successful conclusion of cell selection is signalled by the receipt of a RR-ACTIVATE confirmation primitive. MM forwards the PLMN identification to GMM and GMM to MMI in the form of a GMMREG_ATTACH_IND confirmation primitive.

Preamble:

MGM002



History:

10-Apr-00	ANS	Initial

5.2.2 MGM011: GPRS Cell not found

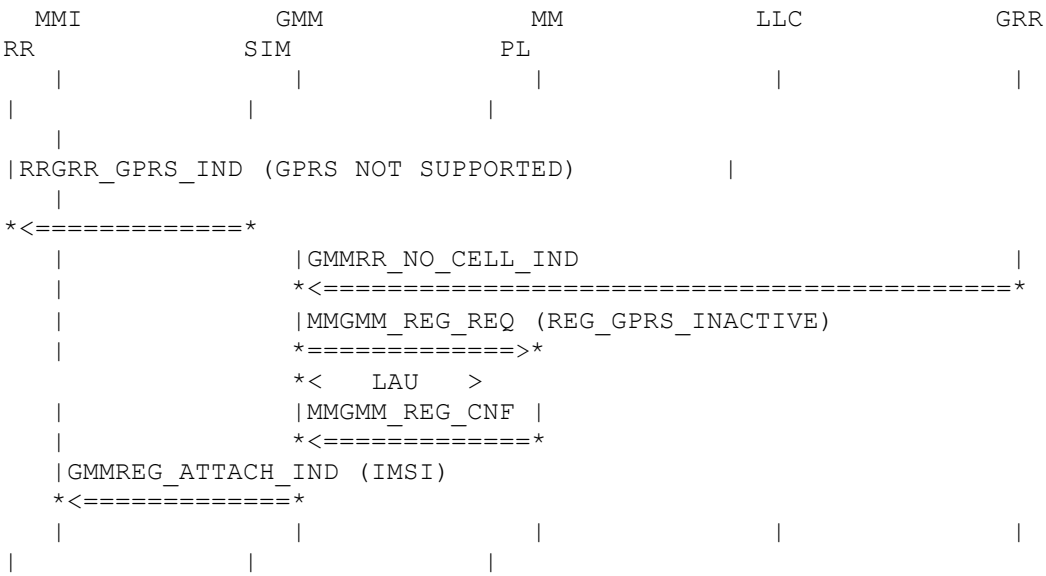
Description:

MS class BG.

No GPRS cell was found by RR. RR informs GRR that the current cell does not support GPRS. GRR passes this information to GMM and GMM switches the main actvities to the GSM side with the MM_ACTIVATE_MM_REQ primitve. MM has to ast as an GSM-only mobile untlil the MM_DEACTVATE_MM_REQ primitive is received. That means, MM has to start the attach procedure on its own. After successful location update (LAU) MM informs GMM and not MMI about the result. GMM forwards this information to MMI.
If the LAI is changed, MM forwards GMM the LAI.

Preamble:

MGM010



History:

10-Apr-00	ANS	Initial
13-Apr-00	DB	Corrected GMMREG_ATTACH_IND

5.2.3 MGM012: GPRS Cell found in state GPRS deactivated

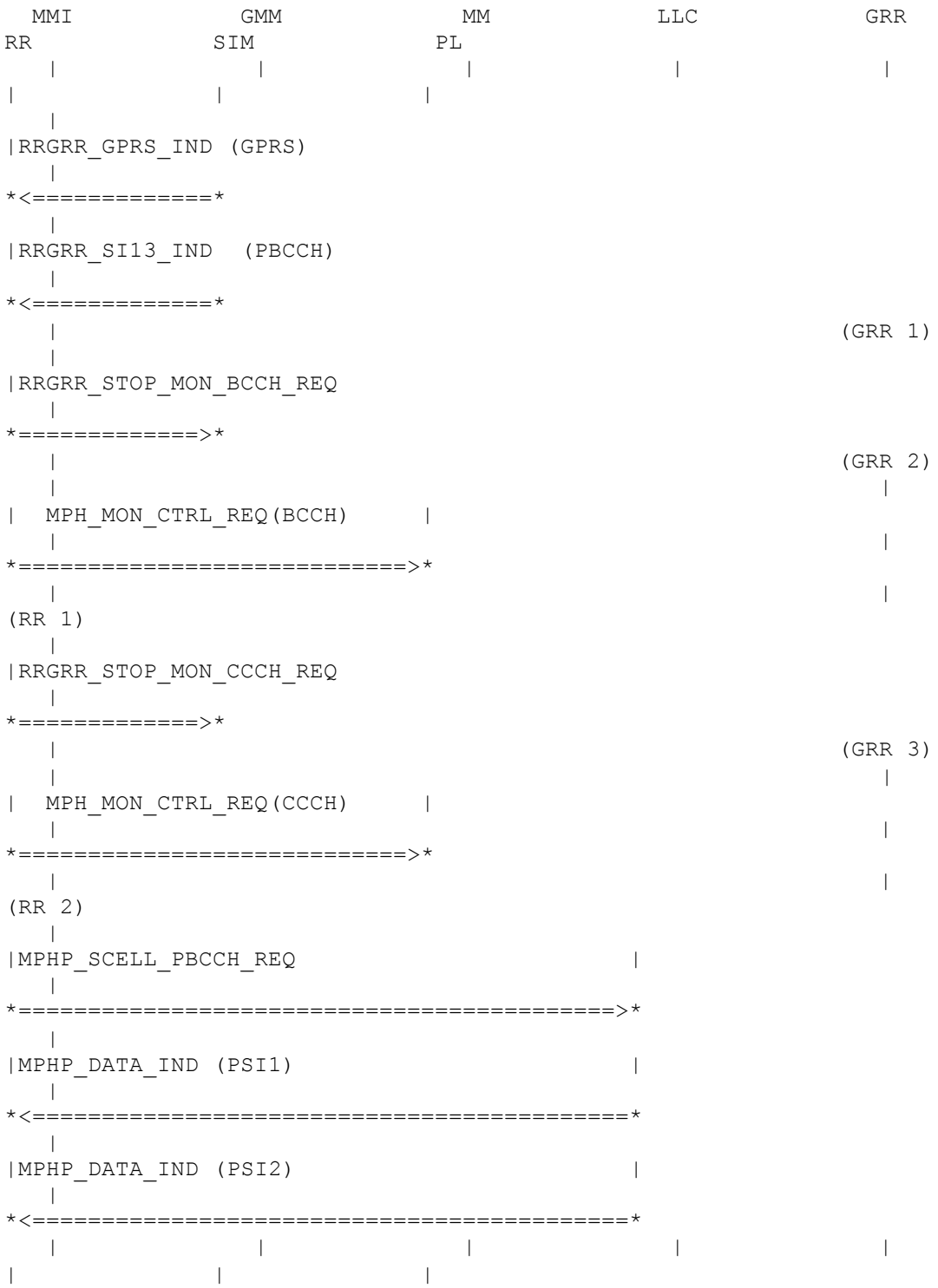
Description:

MS class BG.

RR informs GRR about finding a GPRS cell.

Preamble:

MGM011



(GRR 1)
RR sends the SI13 to GRR. The SI13 indicates that a PBCCH is available.

(GRR 2)
GRR stops BCCH reading in idle mode.

(RR 1)
tbd

(GRR 3)
GRR stops CCCH listening in idle mode.

(RR 2)
tbd

History:

10-Apr-00	ANS	Initial
24-Jul-00	MPA	revised

5.2.4 MGM013: GPRS Cell found in state GPRS deactivated – net mode III

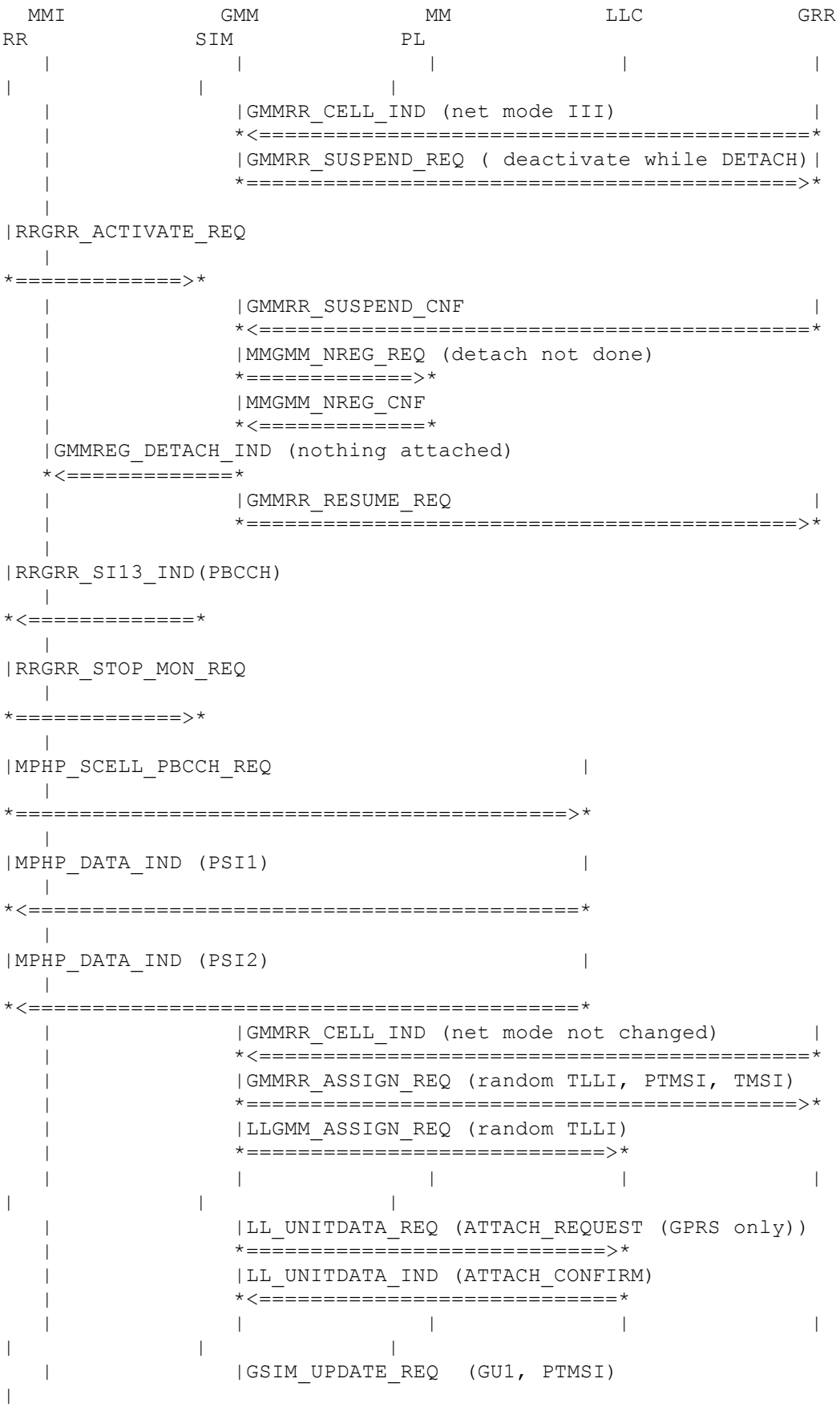
Description:

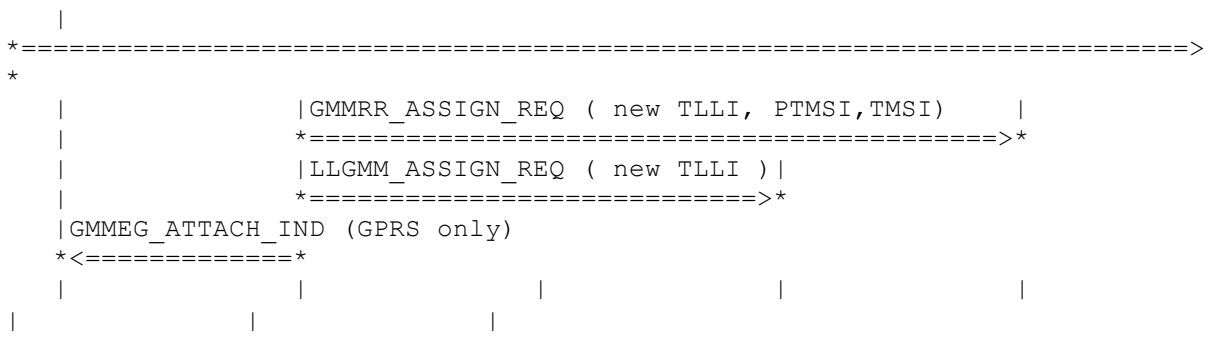
MS class BG.

GRR informs GMM that a cell in network mode of operation III was found.
MM is deactivated and is requested to start its own IMSI detach procedure. When the detach procedure is finished MM forwards the result to GMM and MMI is informed. GMM starts the normal attach procedure.

Preamble:

MGM012


MMI
GMM
MM
LLC
GRR
RR
SIM
PL
GMMRR_CELL_IND (net mode III)
GMMRR_SUSPEND_REQ (deactivate while DETACH)
RRGRR_ACTIVATE_REQ
GMMRR_SUSPEND_CNF
MMGMM_NREG_REQ (detach not done)
MMGMM_NREG_CNF
GMMREG_DETACH_IND (nothing attached)
GMMRR_RESUME_REQ
RRGRR_SI13_IND(PBCCH)
RRGRR_STOP_MON_REQ
MPHP_SCELL_PBCCH_REQ
MPHP_DATA_IND (PSI1)
MPHP_DATA_IND (PSI2)
GMMRR_CELL_IND (net mode not changed)
GMMRR_ASSIGN_REQ (random TLLI, PTMSI, TMSI)
LLGMM_ASSIGN_REQ (random TLLI)
LL_UNITDATA_REQ (ATTACH_REQUEST (GPRS only))
LL_UNITDATA_IND (ATTACH_CONFIRM)
GSIM_UPDATE_REQ (GU1, PTMSI)



History:

10-Apr-00	ANS	Initial
24-Jul-00	MPA	revised

5.2.5 MGM014: Change of net mode from III to II

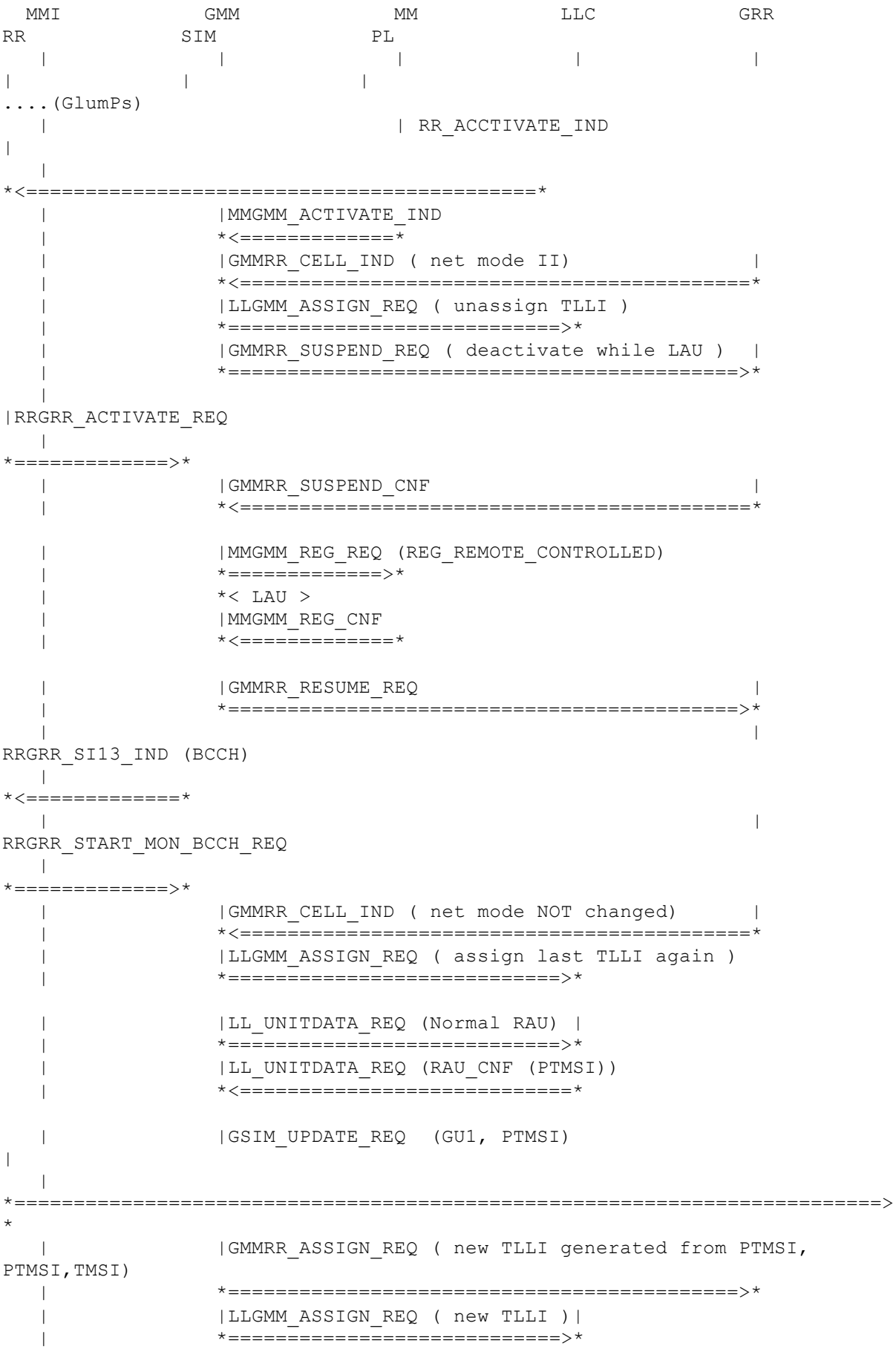
Description:

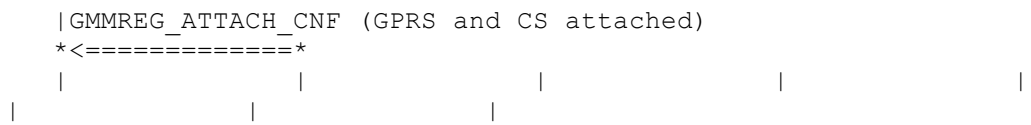
MS class BG.
GPRS-only attached.

GRR changes the routing area and the network mode of operation changes from III to II. GMM suspends GRR and requestes MM to perform the IMSI attach proceduere with indicating the result to GMM at the end. MM is still in state DEACTIVATED. After location update proceudre GRR is resumed, GRR selects all GPRS cell relevant data and passes this data with GMMRR_CELL_IND to GMM. GMM performs the normal routing area update procedure and indicates the result to MMI.

Preamble:

MGM013


MMI
GMM
MM
LLC
GRR
RR
SIM
PL
....(GlumPs)
| RR_ACCTIVATE_IND
|MMGMM_ACTIVATE_IND
|GMMRR_CELL_IND (net mode II)
|LLGMM_ASSIGN_REQ (unassign TLLI)
|GMMRR_SUSPEND_REQ (deactivate while LAU)
|RRGRR_ACTIVATE_REQ
|GMMRR_SUSPEND_CNF
|MMGMM_REG_REQ (REG_REMOTE_CONTROLLED)
*< LAU >
|MMGMM_REG_CNF
|GMMRR_RESUME_REQ
RRGRR_SI13_IND (BCCH)
RRGRR_START_MON_BCCH_REQ
|GMMRR_CELL_IND (net mode NOT changed)
|LLGMM_ASSIGN_REQ (assign last TLLI again)
|LL_UNITDATA_REQ (Normal RAU)
|LL_UNITDATA_REQ (RAU_CNF (PTMSI))
|GSIM_UPDATE_REQ (GU1, PTMSI)
|GMMRR_ASSIGN_REQ (new TLLI generated from PTMSI,
PTMSI,TMSI)
|LLGMM_ASSIGN_REQ (new TLLI)



History:

10-Apr-00	ANS	Initial
25-May-00	ANS	??_activate_ind added
24-Jul-00	MPA	revised

5.2.6 MGM015: Change of net mode from III to I

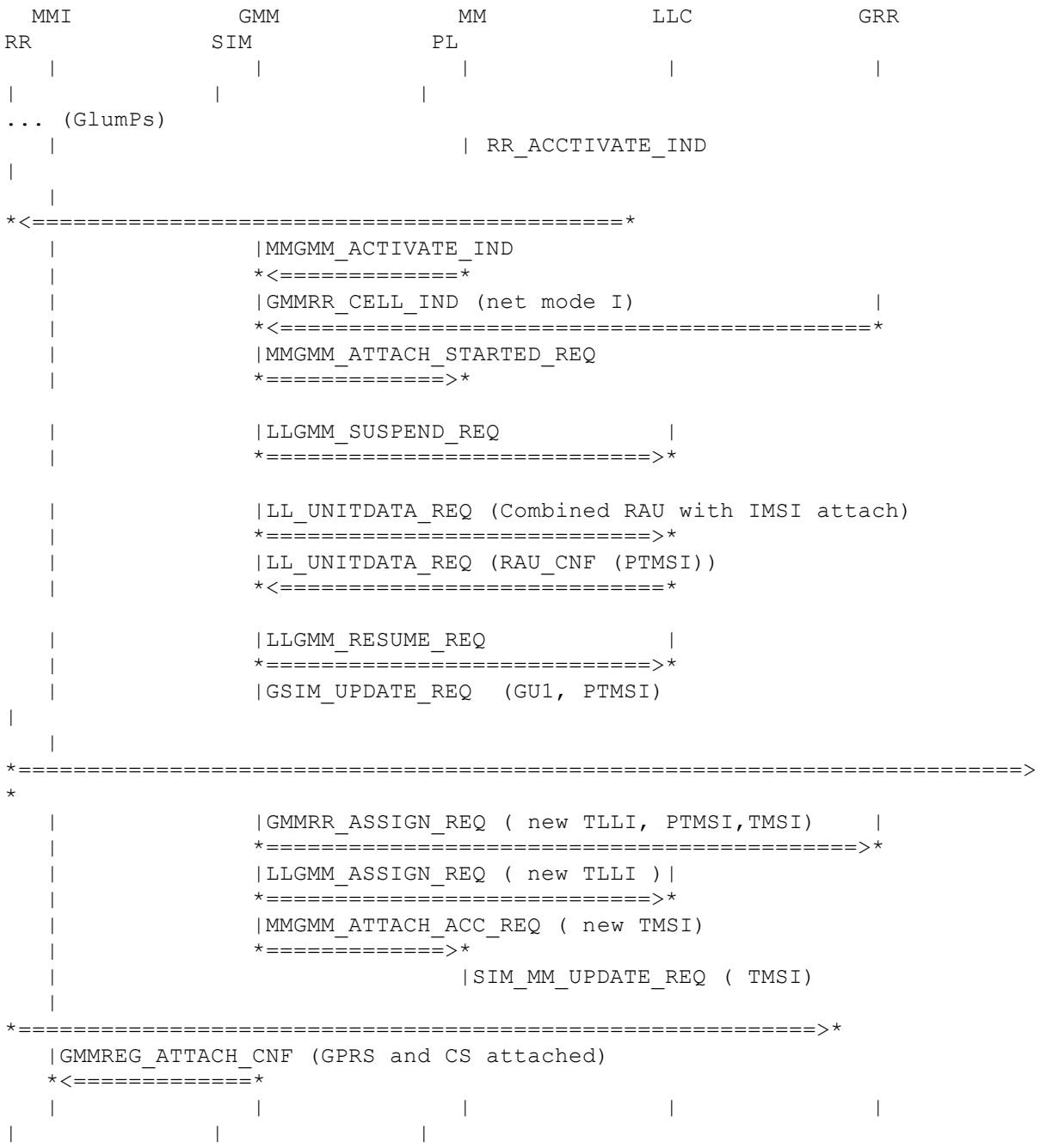
Description:

MS class BG.
GPRS-only attached.

GRR changes the routing area and the network mode of operation changes from III to I. GMM performs the combined routing area update procedure and indicates the result to MM and MMI. MM sets the update state to U1 resets the location update attempt counter and gets the new TMSI. The TMSI is passed to SIM and the PTMSI is passed to GSIM.

Preamble:

MGM013



History:

10-Apr-00	ANS	Initial
25-May-00	ANS	??_activate_ind added

5.2.7 MGM016 Change of net mode from I to II

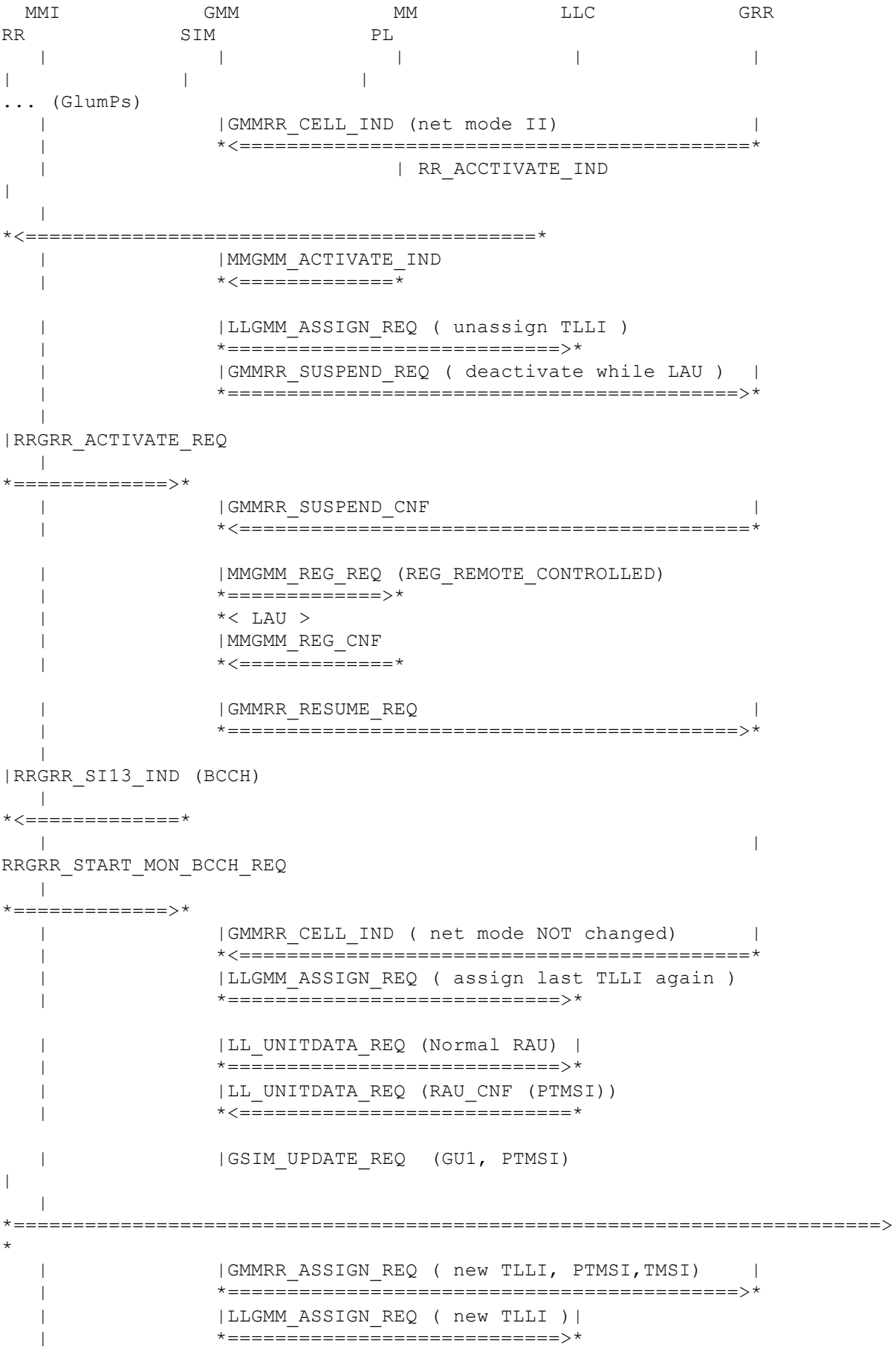
Description:

MS class BG.
net mode I.
Combined attached.

GRR changes the routing area and the network mode of operation changes from I to II. GMM suspends GRR to request MM to perform location update on its own procedures. After finishing location update GMM resumes GRR and performs normal routing area update.

Preamble:

MGM015


MMI
GMM
MM
LLC
GRR
RR
SIM
PL
... (GlumPs)
|GMMRR_CELL_IND (net mode II)
RR_ACCTIVATE_IND
|MMGMM_ACTIVATE_IND
|LLGMM_ASSIGN_REQ (unassign TLLI)
|GMMRR_SUSPEND_REQ (deactivate while LAU)
|RRGRR_ACTIVATE_REQ
|GMMRR_SUSPEND_CNF
|MMGMM_REG_REQ (REG_REMOTE_CONTROLLED)
< LAU >
|MMGMM_REG_CNF
|GMMRR_RESUME_REQ
|RRGRR_SI13_IND (BCCH)
RRGRR_START_MON_BCCH_REQ
|GMMRR_CELL_IND (net mode NOT changed)
|LLGMM_ASSIGN_REQ (assign last TLLI again)
|LL_UNITDATA_REQ (Normal RAU)
|LL_UNITDATA_REQ (RAU_CNF (PTMSI))
|GSIM_UPDATE_REQ (GU1, PTMSI)
|GMMRR_ASSIGN_REQ (new TLLI, PTMSI,TMSI)
|LLGMM_ASSIGN_REQ (new TLLI)

| | | | | |
| | | |

History:

10-Apr-00	ANS	Initial
25-May-00	ANS	??_activate_ind added
24-Jul-00	MPA	revised

5.2.8 MGM017 Change of net mode from I to III

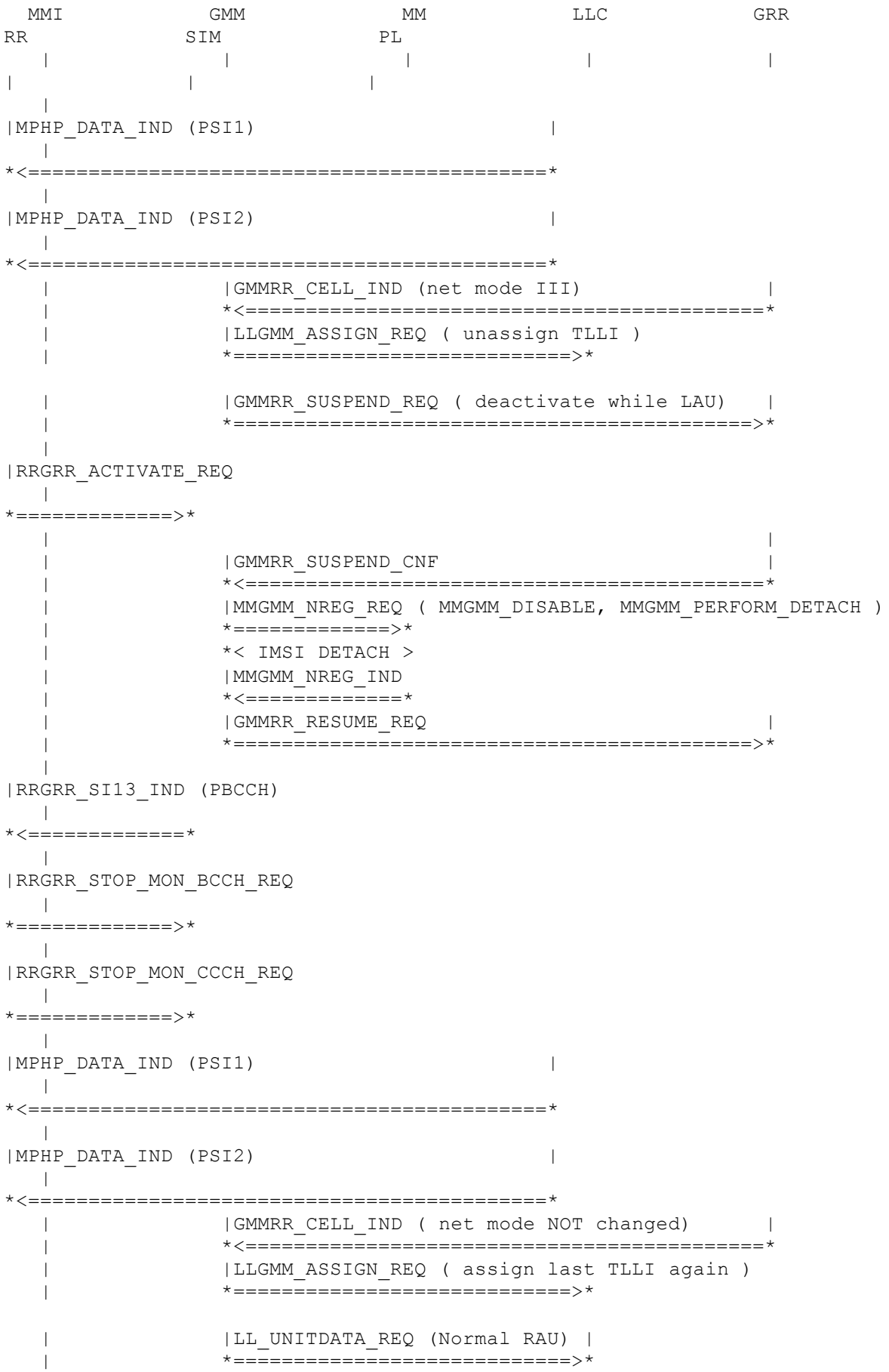
Description:

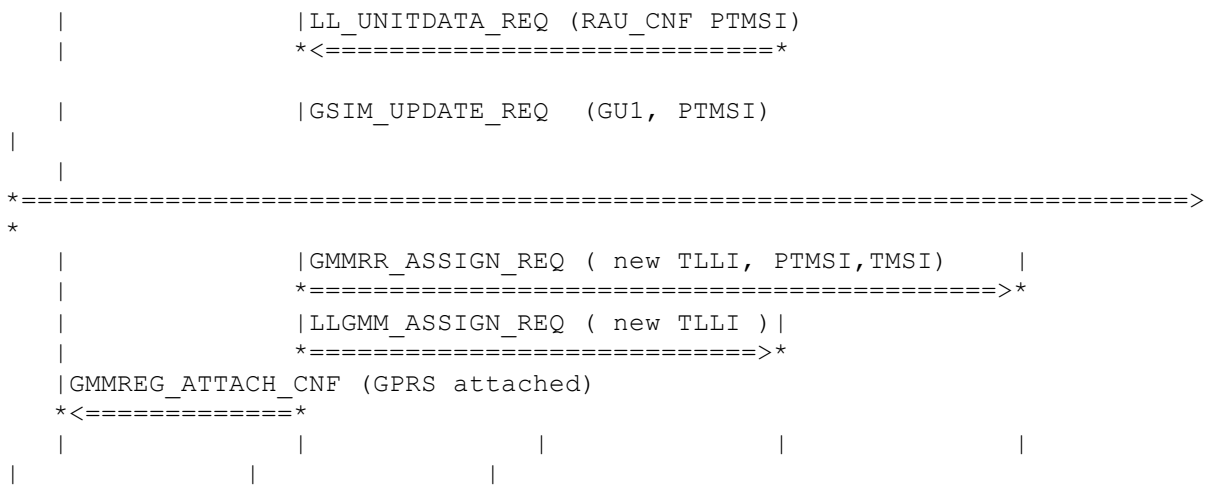
MS class BG.
net mode I.
Combined attached.

GRR changes the routing area and the network mode of operation changes from I to III. GMM suspends GRR to request MM to perform location update by its own procedures. After finishing location update GMM resumes GRR and performs normal routing area update.

Preamble:

MGM015


MMI
GMM
MM
LLC
GRR
RR
SIM
PL
MPHP_DATA_IND (PSI1)
MPHP_DATA_IND (PSI2)
GMMRR_CELL_IND (net mode III)
LLGMM_ASSIGN_REQ (unassign TLLI)
GMMRR_SUSPEND_REQ (deactivate while LAU)
RRGRR_ACTIVATE_REQ
GMMRR_SUSPEND_CNF
MMGMM_NREG_REQ (MMGMM_DISABLE, MMGMM_PERFORM_DETACH)
< IMSI DETACH >
MMGMM_NREG_IND
GMMRR_RESUME_REQ
RRGRR_SI13_IND (PBCCH)
RRGRR_STOP_MON_BCCH_REQ
RRGRR_STOP_MON_CCCH_REQ
MPHP_DATA_IND (PSI1)
MPHP_DATA_IND (PSI2)
GMMRR_CELL_IND (net mode NOT changed)
LLGMM_ASSIGN_REQ (assign last TLLI again)
LL_UNITDATA_REQ (Normal RAU)



History:

10-Apr-00	ANS	Initial
24-Jul-00	MPA	revised

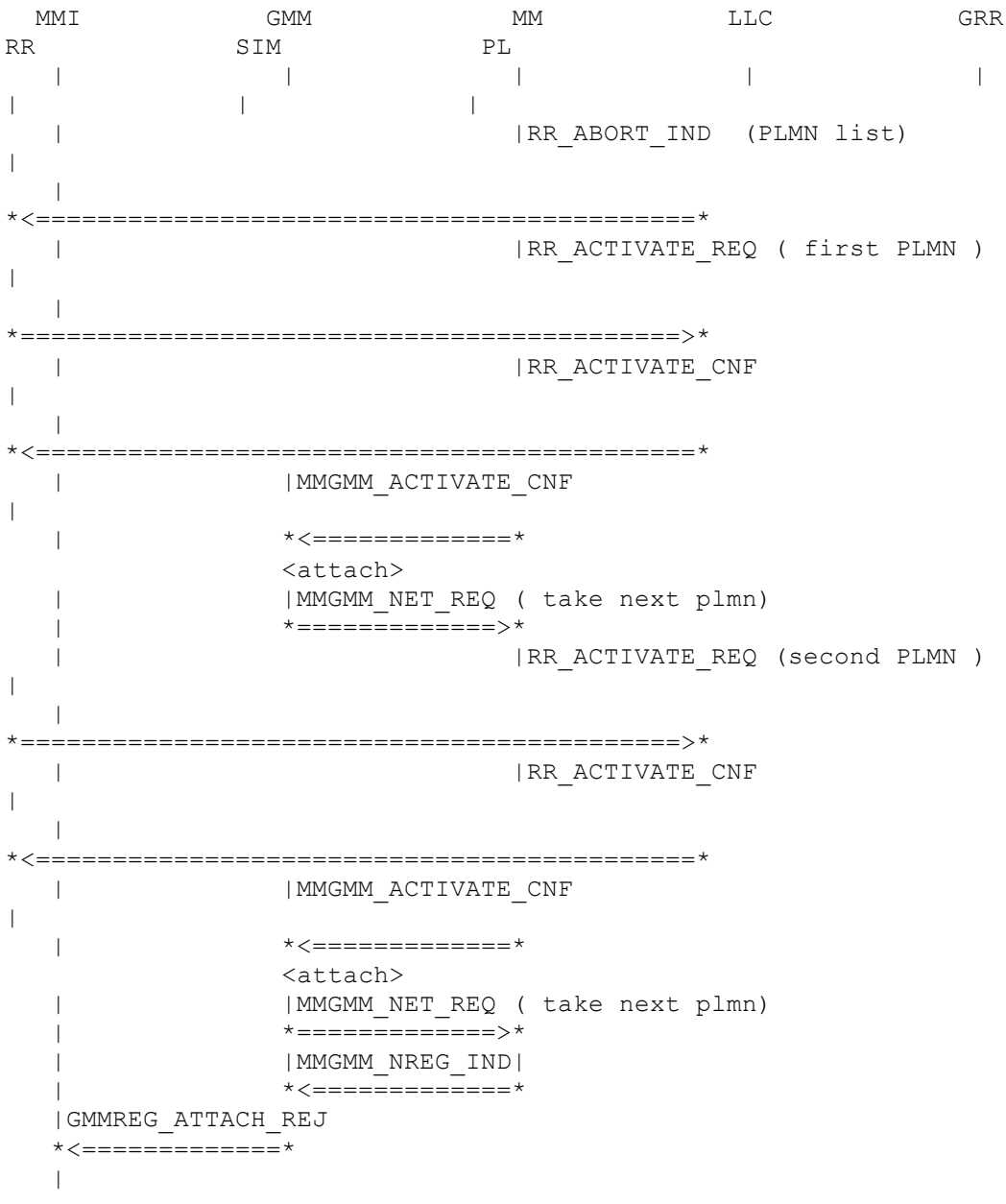
5.2.9 MGM018: Automatic networck selection mode

Description:

MS class BG.

Preamble:

MGM002



History:

	26-Apr-00	ANS	Initial

5.3 Cell found – mobile class BC

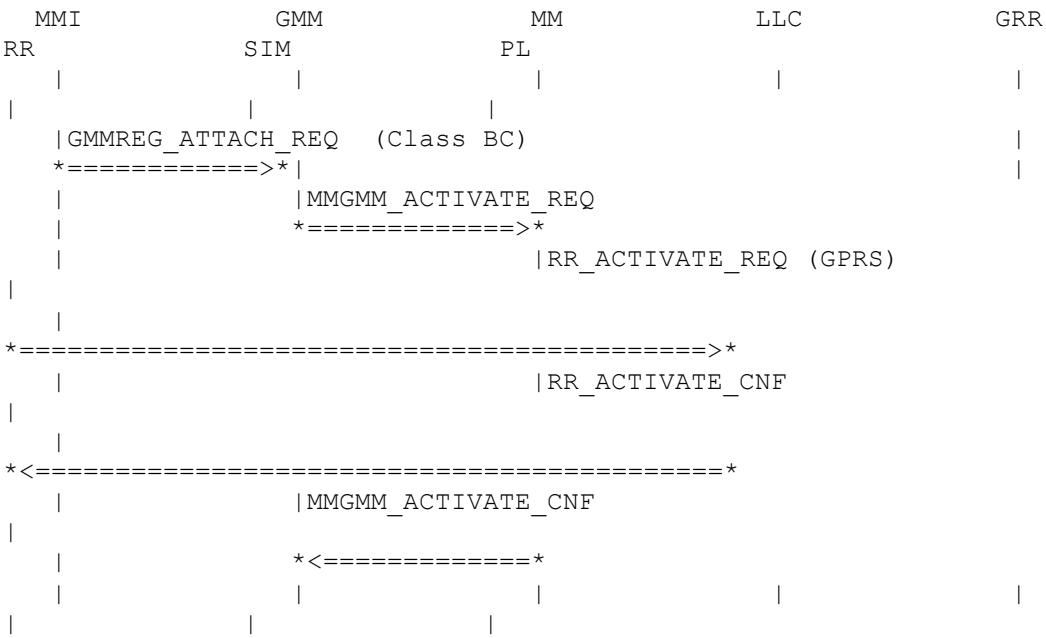
5.3.1 MGM200: IMSI Cell found

Description:

MMI switches to class BC mobile.
Successful conclusion of cell selection is signalled by the receipt of a RR-ACTIVATE confirmation primitive.

Preamble:

MGM013



History:

	10-Apr-00	ANS	Initial

5.3.2 MGM201: GPRS Cell not found

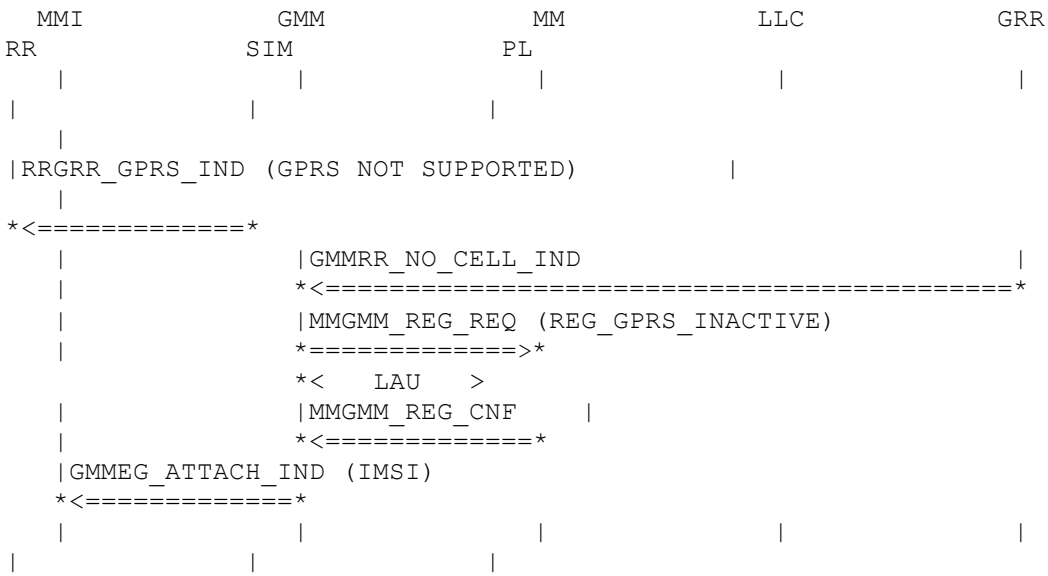
Description:

MS class BC.

NO GPRS cell was found by RR. RR informs GRR that the current cell does not support GPRS. GRR passes this information to GMM and GMM switches the main actvities to the GSM side with the MM_ACTIVATE_MM_REQ primitve. MM has to ast as an GSM-only mobile untlil the MM_DEACTVATE_MM_REQ primitive is received. That means, MM has to start the attach procedure on its own. After successful location update (LAU) MM informs GMM and not MMI about the result. GMM forwards this information to MMI.
If the LAI is changed, MM forwards GMM the LAI.

Preamble:

MGM200



History:

	10-Apr-00	ANS	Initial

5.3.3 MGM202: GPRS Cell found in state GPRS deactivated

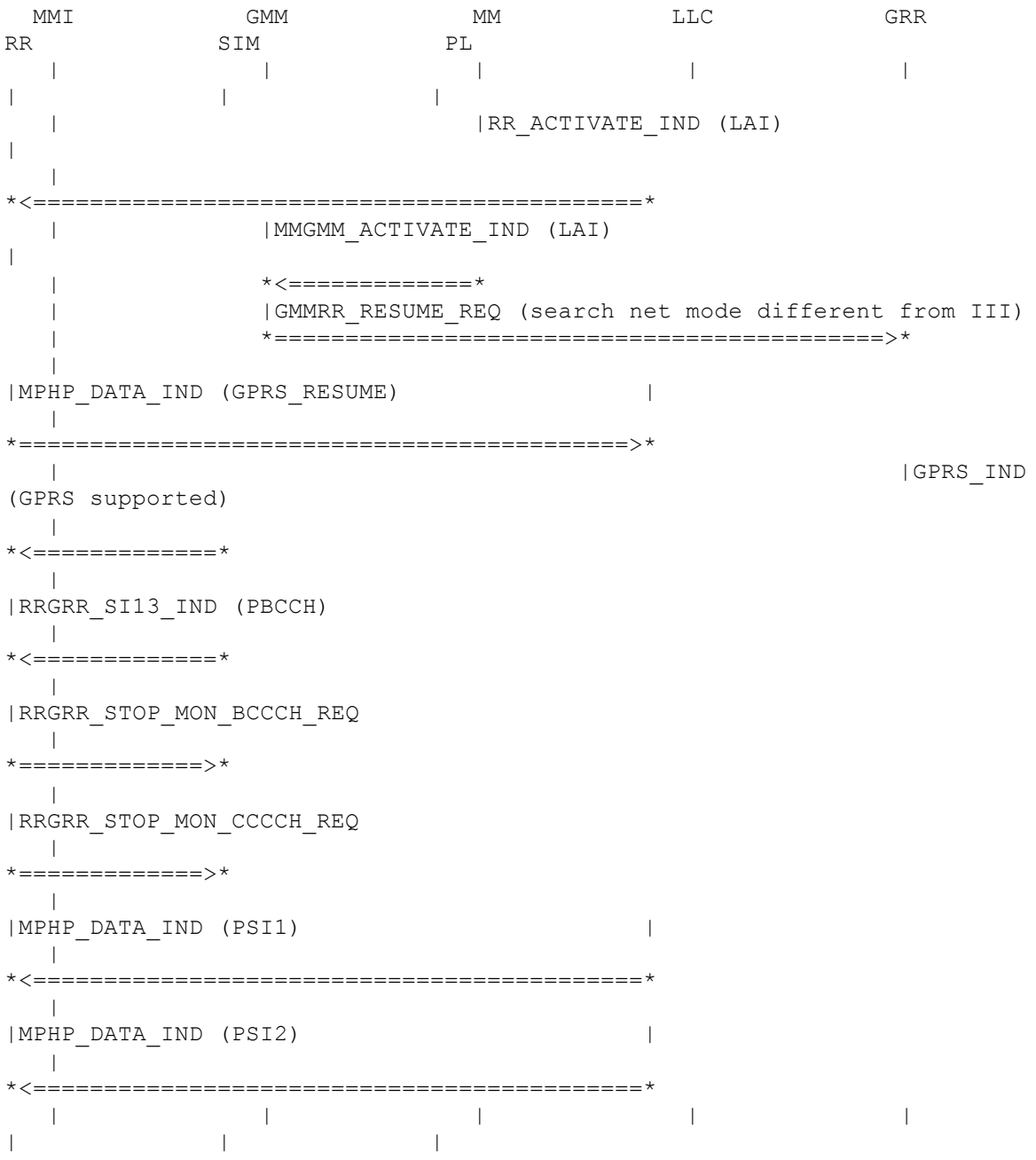
Description:

MS class BC.
IMSI only attached.

RR informs GRR about finding a GPRS cell. GMM requests GRR to search for a cell which supports a different net mode than net mode III.

Preamble:

MGM201



History:

10-Apr-00	ANS	Initial
15-May-00	ANS	MM_DEACTIVATE_REQ removed.

5.3.4 MGM203: GPRS Cell found in state GPRS deaktivated – net mode III

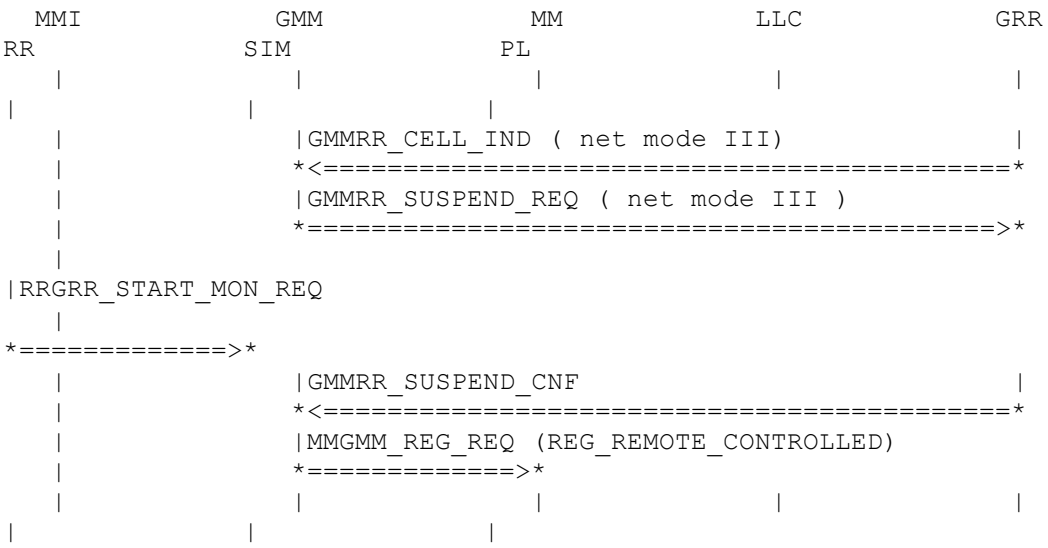
Description:

MS class BC.
IMSI only attached.

GRR informs GMM that a cell in network mode of operation III was found.

Preamble:

MGM202



History:

10-Apr-00	ANS	Initial
15-May-00	ANS	MM_ACTIVATE_MM replaced with MMGMM_REG_REQ

5.3.5 MGM206: Change of net mode from III to a different one

Description:

MS class BC.
IMSI-only attached.

RR indicates that a new cell was selected. MM forwards the new LAI to GMM. If the LAI changed then GMM resumes GRR with search for network of operation request. GRR responses with GMMRR_CELL_IND.

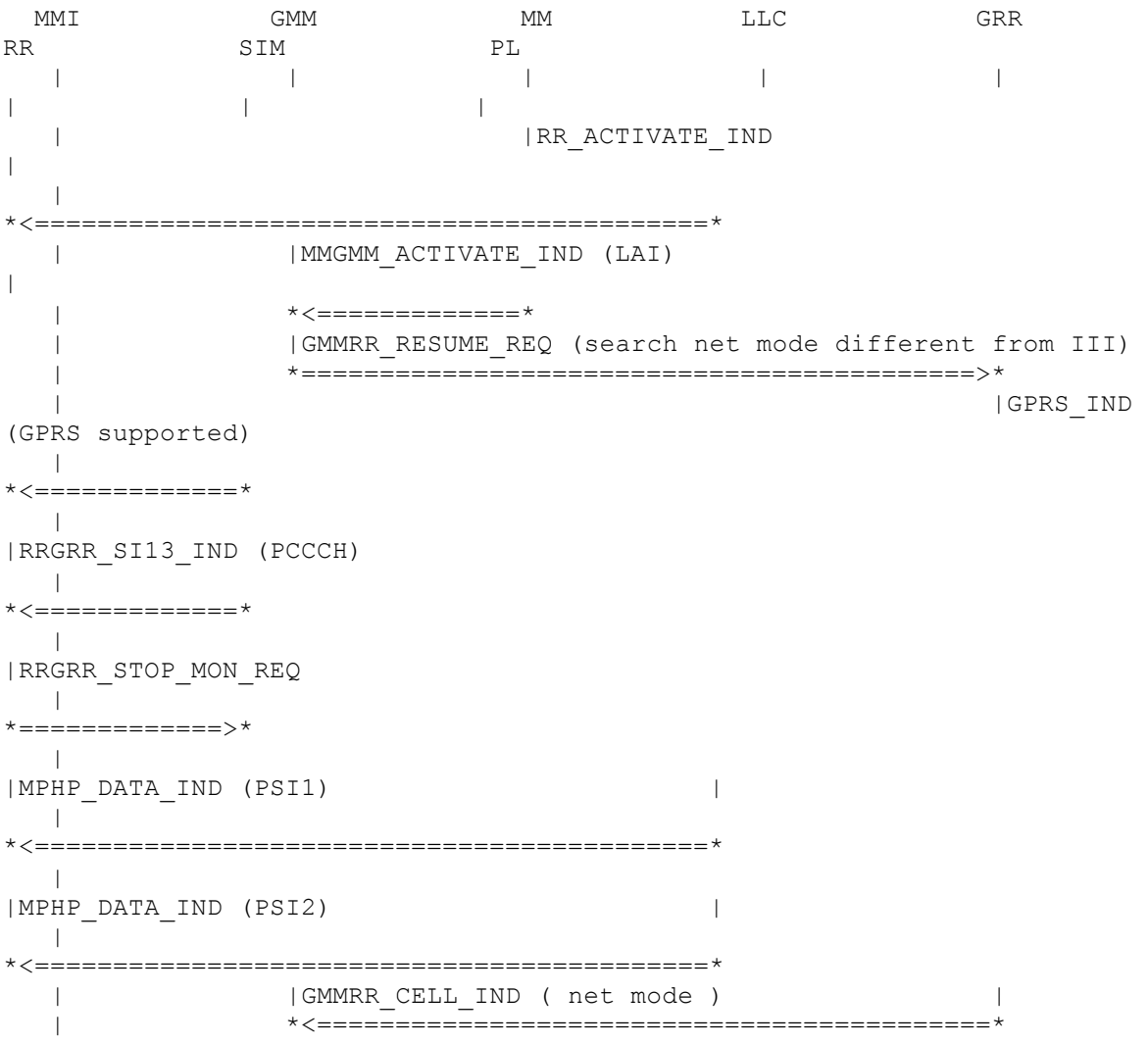
Variant A: net mode I found
Variant B: net mode II found

Preamble:

MGM203

Variants:

<A>....<B>



History:

10-Apr-00	ANS	Initial
15-May-00	ANS	MM_DEACTIVATE_MM removed

5.3.6 MGM204: Change of net mode from III to II

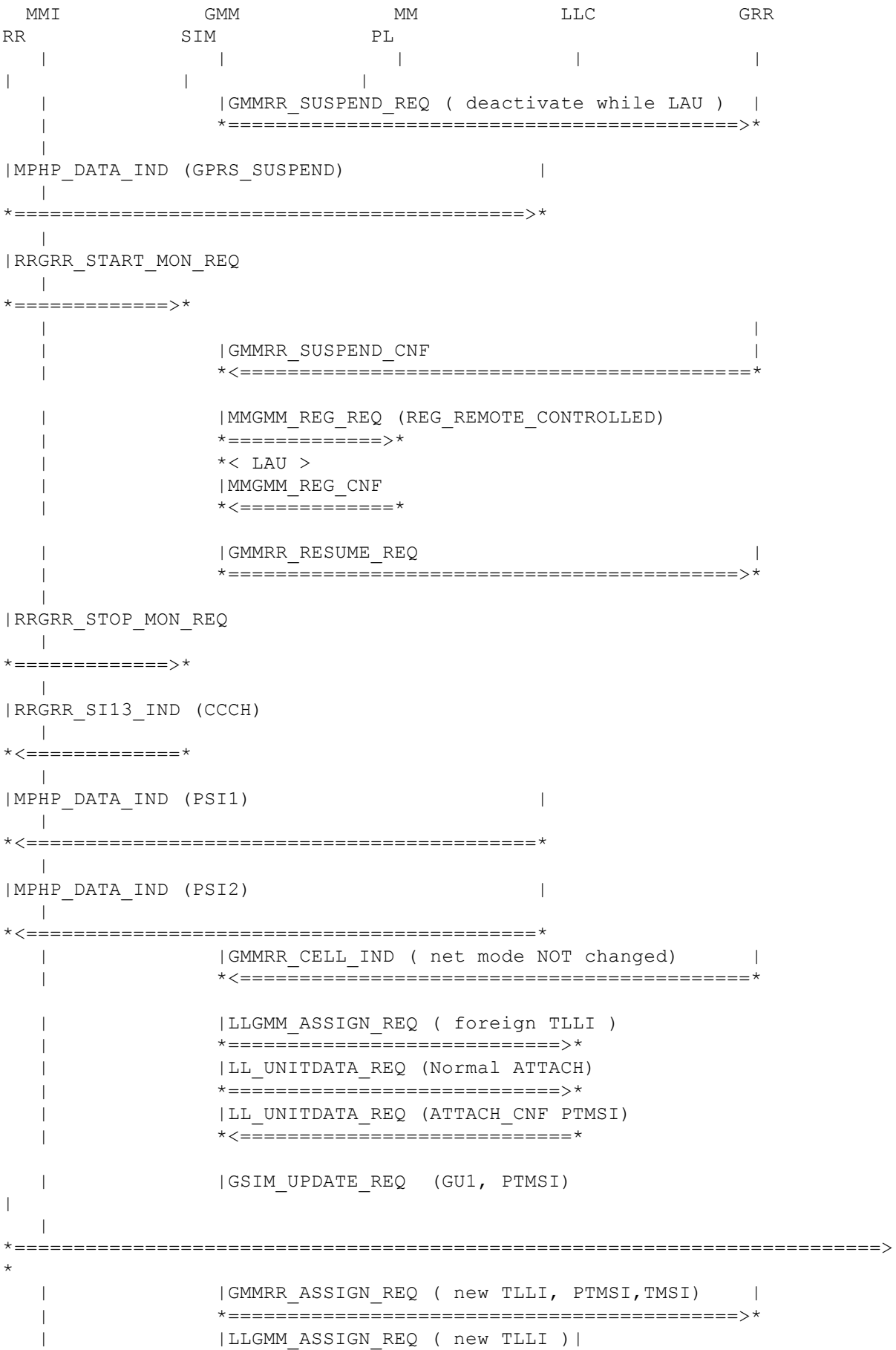
Description:

MS class BC.
IMSI-only attached.
MM deactivated.

GRR has changed the routing area and the network mode of operation changes from III to II. GMM suspends GRR to request MM to perform location update procedure. At the end of this procedure GMM switches on GRR again an perform th GPRS attach procedure.

Preamble:

MGM206B


MMI
GMM
MM
LLC
GRR
RR
SIM
PL
|GMMRR_SUSPEND_REQ (deactivate while LAU)
|MPHP_DATA_IND (GPRS_SUSPEND)
|RRGRR_START_MON_REQ
|GMMRR_SUSPEND_CNF
|MMGMM_REG_REQ (REG_REMOTE_CONTROLLED)
*< LAU >
|MMGMM_REG_CNF
|GMMRR_RESUME_REQ
|RRGRR_STOP_MON_REQ
|RRGRR_SI13_IND (CCCH)
|MPHP_DATA_IND (PSI1)
|MPHP_DATA_IND (PSI2)
|GMMRR_CELL_IND (net mode NOT changed)
|LLGMM_ASSIGN_REQ (foreign TLLI)
|LL_UNITDATA_REQ (Normal ATTACH)
|LL_UNITDATA_REQ (ATTACH_CNF PTMSI)
|GSIM_UPDATE_REQ (GU1, PTMSI)
|GMMRR_ASSIGN_REQ (new TLLI, PTMSI,TMSI)
|LLGMM_ASSIGN_REQ (new TLLI)|

```
   |               *============================>*
   |GMMREG_ATTACH_CNF (combined ATTACHED)
   *<=============*
   |               |               |               |               |
|               |               |
```

History:

10-Apr-00	ANS	Initial
15-May-00	ANS	MMGMM_REG_ substituted

5.3.7 MGM205: Change of net mode from III to I

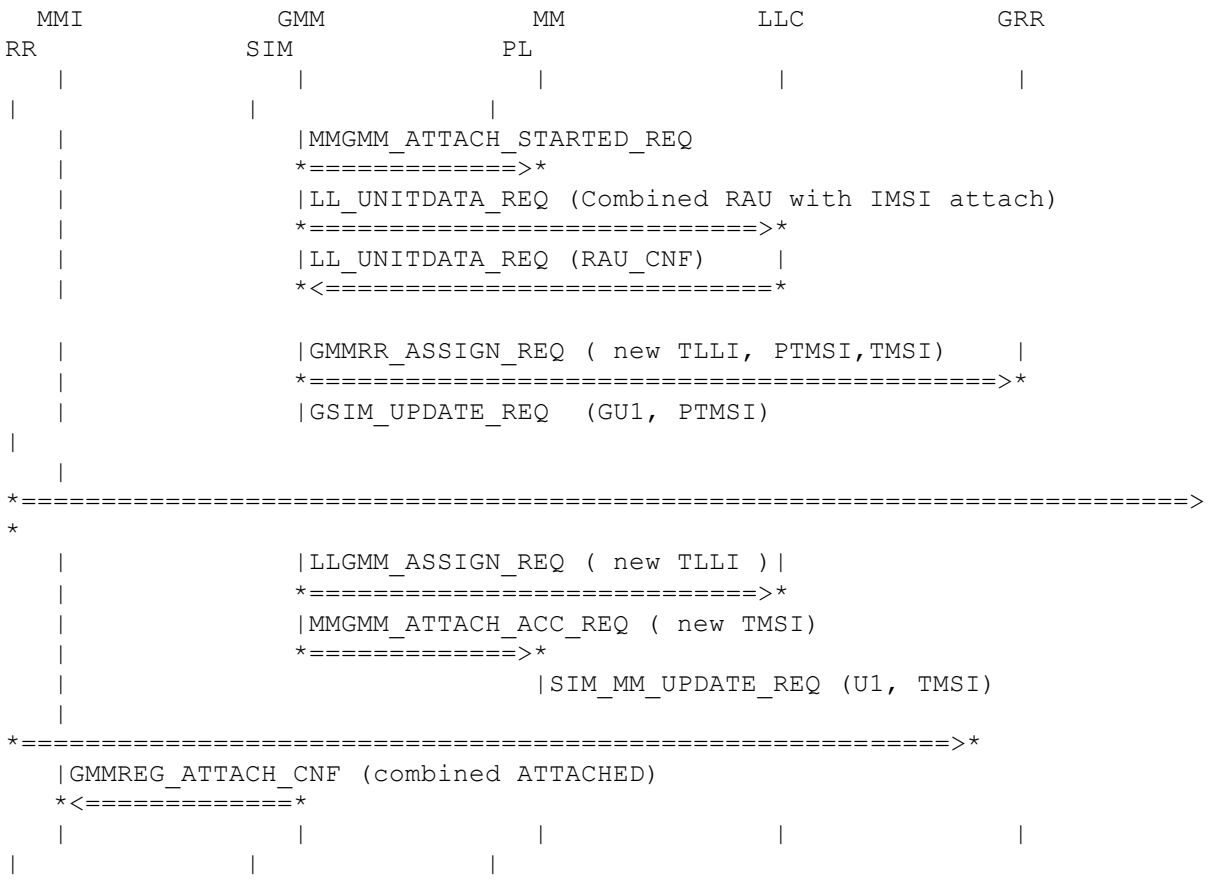
Description:

MS class BC.
IMSI-only attached.
MM deactivated.

GRR has changed the routing area and the network mode of operation changes from III to I. GMM performs the combined routing area update procedure and indicates the result to MM and MMI. MM sets the update state to U1 resets the location update attempt counter and gets the new TMSI. The TMSI is passed to SIM and the PTMSI is passed to GSIM.

Preamble:

MGM206A



History:

10-Apr-00	ANS	Initial
15-May-00	ANS	attach_started and attach_acc included.

5.3.8 MGM207 Change of net mode from I to II

Description:

MS class BG.
net mode I.
Combined attached.

see MGM016.

5.3.9 MGM208 Change of net mode from I to III

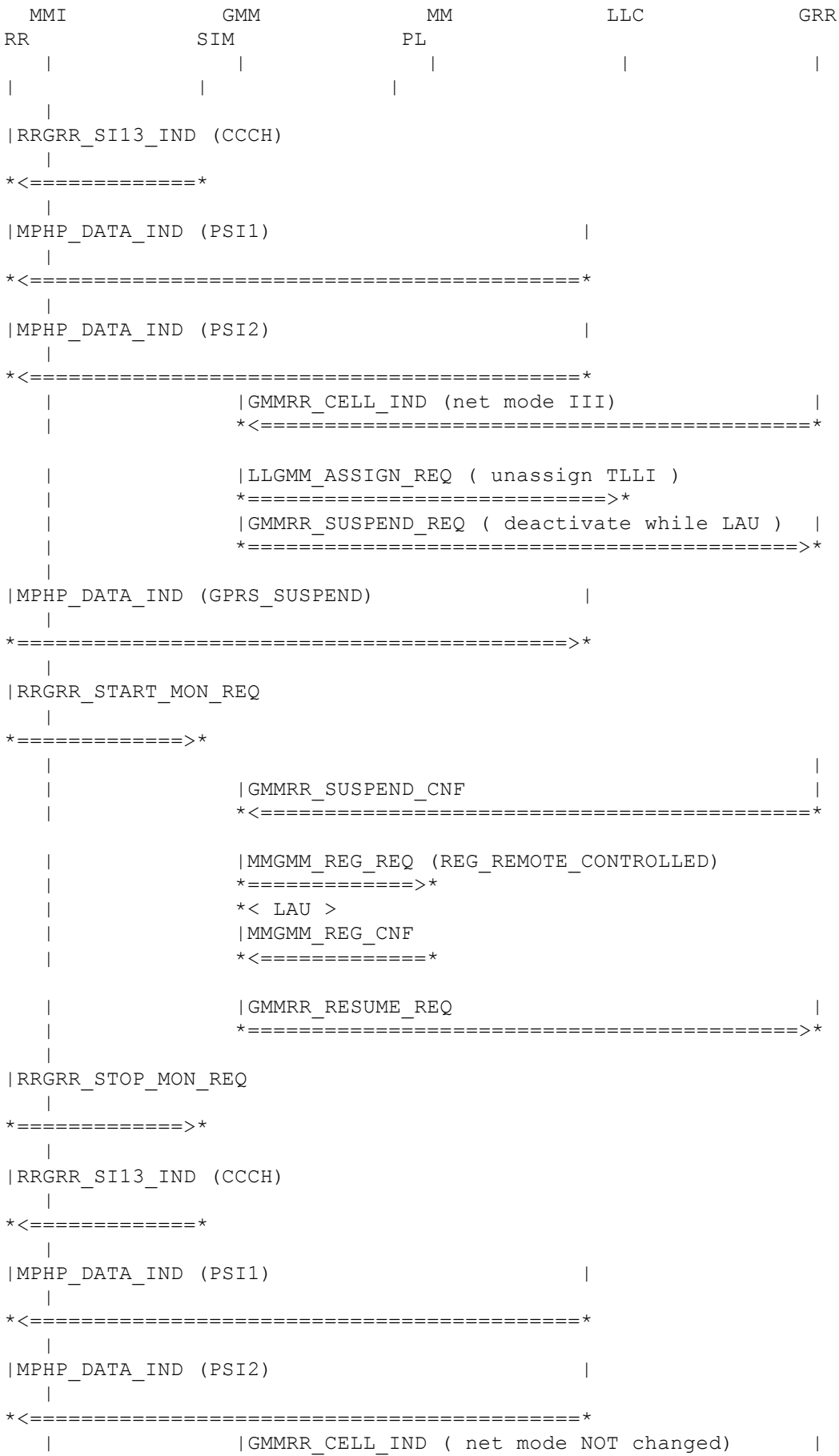
Description:

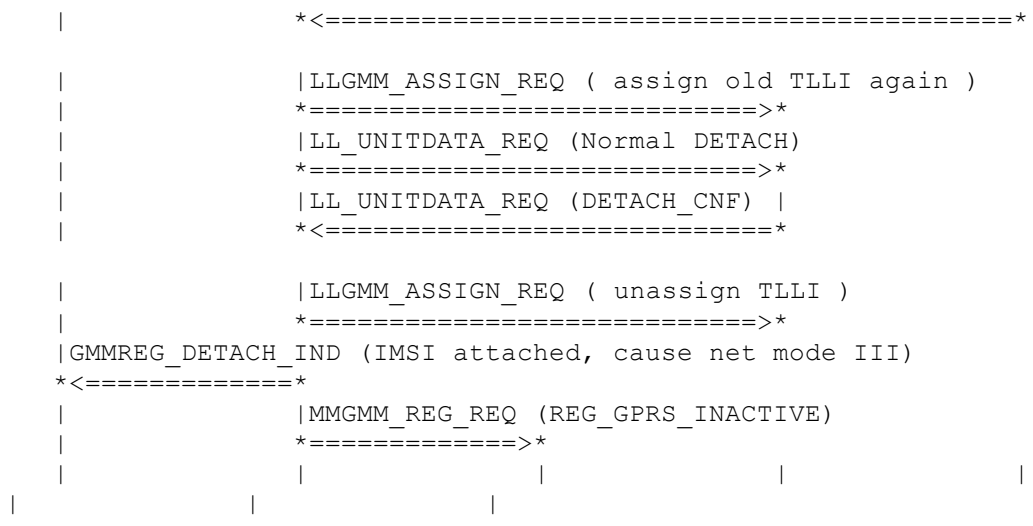
MS class BC.
net mode I.
Combined attached.

GRR changes the routing area and the network mode of operation changes from I to III. GMM suspends GRR to request MM to perform location update by its own procedures. After finishing location update GMM resumes GRR and performs normal detach procedure.

Preamble:

MGM205


MMI
GMM
MM
LLC
GRR
RR
SIM
PL
|RRGRR_SI13_IND (CCCH)
|MPHP_DATA_IND (PSI1)
|MPHP_DATA_IND (PSI2)
|GMMRR_CELL_IND (net mode III)
|LLGMM_ASSIGN_REQ (unassign TLLI)
|GMMRR_SUSPEND_REQ (deactivate while LAU)
|MPHP_DATA_IND (GPRS_SUSPEND)
|RRGRR_START_MON_REQ
|GMMRR_SUSPEND_CNF
|MMGMM_REG_REQ (REG_REMOTE_CONTROLLED)
*< LAU >
|MMGMM_REG_CNF
|GMMRR_RESUME_REQ
|RRGRR_STOP_MON_REQ
|RRGRR_SI13_IND (CCCH)
|MPHP_DATA_IND (PSI1)
|MPHP_DATA_IND (PSI2)
|GMMRR_CELL_IND (net mode NOT changed)



History:

11-Apr-00	ANS	Initial
15-May-00	ANS	MMGMM_REG_REQ appended.

5.4 Mobile originated call

5.4.1 MGM300 Mobile originated call indicated – BG

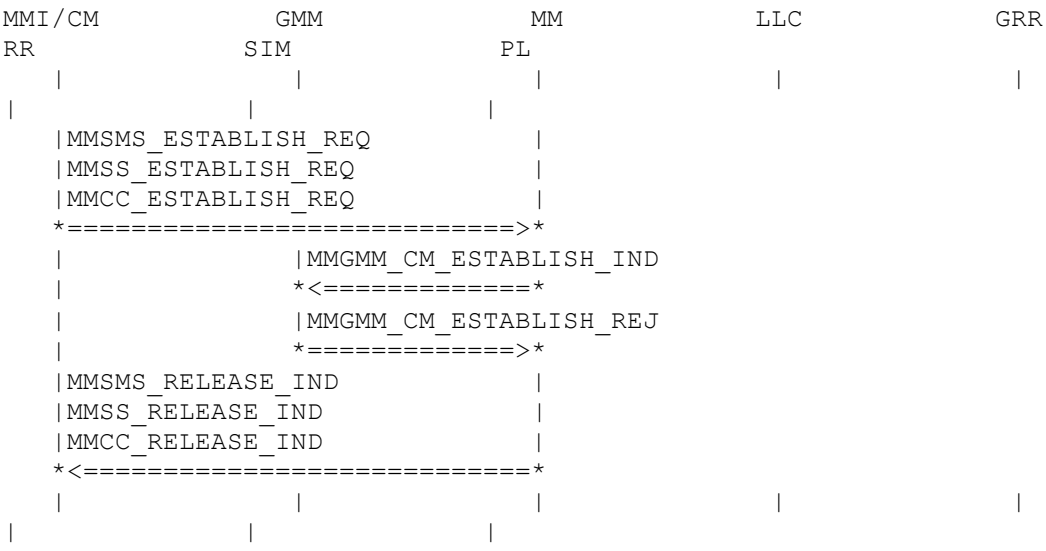
Description:

MS class BG.
net mode III.
GPRS attached.

The trigger from connection management is forwarded to GMM. GMM rejeccts the establish request, because of the mobile class in net mode III.

Preamble:

MGM013



History:

11-Apr-00	ANS	Initial

5.4.2 MGM301 Mobile originated call indicated - BG

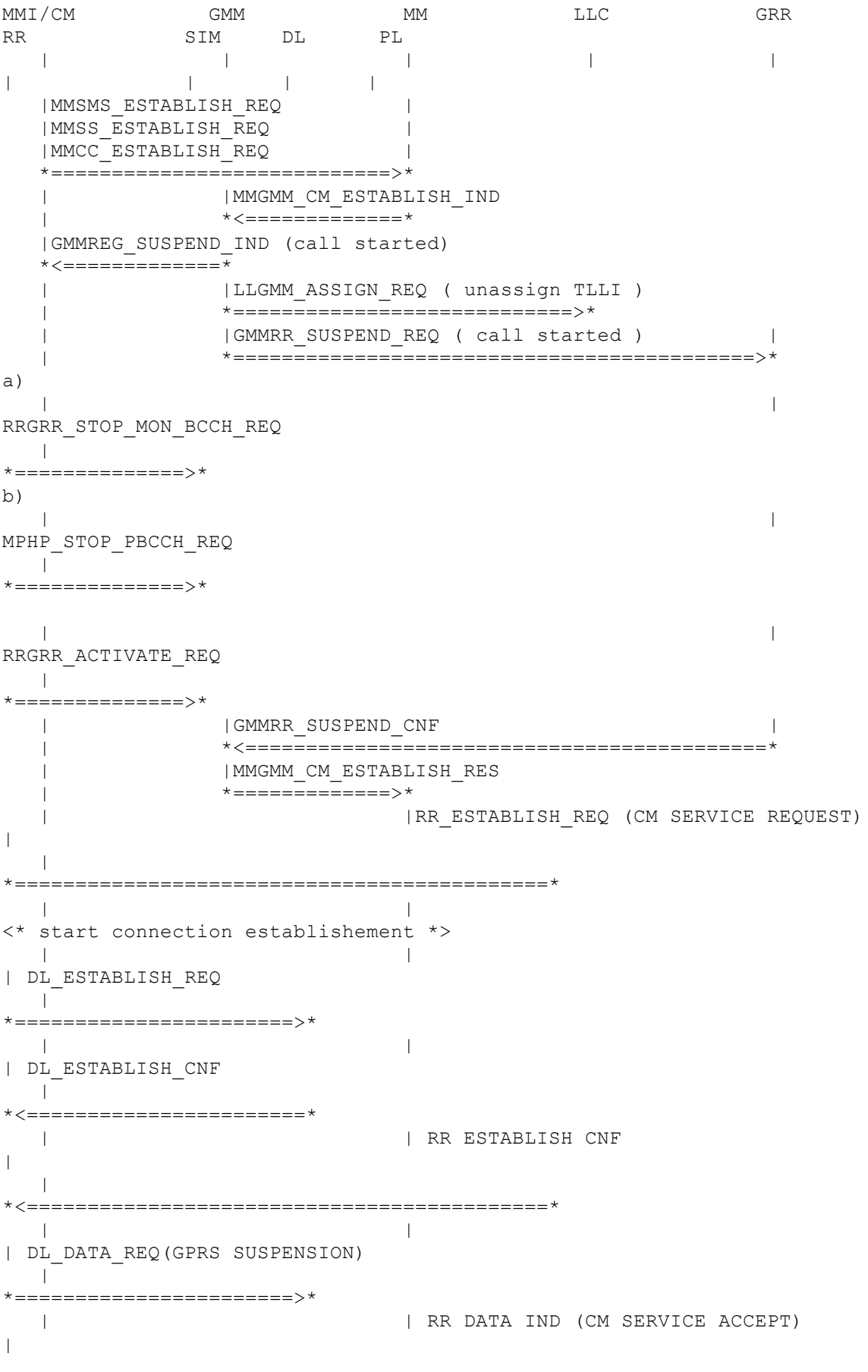
Description:

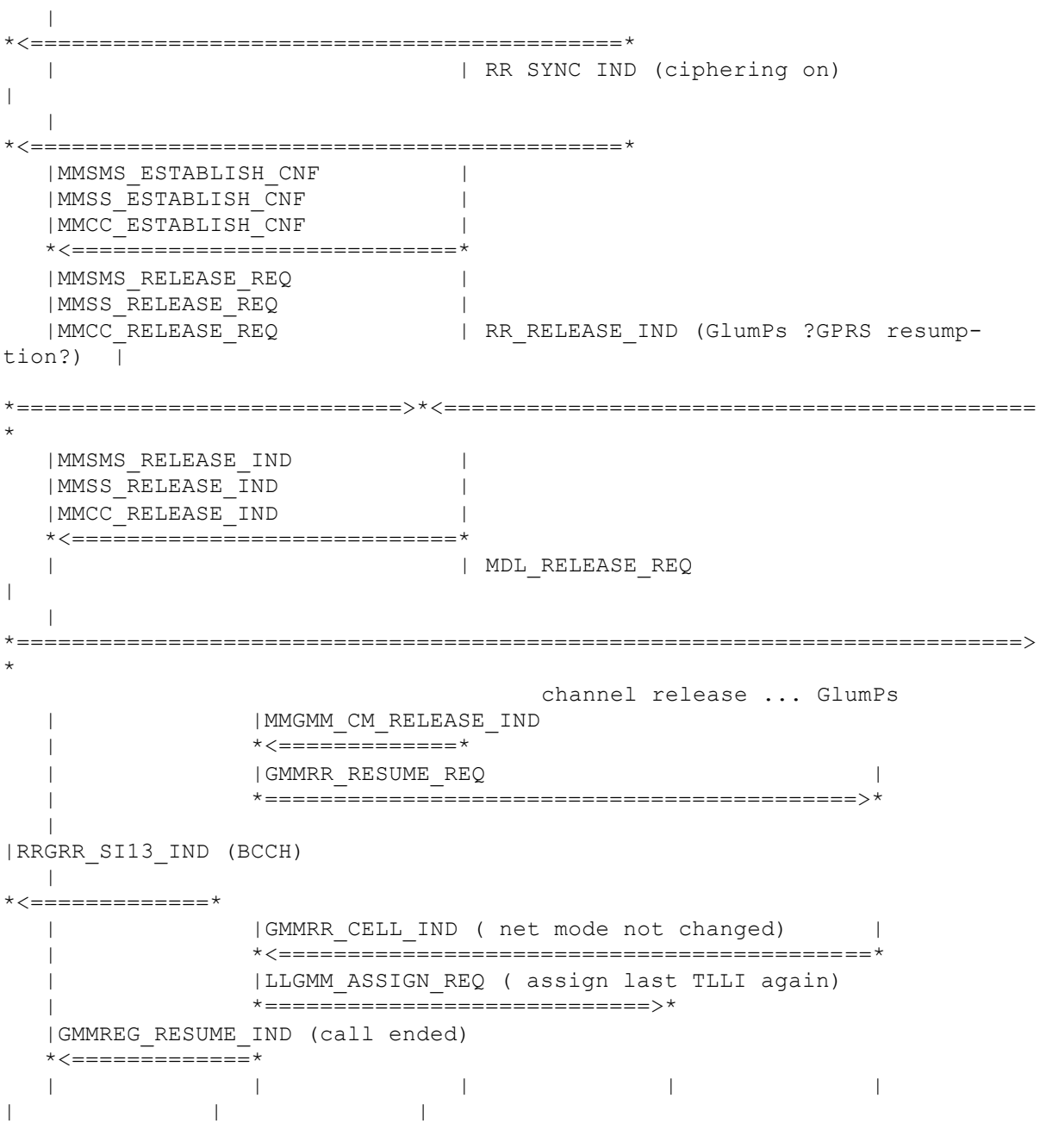
MS class BG.
net mode II.
Combined attached.

The trigger from connection management is forwarded to GMM. GMM suspends the GPRS side and switches to GSM by confirming the cm_establich primitive.

Preamble:

MGM014


MMI/CM
GMM
MM
LLC
GRR
RR
SIM
DL
PL
MMSMS_ESTABLISH_REQ
MMSS_ESTABLISH_REQ
MMCC_ESTABLISH_REQ
MMGMM_CM_ESTABLISH_IND
GMMREG_SUSPEND_IND (call started)
LLGMM_ASSIGN_REQ (unassign TLLI)
GMMRR_SUSPEND_REQ (call started)
a)
RRGRR_STOP_MON_BCCH_REQ
b)
MPHP_STOP_PBCCH_REQ
RRGRR_ACTIVATE_REQ
GMMRR_SUSPEND_CNF
MMGMM_CM_ESTABLISH_RES
RR_ESTABLISH_REQ (CM SERVICE REQUEST)
<* start connection establishement *>
DL_ESTABLISH_REQ
DL_ESTABLISH_CNF
RR ESTABLISH CNF
DL_DATA_REQ(GPRS SUSPENSION)
RR DATA IND (CM SERVICE ACCEPT)



History:

11-Apr-00	ANS	Initial

5.4.3 MGM302 Mobile originated call indicated – BC

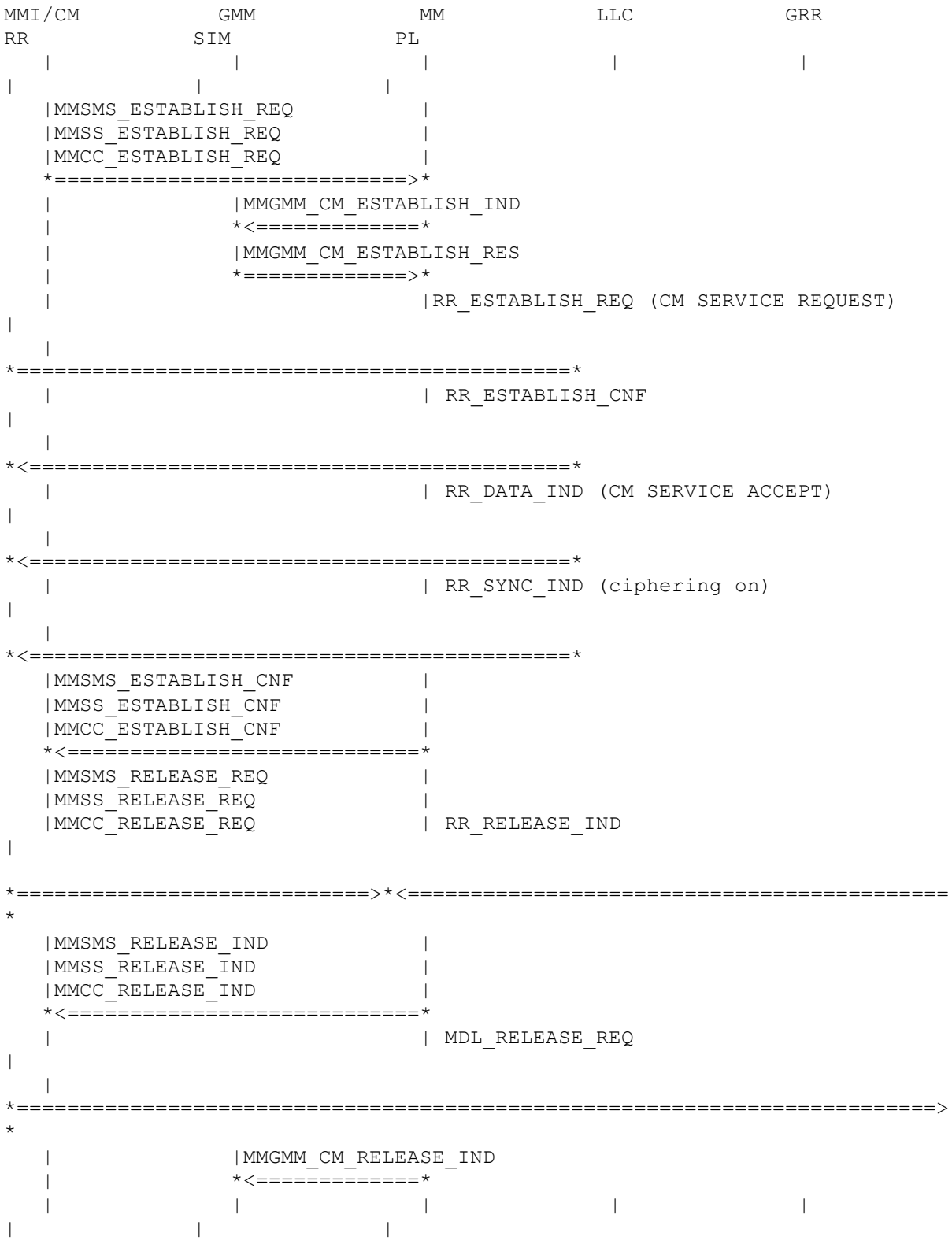
Description:

MS class BC.
net mode III.
IMSI attached.

The trigger from connection management is forwarded to GMM. GMM confirms MM the establish request and MM perform the mobile originated call procedure.

Preamble:

MGM203



History:

	12-Apr-00	ANS	Initial

5.4.4 MGM303 Mobile originated call indicated - BC

Description:

MS class BC.

net mode II.
Combined attached.

equivalent to MGM301.

Preamble:

MGM204

History:

12-Apr-00	ANS	Initial

5.5 Mobile terminated call

MGM400: Mobile terminated call indicated - BG

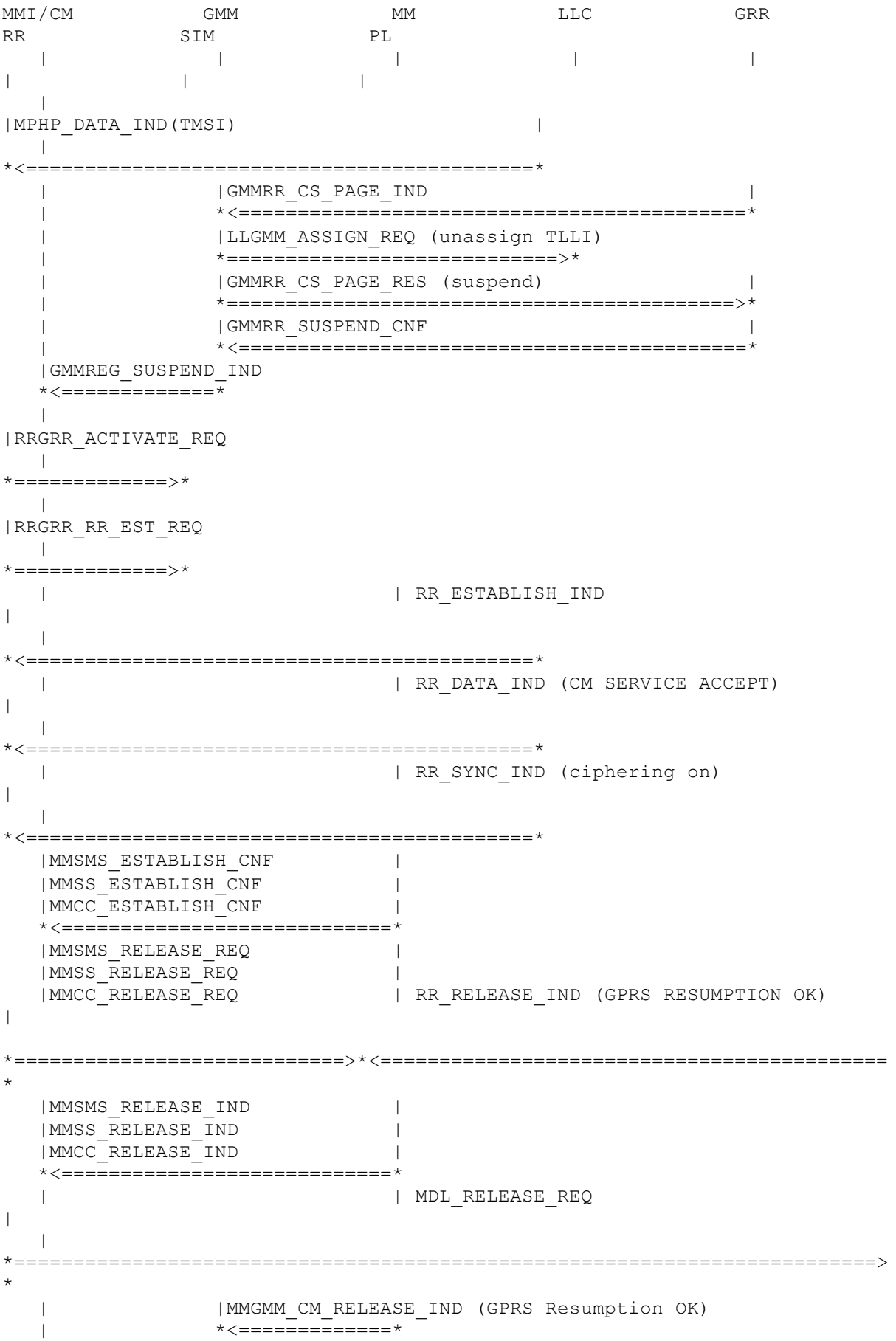
Description:

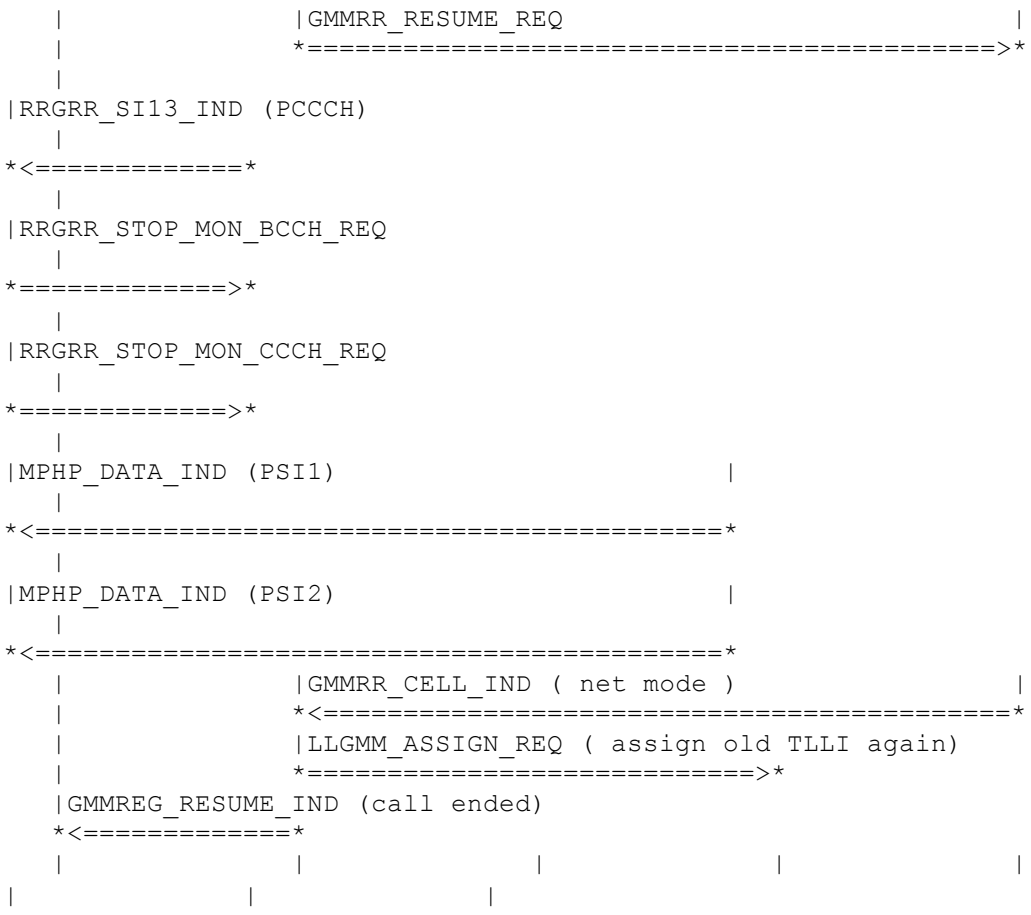
MS class BG.
net mode I.
Combined attached.

GRR receives a paging request for CS and indicates it to GMM. GMM suspends the GPRS side and confirms the paging request. RR follows the normal CS paging procedure.

Preamble:

MGM015


MMI/CM
GMM
MM
LLC
GRR
RR
SIM
PL
MPHP_DATA_IND(TMSI)
GMMRR_CS_PAGE_IND
LLGMM_ASSIGN_REQ (unassign TLLI)
GMMRR_CS_PAGE_RES (suspend)
GMMRR_SUSPEND_CNF
GMMREG_SUSPEND_IND
RRGRR_ACTIVATE_REQ
RRGRR_RR_EST_REQ
RR_ESTABLISH_IND
RR_DATA_IND (CM SERVICE ACCEPT)
RR_SYNC_IND (ciphering on)
MMSMS_ESTABLISH_CNF
MMSS_ESTABLISH_CNF
MMCC_ESTABLISH_CNF
MMSMS_RELEASE_REQ
MMSS_RELEASE_REQ
MMCC_RELEASE_REQ
RR_RELEASE_IND (GPRS RESUMPTION OK)
MMSMS_RELEASE_IND
MMSS_RELEASE_IND
MMCC_RELEASE_IND
MDL_RELEASE_REQ
MMGMM_CM_RELEASE_IND (GPRS Resumption OK)



History:

12-Apr-00	ANS	Initial

MGM401: Mobile terminated call indicated - BG

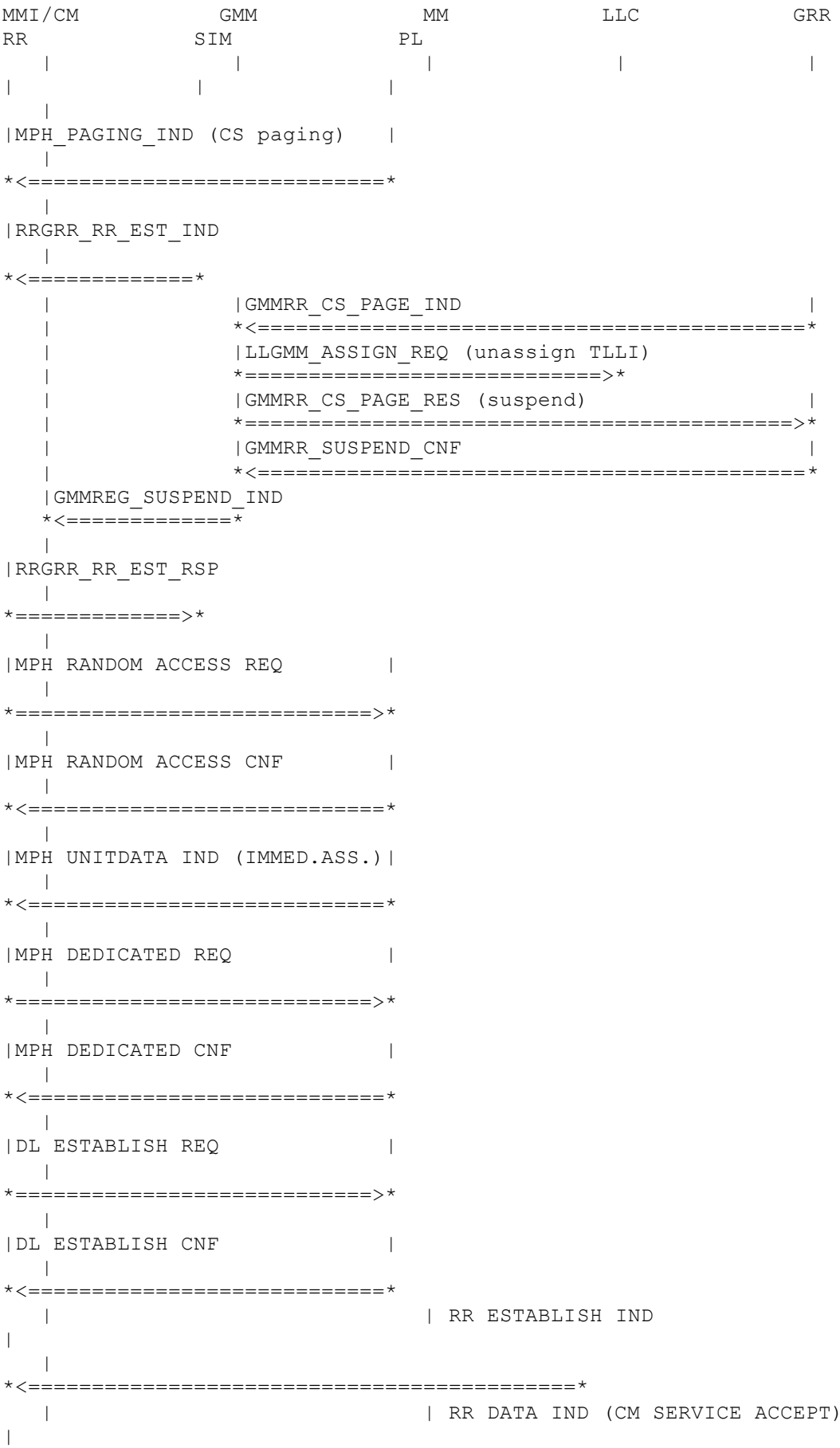
Description:

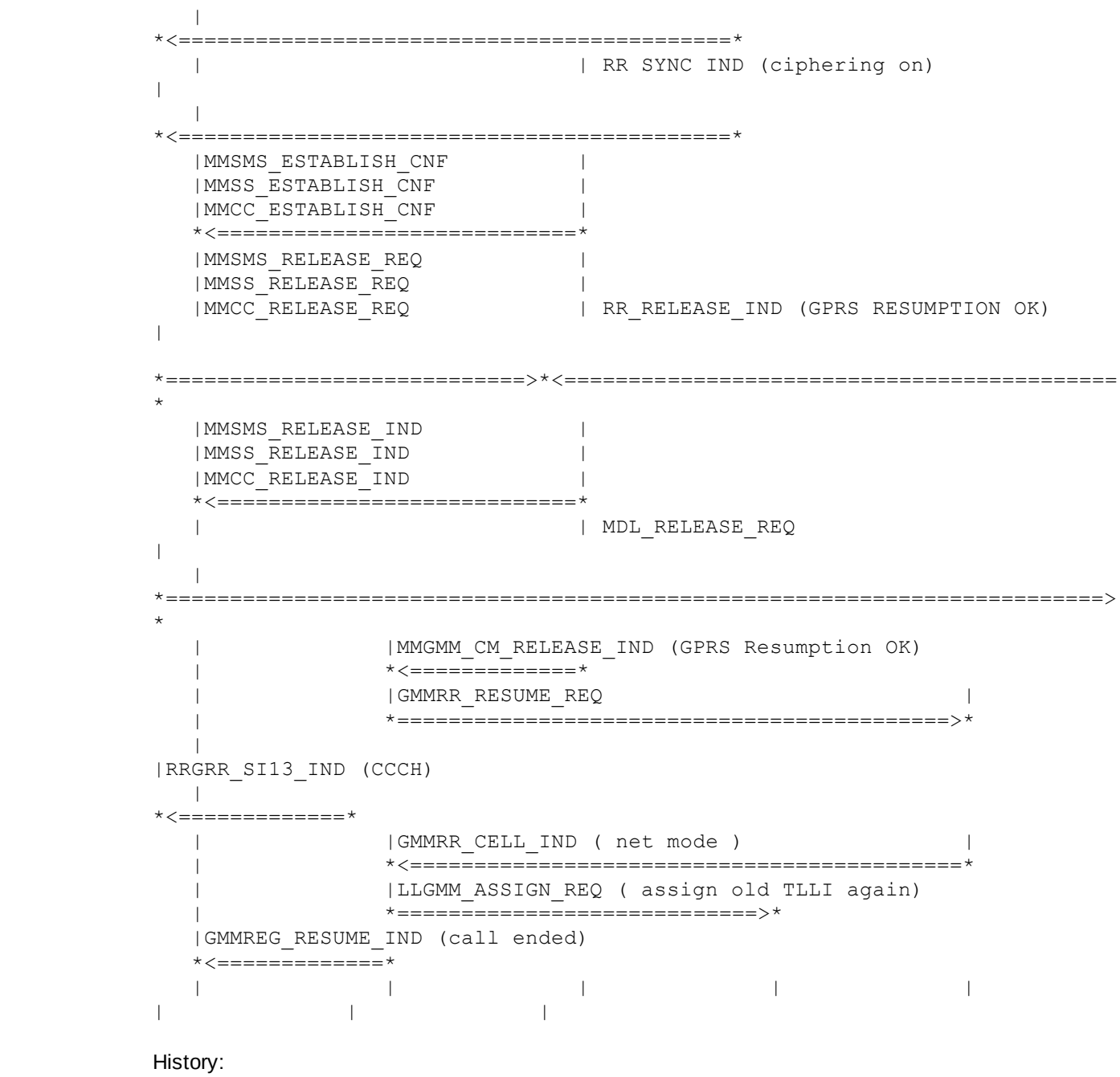
MS class BG.
net mode II.
Combined attached.

RR receives a paging request for CS. Before continuing RR waits for the paging response. GMM suspends the GPRS side and confirms the paging request. RR follows the normal CS paging procedure.

Preamble:

MGM015


MMI/CM
GMM
MM
LLC
GRR
RR
SIM
PL
MPH_PAGING_IND (CS paging)
RRGRR_RR_EST_IND
GMMRR_CS_PAGE_IND
LLGMM_ASSIGN_REQ (unassign TLLI)
GMMRR_CS_PAGE_RES (suspend)
GMMRR_SUSPEND_CNF
GMMREG_SUSPEND_IND
RRGRR_RR_EST_RSP
MPH RANDOM ACCESS REQ
MPH RANDOM ACCESS CNF
MPH UNITDATA IND (IMMED.ASS.)
MPH DEDICATED REQ
MPH DEDICATED CNF
DL ESTABLISH REQ
DL ESTABLISH CNF
RR ESTABLISH IND
RR DATA IND (CM SERVICE ACCEPT)



History:

12-Apr-00	ANS	Initial

MGM402: Mobile terminated call indicated - BC

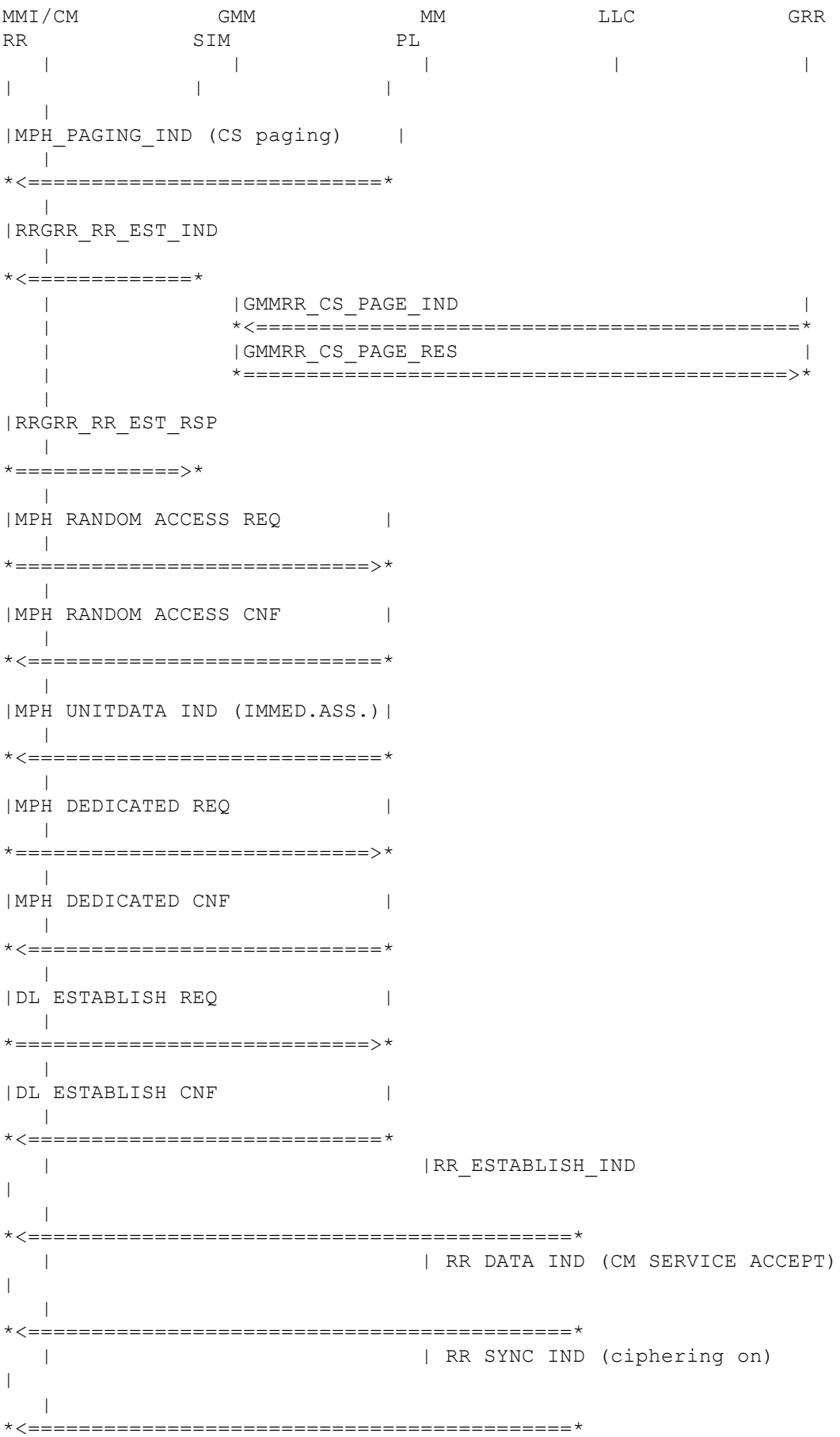
Description:

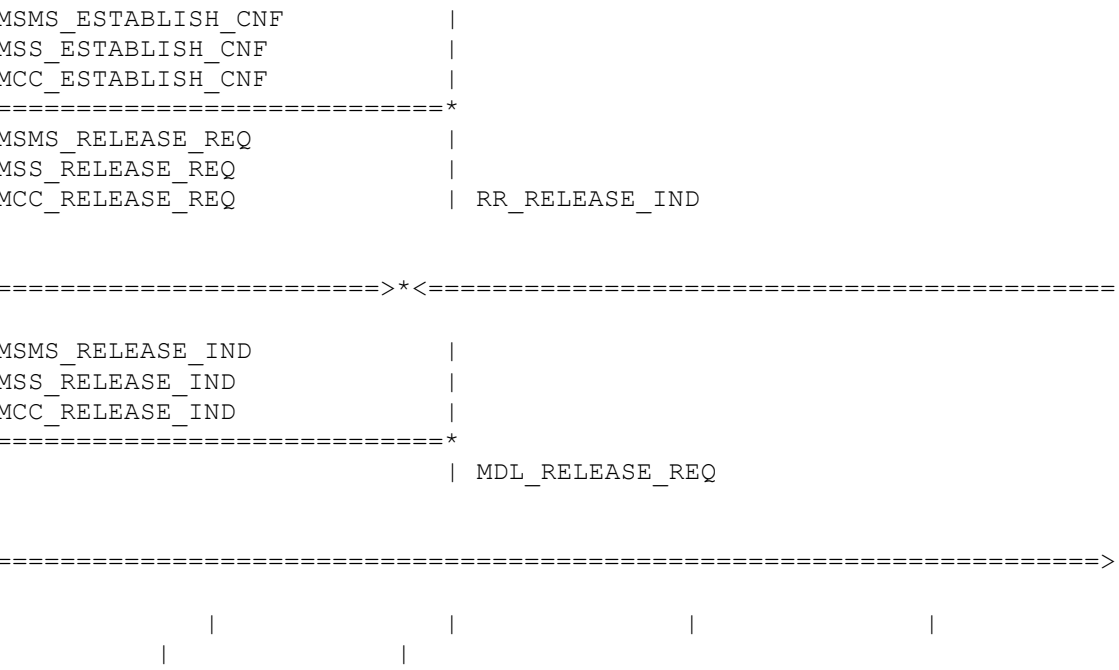
MS class BC.
net mode III.
IMSI attached.

RR receives a paging request for CS. Before continuing RR waits for the paging response. If GMM decides to react on the paging request RR should follow the normal CS paging procedure.

Preamble:

MGM203


MMI/CM
GMM
MM
LLC
GRR
RR
SIM
PL
MPH_PAGING_IND (CS paging)
RRGRR_RR_EST_IND
GMMRR_CS_PAGE_IND
GMMRR_CS_PAGE_RES
RRGRR_RR_EST_RSP
MPH RANDOM ACCESS REQ
MPH RANDOM ACCESS CNF
MPH UNITDATA IND (IMMED.ASS.)
MPH DEDICATED REQ
MPH DEDICATED CNF
DL ESTABLISH REQ
DL ESTABLISH CNF
RR_ESTABLISH_IND
RR DATA IND (CM SERVICE ACCEPT)
RR SYNC IND (ciphering on)



History:

12-Apr-00	ANS	Initial

5.5.1 MGM501: Cell Selection

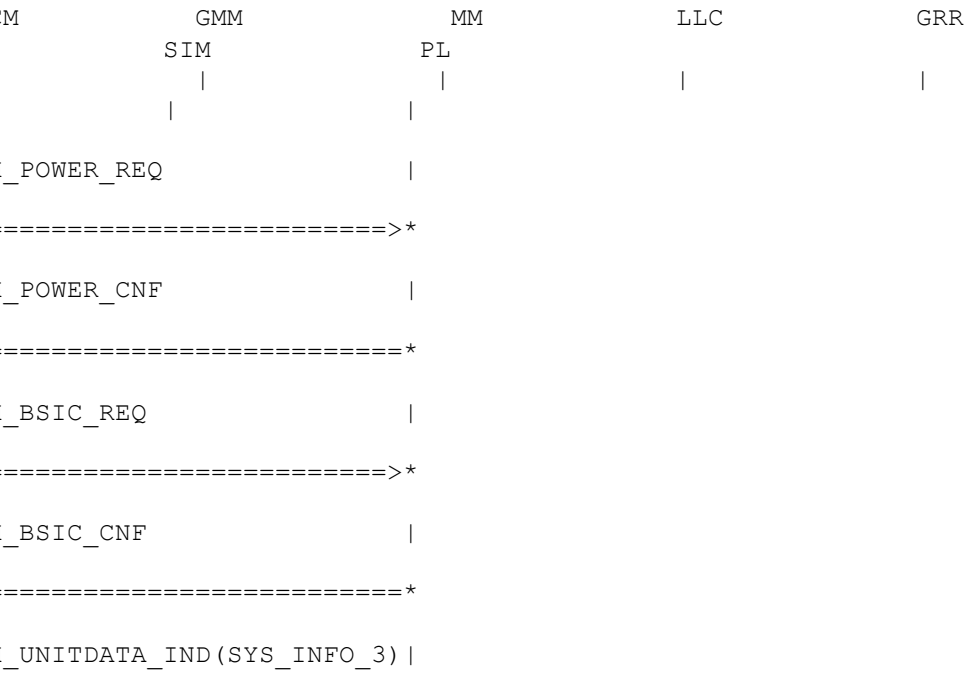
Description:

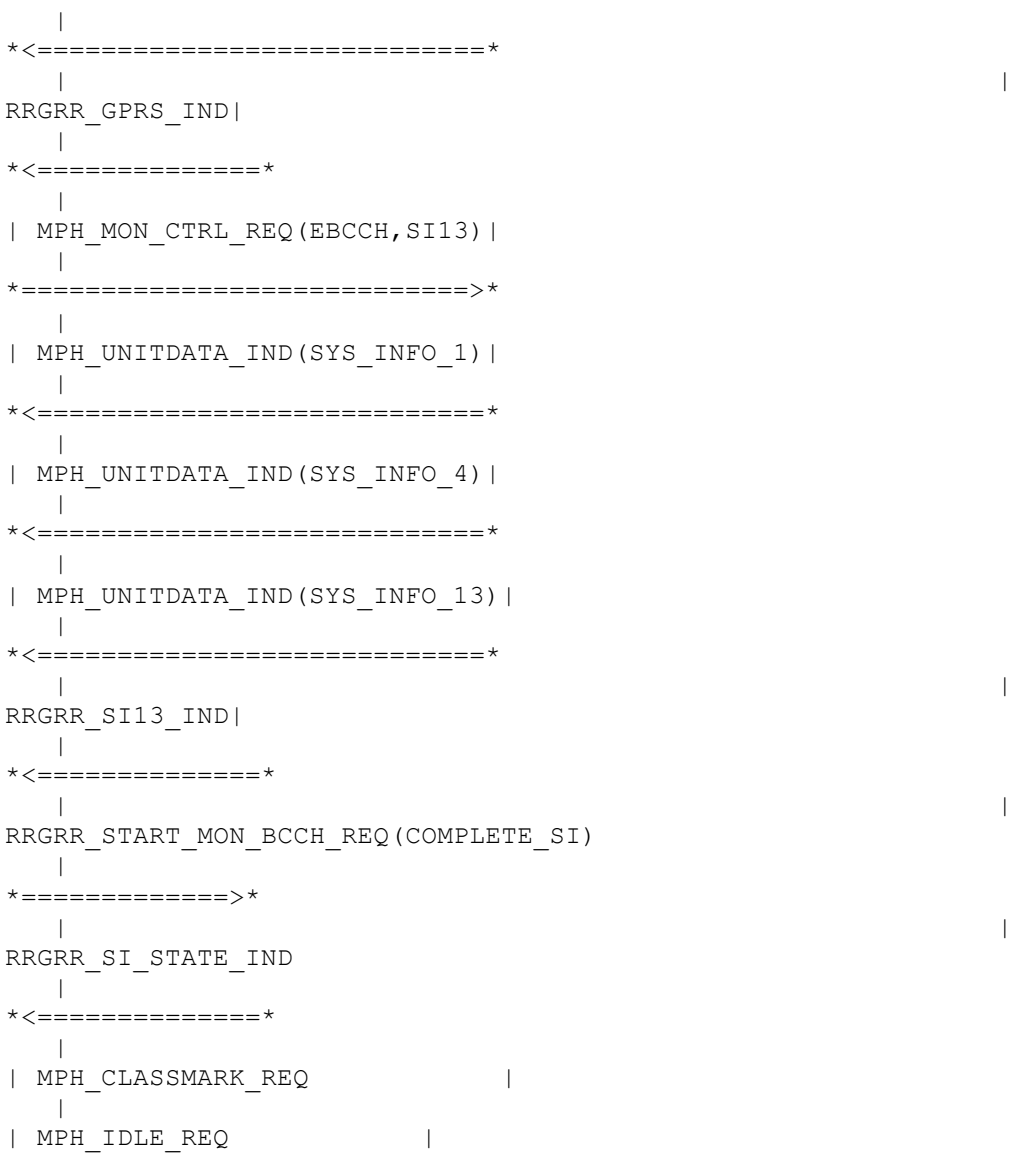
MS class B.
net mode II.
IMSI attached.

The MS does a cell selection and finds a GPRS cell.

Preamble:

MGM




RRGRR_GPRS_IND
MPH_MON_CTRL_REQ(EBCCH,SI13)
MPH_UNITDATA_IND(SYS_INFO_1)
MPH_UNITDATA_IND(SYS_INFO_4)
MPH_UNITDATA_IND(SYS_INFO_13)
RRGRR_SI13_IND
RRGRR_START_MON_BCCH_REQ(COMPLETE_SI)
RRGRR_SI_STATE_IND
MPH_CLASSMARK_REQ
MPH_IDLE_REQ

5.6 Packet Access using CCCH

MGM403: Mobile originated packet access - B

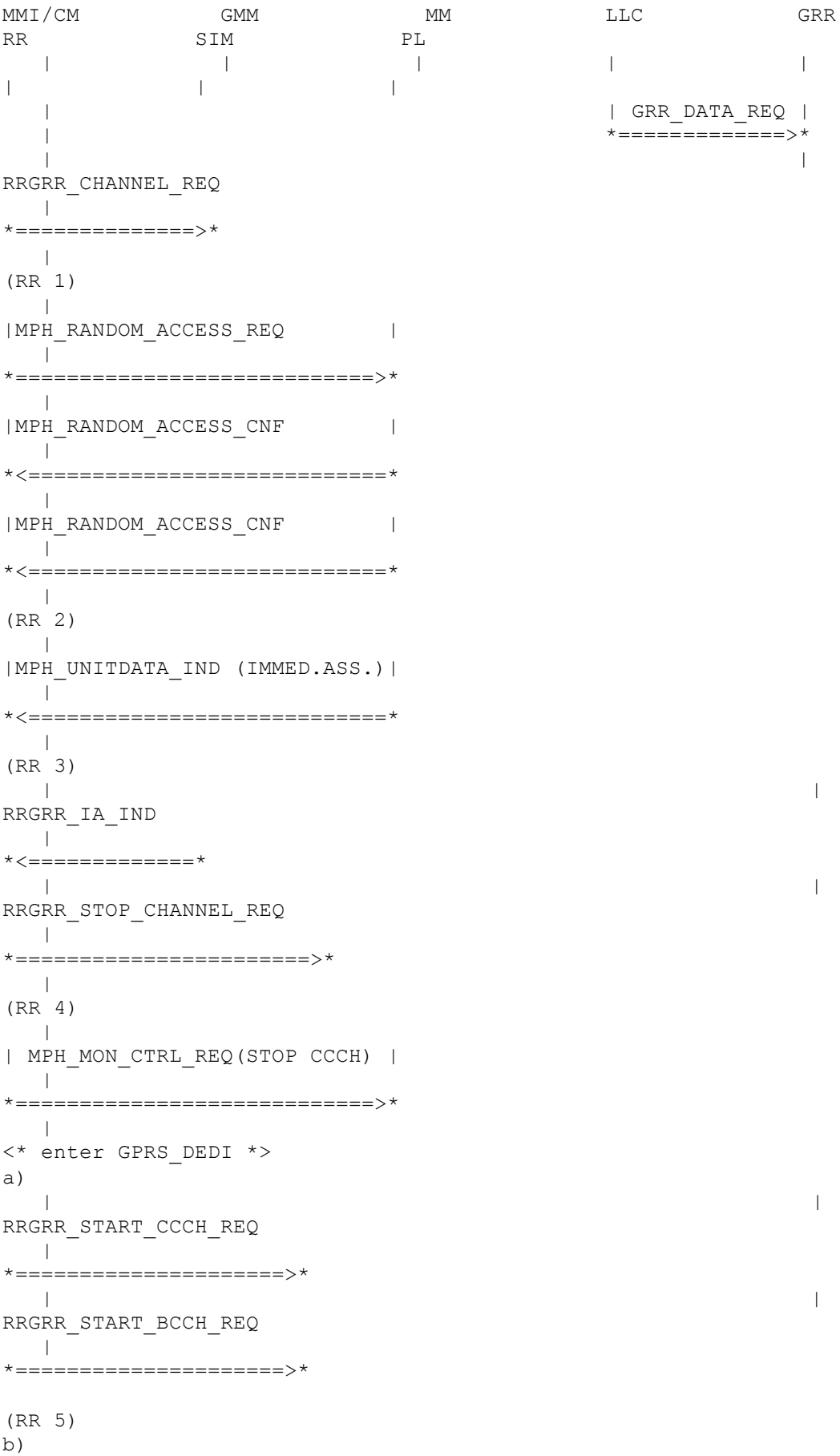
Description:

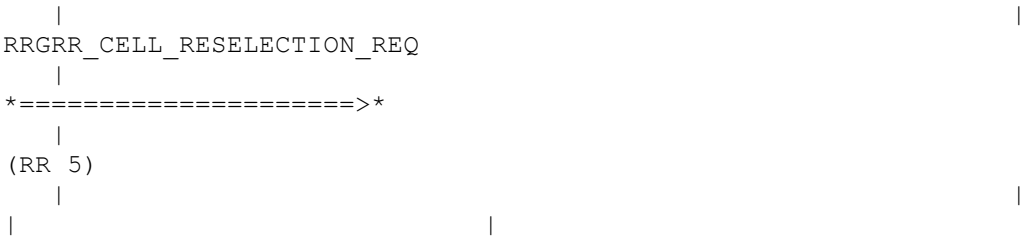
MS class B.
net mode II.
IMSI attached.

The MS successfully allocates a PDCH to start TBF.

Preamble:

MGM


MMI/CM
GMM
MM
LLC
GRR
RR
SIM
PL
GRR_DATA_REQ
RRGRR_CHANNEL_REQ
(RR 1)
MPH_RANDOM_ACCESS_REQ
MPH_RANDOM_ACCESS_CNF
MPH_RANDOM_ACCESS_CNF
(RR 2)
MPH_UNITDATA_IND (IMMED.ASS.)
(RR 3)
RRGRR_IA_IND
RRGRR_STOP_CHANNEL_REQ
(RR 4)
MPH_MON_CTRL_REQ(STOP CCCH)
<* enter GPRS_DEDI *>
a)
RRGRR_START_CCCH_REQ
RRGRR_START_BCCH_REQ
(RR 5)
b)



(RR 1)
RR receives the channel request from GRR. RR starts the access procedure on the CCCH. RR doesnot need to check if there is a call active(GMM/GRR know this) or if the access is allowed(also checked by GRR). The wait indication(T3122) needs not to be checked for packet access and T3142 is checked by GRR.

(RR 2)
T3146 is started after sending all random bursts. T3146 uses T3126(the GSM equivalent) as they are the same.

(RR 3)
On receipt of an Immediate Assignment message RR checks if the Message is either a TBF or dedicated mode assignment (If the Immediate Assignment message was part of a TMA(two message assignment) is by from RR, as PL handles the TMA and sends only the relevant part to RR). RR checks if the IA is valid by comparing the random access reference. For a valid TBF assignment RR informs GRR via the RRGRR_IA_IND(there is also only 1 RRGRR_IA_IND for a two message assignment with all the relevant parts merged). For a dedicated mode assignment RR sends a RRGRR_IA_IND if GRR requested a channel else the normal RR procedures are used. T3146 is stopped on receipt of a valid IA.

(RR 4)
RR waits either for a RRGRR_STOP_CHANNEL_REQ in the case of a PDCH assignment or for a RRGRR_DATA_REQ in the case of a dedicated mode assignment. On receipt of a RRGRR_STOP_CHANNEL_REQ RR stops CCCH listening in PL and enters the GPRS_DEDI state waiting to resume normal operation(ie cell reselection after leaving the PDCH). On receipt of a RRGRR_DATA_REQ RR uses this message as SABM message and enters normal GSM dedicated mode. XXX This has to checkedif this really works(ie. If the data req takes too long time, there is a network timer waiting for the SABM, also-the RR procedure has to be totally reworked. It would be better if we already get the DATA_REQ before receivingthe IA, if possible).

(RR 5)
Entering idle mode. XXX is still open for discussion.

History:

12-Apr-00	MPA	Initial
22-Jul-00	MPA	revised

5.6.1 MGM404: Mobile originated packet access - B

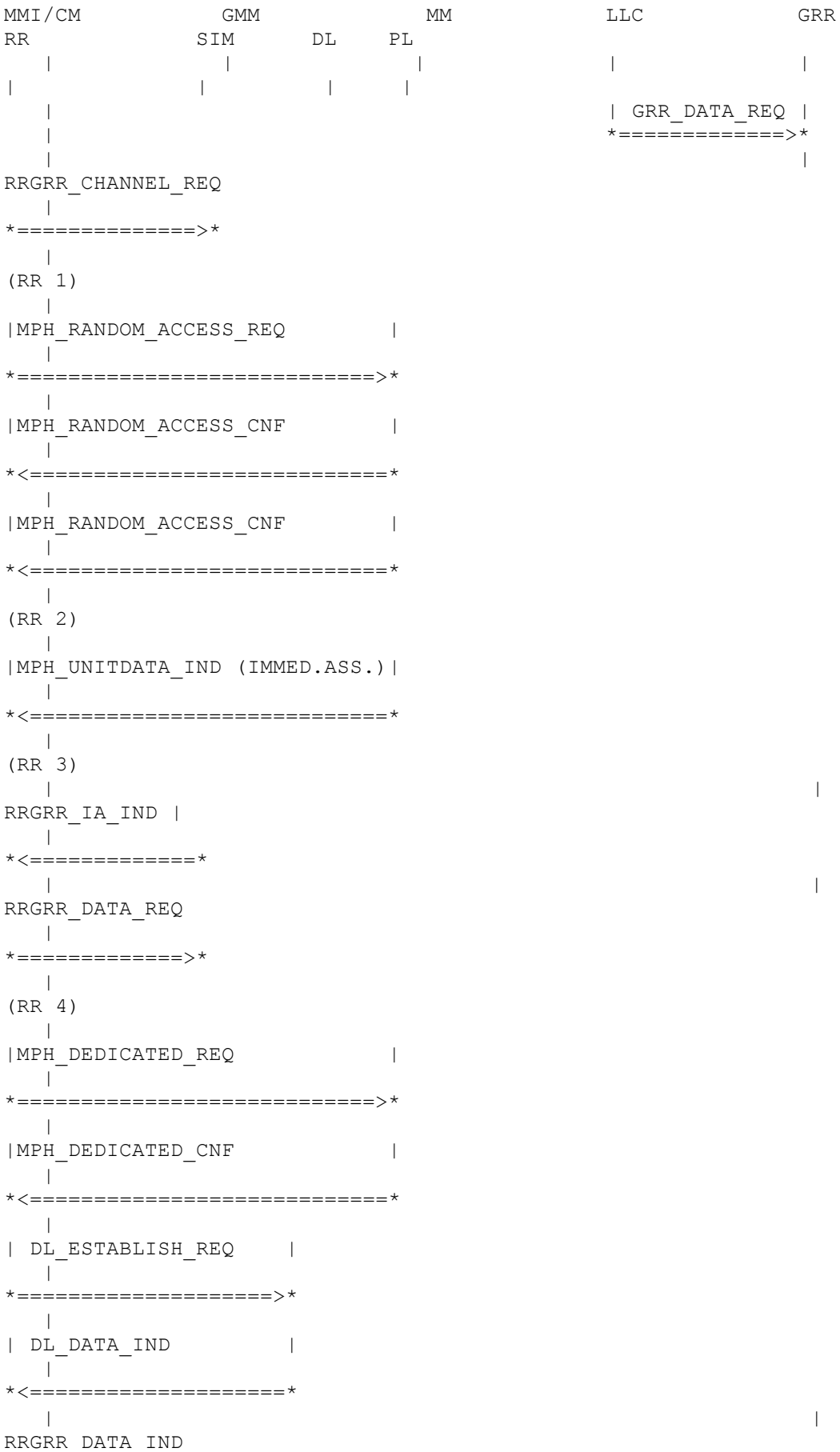
Description:

MS class B.
net mode II.
IMSI attached.

The MS successfully allocates a SDCCH. For comments see MSC above.

Preamble:

MGM


MMI/CM
GMM
MM
LLC
GRR
RR
SIM
DL
PL
GRR_DATA_REQ
RRGRR_CHANNEL_REQ
(RR 1)
MPH_RANDOM_ACCESS_REQ
MPH_RANDOM_ACCESS_CNF
MPH_RANDOM_ACCESS_CNF
(RR 2)
MPH_UNITDATA_IND (IMMED.ASS.)
(RR 3)
RRGRR_IA_IND
RRGRR_DATA_REQ
(RR 4)
MPH_DEDICATED_REQ
MPH_DEDICATED_CNF
DL_ESTABLISH_REQ
DL_DATA_IND
RRGRR_DATA_IND

```
    |
*<=============*
    |                                                                    |
|                                    |
```

History:

12-Apr-00	MPA	Initial

5.6.2 MGM405: Mobile originated packet access - B

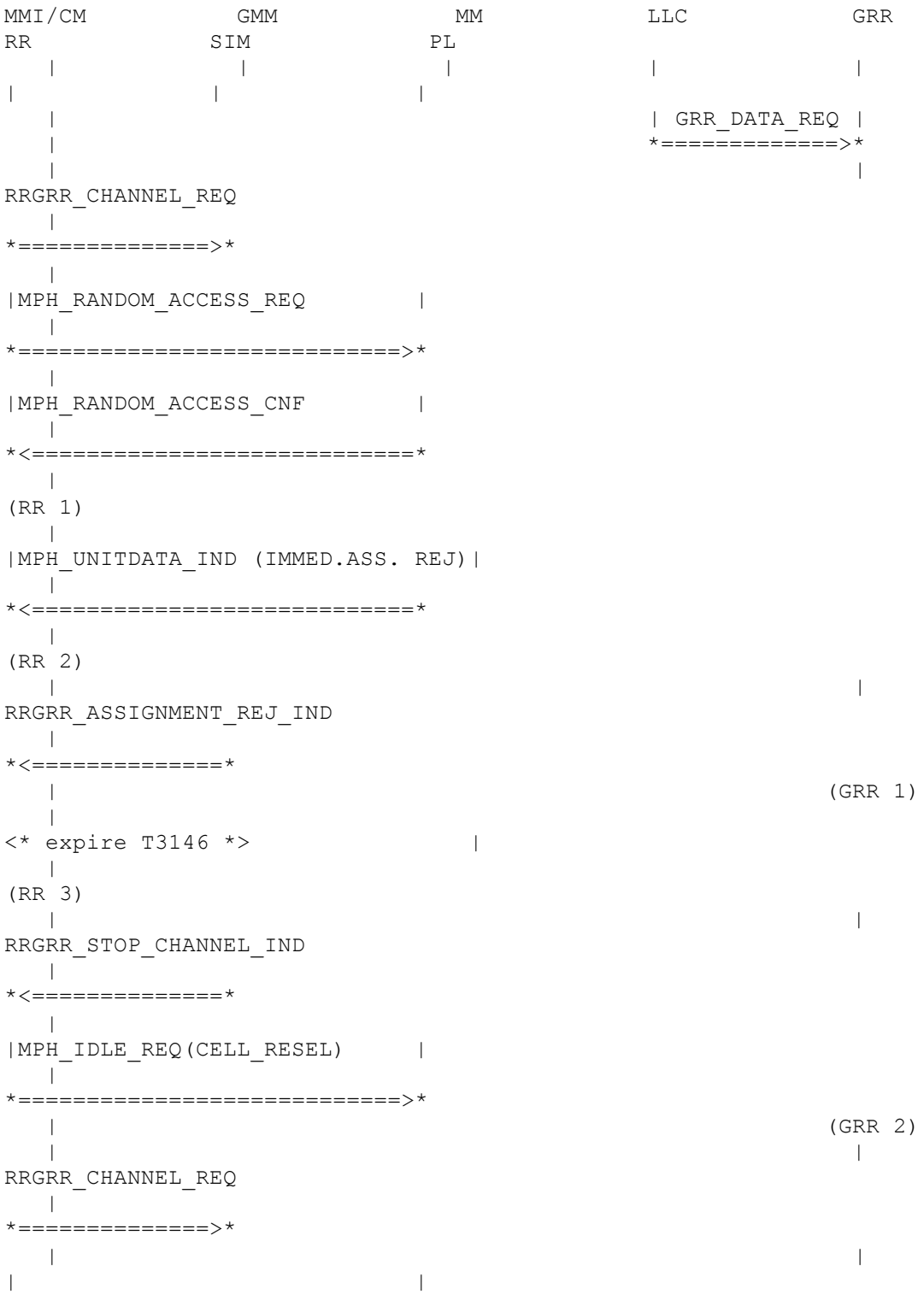
Description:

MS class B.
net mode II.
IMSI attached.

The MS tries to allocate a PDCH but receives a Immediate Assignment Reject.

Preamble:

MGM



(RR 1)
RR starts timer T3146 after sending the last random burst.

(RR 2)
RR receives a Immediate Assignment Reject message. RR checks if the IA is valid by comparing the random access reference and informs GRR via a RRGRR_ASSIGNMENT_REJ_IND.

(GRR 1)
GRR starts the wait indication timer(T3142).

(RR 3)
If timer T3146 expires RR aborts the Packet Access procedure. RR informs GRR via the RRGRR_STOP_CHANNEL_IND and starts a cell reselection to enter idle mode.

(GRR 2)
After T3143 expires GRR can retry the packet access procedure. If there is a GRR_RR_EST_REQ from RR while T3142 is running, the timer can be ignored as it only should prevent packet access.

History:

12-Apr-00	MPA	Initial
23-Jul-00	MPA	revised

5.6.3 MGM404: Mobile originated packet access - B

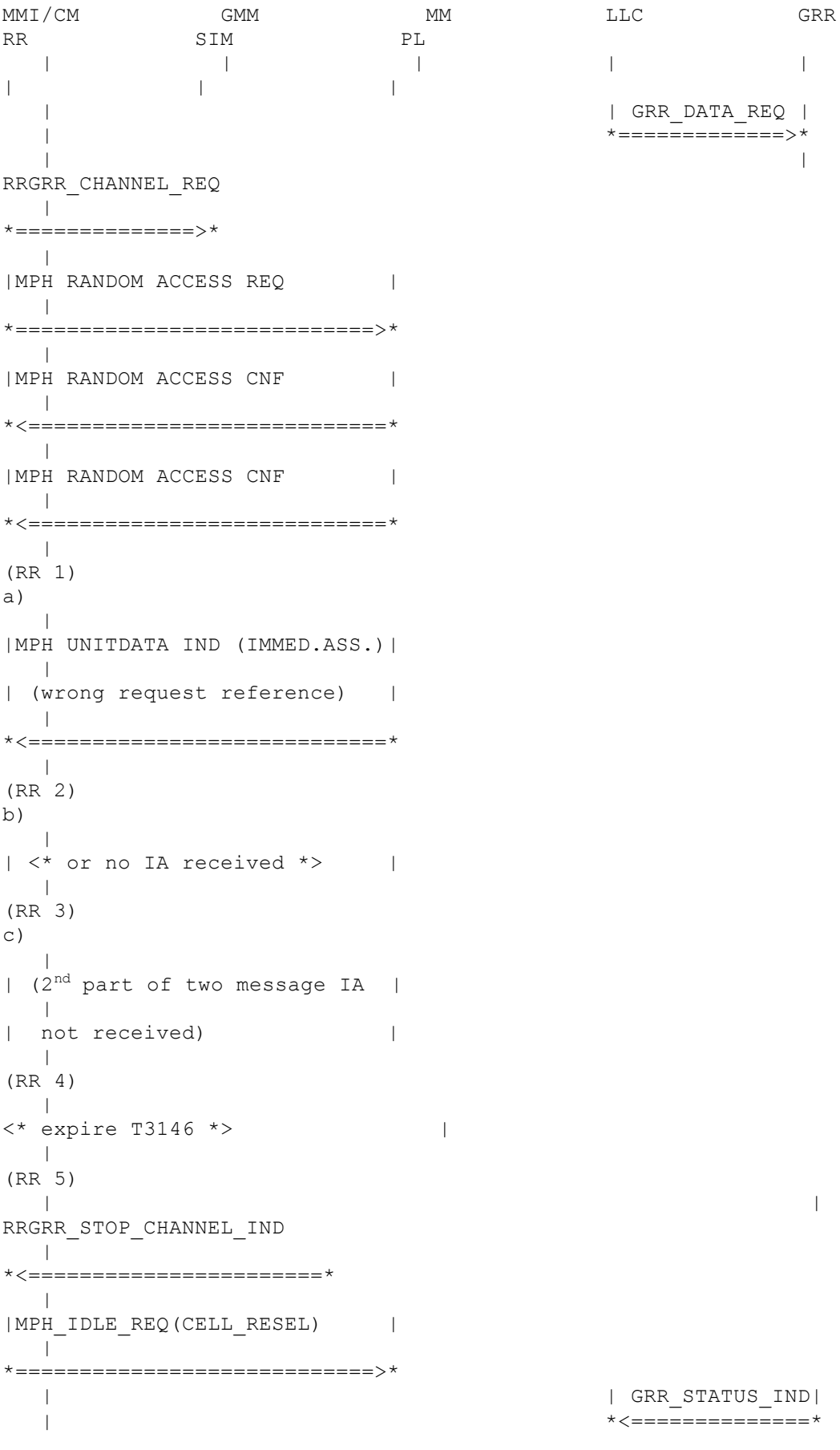
Description:

MS class B.
net mode II.
IMSI attached.

The MS tries to allocate a PDCH but no valid IA is received before T3146 expires.

Preamble:

MGM


MMI/CM
GMM
MM
LLC
GRR
RR
SIM
PL
GRR_DATA_REQ
RRGRR_CHANNEL_REQ
MPH RANDOM ACCESS REQ
MPH RANDOM ACCESS CNF
MPH RANDOM ACCESS CNF
(RR 1)
a)
MPH UNITDATA IND (IMMED.ASS.)
(wrong request reference)
(RR 2)
b)
<* or no IA received *>
(RR 3)
c)
(2nd part of two message IA
not received)
(RR 4)
<* expire T3146 *>
(RR 5)
RRGRR_STOP_CHANNEL_IND
MPH_IDLE_REQ(CELL_RESEL)
GRR_STATUS_IND

| | | |
| | |

(RR 1)
RR starts timer T3146 after sending the last random burst.

(RR 2)
RR receives Immediate Assignment message with a wrong request reference. This Immediate Assignment is ignored.

(RR 3)
RR receives no Immediate Assignment.

(RR 4)
If RR receives no Immediate Assignment message it could also be that only 2nd part of a two message Immediate Assignment was not received because PL handles the correct reception of a TMA and sends only the relevant parts to RR.

(RR 5)
If the Packet Access Timer T3146 expires GRR is informed via the RRGRR_STOP_CHANNEL_IND and RR starts a cell reselection.

History:

12-Apr-00	MPA	Initial

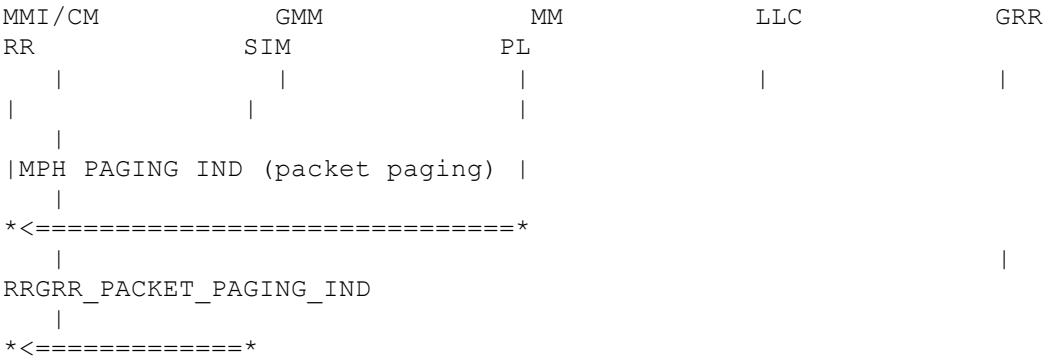
Packet Paging using CCCH

MGM407: Mobile terminated packet access – B??

Description: (under construction/DG 25.7.2000)
MS class B
net mode II.
IMSI attached.

The MS receives packet paging on CCCH. RR informs GRR.

Preamble:
MGM



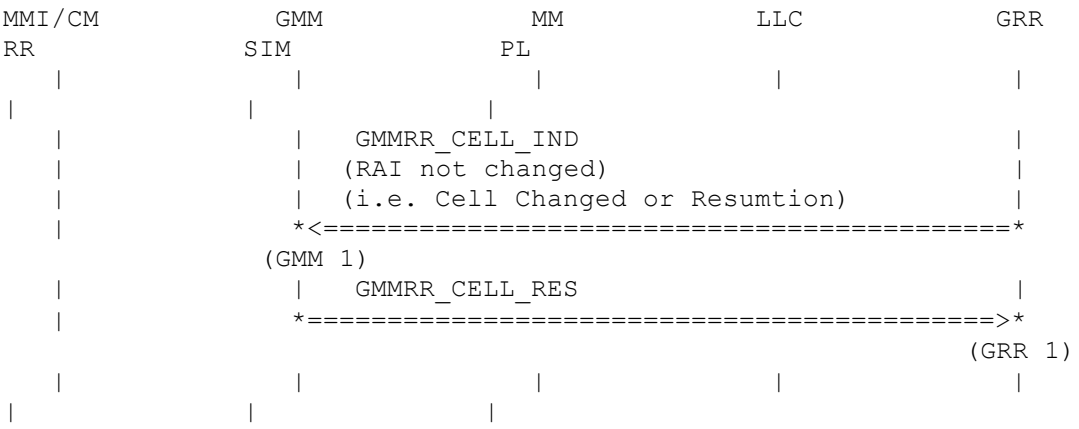
Cell Response Procedure

1. GMM has to response to GMMRR_CELL_IND finally with GMMRR_CELL_RES.
2. GMM may receive more than one GMMRR_CELL_IND before responding with GMMRR_CELL_RES.
3. If LLC is suspended with LLGMM_RAU LLC should at least the first time send GRR_SUSPEND_REQ to GRR to ask GRR for GRR_SUSPEND_READY_IND.
4. Upon receiving GMMRR_CELL_RES GRR should send GMMRR_READY_IND instead of GMMRR_SUSPEND_READY_IND.
5. Upon receiving LLGMM_RESUME_REQ LLC should listen to GMMRR_READY_IND instead of GMMRR_SUSPEND_READY_IND.
6. If LLC is in supended state it should expect LLGMM_SUSPEND_REQ if cause is changed, i.e. if the cause changed to LLGMM_RAU.
7. LLC should not send GRR_SUSPEND_REQ to GRR on causes different from LLGMM_RAU.

5.6.4 MGM800: Normal Cell Change

Description:
MS class B.
For normal cell changes LLC is not suspended. GMM responses immediately with GMMRR_CELL_RES.

Preamble:
none



(GMM 1)
GRR sends cell ind either because cell has changed or just only as an answer to GMMRR_RESUME_REQ.

(GMM 1)
No Suspension is needed.

History:

6-Mar-02	ANS	Initial

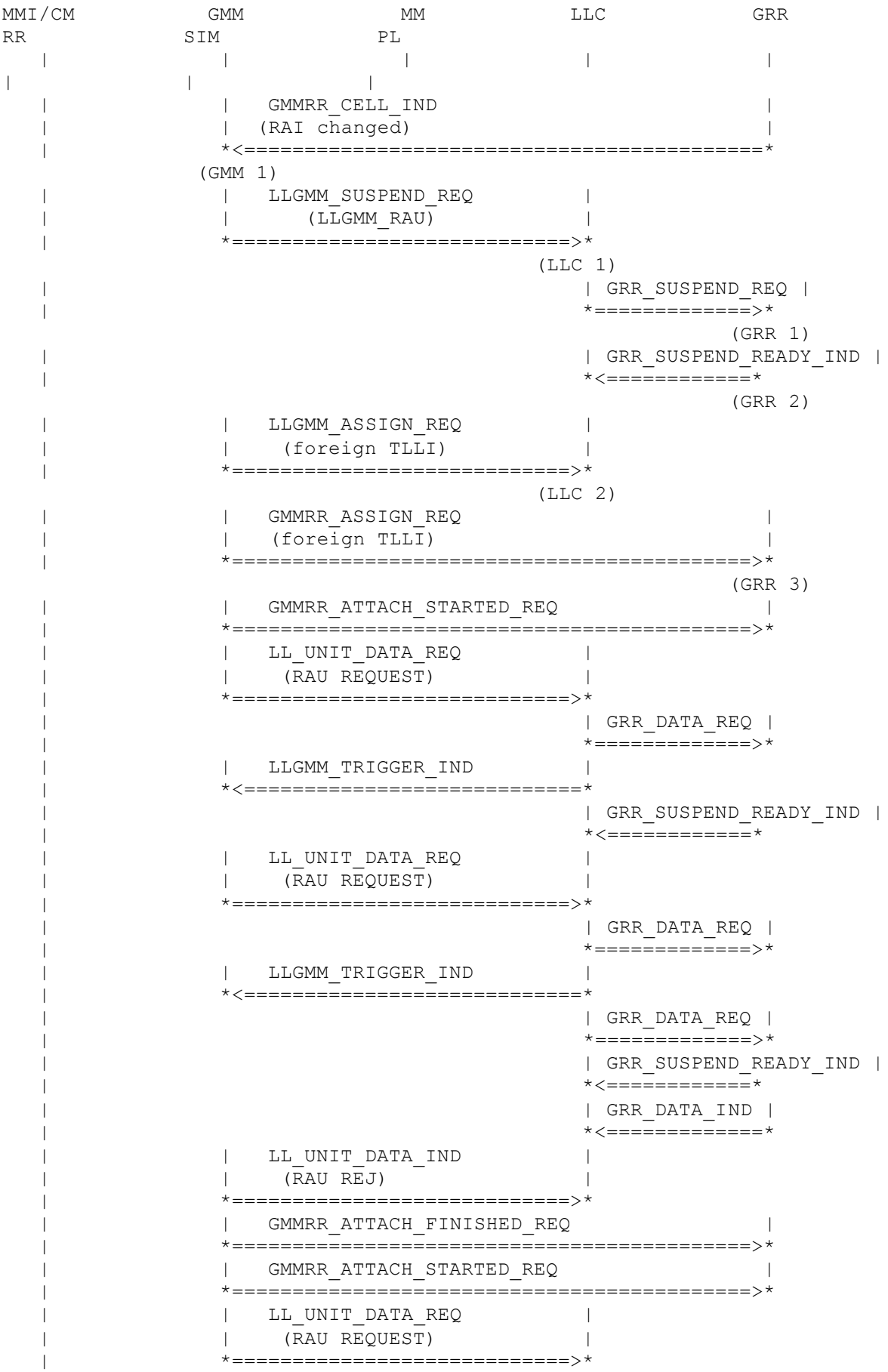
5.6.5 MGM801: RA changed

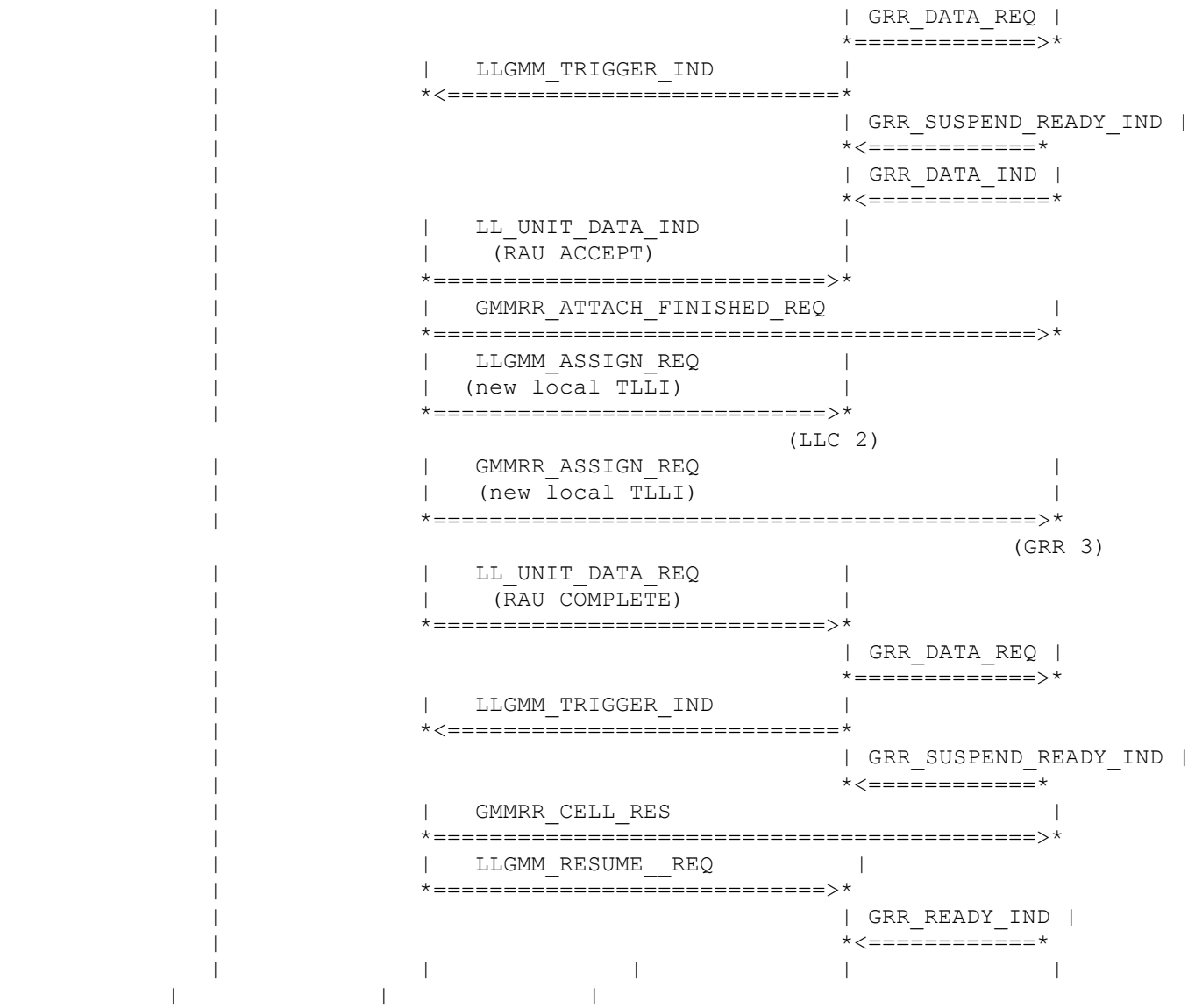
Description:

MS class B.
If RA is changed LLC is suspended with LLGMM_RAU. LLC is forwarding suspension request to GRR to ask for GMMRR_SUSPEND_READY_IND. When RAU is finished GRR is informed via GMMR_CELL_RES and LLC is resumed.

Preamble:

none


MMI/CM
RR
GMM
SIM
MM
PL
LLC
GRR
GMMRR_CELL_IND
(RAI changed)
(GMM 1)
LLGMM_SUSPEND_REQ
(LLGMM_RAU)
(LLC 1)
GRR_SUSPEND_REQ
(GRR 1)
GRR_SUSPEND_READY_IND
(GRR 2)
LLGMM_ASSIGN_REQ
(foreign TLLI)
(LLC 2)
GMMRR_ASSIGN_REQ
(foreign TLLI)
(GRR 3)
GMMRR_ATTACH_STARTED_REQ
LL_UNIT_DATA_REQ
(RAU REQUEST)
GRR_DATA_REQ
LLGMM_TRIGGER_IND
GRR_SUSPEND_READY_IND
LL_UNIT_DATA_REQ
(RAU REQUEST)
GRR_DATA_REQ
LLGMM_TRIGGER_IND
GRR_DATA_REQ
GRR_SUSPEND_READY_IND
GRR_DATA_IND
LL_UNIT_DATA_IND
(RAU REJ)
GMMRR_ATTACH_FINISHED_REQ
GMMRR_ATTACH_STARTED_REQ
LL_UNIT_DATA_REQ
(RAU REQUEST)



(GMM 1)
GRR sends cell ind and the RAU is crossed.

(LLC 1)
LLC is suspended. LLC has to inform GRR.

(GRR 1/2)
GRR switches to GMM queue and sends GRR_SUSPEND_READY to LLC.

(LLC 2/GRR3)
Foreign TLLI is assigned to the mobile

History:

6-Mar-02	ANS	Initial

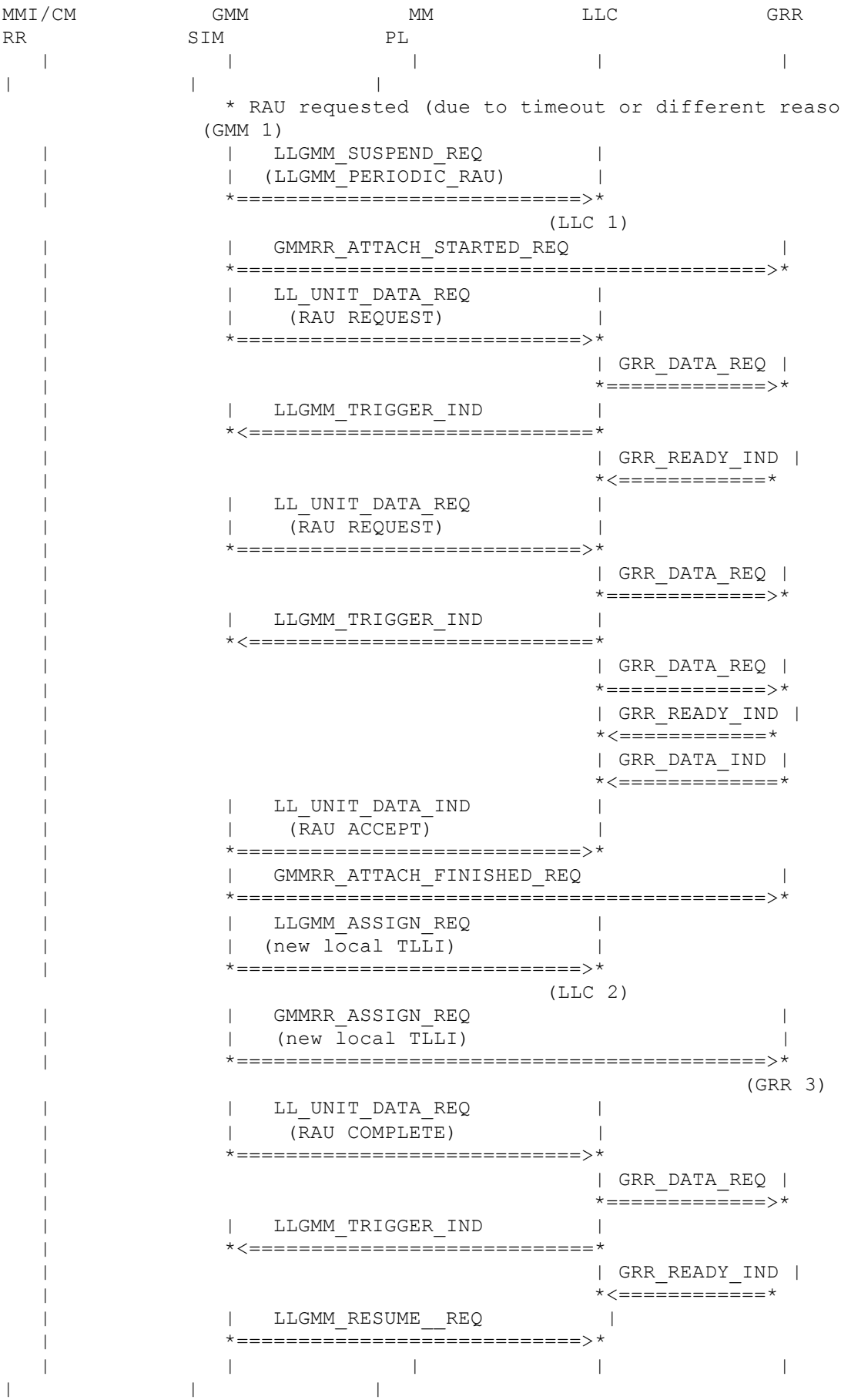
5.6.6 MGM802: RAU w/o Cell Change

Description:

MS class B.
Routing area update should be done, but no cell is changed. LLC is suspended with different cause than LLGMM_RAU. LLC must not suspend GRR. If RAU is finished LLC is resumed by GMM.

Preamble:

none


MMI/CM
RR
GMM
SIM
MM
PL
LLC
GRR
* RAU requested (due to timeout or different reasons)
(GMM 1)
LLGMM_SUSPEND_REQ
(LLGMM_PERIODIC_RAU)
(LLC 1)
GMMRR_ATTACH_STARTED_REQ
LL_UNIT_DATA_REQ
(RAU REQUEST)
GRR_DATA_REQ
LLGMM_TRIGGER_IND
GRR_READY_IND
LL_UNIT_DATA_REQ
(RAU REQUEST)
GRR_DATA_REQ
LLGMM_TRIGGER_IND
GRR_DATA_REQ
GRR_READY_IND
GRR_DATA_IND
LL_UNIT_DATA_IND
(RAU ACCEPT)
GMMRR_ATTACH_FINISHED_REQ
LLGMM_ASSIGN_REQ
(new local TLLI)
(LLC 2)
GMMRR_ASSIGN_REQ
(new local TLLI)
(GRR 3)
LL_UNIT_DATA_REQ
(RAU COMPLETE)
GRR_DATA_REQ
LLGMM_TRIGGER_IND
GRR_READY_IND
LLGMM_RESUME__REQ

History:

6-Mar-02	ANS	Initial

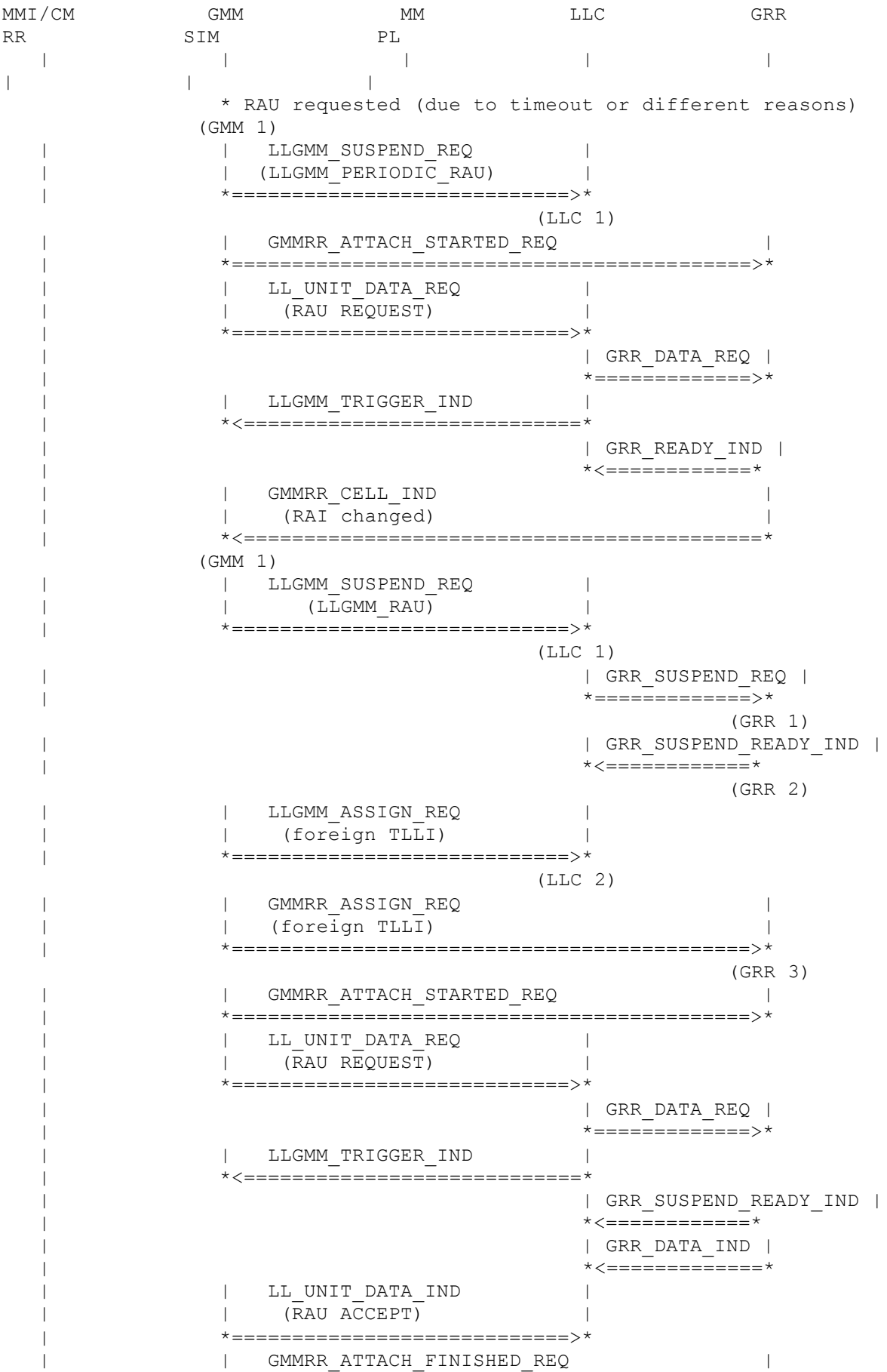
5.6.7 MGM803: Periodic RAU is interupted by RAU change

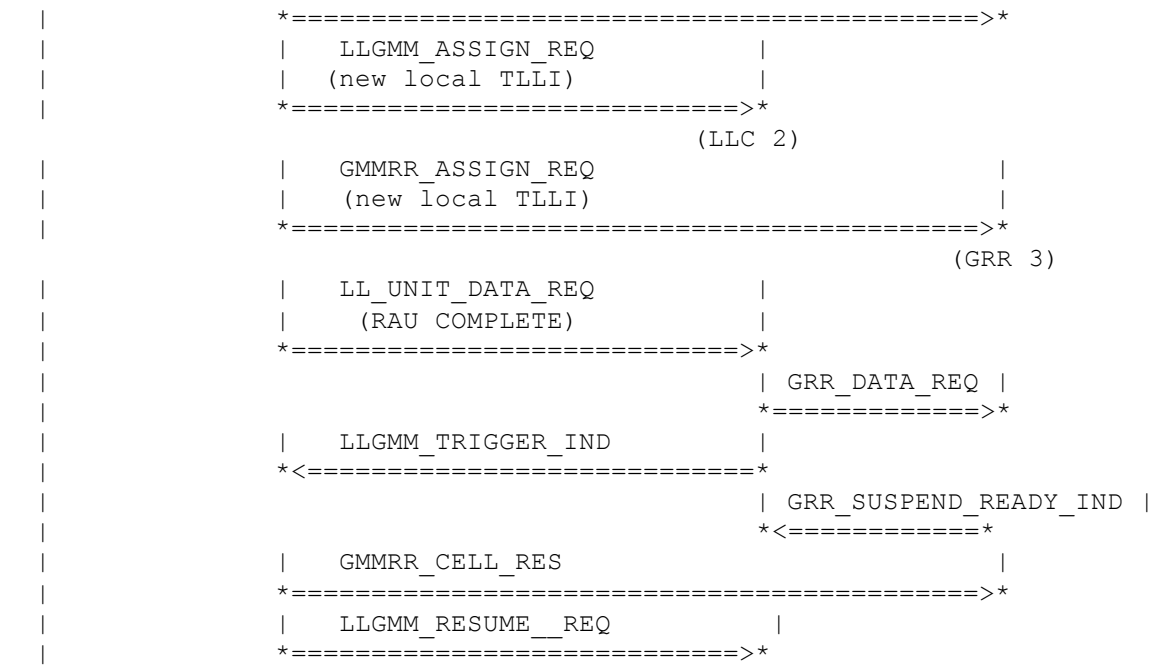
Description:

MS class B.
Routing area update should be done, but no cell is changed. LLC is suspended with different cause than LLGMM_RAU. LLC must not suspend GRR. If RAU is finished LLC is resumed by GMM. RAU procedure is interupted by RA change. GMM requests LLC to suspend GRR via LLGMM_SUSPEND_REQ (LLGMM_RAU). RAU is reinitialized and restarted. When RAU is finished GRR is informed via GMMR_CELL_RES and LLC is resumed.

Preamble:

none


MMI/CM
RR
GMM
SIM
MM
PL
LLC
GRR
* RAU requested (due to timeout or different reasons)
(GMM 1)
LLGMM_SUSPEND_REQ
(LLGMM_PERIODIC_RAU)
(LLC 1)
GMMRR_ATTACH_STARTED_REQ
LL_UNIT_DATA_REQ
(RAU REQUEST)
GRR_DATA_REQ
LLGMM_TRIGGER_IND
GRR_READY_IND
GMMRR_CELL_IND
(RAI changed)
(GMM 1)
LLGMM_SUSPEND_REQ
(LLGMM_RAU)
(LLC 1)
GRR_SUSPEND_REQ
(GRR 1)
GRR_SUSPEND_READY_IND
(GRR 2)
LLGMM_ASSIGN_REQ
(foreign TLLI)
(LLC 2)
GMMRR_ASSIGN_REQ
(foreign TLLI)
(GRR 3)
GMMRR_ATTACH_STARTED_REQ
LL_UNIT_DATA_REQ
(RAU REQUEST)
GRR_DATA_REQ
LLGMM_TRIGGER_IND
GRR_SUSPEND_READY_IND
GRR_DATA_IND
LL_UNIT_DATA_IND
(RAU ACCEPT)
GMMRR_ATTACH_FINISHED_REQ



History:

	6-Mar-02	ANS	Initial

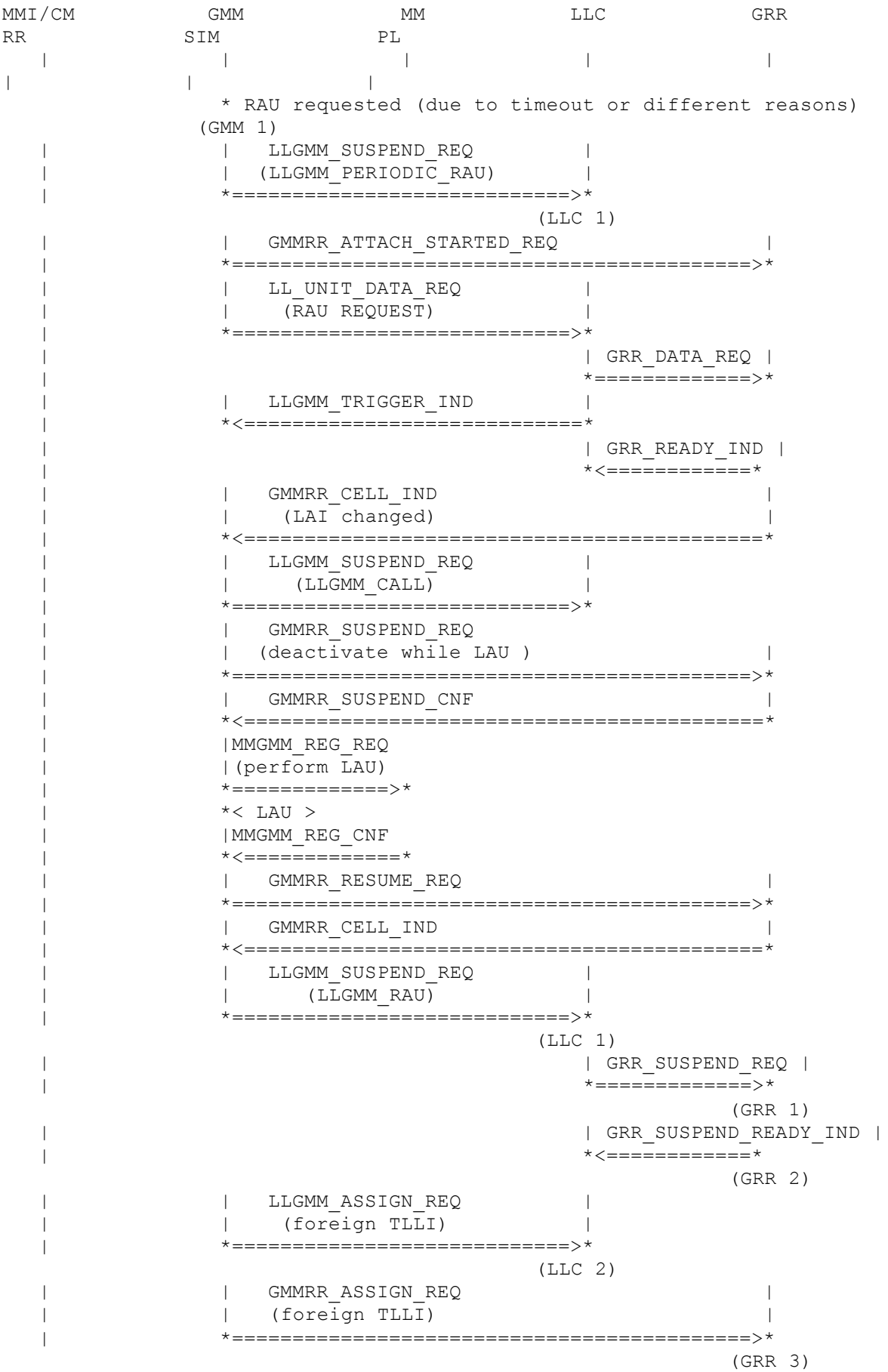
5.6.8 MGM804: Periodic RAU is interupted by LAU change

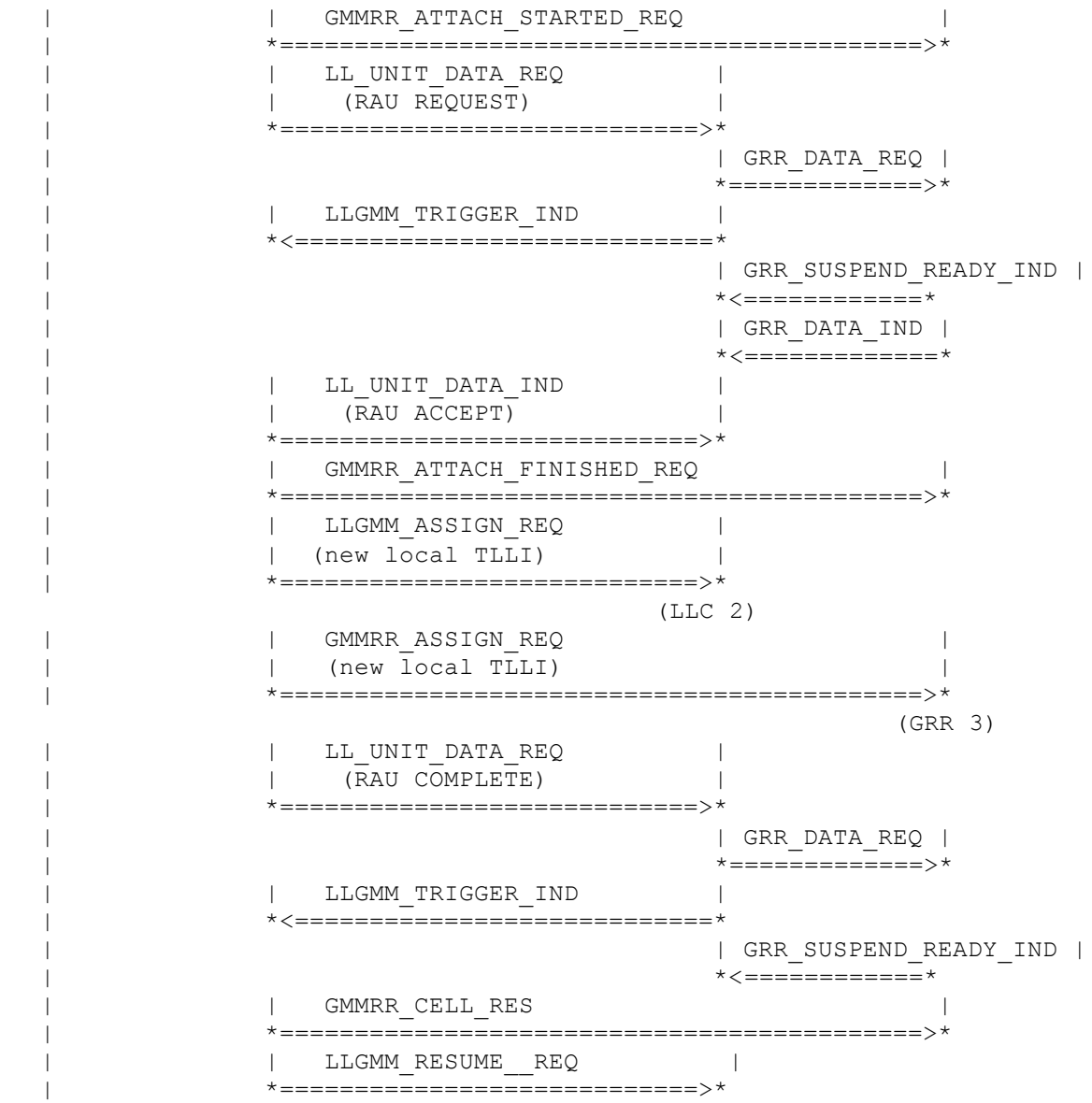
Description:

MS class B.
Routing area update should be done, but no cell is changed. LLC is suspended with different cause than LLGMM_RAU. LLC must not suspend GRR. If RAU is finished LLC is resumed by GMM. RAU procedure is interupted by LA change. GMM requests LLC to suspend GRR via LLGMM_SUSPEND_REQ (LLGMM_RAU). RAU is reinitialized and restarted. When RAU is finished GRR is informed via GMMR_CELL_RES and LLC is resumed.

Preamble:

none


MMI/CM
RR
GMM
SIM
MM
PL
LLC
GRR
* RAU requested (due to timeout or different reasons)
(GMM 1)
LLGMM_SUSPEND_REQ
(LLGMM_PERIODIC_RAU)
(LLC 1)
GMMRR_ATTACH_STARTED_REQ
LL_UNIT_DATA_REQ
(RAU REQUEST)
GRR_DATA_REQ
LLGMM_TRIGGER_IND
GRR_READY_IND
GMMRR_CELL_IND
(LAI changed)
LLGMM_SUSPEND_REQ
(LLGMM_CALL)
GMMRR_SUSPEND_REQ
(deactivate while LAU)
GMMRR_SUSPEND_CNF
MMGMM_REG_REQ
(perform LAU)
< LAU >
MMGMM_REG_CNF
GMMRR_RESUME_REQ
GMMRR_CELL_IND
LLGMM_SUSPEND_REQ
(LLGMM_RAU)
(LLC 1)
GRR_SUSPEND_REQ
(GRR 1)
GRR_SUSPEND_READY_IND
(GRR 2)
LLGMM_ASSIGN_REQ
(foreign TLLI)
(LLC 2)
GMMRR_ASSIGN_REQ
(foreign TLLI)
(GRR 3)



History:

6-Mar-02	ANS	Initial

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/>