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Meeting #10, Bangkok, Thailand
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Source: **TSG CN WG 1**

Title: **CRs to R99 Work Item TEI/ Terminology Crs**

Agenda item: **7.6**

Document for: **APPROVAL**

Introduction:

This document contains **4** CRs on **R99** Work Item **" TEI"**, that have been agreed by **TSG CN WG1**, and are forwarded to TSG CN Plenary meeting #10 for approval.

Spec	CR	Rev	Doc-2nd-Level	Phase	Subject	Cat	Ver_C
23.122	010	1	N1-001415	R99	Correction of terminology "In UMTS", "In GSM"	F	3.4.2
23.034	005		N1-001321	R99	Terminology corrections	F	3.2.0
29.018	011		N1-001267	R99	Terminology corrections	F	3.4.1
24.011	011	1	N1-001376	R99	Terminology CR	F	3.4.0

3GPP TSG-CN1 Meeting #14
Cardiff, Wales - 20 - 24 November, 2000

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CR-Form-v3

CHANGE REQUEST

⌘ **29.018** **CR** **011** ⌘ rev **-** ⌘ Current version: **3.4.1** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM ☐ ME/UE ☐ Radio Access Network ☐ Core Network ☒

Title:	⌘	Terminology corrections
Source:	⌘	Vodafone
Work item code:	⌘	TEI
Date:	⌘	02/11/2000
Category:	⌘	F
Release:	⌘	R99

Use one of the following categories:
F *(essential correction)*
A *(corresponds to a correction in an earlier release)*
B *(Addition of feature),*
C *(Functional modification of feature)*
D *(Editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:

2	*(GSM Phase 2)*
R96	*(Release 1996)*
R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
REL-4	*(Release 4)*
REL-5	*(Release 5)*

Reason for change:	⌘	To bring the specification in line with the guidelines on terminology liaised to N1 from S2.
Summary of change:	⌘	"In GSM," is replaced by "In A/Gb mode". "In UMTS," is replaced by "In Iu mode." "(GSM only)" is replaceed by "(A/Gb mode only)." "(UMTS only)" is replaced by "(Iu mode only)."
Consequences if not approved:	⌘	

Clauses affected:	⌘	various		
Other specs affected:	⌘	☐ Other core specifications ☐ Test specifications ☐ O&M Specifications	⌘	
Other comments:	⌘			

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3GPP TS 29.018 V3.4.1 (2000-10)

Technical Specification

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Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The present document specifies procedures used between the Serving GPRS Support Node (SGSN) and the Visitors Location Register (VLR) for co-ordination between GSM circuit switched services and GSM packet data services within the 3GPP system.

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

Introduction

The present document specifies or references the procedures to provide co-ordination between the GSM circuit switched services controlled at the Visitors Location Register (VLR) and the GSM packet switched services controlled at the Serving GPRS Support Node (SGSN). The procedures specified in the present document are intended to optimise the use of the resources when an MS supports both GSM circuit switched services and GSM packet switched services.

1 Scope

The present document specifies or references procedures used on the Serving GPRS Support Node (SGSN) to Visitors Location Register (VLR) interface for interoperability between GSM circuit switched services and GSM packet data services.

The present document specifies the layer 3 messages and procedures on the Gs interface to allow coordination between databases and to relay certain messages related to GSM circuit switched services over the GPRS subsystem.

The functional split between VLR and SGSN is defined in TS 23.060. The required procedures between VLR and SGSN are defined in detail in the present document.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

2.1 Normative references

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

[1a] TS 21.905: "Vocabulary for 3GPP Specifications".

[2] GSM 02.06: "Digital cellular telecommunications system (Phase 2+); Types of Mobile Stations (MS)".

[3] GSM 02.07: "Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) features".

[4] TS 22.060: "General Packet Radio Service (GPRS); Service description; Stage 1".

[5] TS 23.003: "Numbering, addressing and identification".

[6] TS 23.007: "Digital cellular telecommunications system (Phase 2+); Restoration procedures".

[7] TS 23.122: "Functions related to Mobile Station (MS) in idle mode and group receive mode".

[8] TS 23.060: " General Packet Radio Service (GPRS); Service description; Stage 2".

[9] GSM 03.64: "Digital cellular telecommunications system (Phase 2+); Overall description of the General Packet Radio Service (GPRS) Radio interface; Stage 2".

[10] TS 24.007: " Mobile radio interface signalling layer 3; General aspects".

[11] TS 24.008: " Mobile radio interface layer 3 specification (CC and MM parts)".

[12] GSM 04.64: "Digital cellular telecommunications system (Phase 2+), General Packet Radio Service (GPRS); Logical Link Control (LLC)".

[13] GSM 04.65: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Subnetwork Dependent Convergence Protocol (SNDCP)".

[14] GSM 08.08: "Digital cellular telecommunications system (Phase 2+); Mobile Switching Centre - Base Station System (MSC - BSS) interface: Layer 3 specification".

[15] GSM 08.18: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Serving GPRS Support Node (SGSN) - Base Station System (BSS): BSS GPRS Protocol (BSSGP)".

[16] GSM 08.60: "Digital cellular telecommunications system (Phase 2+); Inband control of remote transcoders and rate adaptors for Enhanced Full Rate (EFR) and full rate traffic channels."

[17] TS 29.002: "Mobile Application Part (MAP) specification".

[18] GSM 09.08: "Digital cellular telecommunications system (Phase 2+); Application of Base Station System Application Part (BSSAP) on the E-interface".

[19] TS 29.010: "General Packet Radio Service (GPRS); Serving GPRS Support Node (SGSN) - Visitors Location Register (VLR): Gs interface Layer 2 specification".

[20] TS 29.016: "Serving GPRS Support Node (SGSN) - Visitors Location Register (VLR): Gs interface Layer 2 specification".

[21] CCITT Recommendation E.164: "Numbering plan for the ISDN era".

[22] 3G TS 25.413: " UTRAN Iu Interface RANAP Signalling ".

2.2 Informative references

[22A] GSM 01.61: "Digital cellular telecommunications system (Phase 2+); GPRS ciphering algorithm requirements".

[23] TS 22.001: "Principles of telecommunication services supported by a GSM Public Land Mobile Network (PLMN)".

[24] TS 22.002: "Bearer Services (BS) supported by a GSM Public Land Mobile Network (PLMN)".

[25] TS 22.003: "Teleservices supported by a GSM Public Land Mobile Network (PLMN)".

[26] GSM 02.08: "Digital cellular telecommunications system (Phase 2+); Quality of service".

[27] GSM 02.09: "Digital cellular telecommunications system (Phase 2+); Security aspects".

[28] TS 22.011: "Service accessibility".

[29] TS 22.016: "International Mobile station Equipment Identities (IMEI)".

[30] GSM 02.17: "Digital cellular telecommunications system (Phase 2+); Subscriber identity modules Functional characteristics".

[31] TS 22.030: "Man-Machine Interface (MMI) of the Mobile Station (MS)".

[32] GSM 03.61: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Point to Multipoint Multicast Service Description; Stage 2".

[33] GSM 03.62: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Point to Multipoint Group Call Service Description; Stage 2".

[34] GSM 04.01: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface General aspects and principles".

[35] TS 24.002: "GSM - UMTS Public Land Mobile Network (PLMN) access reference configuration".

[36] GSM 04.03: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface Channel structures and access capabilities".

[37] GSM 04.04: "Digital cellular telecommunications system (Phase 2+); layer 1 General requirements".

[38] GSM 04.05: "Digital cellular telecommunications system (Phase 2+); Data Link (DL) layer General aspects".

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

[40] TS 24.011: "Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface".

[41] GSM 04.22: "Digital cellular telecommunications system (Phase 2+); Radio Link Protocol (RLP) for data and telematic services on the Mobile Station - Base Station System (MS - BSS) interface and the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

[42] TS 27.060: "Mobile Station (MS) supporting GPRS".

[43] GSM 08.06: "Digital cellular telecommunications system (Phase 2+); Signalling transport mechanism specification for the Base Station System - Mobile Switching Centre (BSS - MSC) interface".

[44] GSM 08.14: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Serving GPRS Support Node (SGSN) - Base Station System (BSS): Gb interface layer 1".

[45] GSM 08.16: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Serving GPRS Support Node (SGSN) - Base Station System (BSS): Network Service".

[46] TS 29.060: "General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp Interface".

[47] TS 29.061: "General requirements on interworking between the Public Land Mobile Network (PLMN) supporting General Packet Radio Service (GPRS) and Packet Data Networks (PDN)".

[48] GSM 12.00 (ETS 300 612-1): "Digital cellular telecommunications system (Phase 2+); Objectives and structure of Network Management (NM)".

[49] GSM 12.01 (ETS 300 612-2): "Digital cellular telecommunications system (Phase 2+); Common aspects of GSM Network Management (NM)".

[50] GSM 12.02: "Digital cellular telecommunications system (Phase 2+); Subscriber, Mobile Equipment (ME) and services data administration".

[51] GSM 12.03: "Digital cellular telecommunications system (Phase 2+); Security management".

[52] GSM 12.13: "Digital cellular telecommunications system (Phase 2+); Maintenance of the Mobile-services Switching Centre (MSC)".

[53] GSM 12.14: "Digital cellular telecommunications system (Phase 2+); Maintenance of location registers".

[54] GSM 12.20: "Digital cellular telecommunications system (Phase 2+); Network Management (NM) procedures and messages".

[55] GSM 12.22: "Digital cellular telecommunications system (Phase 2+); Interworking of GSM Network Management (NM) procedures and messages at the Base Station Controller (BSC)".

[56] CCITT Recommendations I.130: "General modelling methods - Method for the characterisation of telecommunication services supported by an ISDN and network capabilities of an ISDN".

[57] CCITT Recommendation Q.65: "Methodology - Stage 2 of the method for the characterization of services supported by an ISDN".

[58] CCITT Recommendation Q.702: "Specifications of Signalling System No. 7 - Signalling data link".

[59] CCITT Recommendation Q.703: "Signalling link".

[60] CCITT Recommendation Q.704: "Signalling network functions and messages".

[61] CCITT Recommendation Q.711 (3/93): "Functional description of the signalling connection control part".

[62] CCITT Recommendation Q.712 (3/93): "Definition and function of SCCP messages".

[63] CCITT Recommendation Q.713 (3/93): "SCCP formats and codes".

[64] CCITT Recommendation Q.714 (3/93): "Signalling connection control part procedures".

[65] ANSI Recommendation T1.111 (1996): "Signalling System 7 (SS7) Message Transfer Part (MTP)".

[66] ANSI Recommendation T1.112 (1996): "Signalling System 7 (SS7) Signalling Connection Control Part (SCCP)".

3 Definitions, symbols and abbreviations

Unless listed below, the definitions, symbols and abbreviations are listed in GSM 01.04 or GSM 23.060.

4 Description of the association between a VLR and an SGSN

The Gs interface connects the databases in the MSC/VLR and the SGSN. The procedures described in this technical specification are used to co-ordinate the location information of MSs that are IMSI attached to both GPRS and non-GPRS services. The Gs interface is also used to convey some circuit switched related procedures via the SGSN.

The basis for the interworking between a VLR and an SGSN is the existence of an association between those entities per MS. An association consists of the SGSN storing the number of the VLR serving the MS for circuit switched services and the VLR storing the number of the SGSN serving the MS for packet switched services. The association is only applicable to MSs in class-A mode of operation and MSs in class-B mode of operation.

All the messages described in the present document use the SCCP class 0 connectionless service.

When the return option in SCCP is used and the sender receives an N_NOTICE indication from SCCP, the sending entity shall report to the Operation and Maintenance system (see ITU-T Recommendation Q.714).

The behaviour of the VLR and the SGSN entities related to the Gs interface are defined by the state of the association for an MS. Individual states per association, i.e. per MS in class-A mode of operation and MS in class-B mode of operation, are held at both the VLR and the SGSN.

4.1 Association at the VLR

The states associated to the Gs interface in the VLR are specified in this subclause. The state diagram at the VLR is shown in figure 4.1. The state diagram does not include the message error handling specified in clause 16.

4.1.1 States at the VLR

Gs-NULL

There is no association with an SGSN for the MS and therefore the VLR considers that the MS is IMSI detached for GPRS services. In this state no BSSAP+-MS-INFORMATION-REQUEST or BSSAP+-MM-INFORMATION-REQUEST messages are sent to the SGSN. The VLR may initiate paging on the Gs interface if the 'Confirmed by Radio Contact' restoration indicator in the VLR is set to 'false' (see TS 23.007). Any message from the SGSN is ignored apart from the BSSAP+-LOCATION-UPDATE-REQUEST message.

LA-UPDATE PRESENT

The VLR has received a BSSAP+-LOCATION-UPDATE-REQUEST message from the SGSN. In this state the VLR may be waiting for the outcome of the Update Location procedure from the HLR. The VLR shall send BSSAP+-PAGING-REQUEST messages to MSs in class-A and MSs in class-B mode of operation via only the Gs interface.

Gs-ASSOCIATED

The VLR considers that the MS is attached to both GPRS and non-GPRS services. In this state the VLR sends BSSAP+-PAGING-REQUEST messages to MSs in class-A mode of operation and and MSs in class-B mode of operation via only the Gs interface. The VLR can perform the MS Identification procedure and the MM information procedure.

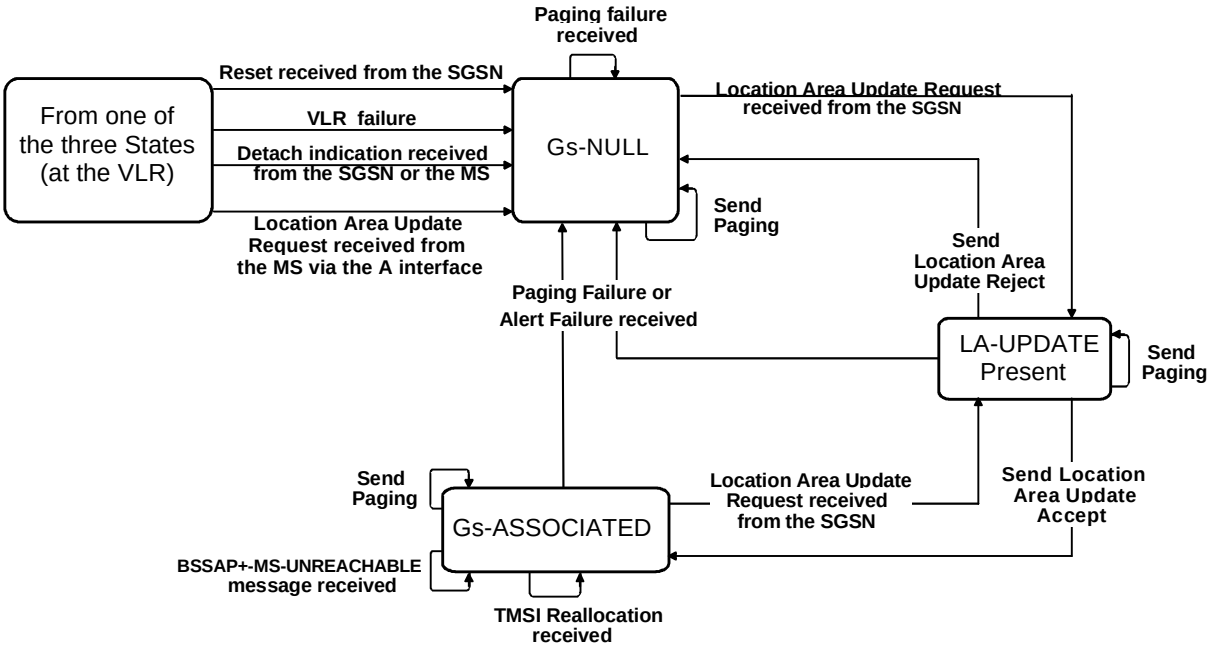

Figure 4.1/GSM 29.018: State diagram at the VLR

4.2 Association at the SGSN

The states and MM context variables associated to the Gs interface in the SGSN are specified in this subclause. The state diagram at the SGSN is shown in figure 4.2. The state diagram does not include the message error handling specified in clause 16.

4.2.1 MM context variables at the SGSN

VLR-Reliable: Boolean

Set to 'false' when the SGSN has received a reset indication from the VLR. The SGSN may request to the MS, upon reception of the next routeing area update (either periodic routeing area update or combined routeing and location area update) procedure, to re-attach to non-GPRS services if the MS is still IMSI attached to non-GPRS services. Alternatively the SGSN may upon reception of a combined routeing and location area update request or a periodic routeing area update from a MS that is still attached for non-GPRS service, perform immediately the location update for non-GPRS services procedure.

SGSN-Reset: Boolean

Set to 'true' when the SGSN restarts after a failure. The 'SGSN-Reset' variable is unique within an SGSN and it applies to all the MM context stored in the SGSN.

4.2.2 States at the SGSN

Gs-NULL

There is no association with a VLR for the MS and therefore the SGSN considers that the MS is IMSI detached of non-GPRS services. In this state the SGSN accepts BSSAP+-PAGING-REQUEST messages to MSs only if the 'SGSN-Reset' restoration indicator in the SGSN is set to 'true'.

LA-UPDATE Requested

The SGSN has sent a BSSAP+-LOCATION-UPDATE-REQUEST message to the VLR. In this state the SGSN waits for the outcome of the Location Update for non-GPRS procedure at the VLR before sending the response to the MS. In this state the SGSN accepts BSSAP+-PAGING-REQUEST messages.

Gs-ASSOCIATED

The SGSN stores an association for that MS. In this state the SGSN performs the Location Update for non-GPRS services procedure towards the VLR for MSs in class-A and MSs in class-B mode of operation when the MS moves to a new LA.

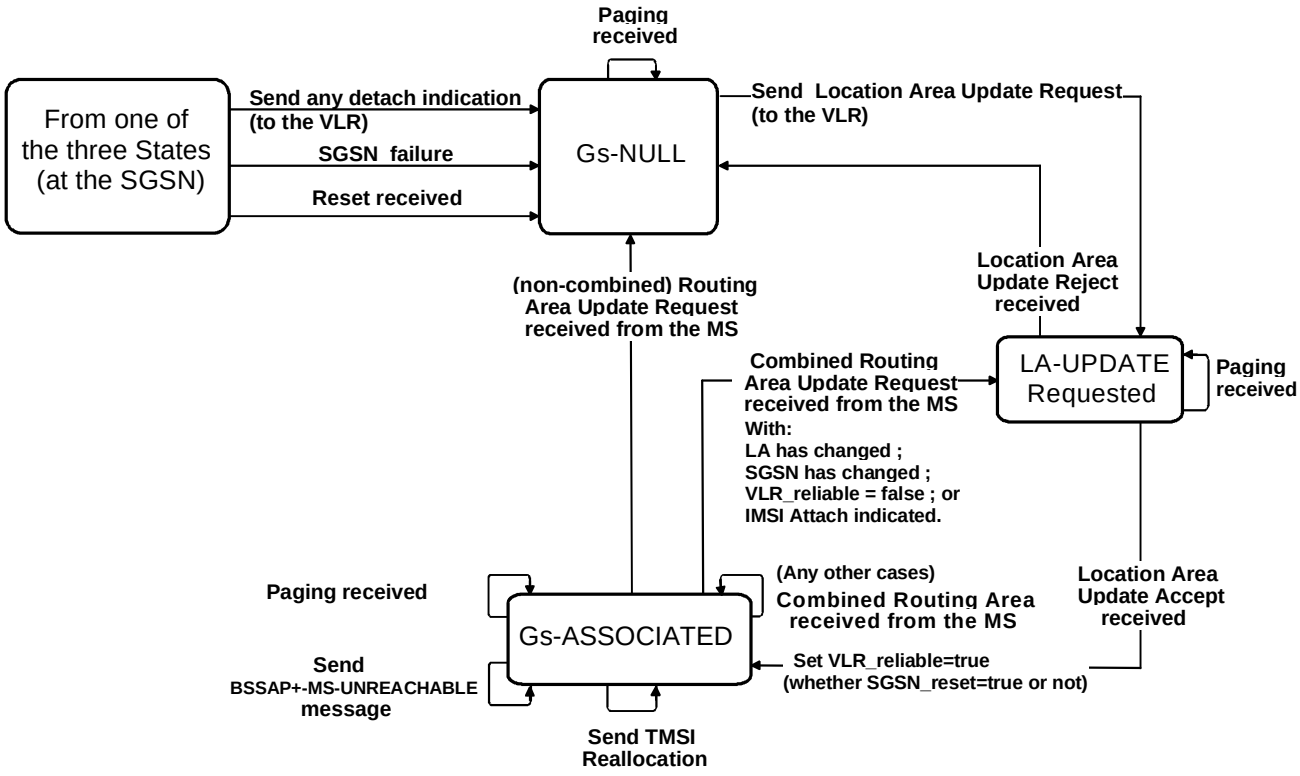

Figure 4.2/GSM 29.018: State diagram at the SGSN

5 Paging for non-GPRS services procedure

5.1 General description

This procedure is used by the VLR to send a BSSAP+-PAGING-REQUEST message to an MS via the GPRS service. This procedure applies to MSs that are simultaneously IMSI attached for GPRS services and non-GPRS services. The procedure can be performed simultaneously with any other procedure at the Gs interface.

5.2 Procedures in the VLR

The VLR shall handle the timers, queuing and retransmission for sending the BSSAP+-PAGING-REQUEST message on the Gs interface in the same way that it handles the sending of a PAGING message on the A interface.

5.2.1 Paging Initiation

When a VLR has to page a GPRS MS it shall check whether the MSC has an SCCP connection for that MS. If no SCCP connection exists the VLR checks the state of the association to an SGSN and the value of the restoration indicators for that MS. The VLR sends BSSAP+-PAGING-REQUEST messages to the SGSN if the state of the association for the MS is Gs-ASSOCIATED, LA-UPDATE-PRESENT or if the state of the association is Gs-NULL and the 'Confirmed by Radio Contact' restoration indicator is set to 'false'. The sending of the BSSAP+-PAGING-REQUEST message does not change the state of the association with the SGSN.

If the 'Confirmed by Radio Contact' restoration indicator is set to 'true', the VLR shall include the Location area identifier IE into the BSSAP+-PAGING-REQUEST message, otherwise (i.e. after a VLR failure) the Location area identifier IE shall not be included. When sending the BSSAP+-PAGING-REQUEST message, the VLR shall start timer T5.

If the state of the association is Gs-NULL and the restoration indicator 'Confirmed by Radio Contact' is set to 'false', the VLR shall also perform a search procedure as specified in GSM 03.18.

5.2.2 Paging Response

The VLR stops the paging procedure on expiry of timer T5 or on receipt of an SCCP connection establishment containing the Initial L3 message from the MS via the A interface.

5.2.3 Paging Failure

On receipt of a BSSAP+-PAGING-REJECT message before the timer T5 expires, the VLR stops timer T5, the association is moved to the Gs-NULL state and within this state the association is marked with the contents of the Gs Cause IE.

5.2.4 MS unreachable

On receipt of a BSSAP+-MS-UNREACHABLE message before the timer T5 expires, the VLR stops timer T5 and the paging procedure for that paging request towards the SGSN is stopped. The state of the association at the VLR is not changed.

5.3 Procedures in the SGSN

The SGSN accepts BSSAP+-PAGING-REQUEST messages in any state of the association apart from Gs-NULL. Nevertheless the SGSN also accepts BSSAP+-PAGING-REQUEST messages in the Gs-NULL state if the 'SGSN-Reset' restoration indicator at the SGSN is set to 'true'. When an SGSN receives a BSSAP+-PAGING-REQUEST message from a VLR, the SGSN shall first check if the MS is known by the SGSN. The handling of the paging request depends on the state of the association and the MM context variables at the SGSN:

a) The MS is known and the restoration indicator 'SGSN-Reset' at the SGSN is set to 'false':

   - If the MS is considered to be IMSI attached for GPRS and non-GPRS services (i.e. the association is not in the state Gs-NULL), the SGSN shall page the MS based on the location information stored in the SGSN.

   - If the MS is marked as IMSI detached for GPRS services or IMSI (implicitly or explicitly) detached for non-GPRS services (i.e. the state of the association is Gs-NULL), the SGSN shall return a BSSAP+-PAGING-REJECT message to that VLR indicating in the Gs Cause IE the detach circumstance ('IMSI detached for GPRS services', 'IMSI detached for non-GPRS services' or 'IMSI implicitly detached for non-GPRS services').

- If the MS is marked as unreachable (i.e. the PPF flag is set to 'false') the SGSN shall return a BSSAP+-MS-UNREACHABLE message to that VLR indicating in the Gs Cause IE 'MS unreachable'. The state of the association does not change at the SGSN.

b) The MS is known and the restoration indicator 'SGSN-Reset' at the SGSN is set to 'true':

- If the BSSAP+-PAGING-REQUEST message includes the Location area identifier IE, the SGSN shall page the MS in all the routeing areas served by the SGSN that are included in the location area indicated in the Location area identifier IE.

- If the BSSAP+-PAGING-REQUEST message does not include the Location area identifier IE, the SGSN may page in all the routeing areas served by the SGSN that are also served by the sending VLR.

c) The MS is not known and the restoration indicator 'SGSN-Reset' at the SGSN is set to 'false':

- The SGSN shall return a BSSAP+-PAGING-REJECT message to that VLR indicating in the Gs Cause IE 'IMSI unknown'.

d) The MS is not known and the restoration indicator 'SGSN-Reset' at the SGSN is set to 'true':

- If the VLR provides the Location area identifier IE, the SGSN shall page within the location area indicated by the VLR. Otherwise the SGSN may page in all the routeing areas served by the SGSN that are also served by the sending VLR.

If the SGSN accepts the paging request, the SGSN shall process the BSSAP+-PAGING-REQUEST message before sending the message on the Gb interface. The result of the processing on the BSSAP+-PAGING-REQUEST message is the PAGING CS message (see GSM 08.18) sent on the Gb interface.

The SGSN shall not retransmit the PAGING CS message.

If within a location area there are cells that do not support GPRS services, the SGSN shall group these cells under a 'null RA'. The SGSN will perform the paging procedure described above within both the RA(s) derived from the location information and the 'null RA(s)' of the corresponding location area(s) (see TS 24.008).

NOTE: The eMLPP priority information element relates to relative priorities within the paged MS and not to the priority in the sending of PAGING CS messages by the BSS.

6 Location Update for non-GPRS services procedure

6.1 General description

The location update for non-GPRS services procedure is a general procedure used by MSs in class-A mode of operation and MSs in class-B mode of operation. This procedure allows MSs and network to perform:

- Combined IMSI attach for GPRS and non-GPRS services;

- IMSI attach for non-GPRS services if the MS is already IMSI attached for GPRS services;

- IMSI attach for GPRS services indication to the VLR if the MS is already IMSI attached for non-GPRS services;

- Normal Location Update procedure to the VLR if the MS is IMSI attached for both GPRS and non-GPRS services;

- Reallocation of TMSI to an MS.

The Location Update for non-GPRS services procedures in the Gs interface is always started as a consequence of a direct action by the MS. The combined routeing area update procedure is further specified in TS 23.060 and 24.008.

The Location Update for non-GPRS services procedure is used by the SGSN to forward to the VLR those parts of the combined routeing area update or IMSI attach procedure which belong to the non-GPRS services. This means that non-GPRS related requests which are included in the combined request, are sent from the SGSN to the VLR. The procedure is also used by the SGSN to indicate to the VLR when an IMSI attach to GPRS services has been performed by an MS that was already IMSI attached to non-GPRS services. The SGSN may also forward a BSSAP+-TMSI-REALLOCATION-COMPLETE message from the MS to the VLR.

The VLR shall acknowledge the BSSAP+-LOCATION-UPDATE-REQUEST message. When the VLR processes the request it does not perform authentication because it relies on the SGSN's security functions.

When an MS is IMSI attached for GPRS and non-GPRS services, any implicit detach timer in the VLR shall be stopped. Instead the Paging Proceed Flag in the SGSN is used to determine the likely availability of the MS to the network. The SGSN does not report to the VLR upon reception of the periodic Routeing Area Update message. When the MS performs a detach only from the GPRS system the GPRS detach indication to the VLR shall cause the VLR's implicit detach timer to be restarted from its initial value.

If the SGSN performs an implicit detach for both GPRS and non-GPRS traffic, then the SGSN shall indicate to the VLR a BSSAP+-IMSI-DETACH-INDICATION message with cause 'Implicit SGSN initiated IMSI detach from non-GPRS service', as further described in clause 'Implicit IMSI detach from non-GPRS service procedure' (the implicit IMSI detach message indicates that the MS is unavailable for both GPRS and non-GPRS services).

The IMSI attach for GPRS services to the VLR, when the MS is already IMSI attached for non-GPRS services, is requested by the MS sending a combined IMSI attach for GPRS and non-GPRS services message to the SGSN, as further specified in TS 23.060 and 24.008.

6.2 Procedures in the SGSN

The Location Update for non-GPRS services is initiated with a routeing area update procedure or a IMSI/GPRS attach procedure. On receipt of a Routeing Area Update message, the SGSN shall handle the GPRS related request as specified in TS 24.008. The Location Update for non-GPRS services procedure may be handled by the SGSN in parallel to the Update Location procedure to the HLR. The SGSN shall wait for the outcome of both location update procedures towards the VLR and the HLR before sending the response message to the MS (see TS 24.008).

6.2.1 Location Update Initiation

If timer T6-1 is not running, the SGSN shall start the Location Update for non-GPRS service procedure when it receives from the MS:

- An Attach request indicating combined IMSI and GPRS attach;
- An Attach request indicating IMSI only attach;
- A Routeing Area Update request indicating that the Location Area has changed; or
- A Routeing Area Update request when the SGSN serving the MS has changed.

The number of the VLR is derived from the RAI where the MS is camping. The SGSN starts Timer T6-1. The BSSAP+-LOCATION-UPDATE-REQUEST message includes the old Location Area Identifier received from the MS. The SGSN shall also include the new Location Area Identifier where the MS is currently camping. The new LAI is derived from the RAI.

The BSSAP+-LOCATION-UPDATE-REQUEST message includes the type of location update performed by the MS in the GPRS location update type IE. If the MS has performed an attach request, the SGSN indicates 'IMSI attach', otherwise the SGSN indicates 'Normal location update'.

The BSSAP+-LOCATION-UPDATE-REQUEST message shall include the TMSI status if received from the MS.

If timer T6-1 is running:

If the SGSN receives from the MS:

- An Attach request indicating combined IMSI and GPRS attach;
- An Attach request indicating IMSI only attach; or
- A Routeing Area Update request indicating that the Location Area has changed.

Then:

- If the new LAI is the same as in the outstanding request, the SGSN shall not process this new request and shall wait for the VLR's response to the ongoing procedure; or
- If the new LAI is different but is in the same VLR as the outstanding request:
  - any response from the VLR to the oustanding request is ignored;
  - Timer T6-1 shall stopped and reset; and
  - The SGSN shall start the Location Update for non-GPRS service procedure; or
- If the new LAI is different, and is in a different VLR to the outstanding request:
  - Any response from the previously addressed VLR to the oustanding request is ignored;
  - Timer T6-1 shall stopped and reset; and
  - the SGSN shall start the Location Update for non-GPRS service procedure.

When the SGSN receives from the MS a Routeing Area Update request and the SGSN serving the MS has changed, the SGSN shall stop and reset timer T6-1.

6.2.2 Location Update Response

If the SGSN receives a BSSAP+-LOCATION-UPDATE-ACCEPT message from the VLR, the SGSN shall:

stop timer T6-1; and

- Move the state of the association to Gs-ASSOCIATED;
- Set the the MM context variable 'VLR-Reliable' to 'true'; and
- Indicate to the MS the acceptance of the VLR to the Location Update procedure. The message to the MS includes the Routeing Area Identity, from which the MS is able to extract the location area identity for which the location update procedure succeeded (see TS 24.008).

The SGSN shall wait for the outcome of the Location Update for non-GPRS service procedure towards the VLR before sending a response to location update procedure to the MS. Any Reject cause that needs to be reported to the MS is specified in TS 24.008

If the VLR included the Mobile Identity IE in the BSSAP+-LOCATION-UPDATE-ACCEPT message, the SGSN shall forward the information received to the MS. This will cause the MS to perform a TMSI reallocation procedure. The SGSN shall send to the VLR the BSSAP+-TMSI-REALLOCATION-COMPLETE message when the SGSN receives the Routeing Area Complete message from the MS.

6.2.3 Location Update Failure

If the SGSN receives a BSSAP+-LOCATION-UPDATE-REJECT message from the VLR, the SGSN shall:

- Stop timer T6-1;
- Move the state of the association to Gs-NULL; and
- Indicate to the MS the rejection of the VLR of the Location Update procedure as specified in TS 24.008. The Reject cause value sent by the VLR shall be forwarded to the MS.

6.2.4 Abnormal cases

If timer T6-1 expires, the SGSN shall abort the Location Update for non-GPRS service procedure and indicate this to the MS with the Reject cause value 'MSC temporarily not reachable'. The state of the association to the VLR shall be Gs-NULL.

If the SGSN receives a BSSAP+LOCATION-UPDATE-ACCEPT message and timer T6-1 is not running then:

- If timer T8 is running (see clause 8), the message shall be ignored;
- If timer T9 is running (see clause 9), the message shall be ignored; or
- If timers T8 and T9 are not running:
  - If the state of the association to the VLR is GS-ASSOCIATED, the message shall be ignored; or
  - If the state of the association to the VLR is different than GS-ASSOCIATED, the message shall be treated as a message incompatible with the protocol state of the SGSN (see subclause 16.3).

6.3 Procedures in the VLR

When a VLR receives a BSSAP+-LOCATION-UPDATE-REQUEST message it shall check whether the IMSI is known. If the IMSI is not known the VLR shall retrieve the MM context of the MS from the HLR.

6.3.1 Location Update Response

If the Location Update is accepted by the VLR and, if necessary by the HLR, the VLR shall:

- Move the association to the Gs-ASSOCIATED state;
- Set the restoration indicator 'Confirmed by Radio Contact' to 'true';
- Update the association by storing the SGSN number included in the BSSAP+-LOCATION-UPDATE-REQUEST message; and
- Send a BSSAP+-LOCATION-UPDATE-ACCEPT message to the sending SGSN. This message includes the Location Area Identification received in the new Cell Global Identity IE in the previous BSSAP+-LOCATION-UPDATE-REQUEST message.

6.3.2 Location Update Failure

If the Location Update is rejected by the VLR it shall:

- Send a BSSAP+-LOCATION-UPDATE-REJECT message to the SGSN with the appropriate reject cause as indicated in TS 24.008; and
- Move the association from any state to Gs-NULL.

6.3.3 TMSI reallocation procedure

If the VLR decides to reallocate the TMSI to the MS it shall include the new TMSI in the BSSAP+-LOCATION-UPDATE-ACCEPT message. If the VLR decides to deallocate the TMSI of the MS it shall include the IMSI of the MS in the BSSAP+-LOCATION-UPDATE-ACCEPT message. After sending the BSSAP+-LOCATION-UPDATE-ACCEPT message the VLR starts timer T6-2.

NOTE: In the BSSAP+-LOCATION-UPDATE-REQUEST the SGSN may indicate, that there is no valid TMSI available in the MS. This information may be used by the VLR to decide whether to reallocate a new TMSI to the MS.

Upon receipt of the BSSAP+-TMSI-REALLOCATION-COMPLETE message, the VLR stops the timer T6-2 and either considers the new TMSI as valid or, if an IMSI was sent to the MS, considers the old TMSI as deleted.

If no BSSAP+-TMSI-REALLOCATION-COMPLETE message is received by the VLR before the timer T6-2 expires, the VLR aborts the TMSI reallocation procedure. The VLR may still perform the TMSI reallocation procedure via the A interface. The outcome of the TMSI reallocation procedure does not change the state of the association. The VLR uses the IMSI or the new TMSI for paging.

6.3.4 Abnormal cases

i) MM signalling via A interface

If the VLR receives a Location Update request or an IMSI detach indication from the MS by the A interface when the state of the association in the VLR is not Gs-NULL, the VLR shall move the state of the association to Gs-NULL.

ii) Additional Location Update Request

If the state of the association in the VLR is in the LA-UPDATE PRESENT state and a BSSAP+-LOCATION-UPDATE-REQUEST message is received, then:

- If the message is from the same SGSN and indicates the same New Location Area as the outstanding location update request, then this additional BSSAP+-LOCATION-UPDATE-REQUEST message shall be ignored;

- If the message is from the same SGSN but indicates a different New Location Area to the outstanding location update request, then this additional BSSAP+-LOCATION-UPDATE-REQUEST message shall be treated and the VLR shall not send any response to the previous BSSAP+-LOCATION-UPDATE-REQUEST message; or

- If the message is from a different SGSN (indicating either the same or different New Location Area) to the outstanding location update request, then this additional BSSAP+-LOCATION-UPDATE-REQUEST message shall be treated and the VLR shall not send any response to the previous BSSAP+-LOCATION-UPDATE-REQUEST message.

iii) Detach signalling from SGSN

If the state of the association in the VLR is in the LA-UPDATE PRESENT state and either a BSSAP+-GPRS-DETACH-INDICATION or a BSSAP+-IMSI-DETACH-INDICATION message is received, then, the Location Update for non-GPRS services procedure shall be abandoned in the VLR (neither a BSSAP+LOCATION-UPDATE-ACCEPT nor a BSSAP+LOCATION-UPDATE-REJECT messages is sent) and the further actions described in clauses 8 or 9 or 10 are followed.

7 Non-GPRS alert procedure

7.1 General description

This procedure is used by the VLR to request from an SGSN an indication when activity (either signalling or data transmission) from an MS is detected. This procedure can be invoked at any time by the VLR. The BSSAP+-ALERT-REQUEST message shall be acknowledged by the SGSN.

7.2 Procedures in the VLR

7.2.1 Alert Initiation

The VLR may start the Non-GPRS alert procedure at any time. When the VLR wants to request to an SGSN that further activity from an MS shall reported by the SGSN, the VLR shall send an BSSAP+-ALERT-REQUEST message to that SGSN. The VLR starts timer T7 when the BSSAP+-ALERT-REQUEST message is sent.

7.2.2 Alert Response

When a BSSAP+-ALERT-ACK message is received, the VLR shall stop the timer T7. The state of the association is not changed.

7.2.3 Alert failure

If a BSSAP+-ALERT-REJECT message is received, the VLR shall stop the timer T7, move the state of the association to Gs-NULL and within this state the association is marked with the contents of the Gs Cause IE.

7.2.4 Alert Indication

The VLR shall not change the state of the association upon reception of an BSSAP+-MS-ACTIVITY-INDICATION message.

7.2.5 Abnormal cases

If no BSSAP+-ALERT-ACK message is received before the timer T7 expires, the VLR shall retransmit the BSSAP+-ALERT-REQUEST message a maximum of N7 times. If no BSSAP+-ALERT-ACK message is received after that, a report shall be made to the O&M system. The state of the association is not changed.

7.3 Procedures in the SGSN

7.3.1 Alert response

The SGSN may receive a BSSAP+-ALERT-REQUEST message at any state of the association. Upon receipt of an BSSAP+-ALERT-REQUEST message from the VLR and if the IMSI is known in the SGSN, the SGSN shall reply with a BSSAP+-ALERT-ACK message and set the NGAF.

7.3.2 Alert failure

If a BSSAP+-ALERT-REQUEST message is received for an IMSI that is unknown at the SGSN, the SGSN shall return a BSSAP+-ALERT-REJECT message to the VLR indicating the Gs Cause IE value 'IMSI unknown'.

7.3.3 Alert indication

The SGSN shall to report to the VLR upon detection of any activity (either signalling or data) from the MS if the NGAF is set. If the SGSN detects GPRS signalling that leads to a procedure towards the VLR, the SGSN shall follow this procedure and reset the NGAF. If the SGSN detects activity that does not lead to any procedure towards the VLR, the SGSN shall send an BSSAP+-MS-ACTIVITY-INDICATION message towards the VLR and reset the NGAF.

8 Explicit IMSI detach from GPRS services procedure

8.1 General description

This procedure is used by the SGSN to indicate to the VLR that the MS has been IMSI detached from GPRS service and therefore the association between the SGSN and the VLR has to be deactivated. This procedure only applies to MSs that are not in the Gs-NULL state at the SGSN. The procedures specified in this subclause apply to GPRS detach indication initiated by the MS or by the network as specified in TS 23.060.

The procedure is also used by the SGSN to indicate to the VLR when a Location Update procedure has been rejected by the SGSN.

The Explicit IMSI detach from GPRS services procedure aborts any other ongoing procedure related to this MS on the Gs interface in the SGSN and in the VLR.

The VLR and the MS should be synchronised as to whether the PBCCH or the BCCH is used, for any of the subsequent paging. In order to achieve this, the SGSN shall attempt to inform the VLR about the detach event by using a retry scheme if the initial delivery of the BSSAP+-GPRS-DETACH-INDICATION message fails.

8.2 Procedures in the SGSN

8.2.1 Explicit GPRS detach initiation

The SGSN shall send a BSSAP+-GPRS-DETACH-INDICATION message to a VLR if:

- The SGSN receives a GPRS only detach from the MS;
- The SGSN performs network-initiated GPRS detach procedure; or
- The combined Routing and Location Area Update procedure is rejected at the SGSN.

If the SGSN receives a Detach Request from an MS and the state of the association to a VLR for that MS is not Gs-NULL, the SGSN shall check the detach type indicated in the message. If the MS is indicating GPRS detach the SGSN shall send a BSSAP+-GPRS-DETACH-INDICATION message to the VLR indicating 'MS initiated IMSI detach from GPRS service'.

If the SGSN decides to perform a network-initiated GPRS detach and the state of the association to a VLR for that MS is not Gs-NULL, the SGSN shall send a BSSAP+-GPRS-DETACH-INDICATION message to the VLR indicating 'SGSN initiated IMSI detach from GPRS service'.

If the combined Routing and Location Area Update procedure is rejected at the SGSN for a MS with an association state different from Gs-NULL, the SGSN shall send a BSSAP+-GPRS-DETACH-INDICATION to the VLR indicating 'GPRS services not allowed'. The SGSN then sends, for example, an Attach Reject message as specified in TS 24.008.

After the sending of the BSSAP+-GPRS-DETACH-INDICATION message, the SGSN shall move the state of the association to Gs-NULL. The SGSN shall start timer T8 upon transmission of the BSSAP+-GPRS-DETACH-INDICATION message and if timer T6-1 is running, timer T6-1 shall be stopped and reset.

8.2.2 Explicit GPRS detach Response

The SGSN shall not wait for the reception of the BSSAP+-GPRS-DETACH-ACK message before sending (if needed) the confirmation of the detach to the MS.

8.2.3 Abnormal cases

If no BSSAP+-GPRS-DETACH-ACK message is received by the SGSN to a previous BSSAP+-GPRS-DETACH-INDICATION message before timer T8 expires, the SGSN shall repeat the BSSAP+-GPRS-DETACH-INDICATION message a maximum of N8 times. If no BSSAP+-GPRS-DETACH-ACK message is received after that, a report shall be made to the O&M system. The state of the association during the acknowledgement procedure remains Gs-NULL.

8.3 Procedures in the VLR

When a VLR receives a BSSAP+-GPRS-DETACH-INDICATION message, the VLR shall send a BSSAP+-GPRS-DETACH-ACK message to the sending SGSN. The state of the association for the MS shall be moved from any state to Gs-NULL. The VLR marks the association as 'IMSI detached for GPRS services' with the reason indicated in the IMSI detach from GPRS service type IE.

If the VLR's implicit detach timer is not running then, the VLR shall set and restart the implicit detach timer upon reception of a BSSAP+-GPRS-DETACH-INDICATION message. If the VLR's implicit detach timer is running (ie the state of the association was already Gs-NULL) then, the reception of a BSSAP+-GPRS-DETACH-INDICATION message shall not affect the VLR's implicit detach timer.

9 Explicit IMSI detach from non-GPRS services procedure

9.1 General description

This procedure is used by the SGSN to indicate to the VLR that the MS has performed IMSI detach from non-GPRS services and therefore the association between the SGSN and the VLR has to be deactivated. This procedure only applies to MSs that are not in the Gs-NULL state at the SGSN . The procedures specified in this subclause only apply to IMSI detach or combined IMSI and GPRS detach requests.

The explicit IMSI detach from non-GPRS services procedure aborts any other ongoing procedure related to this MS on the Gs interface in the SGSN and in the VLR.

The VLR and the MS should be synchronised as to whether the PBCCH or the BCCH is used, for any of the subsequent paging.. In order to achieve this, the SGSN shall attempt to inform the VLR about the detach event by using a retry scheme if the initial delivery of the BSSAP+-IMSI-DETACH-INDICATION message fails.

9.2 Procedures in the SGSN

9.2.1 Explicit IMSI detach initiation

When an SGSN receives a Detach Request from an MS which is not in the Gs-NULL state, it shall check the detach type indicated. If the MS is indicating IMSI detach or combined IMSI and GPRS detach the SGSN shall send an BSSAP+-IMSI-DETACH-INDICATION message to the VLR indicating 'Explicit MS initiated IMSI detach from non-GPRS service' or 'Combined explicit MS initiated IMSI detach from GPRS and non-GPRS services'.

After the sending of the BSSAP+-IMSI-DETACH-INDICATION message to the VLR, the SGSN shall move the state of the association to Gs-NULL. The SGSN shall start timer T9 upon transmission of the BSSAP+-IMSI-DETACH-INDICATION message and if timer T6-1 is running, timer T6-1 shall be stopped and reset..

9.2.2 Explicit IMSI detach Response

If the detach type received from the MS indicated IMSI only detach or combined IMSI and GPRS detach not due to switch off, the SGSN shall wait for the reception of the BSSAP+-IMSI-DETACH-ACK message before sending the confirmation of the detach to the MS.

9.2.3 Abnormal cases

i) with switch off

If the SGSN sent a BSSAP+-IMSI-DETACH-INDICATION message for a combined IMSI and GPRS detach due to switch off and timer T9 expires, the SGSN shall repeat the BSSAP+-IMSI-DETACH-INDICATION message a maximum of N9 times.

ii) with no switch off

If the SGSN sent a BSSAP+-IMSI-DETACH-INDICATION message for a IMSI only detach or a combined IMSI and GPRS detach not due to switch off and timer T9 expires, the SGSN shall repeat the BSSAP+-IMSI-DETACH-INDICATION message a maximum of N9 times. If no BSSAP+-IMSI-DETACH-ACK is received after that the SGSN shall send a detach message to the mobile indicating that the VLR has not responded to the Detach indication. The mobile may, after a determined period of time, try again the detach indication to the VLR.

9.3 Procedures in the VLR

When a VLR receives an BSSAP+-IMSI-DETACH-INDICATION message , the VLR shall send an BSSAP+-IMSI-DETACH-ACK message to the sending SGSN. The state of the association for the MS shall be moved from any state to Gs-NULL. If the BSSAP+-IMSI-DETACH-INDICATION message indicated 'Explicit MS initiated IMSI detach from non-GPRS service', the VLR marks the association as 'IMSI detached for non-GPRS services'. If the BSSAP+-IMSI-DETACH-INDICATION message indicated 'Combined explicit MS initiated IMSI detach from GPRS and non-GPRS services', the VLR marks the association as 'IMSI detached for GPRS and non-GPRS services'.

10 Implicit IMSI detach from non-GPRS services procedure

10.1 General description

This procedure is used by the SGSN to indicate when an internal SGSN timer mechanism has caused the SGSN to delete the GMM context of an MS or mark its GMM context as detached. This procedure only applies to MSs that are not in the Gs-NULL state at the SGSN.

The implicit IMSI detach from non-GPRS services procedure aborts any other ongoing procedure related to this MS on the Gs interface in the SGSN and in the VLR.

The VLR and the MS should be synchronised as to whether the PBCCH or the BCCH is used, for any of the subsequent paging. In order to achieve this, the SGSN shall attempt to inform the VLR about the detach event by using a retry scheme if the initial delivery of the BSSAP+-IMSI-DETACH-INDICATION message fails.

10.2 Procedures in the SGSN

When the implicit IMSI detach from non-GPRS services procedure is started for an MS by the above mentioned internal SGSN timer mechanism, the SGSN shall send a BSSAP+-IMSI-DETACH-INDICATION message to the VLR indicating 'Implicit SGSN initiated IMSI detach from non-GPRS service'.

After the sending of the BSSAP+-IMSI-DETACH-INDICATION message, the SGSN shall move the state of the association to Gs-NULL. The SGSN shall start timer T10 upon transmission of the BSSAP+-IMSI-DETACH-INDICATION message.

If no BSSAP+-IMSI-DETACH-ACK message is received by the SGSN to a previous BSSAP+-IMSI-DETACH-INDICATION message before timer T10 expires, the SGSN shall repeat the BSSAP+-IMSI-DETACH-INDICATION message a maximum of N10 times. The state of the association during the acknowledgement procedure remains Gs-NULL.

10.3 Procedures in the VLR

When a VLR receives the BSSAP+-IMSI-DETACH-INDICATION message and the state of the association is not Gs-NULL, the state of the association for the MS shall be moved to Gs-NULL. The VLR marks the association as 'IMSI implicitly detached for GPRS and non-GPRS services'. The VLR shall also send a BSSAP+-IMSI-DETACH-ACK message to the sending SGSN.

11 VLR failure procedure

11.1 General description

This procedure is used by the VLR to inform to the associated SGSNs about the recovery from an internal failure that has affected the association with the SGSNs.

The VLR recovery procedure shall be handled in such a way that the signalling load on the VLR and SGSN does not create any overload problem.

11.2 Procedures in the VLR

11.2.1 VLR Reset Initiation

In the event of a failure at the VLR which has resulted in the loss of SGSN association information on some MSs, the VLR shall move from any state to the Gs-NULL state for all the associations with SGSNs per MS. The VLR shall also set the 'Confirmed by Radio Contact' restoration indicator to 'false' (see TS 23.007). The VLR shall not send any BSSAP+- MS-INFORMATION-REQUEST or BSSAP+-MM-INFORMATION-REQUEST messages to MSs with the SGSN association in the Gs-NULL state.

When the VLR restarts a BSSAP+-RESET-INDICATION message shall be sent to all the SGSNs connected to the VLR by the Gs interface. This message indicates to the SGSN that for the MSs with an association to that VLR, the associations are no longer reliable. The VLR shall also start timer T11.

11.2.2 VLR Reset Response

Upon receipt of a BSSAP+-RESET-ACK message, the VLR shall stop the timer T11.

11.2.3 Abnormal cases

If the VLR does not receive a BSSAP+-RESET-ACK message from that SGSN before the T11 timer expires, the VLR shall retransmit the BSSAP+-RESET-INDICATION message. The retransmission is repeated a maximum of N11 times. If no BSSAP+-RESET-ACK is received after that a report shall be made to the O&M system.

11.3 Procedures in the SGSN

Upon receipt of a BSSAP+-RESET-INDICATION message from the VLR, the SGSN is informed that all the associations with that VLR for all the MSs registered in the SGSN are no longer reliable because the VLR may have lost information about the state of the MSs and during the failure the VLR may have missed signalling messages. The SGSN shall set the 'VLR-Reliable' MM context variable to 'false' and shall move all the associations containing the restarted VLR to the Gs-NULL state. The detach procedures for deleting the association are still applicable (clauses 'Explicit IMSI detach from GPRS services procedure', 'Explicit IMSI detach from non-GPRS services procedure' and 'Implicit IMSI detach from non-GPRS services procedure'). If the 'VLR-Reliable' MM context variable is set to 'false', upon reception of a Combined Routeing and Location Area update request or a periodic Routeing Area Update from the MS that is attached for non-GPRS service, the SGSN may request the re-attach to non-GPRS services, or may alternatively immediately perform the Location Update for non-GPRS services procedure towards the VLR.

The SGSN sends a BSSAP+-RESET-ACK message to the VLR. This indicates to the VLR that all the associations for the MSs which have an association with that VLR will be moved to the Gs-NULL state.

12 SGSN failure procedure

12.1 General description

This procedure is used by the SGSN to inform to the associated VLRs about the recovery from an internal failure that has affected the association with the VLRs.

The SGSN recovery procedure shall be handled in such a way that the signalling load on the VLR and SGSN does not create any overload problem.

12.2 Procedures in the SGSN

12.2.1 SGSN Reset Initiation

In the event of a failure at the SGSN which has resulted in the loss of VLR association information on some MSs, the SGSN shall move from any state to the Gs-NULL state for all the associations with VLRs per MS. The SGSN shall also set the 'SGSN-Reset' MM context variable to 'true' and start the timer T12-1. When the timer T12-1 expires the 'SGSN-Reset' MM context variable is set to 'false'. The value of the timer T12-1 shall be longer that the periodic routing area update timer at the SGSN.

A BSSAP+-RESET-INDICATION message shall be sent to all the VLRs connected to the SGSN by Gs interfaces. The BSSAP+-RESET-INDICATION message indicates to the VLR that all the associations with that particular SGSN for all the MSs registered in the VLR are no longer reliable. The normal procedures for updating the association are still applicable (clauses 'Location Update for non-GPRS services procedure', 'Explicit IMSI detach from GPRS services procedure', 'Explicit IMSI detach from non-GPRS services procedure' and 'Implicit IMSI detach from non-GPRS services procedure'). The SGSN shall also start timer T12-2.

12.2.2 SGSN Reset Response

Upon receipt of a BSSAP+-RESET-ACK message, the SGSN shall stop the timer T12-2.

12.2.3 Abnormal cases

If the SGSN does not receive a BSSAP+-RESET-ACK message from that VLR before the T12-2 timer expires, the SGSN shall retransmit the BSSAP+-RESET-INDICATION message. The retransmission is repeated a maximum of N12 times. If no BSSAP+-RESET-ACK is received after a report shall be to made the O&M system.

12.3 Procedures in the VLR

Upon receipt of a BSSAP+-RESET-INDICATION message from the SGSN, the VLR is informed that all the associations with that SGSN for all the MSs registered in the SGSN are no longer reliable because the SGSN may have lost information about the state of the MSs for that VLR and during the failure the SGSN may have missed signalling messages. The VLR shall set the 'Confirmed by Radio Contact' restoration indicator to 'false' in all the associations containing the restarted SGSN. If the 'Confirmed by Radio Contact' restoration indicator is 'false' the VLR may send paging messages on both the Gs and the A interface.

The VLR sends a BSSAP+-RESET-ACK message to the SGSN. This indicates to the SGSN that all the associations for the MSs which have an association with that SGSN will be moved to the Gs-NULL state.

13 HLR failure

This chapter decribes the SGSN behaviour towards the VLR as a consequence of an HLR reset.

13.1 General description

In the case of an HLR failure, the HLR informs the associated SGSNs about the recovery from an internal failure that has affected the association with the SGSNs according to the HLR reset procedure specified in TS 29.002.

This information is used in the SGSN to trigger the VLR to perform a location update towards the HLR in order to restore the HLR subscriber data,

13.2 Procedures in the SGSN

Upon receipt of a HLR reset indication from the HLR, the SGSN shall set the NGAF for all registered MSs in the SGSN for which a valid MSC/VLR-association exists.

Upon detection of any activity (either signalling or data) from the MS, the SGSN shall report to the VLR if the NGAF is set for this MS. If the SGSN detects GPRS signalling that leads to a procedure towards the VLR, the SGSN shall follow this procedure and reset the NGAF. If the SGSN detects activity that does not lead to any procedure towards the VLR, the SGSN shall send an BSSAP+-MS-ACTIVITY-INDICATION message towards the VLR and reset the NGAF. The activity indication may be delayed by the SGSN for a maximum operator-configuration depending time period to avoid high signalling load.

14 MS Information procedure

14.1 General description

The MS Information procedure is used by the VLR to request specific parameters about the MS. If the target MS for an MS Information procedure or a Provide Subscriber Info procedure (GSM 03.18, TS 29.002) is GPRS attached (i.e. the state of the association to Gs-ASSOCIATED) the VLR may decide to perform the procedure via GPRS. The outcome of the MS Information procedure does not change the state of the association at the VLR or SGSN.

14.2 Procedures in the VLR

If the target MS for the MS information procedure is GPRS attached and the state of the association for the MS Gs-ASSOCIATED, the VLR may initiate the MS information procedure by transferring a BSSAP+-MS-INFORMATION-REQUEST message to the SGSN. If the state of the association is LA-UPDATE PRESENT, the VLR shall wait until this state is exited. The VLR starts the timer T14. The BSSAP+-MS-INFORMATION-REQUEST message specifies the requested information parameters in the Information requested information element.

Upon receipt of a BSSAP+-MS-INFORMATION-RESPONSE the VLR shall stop timer T14. If no BSSAP+-MS-INFORMATION-RESPONSE for that MS is received before the expiry of timer T14the VLR shall stop the Gs interface MS information procedure. The VLR may perform other actions to obtain the information about the MS (e.g. retry, or send a DTAP IDENTITY REQUEST message on the A interface).

14.3 Procedures in the SGSN

The SGSN shall examine the type of information that is requested and if it is stored in its database shall use this information in its response to the VLR. The BSSAP+-MS-INFORMATION-RESPONSE message contains the information parameters as requested by the VLR. ~~In GSM,~~In A/Gb mode, the Mobile location information indicates a request for Cell Global Identity and Location information age. ~~In UMTS,~~In Iu mode, the Mobile location information indicates a request for Service Area Identification and Location information age. In this case, the SGSN shall use the Location Report Control procedure (see TS 25.413) in order to retrieve the SA.

If the SGSN receives an Information requested information element containing a 'not supported' value, then the value part of the Mobile station state information element in the BSSAP+-MS-INFORMATION-RESPONSE message shall be set to 'Information requested not supported'.

If the information is not locally available and it is a request for mobile identity information, the SGSN forwards the IDENTITY REQUEST message to the MS indicated in the message unless the GPRS activities of the MS are suspended. Upon receipt of the IDENTITY RESPONSE message from the MS, the SGSN shall send a BSSAP+-MS-INFORMATION-RESPONSE message. The BSSAP+-MS-INFORMATION-RESPONSE message contains the information parameters as requested by the VLR. If the GPRS activities of the MS are suspended the SGSN shall return a BSSAP+-MS-INFORMATION-RESPONSE message indicating in the MS state IE 'SUSPENDED'. If the requested information is not available or obtainable at the SGSN, the SGSN shall return a BSSAP+-MS-INFORMATION-RESPONSE message to the VLR without the requested information. The SGSN should include the MS status IE in all BSSAP+-MS-INFORMATION-RESPONSE messages.

If the IMSI is not known at the SGSN, the SGSN shall return a BSSAP+-MS-INFORMATION-RESPONSE message indicating in the MS state IE 'IMSI unknown'.

15 MM information procedure

15.1 General description

The MM information procedure may be performed by the VLR via GPRS if the target MS for the MM information procedure is IMSI attached to both GPRS and non-GPRS services (i.e. the state of the association is Gs-ASSOCIATED). The outcome of the MM Information procedure does not change the state of the association at the VLR or SGSN.

15.2 Procedures in the VLR

If the target MS for the MM information procedure is GPRS attached class A or B MS, the state of the association is Gs-ASSOCIATED, the VLR may initiate the MM information procedure by transferring a BSSAP+-MM-INFORMATION-REQUEST message to the SGSN.

15.3 Procedures in the SGSN

If the state of the association at the SGSN is not Gs-NULL, the SGSN shall forward the MM-INFORMATION message to the MS indicated.

16 Error Handling and Future Compatibility

16.1 General

This clause specifies procedures for the handling of unknown, unforeseen, and erroneous protocol data by the receiving entity. These procedures are called "error handling procedures", but in addition to providing recovery mechanisms for error situations they define a compatibility mechanism for future extensions of the protocol.

In this clause the following terminology is used:

- an IE is defined to be syntactically incorrect in a message if it contains at least one value defined as "reserved", or if its value part violates coding rules. However, it is not a syntactical error that an IE specifies in its Length Indicator a greater length than defined in the relevant clause; and

- a message is defined to have semantically incorrect contents if it contains information which, possibly dependant on the state of the receiver, is in contradiction to the resources of the receiver and/or to the procedural part of GSM 29.018.

When a receiving entity detects the need to send a BSSAP+-MOBILE-STATUS message (see errors detailed below), the entity shall copy the IMSI IE value (if included) of the incorrect message to the IMSI IE on the BSSAP+-MOBILE-STATUS message. The message in error is also included in the BSSAP+-MOBILE-STATUS message. Both the receiving and the sending entity shall abandon the procedure related to the incorrect message and return to the state from where the procedure related to the incorrect message was started.

Both the receiving and the sending entity shall inform the O&M entity upon sending or receiving a BSSAP+-MOBILE-STATUS message.

The next subclauses in this clause shall be applied in order of precedence.

16.2 Message too short

When a message is received that is too short to contain a complete message type information element, that message shall be ignored.

16.3 Unknown or unforeseen message type

If a message is received with a message type not defined or not implemented by the receiver it shall ignore the message. A BSSAP+-MOBILE-STATUS message with the Gs Cause Value set to "message unknown" and the Erroneous message IE containing the received message shall be returned.

If a message is received that is not compatible with the protocol state, a BSSAP+-MOBILE-STATUS message with the Gs Cause Value set to "message not compatible with the protocol state" and the erroneous message shall be returned.

If a message is received that is not defined to be received by that entity (i.e. the message is sent in the wrong direction) it shall be treated as unknown message and the message shall be ignored. A BSSAP+-MOBILE-STATUS message with the Gs Cause Value set to "message unknown" and the Erroneous message IE containing the received message shall be returned.

16.4 Missing mandatory information element

When on receipt of a message, and a "missing mandatory IE" error is diagnosed, the receiver shall ignore the message and return a BSSAP+-MOBILE-STATUS message with the Gs Cause Value set to "missing mandatory information element" and shall return the Erroneous message information element containing the received message.

16.5 IEs unknown or unforeseen in the message

All IEs unknown or unforeseen in a message shall be ignored.

16.6 Out of sequence IEs

All IEs that are out of sequence shall be ignored.

16.7 Repeated IEs

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

16.8 Syntactically incorrect mandatory IE.

On receipt of a message which contains a syntactically incorrect mandatory IE, the receiver shall ignore the message and return a BSSAP+-MOBILE-STATUS message with the Gs Cause Value set to "invalid mandatory information" and shall return the Erroneous message information element containing the received message.

16.9 Syntactically incorrect optional IEs

All optional IEs that are syntactically incorrect in a message shall be treated as not present in the message.

16.10 Conditional IE errors

When a VLR or SGSN receives a message and diagnoses a "missing conditional IE" error or an "unexpected conditional IE" error or when it receives a message containing at least one syntactically incorrect conditional IE which is required to be present in the message, a VLR or SGSN shall ignore the message and return a BSSAP+-MOBILE-STATUS message with the Gs Cause Value set to "conditional IE error" and shall return the Erroneous message information element containing the received message.

When a VLR or SGSN receives a message containing a syntactically incorrect conditional IE which is not required to be present in the message, nor required to be absent in the message, then a VLR or SGSN shall ignore that IE.

16.11 IEs with semantically incorrect contents

When an IE with semantically incorrect contents is received, the foreseen reactions of the procedural part of GSM 29.018 are performed.

If however no such reactions are specified, the receiving entity shall ignore that IE and treat the rest of the message. If, because this IE was ignored, the rest of the message can no longer be handled then the receiving entity shall return a BSSAP+-MOBILE-STATUS message with the Gs Cause Value set to "semantically incorrect message" and shall return the Erroneous message information element containing the received message.

17 Message functional definitions and contents

This clause defines the structure of the messages that are sent between the SGSN and the VLR.

17.1 Message Contents

17.1.1 BSSAP+-ALERT-ACK message

This message is sent by the SGSN to the VLR to acknowledge a previous BSSAP+-ALERT-REQUEST message.

Table 17.1.1/GSM 29.018: BSSAP+-ALERT-ACK message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10

17.1.2 BSSAP+-ALERT-REJECT message

This message is sent from the SGSN to the VLR to indicate that the SGSN could not identify the IMSI indicated in the BSSAP+-ALERT-Request message.

Table 17.1.2/GSM 29.018: BSSAP+-ALERT-REJECT message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
Gs Cause	Gs Cause 18.4.7	M	TLV	3

17.1.2.1 Gs Cause

The value part which is typically sent for this information element in this message is 'IMSI unknown'.

17.1.3 BSSAP+-ALERT-REQUEST message

This message is sent by the VLR to the SGSN to request an indication when next activity from the MS is detected.

Table 17.1.3/GSM 29.018: BSSAP+-ALERT-REQUEST message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10

17.1.4 BSSAP+-DOWNLINK-TUNNEL-REQUEST message

This message is sent from the non-GSM MSC/VLR to the SGSN to convey a tunneling payload to the MS identified by the specified IMSI.

Table 17.1.4/GSM 29.018: BSSAP+-DOWNLINK-TUNNEL-REQUEST message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
VLR number	VLR number 18.4.26	M	TLV	5-11
Downlink Tunnel Payload Control and Info	Downlink Tunnel Payload Control and Info 18.4.3	M	TLV	3-223

17.1.5 BSSAP+-GPRS-DETACH-ACK message

This message is sent by the VLR to the SGSN to acknowledge a previous BSSAP+-GPRS-DETACH-Indication message. The type of detach acknowledged is indicated in the GPRS detach type IE.

Table 17.1.5/GSM 29.018: BSSAP+-GPRS-DETACH-ACK message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10

17.1.6 BSSAP+-GPRS-DETACH-INDICATION message

This message is sent by the SGSN to the VLR to indicate a GPRS detach performed from the MS or the SGSN. The type of detach is indicated in the GPRS detach type IE.

Table 17.1.6/GSM 29.018: BSSAP+-GPRS-DETACH-INDICATION message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
SGSN number	SGSN number 18.4.22	M	TLV	5-11
IMSI detach from GPRS service type	IMSI detach from GPRS service type 18.4.17	M	TLV	3
Cell global identity	Cell global identity 18.4.1	O	TLV	10
Service area identification	Service area identification 18.4.21b	O	TLV	10

17.1.6.1 Cell global identity ~~(GSM only)~~(A/Gb mode only)

~~In GSM,~~In A/Gb mode, the SGSN shall include the Cell global identity where the mobile was in the last radio contact.

17.1.6.2 Service area identification ~~(UMTS only)~~(Iu mode only)

~~In UMTS,~~In Iu mode, the SGSN should include the Service area identification where the mobile was in the last radio contact.

17.1.7 BSSAP+-IMSI-DETACH-ACK message

This message is sent by the VLR to the SGSN to acknowledge a previous BSSAP+-IMSI-DETACH-Indication message. The type of detach acknowledged is indicated in the IMSI detach type IE.

Table 17.1.7/GSM 29.018: BSSAP+-IMSI-DETACH-ACK message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10

17.1.8 BSSAP+-IMSI-DETACH-INDICATION message

This message is sent by the SGSN to the VLR to indicate an IMSI detach performed from the MS. The type of detach is indicated in the IMSI detach type IE.

Table 17.1.8/GSM 29.018: BSSAP+-IMSI-DETACH-INDICATION message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
SGSN number	SGSN number 18.4.22	M	TLV	5-11
Detach type	IMSI detach from non-GPRS service type 18.4.11	M	TLV	3
Cell global identity	Cell global identity 18.4.1	O	TLV	10
Location information age	Location information age 18.4.14	O	TLV	4
Service area identification	Service area identification 18.4.21b	O	TLV	10

17.1.8.1 Cell global identity ~~(GSM only)~~(A/Gb mode only)

~~In GSM,~~In A/Gb mode, the SGSN shall include the Cell global identity where the mobile was in the last radio contact.

17.1.8.2 Location information age

If the detach is due to implicit detach and the Cell global identity is available, then the SGSN should include the Location information age.

17.1.8.3 Service area identification ~~(UMTS only)~~(Iu mode only)

~~In UMTS,~~In Iu mode, the SGSN should include the Service area identification where the mobile was in the last radio contact.

17.1.9 BSSAP+-LOCATION-UPDATE-ACCEPT message

This message is sent by the VLR to the SGSN to indicate that update or IMSI attach in the VLR has been completed.

Table 17.1.9/GSM 29.018: BSSAP+-LOCATION-UPDATE-ACCEPT message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
Location area identifier	Location area identifier 18.4.14	M	TLV	7
New TMSI, or IMSI	Mobile identity 18.4.17	O	TLV	6-10

17.1.9.1 New TMSI, or IMSI

This information element represents the identity to be used for (and then by) the MS.

If this information element is an IMSI, then the mobile station is not allocated any TMSI (and deletes any TMSI accordingly). If this information element is a TMSI, then the mobile station will use this TMSI as the new temporary identity (the MS deletes its old TMSI and stores the new TMSI). If neither a TMSI nor an IMSI are included in this information element, the old TMSI, if any available, will be kept.

17.1.10 BSSAP+-LOCATION-UPDATE-REJECT message

This message is sent by the VLR to the SGSN to indicate that location update or IMSI attach has failed.

Table 17.1.10/GSM 29.018: BSSAP+-LOCATION-UPDATE-REJECT message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
Reject cause	Reject cause 18.4.21	M	TLV	3

17.1.11 BSSAP+-LOCATION-UPDATE-REQUEST message

This message is sent by the SGSN to the VLR either to request update of its location file (normal update) or to request IMSI attach.

Table 17.1.11/GSM 29.018: BSSAP+-LOCATION-UPDATE-REQUEST message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
SGSN number	SGSN number 18.4.22	M	TLV	5-11
Update type	GPRS location update type 18.4.6	M	TLV	3
New Cell global identity	Cell global identity 18.4.1	M	TLV	10
Mobile station classmark	Mobile station classmark 1 18.4.18	M	TLV	3
Old location area identifier	Location area identifier 18.4.14	O	TLV	7
TMSI status	TMSI status 18.4.24	O	TLV	3
New service area identification	Service area identification 18.4.21b	O	TLV	10

17.1.11.1 Old location area identifier

This information element should be included. It is derived from the old routing area identification received in the ROUTING AREA UPDATING REQUEST message defined in TS 24.008.

17.1.11.2 New cell global identity

~~In GSM,~~In A/Gb mode, the cell global identity which shall be included is the one where the MS is in the current radio contact.

~~In UMTS,~~In Iu mode, the cell global identity which shall be included indicates where the MS is in the current location area. The cell identity part of this information shall be ignored by the VLR.

17.1.11.3 TMSI status

This information element shall be included if the TMSI status received in the ATTACH REQUEST or ROUTING AREA UPDATING REQUEST message from the MS indicates, that no valid TMSI is available in the MS.

17.1.11.4 Mobile station classmark

This information element does not serve any useful purpose, but shall be included for reasons of compatibility with earlier versions of the protocol. To ease interworking with old VLR equipment, the SGSN shall encode the contents of this information element as: revision level 'GSM phase 2', 'early classmark sending supported', 'encryption algorithm A5/1 supported', and RF power capability 'class 1'.

17.1.11.5 New service area identification

~~In UMTS,~~In Iu mode, the service area identification which should be included is the one where the MS is in the current radio contact.

17.1.12 BSSAP+-MM-INFORMATION-REQUEST

This message is sent by the VLR to the SGSN to provide the MS with subscriber specific information.

Table 17.1.12/GSM 29.018: BSSAP+-MM-INFORMATION-REQUEST message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
MM information	MM information 18.4.16	O	TLV	3-n

17.1.12.1 MM information

This information element should be included in this message.

17.1.13 BSSAP+-MOBILE-STATUS message

This message is sent by both the SGSN or the VLR to indicate an error.

Table 17.1.13/GSM 29.018: BSSAP+-MOBILE-STATUS message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	O	TLV	6-10
Gs Cause	Gs Cause 18.4.7	M	TLV	3
Erroneous message	Erroneous message 18.4.5	M	TLV	3-n

17.1.13.1 IMSI

If the MS is identified by the IMSI, then this information element shall be included.

17.1.14 BSSAP+-MS-ACTIVITY-INDICATION message

This message is sent by the SGSN to the VLR to indicate that activity from an MS has been detected.

Table 17.1.14/GSM 29.018: BSSAP+-MS-ACTIVITY-INDICATION message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
Cell global identity	Cell global identity 18.4.1	O	TLV	10
Service area identification	Service area identification 18.4.21b	O	TLV	10

17.1.14.1 Cell global identity ~~(GSM only)~~(A/Gb mode only)

~~In GSM,~~In A/Gb mode, the SGSN shall include the cell global identity where the MS was in the last radio contact.

17.1.14.2 Service area identification ~~(UMTS only)~~(Iu mode only)

~~In UMTS,~~In Iu mode, the SGSN should include the Service area identification where the mobile was in the last radio contact.

17.1.15 BSSAP+-MS-INFORMATION-REQUEST message

This message is sent from the VLR to the SGSN to request information associated with the indicated IMSI. The type of information requested is specified in the Information requested IE.

Table 17.1.15/GSM 29.018: BSSAP+-MS-INFORMATION-REQUEST message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
Information requested	Information requested 18.4.13	M	TLV	3

17.1.16 BSSAP+-MS-INFORMATION-RESPONSE message

This message is sent from the SGSN to the VLR as a response to a previous BSSAP+- MS-INFORMATION - REQUEST message. (At least one of the requested identities shall be sent).

Table 17.1.16/GSM 29.018: BSSAP+-MS-INFORMATION-RESPONSE message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
TMSI	TMSI 18.4.23	O	TLV	6
PTMSI	PTMSI 18.4.20	O	TLV	6
IMEI	IMEI 18.4.8	O	TLV	10
IMEISV	IMEISV 18.4.9	O	TLV	10
Cell global identity	Cell global identity 18.4.1	O	TLV	10
Location information age	Location information age 18.4.15	O	TLV	4
Mobile station state	Mobile station state 18.4.19	O	TLV	3
Service area identification	Service area identification 18.4.21b	O	TLV	10

17.1.16.1 IMEI

This information element should be included if it was requested in the BSSAP+-MS-INFORMATION-REQUEST message and if this information is obtainable.

17.1.16.2 IMIESV

This information element should be included if it was requested in the BSSAP+-MS-INFORMATION-REQUEST message and if this information is obtainable.

17.1.16.3 Cell global identity ~~(GSM only)~~(A/Gb mode only)

~~In GSM,~~In A/Gb mode, cell global identity where the MS was in the last radio contact.

This information element should be included if it was requested in the BSSAP+-MS-INFORMATION-REQUEST message and if this information is obtainable.

17.1.16.4 Location information age

Time in minutes since the MS last established a radio transaction.

This information element should be included if it was requested in the BSSAP+-MS-INFORMATION-REQUEST message and if this information is obtainable.

17.1.16.5 Mobile station state

This information element should be included in this message, irrespective of the information requested.

17.1.16.6 TMSI

This information element should be included if it was requested in the BSSAP+-MS-INFORMATION-REQUEST message and if this information is obtainable. .

17.1.16.7 Service area identification ~~(UMTS only)~~(Iu mode only)

~~In UMTS,~~In Iu mode, service area identification where the MS was in the last radio contact.

This information element should be included if it was requested in the BSSAP+-MS-INFORMATION-REQUEST message and if this information is obtainable.

17.1.17 BSSAP+-MS-UNREACHABLE message

This message is sent from the SGSN to the VLR to indicate that, for example, paging could not be performed because the MS is marked as unreachable at the SGSN.

Table 17.1.17/GSM 29.018: BSSAP+-MS-UNREACHABLE message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
Gs Cause	Gs Cause 18.4.7	M	TLV	3

17.1.17.1 Gs Cause

The value part which is typically sent for this information element in this message is 'MS unreachable'.

17.1.18 BSSAP+-PAGING-REJECT message

This message is sent from the SGSN to the VLR to indicate that the delivery of a previous BSSAP+-PAGING-REQUEST message has failed.

Table 17.1.18/GSM 29.018: BSSAP+-PAGING-REJECT message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
Gs Cause	Gs Cause 18.4.7	M	TLV	3

17.1.19 BSSAP+-PAGING-REQUEST message

This message is sent from the VLR to the SGSN and contains sufficient information to allow the paging message to be transmitted by the correct cells at the correct time.

Table 17.1.19/GSM 29.018: BSSAP+-PAGING_REQUEST message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
VLR number	VLR number 18.4.26	M	TLV	5-11
TMSI	TMSI 18.4.23	O	TLV	6
Location area identifier	Location area identifier 18.4.14	O	TLV	7
Channel needed	Channel needed 18.4.2	O	TLV	3
eMLPP Priority	eMLPP Priority 18.4.4	O	TLV	3

17.1.19.1 TMSI

This element is omitted in the exceptional case where the IMSI is used instead of the TMSI as a paging address at the radio interface.

17.1.19.2 Location area identifier

If the location area identifier is not included, then the SGSN shall page the MS in all the cells served by the VLR and the SGSN, unless the SGSN has reliable information about the location of the MS.

17.1.19.3 Channel needed

If the Channel needed Information Element is not present, then the default value is assumed to be " any channel ".

17.1.19.4 eMLPP priority

This information element may be included when the subscriber has a subscription for eMLPP.

17.1.20 BSSAP+-RESET-ACK message

This message is sent from the SGSN or the VLR to acknowledge a previous BSSAP+-RESET-INDICATION message. This message indicates that all the associations to the VLR or the SGSN have been be marked as invalid.

The sending entity (either SGSN or VLR) includes its identity in the BSSAP+-RESET-ACK message.

Table 17.1.20/GSM 29.018: BSSAP+-RESET-ACK message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
SGSN number	SGSN number 18.4.22	C	TLV	5-11
VLR number	VLR number 18.4.26	C	TLV	5-11

17.1.20.1 SGSN number

If the SGSN is the sending entity, then it shall indicate its address by including its SGSN number Information Element. Otherwise (i.e. if the VLR is the sending entity), then the SGSN number Information Element shall not be included.

17.1.20.2 VLR number

If the VLR is the sending entity, then it shall indicate its address by including its VLR number Information Element. Otherwise (i.e. if the SGSN is the sending entity), then the VLR number Information Element shall not be included.

17.1.21 BSSAP+-RESET-INDICATION message

This message is sent from the VLR to the SGSN to indicate that a failure in the VLR has occurred and all the associations to the VLR shall be marked as invalid.

This message is also sent from the SGSN to the VLR to indicate that a failure in the SGSN has occurred and all the associations to the SGSN shall be marked as invalid.

The sending entity (either SGSN or VLR) includes its identity in the BSSAP+-RESET-INDICATION message.

Table 17.1.21/GSM 29.018: BSSAP+-RESET-INDICATION message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
SGSN number	SGSN number 18.4.22	C	TLV	5-11
VLR number	VLR number 18.4.26	C	TLV	5-11

17.1.21.1 SGSN number

If the SGSN is the sending entity, then it shall indicate its address by including its SGSN number Information Element. Otherwise (i.e. if the VLR is the sending entity), then the SGSN number Information Element shall not be included.

17.1.21.2 VLR number

If the VLR is the sending entity, then it shall indicate its address by including its VLR number Information Element. Otherwise (i.e. if the SGSN is the sending entity), then the VLR number Information Element shall not be included.

17.1.22 BSSAP+-TMSI-REALLOCATION-COMPLETE message

This message is sent by the SGSN to the VLR to indicate that TMSI reallocation or deletion on the MS has been successfully completed.

Table 17.1.22/GSM 29.018: BSSAP+-TMSI-REALLOCATION-COMPLETE message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
Cell global identity	Cell global identity 18.4.1	O	TLV	10
Service area identification	Service area identification 18.4.21b	O	TLV	10

17.1.22.1 Cell global identity ~~(GSM only)~~(A/Gb mode only)

The SGSN shall include the cell global identity where the Mobile Station was in the last radio contact.

17.1.22.2 Service area identification ~~(UMTS only)~~(Iu mode only)

~~In UMTS,~~In Iu mode, the SGSN should include the Service area identification where the mobile was in the last radio contact.

17.1.23 BSSAP+-UPLINK-TUNNEL-REQUEST message

This message is sent from the SGSN to the non-GSM MSC/VLR to convey the tunneling payload received from the MS identified by the specified IMSI.

Table 17.1.23/GSM 29.018: BSSAP+-UPLINK-TUNNEL-REQUEST message content

Information Element	Type/Reference	Presence	Format	Length
Message type	Message type 18.2	M	V	1
IMSI	IMSI 18.4.10	M	TLV	6-10
SGSN number	SGSN number 18.4.22	M	TLV	5-11
Uplink Tunnel Payload Control and Info	Uplink Tunnel Payload Control and Info 18.4.25	M	TLV	3-223

18 Message format and information element coding

This clause specifies the coding of the Information Elements used in by the BSSAP+ protocol. The spare bits in the coding of an IE shall be set to zero by the sender and shall be ignored by the receiver.

All unassigned codes (whether omitted or explicitely *Unassigned* in the text) shall be treated as unknown (see clause 'Error Handling and Future Compatibility').

18.1 Overview

18.2 Message type

Message type uniquely identifies the message being sent. It is a single octet element, mandatory in all messages.

Table 18.2/GSM 29.018: Message type information element

8 7 6 5 4 3 2 1	Message type	*Reference*
0 0 0 0 0 0 0 0	*Unassigned:* treated as an unknown Message type.	18&16
0 0 0 0 0 0 0 1	BSSAP+-PAGING-REQUEST	17.1.19
0 0 0 0 0 0 1 0	BSSAP+-PAGING-REJECT	17.1.18
0 0 0 0 0 0 1 1 to 0 0 0 0 0 1 1 0	*Unassigned:* treated as an unknown Message type.	18&16
0 0 0 0 0 1 1 1	BSSAP+-DOWNLINK-TUNNEL-REQUEST	17.1.4
0 0 0 0 1 0 0 0	BSSAP+-UPLINK-TUNNEL-REQUEST	17.1.23
0 0 0 0 1 0 0 1	BSSAP+-LOCATION-UPDATE-REQUEST	17.1.11
0 0 0 0 1 0 1 0	BSSAP+-LOCATION-UPDATE-ACCEPT	17.1.9
0 0 0 0 1 0 1 1	BSSAP+-LOCATION-UPDATE-REJECT	17.1.10
0 0 0 0 1 1 0 0	BSSAP+-TMSI-REALLOCATION-COMPLETE	17.1.22
0 0 0 0 1 1 0 1	BSSAP+-ALERT-REQUEST	17.1.3
0 0 0 0 1 1 1 0	BSSAP+-ALERT-ACK	17.1.1
0 0 0 0 1 1 1 1	BSSAP+-ALERT-REJECT	17.1.2
0 0 0 1 0 0 0 0	BSSAP+-MS-ACTIVITY-INDICATION	17.1.14
0 0 0 1 0 0 0 1	BSSAP+-GPRS-DETACH-INDICATION	17.1.6
0 0 0 1 0 0 1 0	BSSAP+-GPRS-DETACH-ACK	17.1.5
0 0 0 1 0 0 1 1	BSSAP+-IMSI-DETACH-INDICATION	17.1.8
0 0 0 1 0 1 0 0	BSSAP+-IMSI-DETACH-ACK	17.1.7
0 0 0 1 0 1 0 1	BSSAP+-RESET-INDICATION	17.1.21
0 0 0 1 0 1 1 0	BSSAP+-RESET-ACK	17.1.20
0 0 0 1 0 1 1 1	BSSAP+-MS-INFORMATION-REQUEST	17.1.15
0 0 0 1 1 0 0 0	BSSAP+-MS-INFORMATION-RESPONSE	17.1.16
0 0 0 1 1 0 0 1	*Unassigned:* treated as an unknown Message type.	18&16
0 0 0 1 1 0 1 0	BSSAP+-MM-INFORMATION-REQUEST	17.1.12
0 0 0 1 1 1 0 1	BSSAP+-MOBILE-STATUS	17.1.13
0 0 0 1 1 1 1 0	*Unassigned:* treated as an unknown Message type.	18&16
0 0 0 1 1 1 1 1	BSSAP+-MS-UNREACHABLE	17.1.17

18.3 Information Element Identifiers

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

Table 18.3/GSM 29.018: Information Element Identifier coding

8 7 6 5 4 3 2 1	Information element	Reference
0 0 0 0 0 0 0 1	IMSI	18.4.10
0 0 0 0 0 0 1 0	VLR number	18.4.26
0 0 0 0 0 0 1 1	TMSI	18.4.23
0 0 0 0 0 1 0 0	Location area identifier	18.4.14
0 0 0 0 0 1 0 1	Channel Needed	18.4.2
0 0 0 0 0 1 1 0	eMLPP Priority	18.4.4
0 0 0 0 0 1 1 1	TMSI status	18.4.24
0 0 0 0 1 0 0 0	Gs cause	18.4.7
0 0 0 0 1 0 0 1	SGSN number	18.4.22
0 0 0 0 1 0 1 0	GPRS location update type	18.4.6
0 0 0 0 1 0 1 1	*Unassigned:* treated as an unknown IEI.	18&16
0 0 0 0 1 1 0 0	*Unassigned:* treated as an unknown IEI.	18&16
0 0 0 0 1 1 0 1	Mobile station classmark 1	18.4.18
0 0 0 0 1 1 1 0	Mobile identity	18.4.17
0 0 0 0 1 1 1 1	Reject cause	18.4.21
0 0 0 1 0 0 0 0	IMSI detach from GPRS service type	18.4.11
0 0 0 1 0 0 0 1	IMSI detach from non-GPRS service type	18.4.12
0 0 0 1 0 0 1 0	Information requested	18.4.13
0 0 0 1 0 0 1 1	PTMSI	18.4.20
0 0 0 1 0 1 0 0	IMEI	18.4.8
0 0 0 1 0 1 0 1	IMEISV	18.4.9
0 0 0 1 0 1 1 0	*Unassigned:* treated as an unknown IEI.	18&16
0 0 0 1 0 1 1 1	MM information	18.4.16
0 0 0 1 1 0 0 0	Cell Global Identity	18.4.1
0 0 0 1 1 0 0 1	Location information age	18.4.15
0 0 0 1 1 0 1 0	Mobile station state	18.4.19
0 0 0 1 1 0 1 1	Erroneous message	18.4.5
0 0 0 1 1 1 0 0	Downlink Tunnel Payload Control and Info	18.4.3
0 0 0 1 1 1 0 1	Uplink Tunnel Payload Control and Info	18.4.25
0 0 0 1 1 1 1 0	Service Area Identification	18.4.21b
0 0 0 1 1 1 1 1 to 1 1 1 1 1 1 1 1	*Unassigned:* treated as an unknown IEI.	18&16

18.4 Information elements

18.4.1 Cell global identity

This information element uniquely identifies one cell.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3 to Octet 10	The rest of the information element is coded as the the value part of the cell global id IE defined in GSM 08.18 (not including GSM 08.18 IEI and GSM 08.18 length indicator).							

Figure 18.4.1/GSM 29.018: Cell global identity IE

18.4.2 Channel needed

The purpose of the *Channel Needed* information element is to indicate which type of channel is needed for the transaction linked to the paging procedure.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	The rest of the information element is coded as the IEI part and the value part of the Channel Needed IE defined in TS 24.008.							

Figure 18.4.2/GSM 29.018: Channel needed IE

18.4.3 Downlink Tunnel Payload Control and Info

This information element is used to convey the payload of octets to be delivered to the identified mobile.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator (n)							
Octet 3	Spare	Protocol Discriminator				E	Tunnel Priority	
Octet 4 to Octet n+1	Tunnel payload							

Figure 18.4.1/GSM 29.018: Downlink Tunnel Payload Control and Info IE

Protocol Discriminator: Identifies the protocol using tunnelling of non-GSM signalling.

E: Cipher Request. When set to 1 indicates that the SGSN shall cipher the payload, when set to 0 indicates that the SGSN shall not cipher the payload.

Tunnel Priority: Indicates the priority of the Tunnel Payload.

18.4.4 eMLPP Priority

This element indicates the eMLPP-Priority.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	The rest of the information element is coded as the value part of the eMLPP-Priority IE defined in GSM 08.08 (not including GSM 08.08 IEI and GSM 08.08 length indicator).							

Figure 18.4.44/GSM 29.018: eMLPP Priority IE

18.4.5 Erroneous message

The Erroneous message IE is a TLV IE that encapsulates the message in error.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3 - Octet n	Erroneous message including the message type.							

Figure 18.4.5/GSM 29.018: Erroneous message IE

18.4.6 GPRS location update type

The purpose of the GPRS location update type information element is to indicate to the VLR whether an IMSI attach or a normal location update has been performed by the MS.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	GPRS location update type value							

Figure 18.4.6/GSM 29.018: GPRS location update type IE

Table 18.4.6/GSM 29.018: GPRS location update type IE value part

GPRS location update type value (octet 3)

Bits 8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	Shall not be sent in this version of the protocol. If received, shall be treated as '00000010'.
0 0 0 0 0 0 0 1	IMSI attach
0 0 0 0 0 0 1 0	Normal location update
0 0 0 0 0 0 1 1	Shall not be sent in this version of the protocol. If received, to shall be treated as 00000010'.
To 1 1 1 1 1 1 1 1	

18.4.7 Gs cause

The purpose of the value part of the Gs Cause information element is to indicate an error to the receiving entity. This could be a protocol data error or to indicate to the VLR the reason why a paging procedure could not be performed.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	Gs Cause value							

Figure 18.4.7/GSM 29.018: Gs Cause IE

Table 18.4.7/GSM 29.018: Gs Cause IE value part

Gs Cause value (octet 3) Bits 8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	*Normal, unspecified* in this version of the protocol.
0 0 0 0 0 0 0 1	IMSI detached for GPRS services
0 0 0 0 0 0 1 0	IMSI detached for GPRS and non-GPRS services
0 0 0 0 0 0 1 1	IMSI unknown
0 0 0 0 0 1 0 0	IMSI detached for non-GPRS services
0 0 0 0 0 1 0 1	IMSI implicitly detached for non-GPRS services
0 0 0 0 0 1 1 0	MS unreachable
0 0 0 0 0 1 1 1	Message not compatible with the protocol state
0 0 0 0 1 0 0 0	Missing mandatory information element
0 0 0 0 1 0 0 1	Invalid mandatory information
0 0 0 0 1 0 1 0	Conditional IE error
0 0 0 0 1 0 1 1	Semantically incorrect message
0 0 0 0 1 1 0 0	Message unknown
0 0 0 0 1 1 0 1	Address error
0 0 0 0 1 1 1 0	TOM functionality not supported
0 0 0 0 1 1 1 1	Ciphering request cannot be accommodated
0 0 0 1 0 0 0 0 to 1 1 1 1 1 1 1 1	*Normal, unspecified* in this version of the protocol

NOTE: *'Normal,* unspecified' has the same meaning than in TS 24.008, informative Annex H (GSM specific cause values for call control). It is used to report a normal event, and should not be interpreted as syntactically incorrect nor unknown if received.

18.4.8 IMEI

The IMEI is coded as a sequence of BCD digits, compressed two into each octet. The IMEI consists of 15 digits (see TS 23.003).

	8	**7**	**6**	**5**	**4**	**3**	**2**	**1**
octet 1	IEI							
octet 2	length indicator							
octet 3	TAC digit 2				TAC digit 1			
octet 4	TAC digit 4				TAC digit 3			
octet 5	TAC digit 6				TAC digit 5			
octet 6	FAC digit 2				FAC digit 1			
octet 7	SNR digit 2				SNR digit 1			
octet 8	SNR digit 4				SNR digit 3			
octet 9	SNR digit 6				SNR digit 5			
octet 10	1	1	1	1	0	0	0	0

Figure 18.4.8/GSM 29.018: IMEI IE

18.4.9 IMEISV

The IMEISV is coded as a sequence of BCD digits, compressed two into each octet. The IMEISV consists of 16 digits (see TS 23.003).

	8	7	6	5	4	3	2	1
octet 1	IEI							
octet 2	length indicator							
octet 3	TAC digit 2				TAC digit 1			
octet 4	TAC digit 4				TAC digit 3			
octet 5	TAC digit 6				TAC digit 5			
octet 6	FAC digit 2				FAC digit 1			
octet 7	SNR digit 2				SNR digit 1			
octet 8	SNR digit 4				SNR digit 3			
octet 9	SNR digit 6				SNR digit 5			
octet 10	SVN digit 2				SVN digit 1			

Figure 18.4.9/GSM 29.018: IMEISV IE

18.4.10 IMSI

The IMSI is coded as a sequence of BCD digits, compressed two into each octet. This is a variable length element, and includes a length indicator. The IMSI is defined in TS 23.003. It shall not exceed 15 digits (see TS 23.003).

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	IMSI digit 1				* parity	0	0	1
Octet 4	IMSI digit 3				IMSI digit 2			
Octet 4+x	IMSI digit i+1				IMSI digit i			

Figure 18.4.10/GSM 29.018: IMSI IE

Where x = (i-2)/2 and i is always even

* The value of the parity bit (bit 4 in octect 3) indicates:

0 Even number of IMSI digits

1 Odd number of IMSI digits

If the number of IMSI digits is even then bits 5 to 8 of the last octet shall be filled with an end mark coded as 1111.

18.4.11 IMSI detach from GPRS service type

The purpose of the IMSI detach from GPRS service type information element is to indicate to the VLR the type of IMSI detach from GPRS service performed by the MS or the SGSN.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	IMSI detach from GPRS service type value							

Figure 18.4.11/GSM 29.018: IMSI detach from GPRS service type IE

Table 18.4.11/GSM 29.018: IMSI detach from GPRS service type IE value part

IMSI detach from GPRS service type value (octet 3)	
Bits	
8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	Interpreted as *reserved* in this version of the protocol
0 0 0 0 0 0 0 1	Network initiated IMSI detach from GPRS service
0 0 0 0 0 0 1 0	MS initiated IMSI detach from GPRS service
0 0 0 0 0 0 1 1	GPRS services not allowed
0 0 0 0 0 1 0 0 to 1 1 1 1 1 1 1 1	Interpreted as *reserved* in this version of the protocol

18.4.12 IMSI detach from non-GPRS service type

The purpose of the IMSI detach from non-GPRS service type information element is to indicate to the VLR if the type of IMSI detach from non-GPRS service was explicitly performed by the MS or implicitly performed by the SGSN.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	IMSI detach from non-GPRS service type value							

Figure 18.4.12/GSM 29.018: IMSI detach from non-GPRS service type IE

Table 18.4.12/GSM 29.018: IMSI detach from non-GPRS service type IE value part

IMSI detach from non-GPRS service type value (octet 3)	
Bits	
8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	Interpreted as *reserved* in this version of the protocol
0 0 0 0 0 0 0 1	Explicit MS initiated IMSI detach from non-GPRS service
0 0 0 0 0 0 1 0	Combined explicit MS initiated IMSI detach from GPRS and non-GPRS services
0 0 0 0 0 0 1 1	Implicit SGSN initiated IMSI detach from non-GPRS service
0 0 0 0 0 1 0 0 to 1 1 1 1 1 1 1 1	Interpreted as *reserved* in this version of the protocol

18.4.13 Information requested

The Information requested IE is a TLV IE that indicates to the SGSN the type of information requested by the VLR. The coding of the V field is as follows.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	Information requested value							

Figure 18.4.13/GSM 29.018: Information requested IE

Table 18.4.13/GSM 29.018: Information requested IE value part

Information requested value (octet 3) Bits 8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	Interpreted as *Not supported* in this version of the protocol.
0 0 0 0 0 0 0 1	PTMSI
0 0 0 0 0 0 1 0	IMEI
0 0 0 0 0 0 1 1	IMEISV
0 0 0 0 0 1 0 0	PTMSI and IMEI
0 0 0 0 0 1 0 1	PTMSI and IMEISV
0 0 0 0 0 1 1 0	IMEI and IMEISV
0 0 0 0 0 1 1 1	PTMSI, IMEI, and IMEISV
0 0 0 0 1 0 0 0	Mobile location information
0 0 0 0 1 0 0 1	TMSI
0 0 0 0 1 0 1 0 to 1 1 1 1 1 1 1 1	Interpreted as *Not supported* in this version of the protocol.

NOTE: The behaviour of the receiver in the case of a *Not supported* value is described in Sub-clause 14.3, *Procedures in the SGSN*.

18.4.14 Location area identifier

This element uniquely identifies one Location Area.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length Indicator							
Octet 3 - Octer 7	The rest of the information element is coded as the value part of the location area identifier IE defined in GSM 08.18 (not including GSM 08.18 IEI and GSM 08.18 length indicator).							

Figure 18.4.14/GSM 29.018: Location area identifier IE

18.4.15 Location information age

The Location information age IE is a TLV IE that indicates the elapsed time in minutes since the last network contact of the mobile station.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3Octet 4	The rest of the IE is coded as the value part of the AgeOfLocationInformation as specified in TS 29.002.							

Figure 18.4.15/GSM 29.018: Location information age IE

18.4.16 MM information

The MM information IE is a TLV IE that encapsulates the user information that the SGSN forwards to the MS.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length Indicator							
Octet 3 – Octet n	User information: This field is composed of one or more of the information elements of the MM information message as defined in TS 24.008, excluding the Protocol discriminator, Skip indicator and Message type. This field includes the IEI and length indicatior of the other information elements.							

Figure 18.4.6/GSM 29.018: MM information IE

18.4.17 Mobile identity

The purpose of the *Mobile identity* information element is to provide either:

- The International Mobile Subscriber Identity (IMSI);
- The Temporary Mobile Subscriber Identity (TMSI);
- The International Mobile Equipment Identity (IMEI); or
- The International Mobile Equipment Identity together with the Software Version number (IMEISV).

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length Indicator							
Octet 3 - Octet n	The rest of the information element is coded as the value part of the mobile identity IE defined in TS 24.008 (not including TS 24.008 IEI and TS 24.008 length indicator).							

Figure 18.4.17/GSM 29.018: Mobile identity IE

18.4.18 Mobile station classmark 1

The purpose of the *Mobile Station Classmark 1* information element is to provide the network with information concerning aspects of high priority of the mobile station equipment.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	The rest of the information element is coded as the value part of the mobile station classmark 1 IE defined in TS 24.008 (not including TS 24.008 IEI)							

Figure 18.4.18/GSM 29.018: Mobile station classmark 1 IE

18.4.19 Mobile station state

The Mobile station state IE is a TLV IE that indicates to the VLR the GMM and GSM states of the MS in the SGSN. The coding of the V field is as follows.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	Mobile station state value							

Figure 18.4.19/GSM 29.018: Mobile station state IE

Table 18.4.19/GSM 29.018: Mobile station state IE value part

Mobile station state value (octet 3)	
Bits	
8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	IDLE
0 0 0 0 0 0 0 1	STANDBY, 0 PDP contexts active
0 0 0 0 0 0 1 0	STANDBY, 1 or more PDP contexts active
0 0 0 0 0 0 1 1	SUSPENDED, 0 PDP contexts active
0 0 0 0 0 1 0 0	SUSPENDED, 1 or more PDP contexts active
0 0 0 0 0 1 0 1	READY, 0 PDP contexts active
0 0 0 0 0 1 1 0	READY, 1 or more PDP contexts active
0 0 0 0 0 1 1 1	IMSI unknown
0 0 0 0 1 0 0 0	Information requested not supported
0 0 0 0 1 0 0 1	Shall not be sent in this version of the protocol.
to	If received, shall be treated as '00001000'.
1 1 1 1 1 1 1 1	

18.4.20 PTMSI

The PTMSI consists of 4 octets. It can be coded using a full hexadecimal representation (see TS 23.003).

	8	7	6	5	4	3	2	1
octet 1	IEI							
octet 2	length indicator							
octet 3	PTMSI octet 1							
octet 4	PTMSI octet 2							
octet 5	PTMSI octet 3							
octet 6	PTMSI octet 4							

Figure 18.4.20/GSM 29.018: PTMSI IE

18.4.21 Reject cause

The purpose of the *Reject Cause* information element is to indicate the reason why a request from the mobile station is rejected by the network .

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length Indicator							
Octet 3	The rest of the information element is coded as the value part of the reject cause IE defined in TS 24.008, not including TS 24.008 IEI.							

Figure 18.4.21/GSM 29.018: Reject cause IE

18.4.21b Service Area Identification

This information element uniquely identifies one service area.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3 to Octet 10	The rest of the information element is coded as the the value part of the SAI IE defined in 3G TS 25.413 (not including 3G TS 25.413 IEI and 3G TS 25.413 length indicator).							

Figure 18.4.27/GSM 29.018: Service Area Identification IE

18.4.22 SGSN number

The SGSN number is coded as a sequence of TBCD digits (as specified in TS 29.002), compressed two into each octet. The Number is in international E.164 format as indicated by Octet 3 which coding is specified in 29.002. This is a variable length information element, and includes a length indicator. The value part of the SGSN number information element (not including IEI, Length indicator and Octet 3) shall not exceed 15 digits.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	1	0	0	1	0	0	0	1
Octet 4	digit 2				digit 1			
Octet n	digit i+1				digit i			

Figure 18.4.22/GSM 29.018: SGSN number IE

18.4.23 TMSI

The TMSI consists of 4 octets. It can be coded using a full hexadecimal representation (see TS 23.003).

	8	7	6	5	4	3	2	1
octet 1	IEI							
octet 2	length indicator							
octet 3	TMSI octet 1							
octet 4	TMSI octet 2							
octet 5	TMSI octet 3							
octet 6	TMSI octet 4							

Figure 18.4.23/GSM 29.018: TMSI IE

18.4.24 TMSI status

The purpose of the TMSI status information element is to indicate to the VLR whether a valid TMSI is available in the MS.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	Spare							TMSI flag

Figure 18.4.24/GSM 29.018: TMSI status IE

Table 18.4.24/GSM 29.018: TMSI status IE value part

TMSI flag (octet 3)
Bit
1
0 no valid TMSI available
1 valid TMSI available

Bits 2-8 in octet 3 are spare and shall be coded all equal to 0.

18.4.25 Uplink Tunnel Payload Control and Info

This information element is used to convey the payload of octets received from the mobile to the appropriate non-GSM MSC/VLR.

	8	7	6	5	4	3	2	1
Octet 1	IEI							
Octet 2	Length indicator (n)							
Octet 3	Spare	Protocol Discriminator				E	Tunnel Priority	
Octet 4 to Octet n+1	Tunnel payload							

Figure 18.4.25/GSM 29.018:Upnlink Tunnel Payload Control and Info IE

Protocol Discriminator: Identifies the protocol using tunnelling of non-GSM signalling.

E: Cipher Request. When set to 1 indicates that the SGSN received the payload in ciphered form, when set to 0 indicates that the SGSN did not receive the payload in ciphered form.

Tunnel Priority: Indicates the priority of the Tunnel Payload.

18.4.26 VLR number

The VLR number is coded as a sequence of TBCD digits (as specified in 29.002), compressed two into each octet. The Number is in international E.164 format as indicated by Octet 3 which coding is specified in TS 29.002. This is a variable length information element, and includes a length indicator. The value part of the VLR number information element (not including IEI, length indicator and Octet 3), shall not exceed 15 digits.

Table 18.4.26/GSM 29.018: VLR number IE

	8	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Octet 1	IEI							
Octet 2	Length indicator							
Octet 3	1	0	0	1	0	0	0	1
Octet 4	digit 2				digit 1			
Octet n	digit i+1				digit i			

19 List of system variables

19.1 Timers

This subclause lists the management timers specified for the operation of the BSSAP+ protocol. All the implementation shall support the range of values specified below. The specific value of the timers shall be under the control of the operator.

Table 19.1/GSM 29.018: Management Timers

Timer name	Default value	Timer range	Granula-rity	Notes	Relation to other timers
T5	-	2-20 secs	100 ms	Guards the Paging procedure at the VLR.	Value is correlated to DRX parameter Split PG CYCLE (max possible = 16 sec) Default should be set acc. to max split cycle supported by the SGSN (operator choice)
T6-1	-	10-90 secs	1 sec	Guards the Location Update procedure.	It should be higher than 2 times the maximum transmission time in the Gs interface, plus the supervision timer of the Update Location procedure [TS 29.002]
T6-2	40 secs	5-60 secs	1 sec	Guards the TMSI reallocation procedure.	It should be higher than 2 times the maximum transmission time in the Gs interface, plus 4 times T3350 [TS 24.008]
T7	4 secs	1-30 secs	1 sec	Guards the Non-GPRS alert procedure.	None.
T8	4 secs	1-30 secs	1 sec	Guards the Explicit IMSI detach from GPRS services procedure.	None.
T9	4 secs	1-30 secs	1 sec	Guards the Explicit IMSI detach from non-GPRS services procedure.	None.
T10	4 secs	1-30 secs	1 sec	Guards the Implicit IMSI detach from non-GPRS services procedure.	None.
T11	4 secs	1-120 secs	1 sec	Guards the VLR reset procedure.	None.
T12-1	-	8 - 60x384 +8 secs	1 min	Controls the resetting of the 'SGSN-Reset' variable.	It should be longer than the longest Periodic RAU timer running on the SGSN, plus the transmission delay on the radio interface.
T12-2	4 secs	1-120 secs	1 sec	Guards the SGSN reset procedure.	None.
T14	-	4-36 secs	1 sec	Guards the MS Information procedure.	None
NOTE: The Default value is the recommended value.					

19.2 Retry counters

This subclause lists the management retry counters specified for the operation of the BSSAP+ protocol. The values indicated are recommended values.

Table 19.2/GSM 29.018: Management Retry counters

Retry mnemonic	Retry value	Notes
N7	2	Recommended value
N8	2	Recommended value
N9	2	Recommended value
N10	2	Recommended value
N11	2	Recommended value
N12	2	Recommended value

20 Procedures for Tunnelling Non-GSM Signalling

This procedure is used to tunnel non-GSM signalling messages between an MS and a non-GSM MSC/VLR.

20.1 Procedures in the non-GSM MSC/VLR

When the non-GSM MSC/VLR has a message to be tunnelled to an MS, whose Gs state is not Gs-NULL, it shall send a BSSAP+-DOWNLINK-TUNNEL-REQUEST message to the SGSN associated with the MS. If LLC ciphering is required, the cipher request field E shall be set to 1. The Tunnel Priority field for the payload shall be set as required. On receiving a BSSAP+-UPLINK-TUNNEL-REQUEST message from an SGSN, the action taken by the non-GSM MSC/VLR is technology dependent.

20.2 Procedures in the SGSN

A message received by the SGSN from an MS or sent by the SGSN to an MS on one of the Tunneling of Messages (TOM) LLC SAPs is called a *TOM Protocol Envelope* (see GSM 04.64). The *TOM Protocol Envelope* is composed of the *TOM Protocol Header* immediately followed by a *Message Capsule*.

Upon receipt of a *TOM Protocol Envelope* with a *TOM Protocol Header* indicating the presence of one or more non-GSM signalling messages, the SGSN shall determine the non-GSM MSC/VLR to which the *Message Capsule* in the *TOM Protocol Envelope* shall be forwarded. The SGSN shall make this determination based upon the RAI of the MS, the *TOM Protocol Discriminator* field in the *TOM Protocol Header*, and *TOM Protocol Discriminator* specific information in the remaining octets (if any) in the *TOM Protocol Header*. The SGSN shall then forward a BSSAP+-UPLINK-TUNNEL-REQUEST message to the selected non-GSM MSC/VLR with the received *Message Capsule* in the *Tunnel Payload* field. The *Protocol Discriminator* field in the BSSAP+-UPLINK-TUNNEL-REQUEST message shall be set based on the *TOM Protocol Discriminator* in the *TOM Protocol Envelope*. *Tunnel Priority* field in the BSSAP+-UPLINK-TUNNEL-REQUEST message shall be set based on the LLC SAP on which the *TOM Protocol Envelope* was received. The *E* field shall be set to 1 if the *TOM Protocol Envelope* was received by the LLC in ciphered form, otherwise it shall be set to 0.

Upon receipt of a BSSAP+-DOWNLINK-TUNNEL-REQUEST message from a non-GSM MSC/VLR, the SGSN shall construct a *TOM Protocol Envelope* by mapping the *Tunnel Payload* field to the *Message Capsule* portion of the *TOM Protocol Envelope*. The *TOM Protocol Header* shall be constructed based on the *Protocol Discriminator* in the BSSAP+-DOWNLINK-TUNNEL-REQUEST message. The SGSN shall then send the *TOM Protocol Envelope* to the MS on a specific LLC SAP. That LLC SAP shall be determined by the *Tunnel Priority* field in the BSSAP+-DOWNLINK-TUNNEL-REQUEST message. LLC ciphering shall be enabled or disabled based upon the value of the *E* field in this message. If the SGSN is unable to send the *TOM Protocol Envelope* to the indicated MS for any reason, including the inability to accommodate the ciphering request as indicated in the BSSAP+-DOWNLINK-TUNNEL-REQUEST message, then it shall send a BSSAP+-MOBILE-STATUS message to the non-GSM MSC/VLR with an appropriate *Gs Cause* code.

The association between the LLC SAPs and the *Tunnel Priority* shall be as in the following table, where 00 is top-most priority and 11 is lowest priority:

Table 20.1: Association between Tunnel Priority and LLC SAPs

Tunnel Priority	LLC SAP
00	TOM2
01	Not defined
10	TOM8
11	Not defined

Annex A (informative): Change history

TSG CN#	**Spec**	**Version**	**CR**	**New Version**	**Subject**	**Comment**
Apr 1999	GSM 29.018	6.3.0				Transferred to 3GPP CN1
CN#03	29.018			3.0.0		Approved at CN#03
CN#4	29.018	3.0.0	001	3.1.0		Approved CN#4
CN#5	29.018	3.1.0	001	3.2.0	Gs Interface Changes to Support Tunnelling of non-GSM Messages	CR 001 were not implemented correctly in v 3.1.0,
CN#5	29.018	3.1.0	002	3.2.0	Clarification of the null RA and other corrections.	CR 002 were not implemented correctly in v 3.1.0,
CN#5	29.018	3.1.0	003	3.2.0	TMSI requested by the MSC trough the Gs interface	CR 003 were not implemented correctly in v 3.1.0,
CN#5	29.018	3.1.0	005	3.2.0	TMSI status indication	Approved in CN#5 as CR001r1, NP-99268
CN#5	29.018	3.1.0	006	3.2.0	Explicit IMSI detach, abnormal case SGSN side	Approved in CN#5 as CR002, NP-99268
CN#5	29.018	3.1.0	004	3.2.0	Clarify that no acknowledgement is made for TMSI deallocation	
CN#7	29.018	3.2.0	003r2	3.3.0	SGSN reaction upon a RAU request after VLR failure	NP-000091
CN#7	29.018	3.2.0	007r3	3.3.0	Introduction of the Service Area Identification	NP-000101
CN#7	29.018	3.2.0	009	3.3.0	Encoding of MS classmark in LUP Request	NP-000091
CN#9	29.018	3.3.0	010	3.4.0	Reject cause in case of expiry of T6-1	NP- 000441/ N1-000911
	29.018	3.4.0		3.4.1	editorial correction of misimplementation of CR010. A single quote is missing in the cause value in clause 6.2.4	

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CHANGE REQUEST

⌘ **23.034** **CR** **005** ⌘ rev **-** ⌘ Current version: **3.2.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM ☐ ME/UE ☐ Radio Access Network ☐ Core Network ☐

Title:	⌘	Terminology corrections
Source:	⌘	Nokia
Work item code:	⌘	TEI
Date:	⌘	19 Nov 2000
Category:	⌘	**F**
Release:	⌘	R99

Use one of the following categories:
- ***F*** *(essential correction)*
- ***A*** *(corresponds to a correction in an earlier release)*
- ***B*** *(Addition of feature),*
- ***C*** *(Functional modification of feature)*
- ***D*** *(Editorial modification)*

Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:

2	*(GSM Phase 2)*
R96	*(Release 1996)*
R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
REL-4	*(Release 4)*
REL-5	*(Release 5)*

Reason for change:	⌘	To change terms "in GSM" and "in UMTS" to "in A/Gb mode" and "in Iu mode". Furthermore referencies to other specifications are corrected to follow drafting rules.
Summary of change:	⌘	
Consequences if not approved:	⌘	

Clauses affected:	⌘	1, 2, 3, 4, 4.2, 4.2.1, 5.1, 5.2, 5.3.1, 5.4.1, 5.6
Other specs affected:	⌘	☐ Other core specifications ⌘ ☐ Test specifications ☐ O&M Specifications
Other comments:	⌘	

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2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://www.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2000-09 contains the specifications resulting from the September 2000 TSG meetings.
3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

3G TS 23.034 V3.2.0 (2000-03)

Technical Specification

3rd Generation Partnership Project; Technical Specification Group Core Network; High Speed Circuit Switched Data (HSCSD) - Stage 2 (Release 1999)

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Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The present document specifies the Stage 2 description of High Speed Circuit Switched Data (HSCSD) within the 3GPP system.

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document contains the stage 2 service description for a High Speed Circuit Switched Data (HSCSD) on GSM/GERAN. HSCSD utilizes the multislot mechanism, i.e. using multiple traffic channels (/bearers) for the communication. In ~~UMTS/UTRAN~~ Iu mode one bearer can provide all needed data rates, and the multislot mechanism is therefore not needed. The ~~UMTS~~ Iu mode aspects concerning HSCSD are described exclusively in subclause 4.2.

In analogy with ITU-T Recommendations I.130 [6] (refer to annex A) and with reference of ITU-T Recommendations VI.1 Q.65 [7] (Stage 2 of the method for characterization of services supported by an ISDN), the second stage of the HSCSD is defined as follows.

Stage 2 identifies the functional capabilities and information flows needed to support the service as described in High Speed Circuit Switched Data (HSCSD) - Stage 1, TS 22.034 [9]. Furthermore, it identifies various possible physical locations for the functional capabilities. The output of Stage 2, which is signalling system independent, is used as an input to Stage 3, the design of signalling system and switching Recommendations.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] 3GPP TS ~~GSM~~ 01.04 ~~(ETR 350)~~: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[1a] 3GPP TS 21.905: "3G Vocabulary for 3GPP Specifications".

[2] 3GPP TS ~~GSM~~ 05.02 ~~(ETS 300 908)~~: "Digital cellular telecommunications system (Phase 2+); Multiplexing and multiple access on the radio path".

[3] 3GPP TS 24.008: "Mobile radio interface layer 3 specification; Core Network Protocols - Stage 3".

[4] 3GPP TS ~~GSM~~ 08.08: "Digital cellular telecommunications system (Phase 2+); Mobile-services Switching Centre - Base Station System (MSC - BSS) interface; Layer 3 specification".

[5] 3GPP TS 24.022: "Radio Link Protocol (RLP) for data and telematic services on the Mobile Station - Base Station System (MS - BSS) interface and the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

[6] ITU-T Recommendation I.130: "Method for the characterization of telecommunication services supported by an ISDN and network capabilities of an ISDN".

[7] ITU-T Recommendation Q.65: "Stage 2 of the method for the characterization of services supported by an ISDN".

[8] ITU-T Recommendation I.460: "Multiplexing, rate adaptation and support of existing interfaces".

[9] 3GPP TS 22.034: "High Speed Circuit Switched Data (HSCSD) - Stage 1".

[10] 3GPP TS ~~GSM~~ 03.20 ~~(ETS 300 929)~~: "Digital cellular telecommunications system (Phase 2+); Security related network functions".

[11] 3GPP TS ~~GSM~~ 04.21 ~~(ETS 300 945)~~: "Digital cellular telecommunications system (Phase 2+); Rate adaption on the Mobile Station - Base Station System (MS - BSS) Interface".

[12] 3GPP TS ~~GSM~~ 08.20: "Digital cellular telecommunications system (Phase 2+); Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

[13] 3GPP TS 27.002: "Terminal Adaptation Functions (TAF) for services using asynchronous bearer capabilities".

[14] 3GPP TS 27.003: "Terminal Adaptation Functions (TAF) for services using synchronous bearer capabilities".

[15] 3GPP TS ~~GSM~~ 05.08 ~~(ETS 300 911)~~: "Digital cellular telecommunications system (Phase 2+); Radio subsystem link control".

[16] 3GPP TS 23.008: "Organisation of subscriber data".

[17] 3GPP TS ~~GSM~~ 04.18: "Mobile radio interface layer 3 specification, Radio Resource Control Protocol~~RR part of 04.08~~".

3 Definitions

GERAN: GSM/EDGE radio access network
HSCSD: High Speed Circuit Switched Data
HSCSD configuration: multislot configuration consisting of one or several full rate traffic channels for data transmission
HSCSD channel: full rate traffic channel belonging to a HSCSD configuration
main channel: only channel in a HSCSD configuration carrying an FACCH
symmetric configuration: configuration consisting of bi-directional channels
asymmetric configuration: configuration consisting of bi-directional channels and at least one uni-directional channel

For further GSM abbreviations see ~~GSM~~ 3GPP TS 01.04 [1].

4 Main concepts

The air interface user rate in the original GSM data transmission is limited to 9.6 kbps with the 12 kbps air interface rate. The HSCSD described in the present document Stage 2 description allows higher air interface user rates to be used for transparent and non-transparent data services.

NOTE: In this document the term "air interface user rate" corresponds to the transfer rate in radio interface for user data and "air interface rate" includes additional data related to transmission protocols.

HSCSD is a feature enabling the co-allocation of multiple full rate traffic channels (TCH/F) into a HSCSD configuration. The aim of HSCSD is to provide a mixture of services with different air interface user rates by a single physical layer structure. Further improvements in data rates are achieved through enhancement of the radio interface (modulation and coding schemes), which allows higher bit rates per one GSM time slot. The available capacity of a HSCSD configuration is several times the capacity of a TCH/F, leading to a significant enhancement in the air interface data transfer rate.

Figure 1 represents the network architecture to support GSM HSCSD based on the concept of multiple independent channels in one HSCSD configuration. In case when enhanced modulation is used the number of time slots in the radio interface may not correspond to the number of data streams in the network side, for example a 28.8 kbps service may be offered through one air interface time slot, but it requires two 14.4 (16 kbps) Abis channels. Another example is bit transparent 56/64 kbps service where two air interface time slots of 32 kbps are multiplexed onto one 64 kbps data stream on the network side.

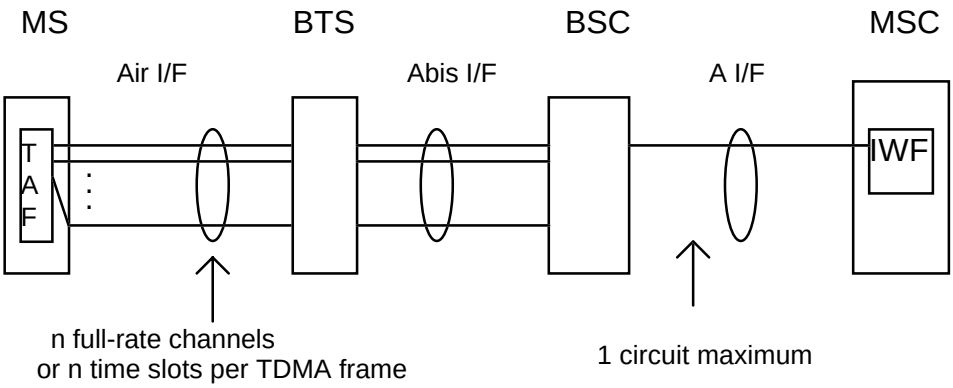


Figure 1: Network architecture for supporting HSCSD

A new functionality is introduced at the network and MS to provide the functions of combining and splitting the data into separate data streams which will then be transferred via n channels at the radio interface, where n = 1, 2, 3, ... 8. Once split, the data streams shall be carried by the n full rate traffic channels, called HSCSD channels, as if they were independent of each other, for the purpose of data relay and radio interface L1 error control, until to the point in the network where they are combined. However, logically the n full rate traffic channels at the radio interface belong to the same HSCSD configuration, and therefore they shall be controlled as one radio link by the network for the purpose of cellular operations, e.g. handover. This requires a new functionality in BSS.

The different user data substreams carried on the radio channels (one substream being the data flow over a single TCH) shall be mapped over the A interface, and vice versa, following the rules defined in 3GPPTS 24.008 [3] and 3GPP TS ~~GSM~~ 08.20 [8].

On the A and E interfaces, the use of resources is restricted to one 64 kbps circuit by multiplexing the data streams into one A interface circuit (see ITU-T Recommendation I.460 [8]).

4.1 HSCSD service aspects

At call setup a user indicates a maximum number of TCH/F, acceptable channel codings (including extensions to acceptable channel codings for ECSD channel codings), possible other modem type, and fixed network user rate values. For non-transparent HSCSD connection, in addition, wanted air interface user rate is indicated and the network resource needs, if user wishes to make use of the user initiated modification of the maximum number of TCH/F and/or wanted air interface user rate (user initiated service level up- and downgrading described in subclause 5.2.4) during the call. In case the indicated acceptable channel coding(s) implies that enhanced modulation is possible, the user may indicate a preference for channel coding asymmetry, i.e. downlink biased channel coding asymmetry, uplink biased channel coding asymmetry or channel coding symmetry. Together these parameters describe the HSCSD characteristics and network uses them to allocate an appropriate HSCSD connection.

For both transparent and non-transparent HSCSD connections the call can be established with any number of TCH/F from one up to the maximum number of TCH/F, i.e. the minimum channel requirement is always one TCH/F.

If the wanted air interface user rate requirement cannot be met using a symmetric configuration, an asymmetric configuration can be chosen. The network shall in this case give priority to fulfilling the air interface user rate requirement in downlink direction.

For non-transparent HSCSD connection the network can use dynamic allocation of resources, i.e. TCH/F, as long as the configuration is not in contradiction with the limiting values defined by the MS and the mobile equipment is capable of handling the allocated channel configuration. For transparent HSCSD connection the dynamic resource allocation is applicable, if the air interface user rate is kept constant. The change of channel configuration within the limits of minimum and maximum channel requirements is done with resource upgrading and resource downgrading procedures (described in subclause 5.2.3) during the call.

The MS may request a service level up- or downgrading during the call, if so negotiated in the beginning of the call. In the user initiated modification procedure, the user can modify the channel coding asymmetry preference when enhanced modulation is indicated. This modification of channel requirements and/or wanted air interface user rate and/or channel coding asymmetry preference is applicable to non-transparent HSCSD connections only.

4.2 ~~UMTS/UTRAN vs.~~ HSCSD service aspects in Iu mode

The multislot mechanism is not needed in ~~UMTS/UTRAN~~Iu mode, as one bearer can provide all needed data rates. In Iu mode, ~~C~~consequently the parameters required for setup of a multislot call are not needed in a ~~UMTS/UTRAN~~ call setup, and the MSC shall ignore the parameters.

The parameters which are specific to multislot are (all contained in the Bearer Capability Information Element):

- Maximum number of traffic channels.
- Acceptable Channel coding(s).
- UIMI, User initiated modification indication.
- Acceptable Channel Codings extended.

4.2.1 UMTS to GSM handover

In case of handover from UMTS to GSM the multislot parameters are required in the middle of an ongoing call. A dual mode mobile station shall therefore always include the multislot parameters in the setup, also in ~~UMTS~~Iu mode.

5 HSCSD architecture and transmission

5.1 Air interface

The HSCSD configuration is a multislot configuration using the TCH/F data channel mapping described in 3GPP TS ~~GSM~~ 05.02 [2].

Two types of HSCSD configurations exist, symmetric configuration and asymmetric configuration. For both types of configurations the channels may be allocated on either consecutive or non-consecutive time slots taking into account the restrictions defined by the classmark.

An example of the HSCSD operation with two consecutive time slots is shown in figure 2.

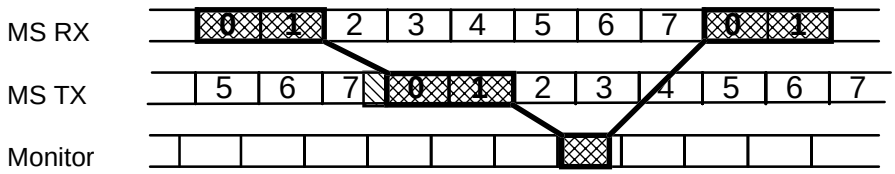


Figure 2: Double slot operation in the air interface

A symmetric HSCSD configuration consists of a bi-directional FACCH and co-allocated bi-directional TCH/F and SACCH channels. An asymmetric HSCSD configuration consists of a bi-direction FACCH and co-allocated uni-directional or bi-directional TCH/F and SACCH channels. A bi-directional channel is a channel on which the data is transferred in both uplink and downlink directions. On uni-directional channels for HSCSD the data is transferred in downlink direction, only.

In both symmetric and asymmetric HSCSD configurations one bi-directional channel, the main channel, carries a FACCH used for all the signalling not carried on the SACCH(s).

For HSCSD configuration all SACCHs are synchronized so that idle frames for each time slot coincide.

The classification of mobile stations used for HSCSD shall be based on Multislot classes, described in detail in ~~GSM~~3GPP TS 05.02 [2]. Further classification shall be based on the Mobile Station Classmark depending on the supported modulations.

The same frequency hopping sequence and training sequence is used for all the channels in the HSCSD configuration.

The same channel coding is used for all the channels in the HSCSD configuration, though in the enhanced modulation mode, for non-transparent services, it is possible to have one channel coding used in the downlink and another channel coding used in the uplink. Different channel codings for up- and downlink could be applied in three cases, see 22.034:

a) If the mobile station only supports enhanced modulation in the downlink direction.

b) If the mobile station supports enhanced modulation in both directions, but the user indicates preference for uplink or downlink biased channel coding asymmetry.

c) If the mobile station supports enhanced modulation in both directions, and the user indicates preference for channel coding symmetry, but the link conditions justifies different channel coding in uplink or downlink.

For Mobile Stations supporting 8-PSK modulation additional channel codings shall apply. The change between different TCH/F channel codings can be provided with RR Channel Mode Modify or Configuration Change procedure. It shall be possible to change between channel codings of different modulation schemes.

In symmetric HSCSD configuration individual signal level and quality reporting for each HSCSD channel is applied.

For an asymmetric HSCSD configuration individual signal level and quality reporting is used for those channels, which have uplink SACCH associated with them. The quality measurements reported on the main channel are based on the worst quality measured among the main and the uni-directional downlink time slots used.

In both symmetric and asymmetric HSCSD configuration the neighbouring cell measurement reports are copied on every uplink channel used. See ~~GSM~~3GPP TS 05.08 [15] for more detail on signal level and quality reporting.

Separate ciphering keys are used for each HSCSD channels. The ciphering keys used on different channels are derived from the Kc. See ~~GSM~~3GPP TS 03.20 [10] for more details.

5.2 Functions and information flows

The procedures discussed in this subclause follow the procedures described in detail in ~~GSM~~3GPP TS 08.08 [4] and 3GPP TS 24.008 [3]. Modifications are referred with text in brackets and conditional procedures with dashed line. Normal signalling or signalling presented earlier in the document is drawn with ovals.

5.2.1 Call establishment procedures

5.2.1.1 Mobile originated call establishment

Figure 3 depicts the procedures for a successful HSCSD call establishment in mobile originated case.

The Multislot class is sent from MS to network using the early classmark sending.

At the call setup the mobile station sends a set of parameters describing the HSCSD characteristics to the network. These parameters and their presence in the Setup message in transparent (T) and non-transparent (NT) calls are as follows:

- Other Modem Type, OMT (T/NT).
- Fixed Network User Rate, FNUR (T/NT).
- Acceptable Channel Codings, ACC (including ACC ext.) (T/NT).
- maximum number of traffic channels, Max TCH/F (T/NT).
- User Initiated Modification Indication, UIMI (NT).
- wanted Air Interface User Rate, AIUR (NT),and
- channel coding ASYMmetry indication, ASYM (NT).

In reply the network responds in Call Proceeding with the Other Modem Type, OMT, Fixed Network User Rate, FNUR, and User Initiated Modification Indication, UIMI (NT only), parameters it is prepared to give to the mobile station.

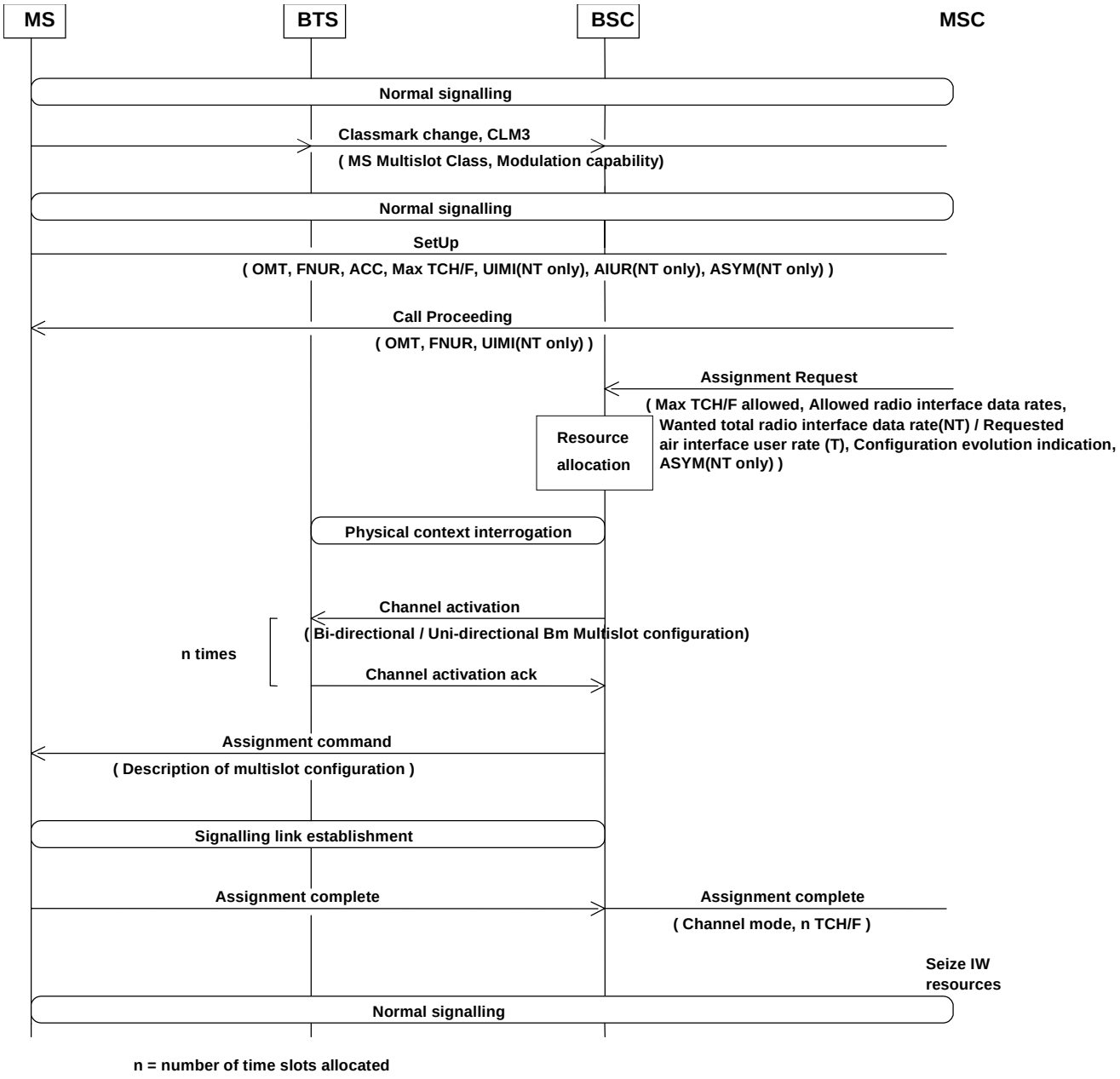


Figure 3: Mobile originated call establishment

The MSC requests the BSC to allocate the channel configuration using parameters derived from the HSCSD related parameters agreed in the setup phase. Based on these parameters and operator preferences the BSC then allocates a suitable number of channels and a suitable channel coding for the connection.

The following rule for the channel allocation apply:

- The BSS shall try to reach but not exceed, with one exception, the wanted AIUR. The exception is the case when the chosen configuration can reach the wanted AIUR with lower number of TCH/F, e.g. in case AIUR=14.4 kbit/s, max number of TCH/F=3, ACC=TCH/F4.8 and TCH/F9.6, the network shall choose 2x9.6 over 3x4.8 if the TCH/F9.6 is available in the cell.

- A separate channel activation is applied for each of the HSCSD channels before the selected channel configuration with information of the channel coding is forwarded to the mobile station. When the preference for downlink or uplink biased channel coding asymmetry is indicated by the user, and an asymmetric channel coding connection is set up based on this indication, the BSC shall always assign a TCH/F14.4 channel on the unbiased link of the connection.

- At assignment completion, the BSS informs the MSC of the chosen HSCSD configuration and the MSC may seize the IW resources accordingly.

5.2.1.2 Mobile terminated call establishment

Figure 4 depicts the procedures for a successful HSCSD call establishment in mobile terminated case.

At the call setup the network sends the Other Modem Type,OMT, Fixed Network User Rate,FNUR, and User Initiated Modification Indication,UIMI (NT only), parameters to the mobile station.

In reply the mobile station responds to the network with the set of parameters describing the HSCSD characteristics. These parameters and their presence in the Call Confirmed message in transparent (T) and non-transparent (NT) calls are as follows:

- wanted Other Modem Type, OMT (T/NT);
- wanted Fixed Network User Rate, FNUR (T/NT);
- Acceptable Channel Codings, ACC (including ACC ext.) (T/NT);
- maximum number of traffic channels, Max TCH/F (T/NT);
- User Initiated Modification Indication, UIMI (NT);
- wanted Air Interface User Rate, AIUR (NT),and
- channel coding ASYMmetry indication, ASYM (NT).

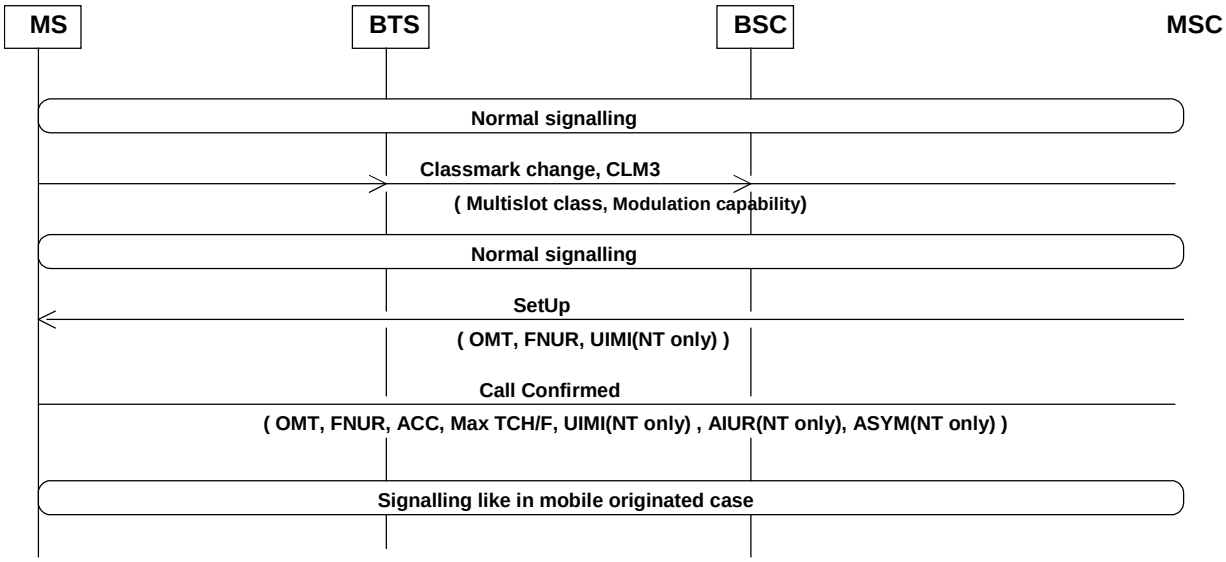


Figure 4: Mobile terminated call establishment

The MSC requests the BSC to allocate the channel configuration using parameters derived from the HSCSD related parameters agreed in the setup phase. Based on these parameters and operator preferences the BSC then allocates a suitable number of channels and a suitable channel coding for the connection.

The same channel allocation rules as in mobile originated case apply.

The same channel activation rules as in mobile originated case apply.

At assignment completion, the BSS informs the MSC of the chosen HSCSD configuration and the MSC may seize the IW resources accordingly.

5.2.2 Handover procedures

5.2.2.1 Intra BSC handover

Figure 5 depicts the procedures for a successful HSCSD intra BSC handover.

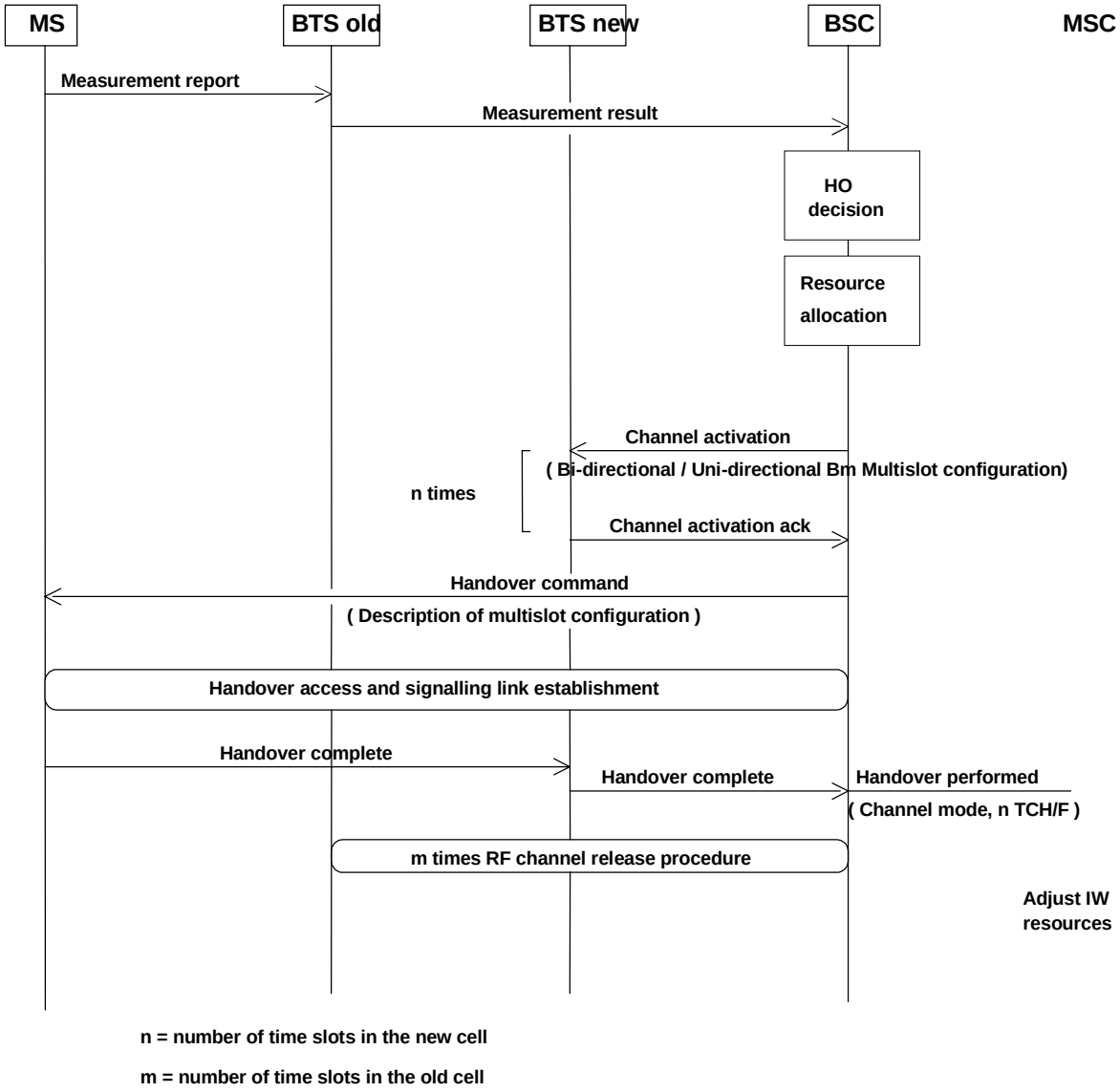


Figure 5: Intra BSC handover

For a non-transparent call, the HSCSD configuration may be modified during an intra BSS handover within the maximum number of TCH/F and channel codings acceptable for the user and allowed by the network.

The same allocation and activation rules as in call establishment apply.

At handover completion, the BSC signals to the MSC the new HSCSD configuration and the MSC may adjust the IW resources accordingly.

5.2.2.2 Inter BSC, intra-MSC handover

Figure 6 depicts the procedures for a successful HSCSD inter BSC handover.

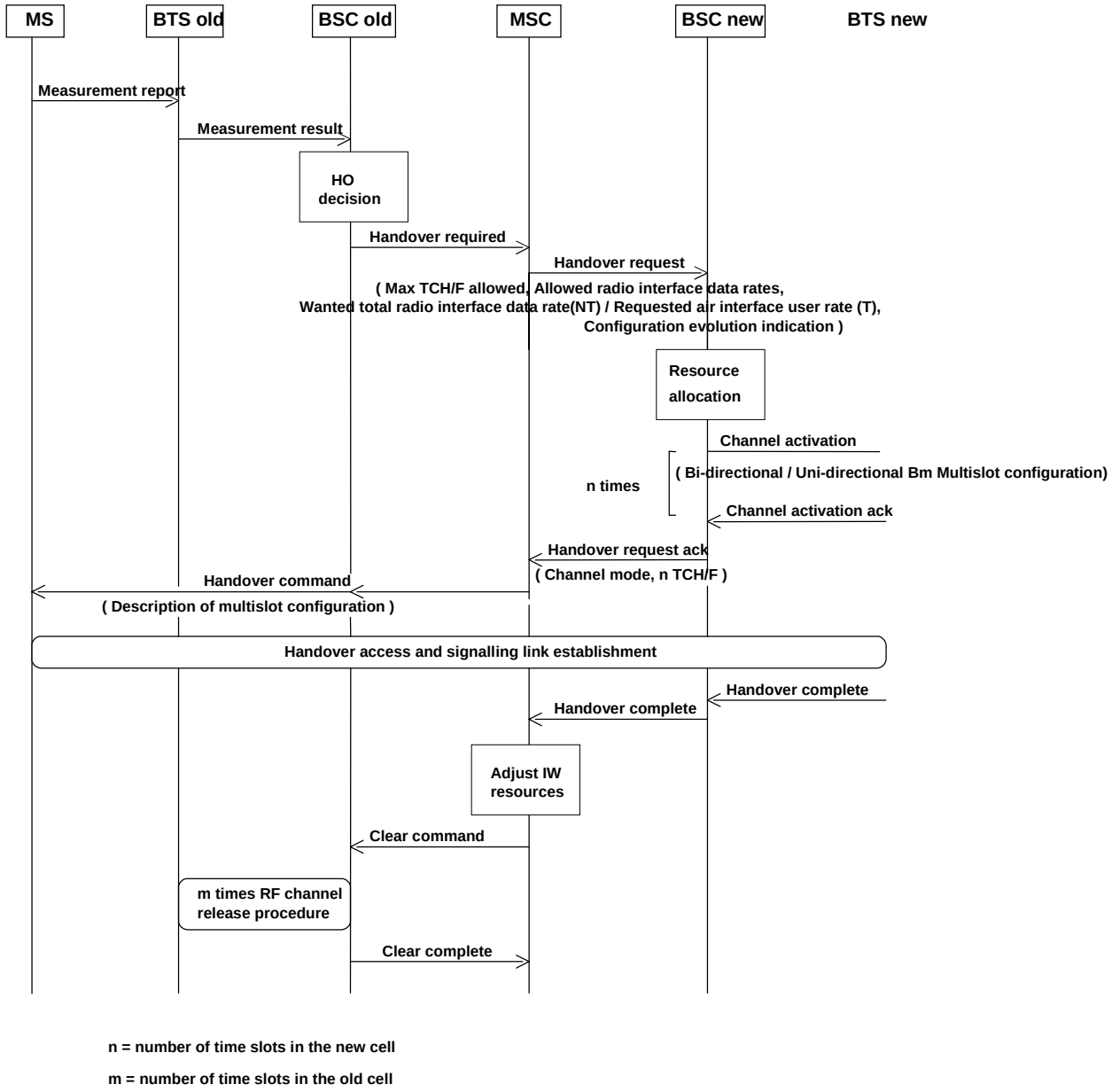


Figure 6: Inter BSC intra MSC handover

In inter BSS handover the MSC requests the new BSS to allocate a channel configuration using parameters derived from the HSCSD related parameters agreed earlier during the call. Based on these parameters and operator preferences the BSC then allocates a suitable number of TCH/F and a suitable channel coding for the connection.

For a non-transparent call, the HSCSD configuration may be modified during an intra BSS handover within the maximum number of TCH/F and channel codings acceptable for the user and allowed by the network.

The same channel allocation and activation rules as in call establishment apply.

The BSC informs the MSC of the chosen HSCSD configuration and at handover completion the MSC may adjusts the IW resources accordingly.

5.2.2.3 Inter MSC handover

In inter MSC handover the requested channel configuration is forwarded to a BSS within the new MSC using MAP protocol between MSCs. Procedures similar to those in inter BSS handover case can be applied in order to establish the HSCSD connection in a new cell.

5.2.3 Resource upgrading, downgrading and configuration change

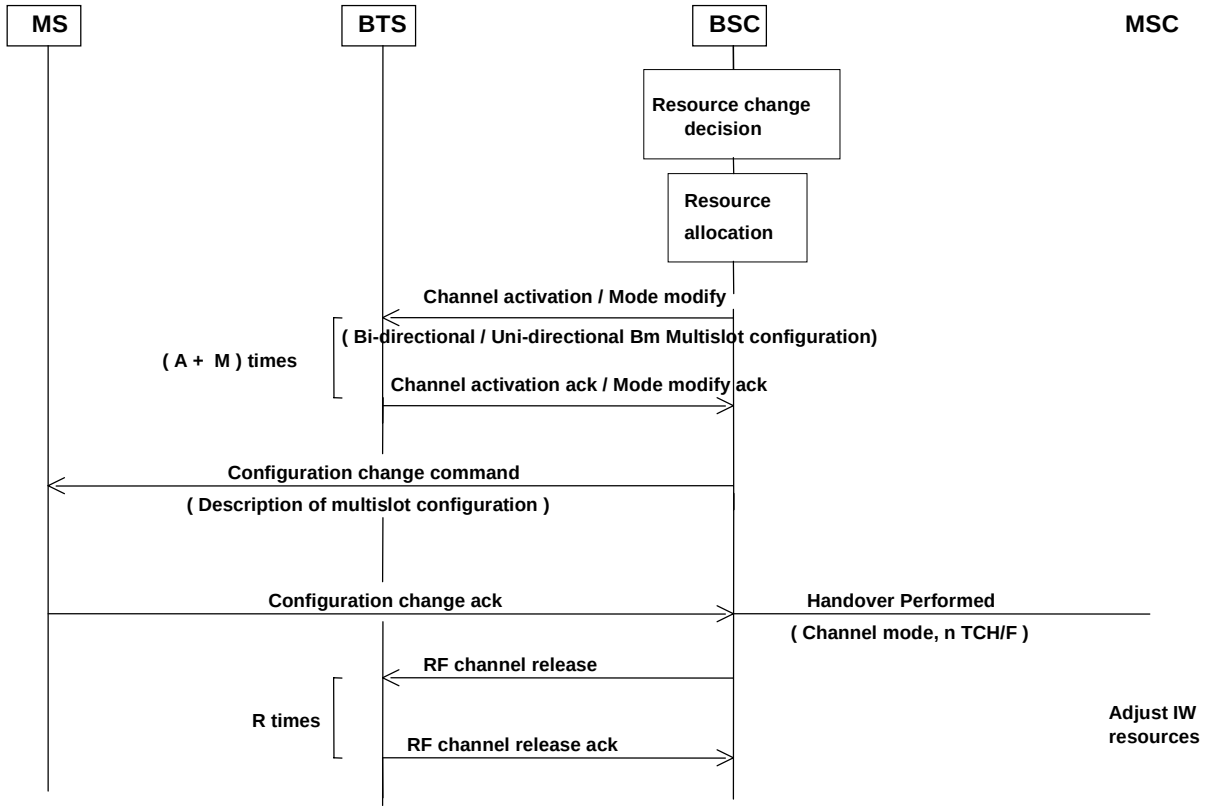
Resource upgrading means allocating more channels to the HSCSD configuration. Similarly, in resource downgrading channels are released.

Both of these procedures are initiated by the network and they are used in non-transparent calls to alter the channel resources between one TCH/F and the maximum number of TCH/F allowed. For transparent connection the alteration of resources is also applicable required that the AIUR for the connection remains constant.

Figure 7 depicts the procedures for a successful resource upgrading and downgrading for an ongoing HSCSD call, in case the position of the main TCH/F remains unchanged.

A separate channel activation for the new HSCSD channels is carried out and the earlier activated HSCSD channels may be modified, before RR Configuration change procedure is used for forwarding the new channel configuration to the mobile station. Similarly, the Configuration change procedure can be used in both transparent and non-transparent calls for reordering the channels in a call without changing the number of TCH/Fs allocated.

At resource modification completion, the BSC signals to the MSC the new HSCSD configuration and the MSC may adjusts the IW resources accordingly.



A = number of time slots added to the connection

R = number of time slots released from the connection

M = number of time slots modified

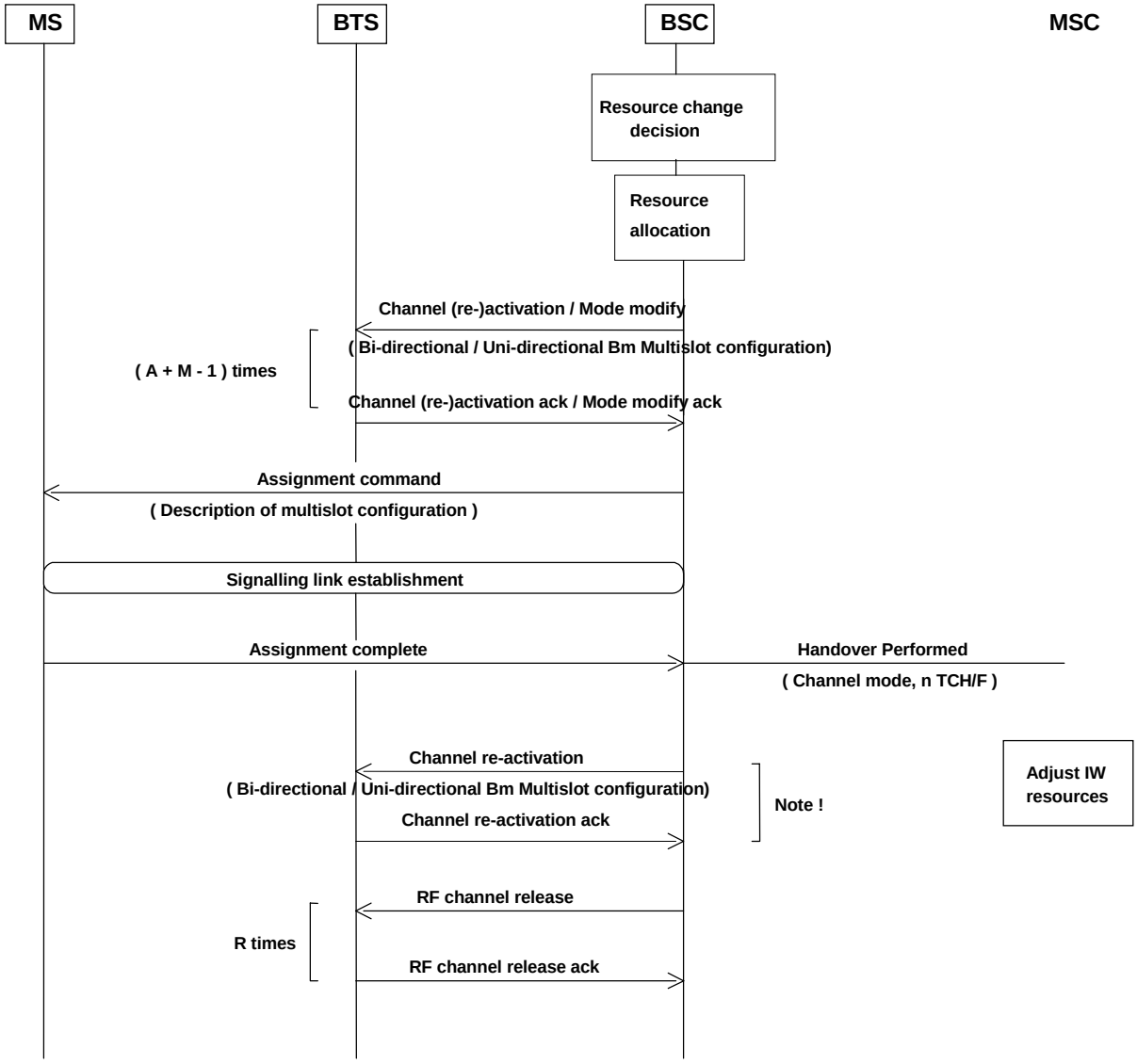
n = number of time slots after upgrading/downgrading

Figure 7: Resource upgrading and downgrading, the position of the main channel unchanged

Figure 8 depicts the procedures for a successful resource upgrading and downgrading for an ongoing HSCSD call in case the position of the main channel is changed.

A separate channel activation for the new HSCSD channels, is carried out and the earlier activated HSCSD channels may be modified or, in case of the new main channel, reactivated, before RR Assignment procedure is used for forwarding the new channel configuration to the mobile station. Similarly, the Assignment procedure can be used in both transparent and non-transparent calls for reordering the channels in a call without changing the number of TCH/Fs allocated.

At resource modification completion, the BSC signals to the MSC the new HSCSD configuration and the MSC may adjusts the IW resources accordingly.



NOTE: Deactivates the old signalling link by modifying the old main channel. The old main can not be modified before a new main has been established. If the time slot for the old main is not used in the new HSCSD configuration, RF channel release is used instead.

A = number of time slots added to the HSCSD connection

R = number of time slots released from the HSCSD connection

M = number of time slots modified or re-activated

n = number of time slots after upgrading/downgrading

Figure 8: Resource upgrading and downgrading, the position of the main channel changed

5.2.4 User initiated service level up- and downgrading

Figure 9 depicts the procedures for a successful user initiated service level up- and downgrading for on-going HSCSD call.

During a HSCSD call the user may request, if so indicated in the call setup, the network to change the current maximum number of traffic channels and air interface user rate parameters and/or channel coding asymmetry preference. This is done by using the CC User initiated service level up- and downgrading procedure.

If network allows the modification, the resulting new parameters are forwarded to BSC and the radio interface resources may be adjusted accordingly. The resource upgrading or downgrading is done separately from the change in HSCSD parameters. However, if a contradiction between the new parameters and the used air interface resources exists, the resource downgrading may be needed before the network acknowledges the new parameters.

The user initiated service level up- and downgrading is applicable in non-transparent mode connections, only.

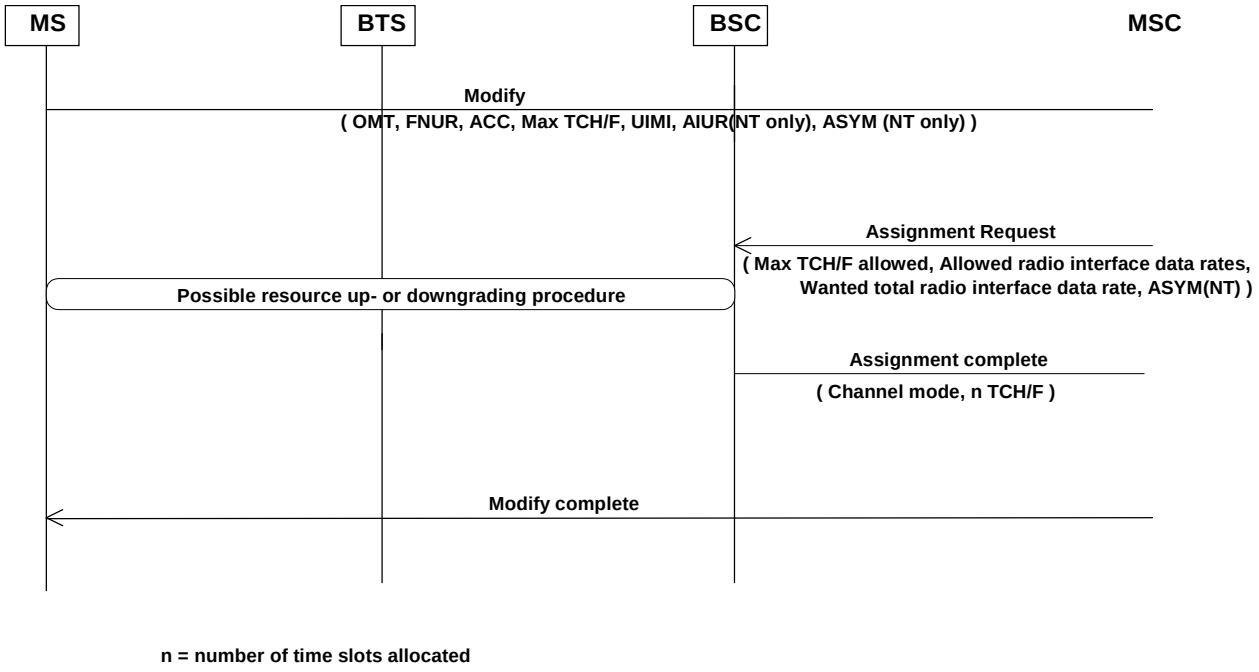


Figure 9: User initiated service level up- and downgrading

5.2.5 Link adaptation for ECSD

Link adaptation for ECSD particularly in high data rate call becomes essential in order to provide good enough service over large coverage areas. Signalling for link adaptation between channel coding schemes in 8-PSK modulation and between GMSK and 8-PSK coding schemes is done using existing signalling mechanisms, i.e. RR Channel Mode Modify procedure, intracell handover, etc. In performing link adaption between 8-PSK modulated channels, the normal Channel Mode (or the assignment or the intra-cell HO procedure) should be used and in case of link adaptation between 8-PSK modulated channels and GMSK modulated channels the assignment procedure or the intra-cell handover should be used.

5.2.6 Start of ciphering

In order to start ciphering, the RR Encryption procedure is controlled by the main signalling link, only. The encryption information for secondary HSCSD channel is forwarded to the corresponding TCH/F in initial channel activation or later in the channel reactivation or Mode modify message.

The change of ciphering modes for separate channels within the HSCSD connection might not be perfectly synchronized.

5.3 Transparent data transmission

5.3.1 Numbering of data substreams

In transparent data transmission the V.110 data frames on the HSCSD channels carry data substream numbers to retain the order of transmission over GSM, between the split/combine functions. Between these functions a channel internal multiframing is also used in order to increase the tolerance against inter channel transmission delays. Depending on the location of the access point to external networks the split/combine functionality is located in the BSS or in the IWF on the network side, and at the mobile station.

A detailed description of the numbering scheme is given in ~~GSM~~3GPP TS 04.21 [12].

5.3.2 Padding

HSCSD also supports user rates which are not multiples of rates provided by one TCH/F.

If the selected user rate requires n TCH/F channels but is less than the total rate that can be achieved with these n TCH/F then in the first n-1 channels the data frames carry user data on all D bits. In the n th channel the unneeded D bits of the V.110 frames are padded with fill bits.

5.4 Non-Transparent data transmission

5.4.1 HSCSD RLP

Non-transparent mode of HSCSD is realized by modifying the RLP and L2R functions to support multiple parallel TCH/Fs instead of only one TCH/F (figure 9a). In addition the RLP frame numbering is increased to accommodate the enlarged data transmission rate.

The detailed specification of the RLP is given in 3GPP TS 24.022 [5], and L2R is defined in 3GPP TS 27.002 [13] and 3GPP TS 27.003 [14].

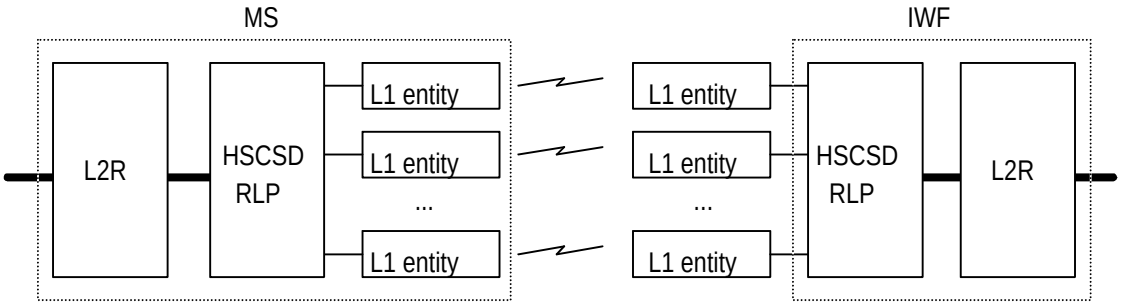


Figure 9a: The HSCSD concept in non-transparent mode

5.5 Interworking

Interworking of HSCSD will be arranged to all the services to which interworking is provided in the existing GSM-system; these services are PSTN, ISDN, CSPDN and PSPDN.

5.6 Subscription aspects and storage of subscriber data

The HSCSD uses general bearer services defined in 02 series specifications. No HSCSD related subscriber data is stored in HLR or VLR with the exception of the bearer capability allocation (see 3GPP TS 23.008 [16]).

6 Charging

6.1 General principles

The A party is liable for the usage of all TCH/F in her PLMN. The B party may have to pay for one or more TCH/F in her PLMN. In case the originating or terminating subscriber is in the PSTN there is no additional charge for them.

6.2 Call forwardings

The A party is liable for the leg A-B. The B party who forwards the call to the forwarded-to subscriber (C party) is liable for the primary (basic) channel on the leg B-C. Forwarded-to (C party) is liable for the usage of one or more TCH/F in her PLMN.

6.3 AoC and toll ticketing

MSC will send the modified e-parameters to the MS, both in MO and in MT calls, every time the charging rate will change. This can happen when:

- the coding on the air interface channel is changed;
- the number of TCH/F allocated is increased or decreased;

during an existing HSCSD data call and when AoC supplementary service is activated.

Appropriate information concerning these changes have to also be included in the charging record (toll ticket).

Annex A:
Change history

Change history								
TSG CN#	**Spec**	**Version**	**CR**	**Rev.**	**Rel.**	**New Version**	**Subject**	**Comment**
Apr 1999	GSM 03.34							Transferred to 3GPP CN1
CN#03	23.034					3.0.0		Approved at CN#03
CN#5	23.034	3.0.0	001	2	R99	3.1.0	CR to 23.034 due to asymmetry for ECSD	V3.1.1 was to correct the implementation of this CR
CN#7	23.034	3.1.1	003	2	R99	3.2.0	Modifications to Stage 2 service description due to EDGE	
CN#7	23.034	3.1.1	004	1	R99	3.2.0	Support of high speed data in UMTS/UTRAN	

History

Document history		
V3.0.0	May 1999	Approved at TSGN #3. Under TSG TSG CN Change Control.
V3.1.0	October 99	Approved at TSGN # 5.
V3.1.1	December 1999	Editorial changes to correct the implementation of the previous version
V3.2.0	March 2000	Approved by TSGN#7

3GPP TSG-CN1 Meeting #14
Cardiff, Wales - 20 - 24 November, 2000

Tdoc N1-~~001219~~001376

CR-Form-v3

CHANGE REQUEST

⌘ **24.011** **CR** **011** ⌘ rev **-1** ⌘ Current version: **3.4.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM ☐ ME/UE **X** Radio Access Network ☐ Core Network **X**

Title:	⌘	Terminology CR
Source:	⌘	NTT Communicationware
Work item code:	⌘	TEI
Date:	⌘	10-Nov-2000
Category:	⌘	**F**
Release:	⌘	R99

Use one of the following categories:
- ***F*** *(essential correction)*
- ***A*** *(corresponds to a correction in an earlier release)*
- ***B*** *(Addition of feature),*
- ***C*** *(Functional modification of feature)*
- ***D*** *(Editorial modification)*

Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:

2	*(GSM Phase 2)*
R96	*(Release 1996)*
R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
REL-4	*(Release 4)*
REL-5	*(Release 5)*

Reason for change:	⌘	It was agreed in CN#9 (NP-000413) to change terminologies to stand for the radio access technology. According to the decision, it is proposed to update the terminologies.
Summary of change:	⌘	Following changes are proposed: **In GSM -> In A/Gb mode** **In UMTS -> In Iu mode** **(GSM only) -> (A/Gb mode only)** **(UMTS only) -> (Iu mode only)**
Consequences if not approved:	⌘	Inconsistent terminologies are left in the specifications.

Clauses affected:	⌘	1.2; 2.1; 2.2; 2.4; 2.5; 5.1; 5.2.2.1.2; 5.3.2.1; Annex A;
Other specs affected:	⌘	☐ Other core specifications ☐ Test specifications ☐ O&M Specifications
Other comments:	⌘	

How to create CRs using this form:
Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://www.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2000-09 contains the specifications resulting from the September 2000 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

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Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The present document defines the Short Message Service (SMS) support on mobile radio interface within the 3GPP system.

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document specifies the procedures used across the mobile radio interface by the signalling layer 3 function Short Message Control (SMC) and Short Message Relay function (SM-RL) for both circuit switched ~~GSM~~ in A/Gb mode and GPRS.

1.1 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] 3GPP TS 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[1a] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.040: "Technical realization of the Short Message Service (SMS) Point-to-Point (PP)".

[3a] 3GPP TS 23.060: "General Packet Radio Service (GPRS); Service description; Stage 2".

[3] 3GPP TS 04.06: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface Data Link (DL) layer specification".

[4] 3GPP TS 24.007: "Mobile radio interface signalling layer 3; General aspects".

[5] 3GPP TS 24.008: "Mobile radio interface layer 3 specification".

[6a] 3GPP TS 04.64: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Logical Link Control (LLC)".

[6] ISO 7498: "Information processing systems - Open Systems Interconnection - Basic Reference Model".

[7] 3GPP TS 04.18: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification; Radio Resource Control Protocol".

1.2 Abbreviations

Abbreviations used in the present document are listed in GSM 01.04 and 3GPP TR 21.905, except below:

RR connection: A RR connection is a dedicated physical circuit switched domain connection used by the two RR or RRC peer entities to support the upper layers' exchange of information flows.

PS signalling connection: is a peer to peer UMTS connection between MS and CN packet domain node.

GPRS: Packet Services for GSM and UMTS system.

The label **(~~GSM~~ A/Gb mode only):** indicates this section or paragraph applies only to GSM system. For multi system case this is determined by the current serving radio access network.

The label **(~~UMTS~~ Iu mode only):** indicates this section or paragraph applies only to UMTS system. For multi system case this is determined by the current serving radio access network.

In ~~GSM~~A/Gb mode,...: Indicates this paragraph applies only to GSM System. For multi system case this is determined by the current serving radio access network.

In ~~UMTS~~Iu mode,...: Indicates this paragraph applies only to UMTS System. For multi system case this is determined by the current serving radio access network.

SIM: Subscriber Identity Module (see TS GSM 02.17). This specification makes no distinction between SIM and USIM.

MS: Mobile Station. This specification makes no distinction between MS and UE.

2 Overview of Short Message Service (SMS) support

The purpose of the Short Message Service is to provide the means to transfer messages between a GSM PLMN Mobile Station (MS) and a Short Message Entity via a Service Centre, as described in TS 23.040. The terms "MO" - Mobile Originating - and "MT" - Mobile Terminating - are used to indicate the direction in which the short message is sent.

The present document describes the procedures necessary to support the Short Message Service between the MS and the MSC or SGSN and vice versa, as described in TS 23.040.

The procedures are based on services provided by the Mobility Management sublayer as described in TS24.007/24.008 for ~~GSM~~ CS in A/Gb mode and ~~UMTS~~ CS/PS services in Iu mode and the Logical Link Control layer described in GSM 04.64 for GPRS services.

2.1 Protocols and protocol architecture

In ~~UMTS~~Iu mode only, integrity protected signalling (see TS 24.008, subclause 'Integrity Protection of Signalling Messages,' and in general, see TS 33.102) is mandatory. In ~~UMTS~~Iu mode only, all protocols shall use integrity protected signalling. Integrity protection of all SMS signalling messages is the responsibility of lower layers. It is the network which activates integrity protection. This is done using the security mode control procedure (TS 25.331).

The hierarchical model in Figure 2.1a shows the layer structure of the MSC and the MS in ~~GSM~~A/Gb mode. The hierarchical model in Figure 2.1c shows the layer structure of the SGSN and the MS in ~~UMTS~~Iu mode.

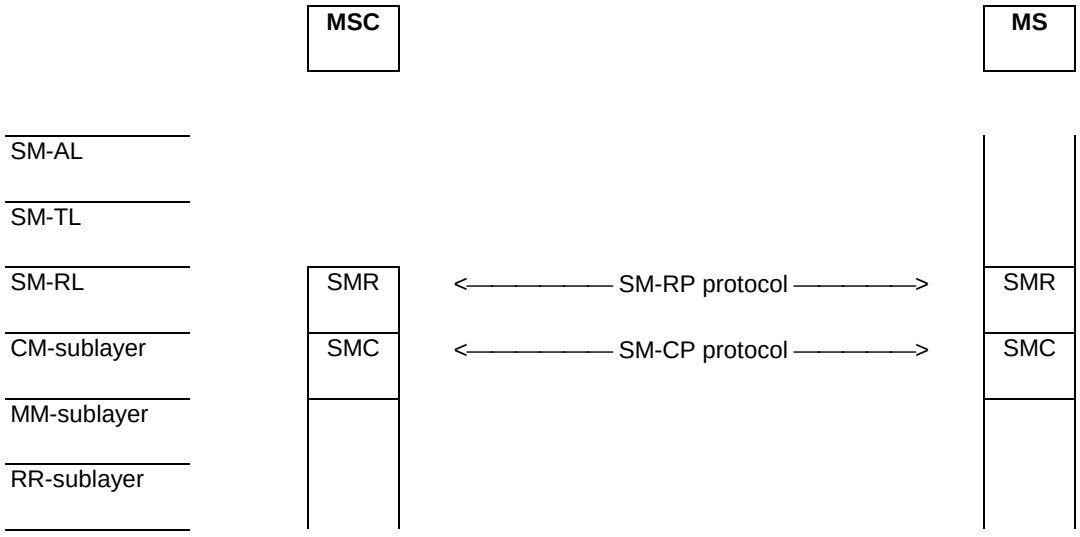


Figure 2.1a/TS 24.011: Protocol hierarchy for circuit switched service

The hierarchical model in Figure 2.1b shows the layer structure of the SGSN and the MS.

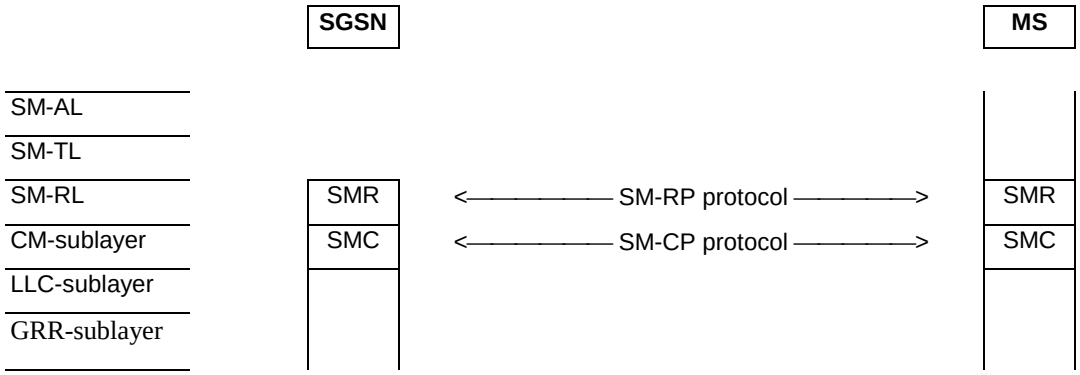


Figure 2.1b/TS 24.011: Protocol hierarchy for GPRS in ~~GSM~~A/Gb mode

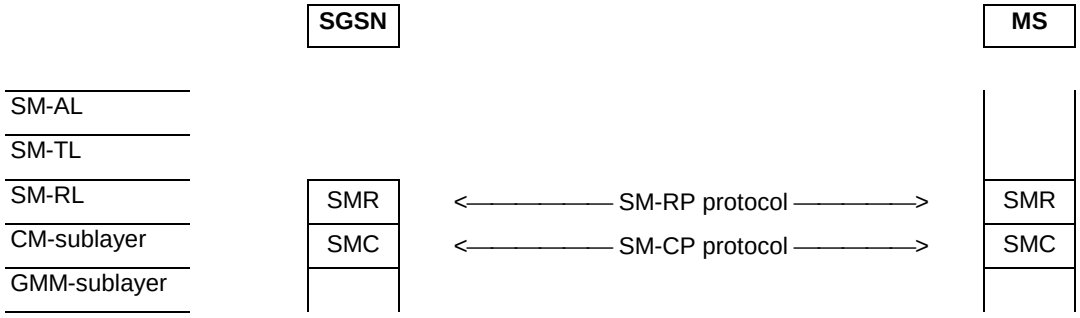


Figure 2.1c/24.011: Protocol hierarchy for packet switched service in ~~UMTS~~Iu mode

The CM-sublayer, in terms of the Short Message Service Support, provides services to the Short Message Relay Layer.

On the MS-side the Short Message Relay Layer provides services to the Short Message Transfer Layer. The Short Message Relay Layer is the upper layer on the network side (MSC or SGSN), and the SM-user information elements are mapped to TCAP/MAP.

The peer protocol between two SMC entities is denoted SM-CP, and between two SMR entities, SM-RP.

Abbreviations:

SM-AL	Short Message Application Layer
SM-TL	Short Message Transfer Layer
SM-RL	Short Message Relay Layer
SM-RP	Short Message Relay Protocol
SMR	Short Message Relay (entity)
CM-sub	Connection Management sublayer
SM-CP	Short Message Control Protocol
SMC	Short Message Control (entity)
MM-sub:	Mobility Management sublayerGMM-sub: GPRS Mobility Management sublayer
RR-sub:	Radio Resource Management sublayer
LLC-sub	Logical Link Control sublayer
GRR-sub	GPRS Radio Resource sublayer in GSM

2.2 Use of channels (~~GSM~~ A/Gb mode only)

Table 2.1/TS 24.011 summarizes the use of channels for the short message service for circuit switched ~~GSM~~in A/Gb mode. Arrows indicate changes of channel.

Table 2.1/TS 24.011: Channels used for short message transfer over circuit switched ~~GSM~~in A/Gb mode

Channel dependency	Channel used
TCH not allocated	SDCCH
TCH not allocated -> TCH allocated	SDCCH -> SACCH
TCH allocated	SACCH
TCH allocated -> TCH not allocated	SACCH -> SACCH opt. SDCCH[3]

The short message service for GPRS shall be supported by a PDTCH.

2.3 Layer 2 SAPI 3 handling for circuit switched in A/Gb mode~~GSM~~

General rule:

The Radio Resource Management (RR reference GSM 04.18) in the Mobile Station and on the network side (i.e. in the BSC) shall establish the acknowledged mode of operation on SAPI 3 whenever needed, i.e. when a message requiring SAPI 3 transfer shall be transmitted.

RR shall control the layer 2 also for SAPI 3, and keep knowledge of the mode.

The network side may initiate release of the acknowledged mode for SAPI 3 either explicitly (by the use of DISC- and UA-frames, see GSM 04.06) or indirectly by channel release (see GSM 04.18).

This means:

- the Mobile Station side will initiate establishment of SAPI 3 acknowledged mode in the case of mobile originating short message transfer;
- the network side will initiate establishment of SAPI 3 acknowledged mode in the case of mobile terminating short message transfer;
- the network side may choose to keep the channel and the acknowledged mode of operation to facilitate transfer of several short messages for or from the same Mobile Station. The queuing and scheduling function for this should reside in the MSC.

2.4 Layer 2 (LLC) GPRS support (~~GSM only~~A/Gb mode only)

It shall be possible for a GPRS-attached MS of any class (A, B, C) to send and receive short messages over GPRS radio channels.

GPRS shall use the unacknowledged mode of LLC frame transfer as described in GSM 04.64, and shall use SAPI 7 to identify the SMS Logical Link Entity within the LLC layer.

A description of the different GPRS MS classes can be found in 23.060, and a brief overview is given below:-

- Class A/B MSs may be able to send and receive short messages using either the MM sublayer (using SACCH or SDCCH) or the LLC layer (using PDTCH).
- Class C MSs may be able to send and receive short messages using only the LLC layer (using the PDTCH). The capability for GPRS-attached class-C MSs to receive and transmit SMS messages is optional.

The GSMS entity for GPRS class A/B MS is shown in Figure 3. The GSMS shall communicate with the MM entity via the GMMSMS-SAP for GPRS Class A/B MO SMS, in order to ascertain which transport service to use.

SMS delivery via GPRS is normally a more radio resource efficient method than SMS delivery via CS ~~GSM~~in A/Gb mode. The delivery path for MO SMS is selected by the MS.

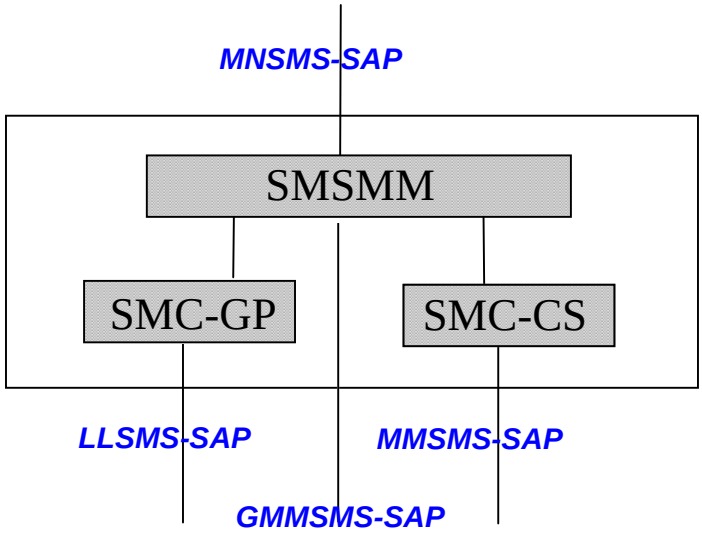


Figure 2.2/TS 24.011: GSMS entity for GPRS Class A/B MS

2.5 GSMS entity in UMTSn Iu mode

It shall be possible for a PS-attached MS of any mode of operation to send and receive short messages over UMTS radio channelsin Iu mode.

A description of the different mode of operation UMTS MS can be found in 23.060, and a brief overview is given below:-

- CS/PS mode of operation MSs may be able to send and receive short messages using either the MM sublayer or the GMM sublayer.
- PS mode of operation MSs may be able to send and receive short messages using only GMM sublayer.

The GSMS entity for CS/PS mode of operation MS is shown in Figure 2.3. The GSMS shall communicate with the MM entity via the GMMSMS-SAP for UMTS CS/PS mode of operation MO SMS in Iu mode, in order to ascertain which transport service to use.

The delivery path for MO SMS is selected by the MS.

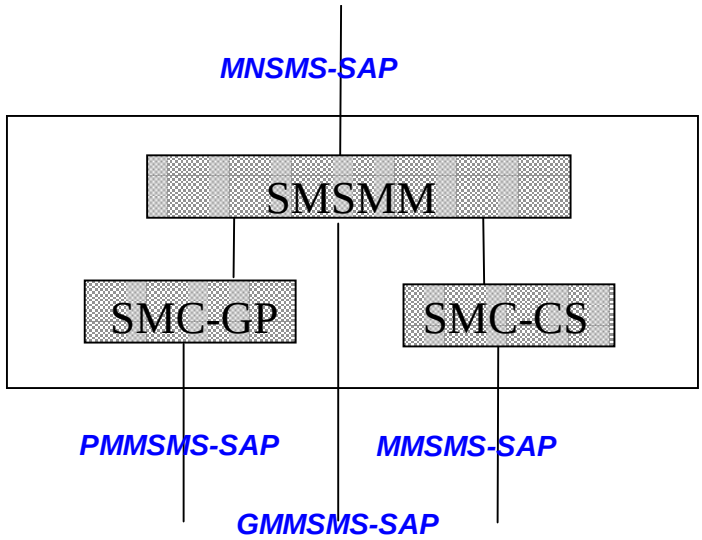


Figure 2.3/TS 24.011: GSMS entity for CS/PS mode of operation MS in UMTSn Iu mode

*** Next Modified Section ***

4 [Void]

5 CM-procedures

5.1 General

This clause describes the procedures used by the SMC entity on the Connection Management sublayer. An SMC entity communicates with a corresponding peer entity using an MM-connection for CS ~~GSM/UMTS~~in A/Gb and Iu mode or the LLC layer for GPRS in ~~GSM~~ A/Gb mode or the GMM-connection in for PS in ~~UMTS~~Iu mode.

Multiple MM-connections may be established at the same time, allowing parallel transactions. The description of the procedures is related to one single transaction.

For circuit switched service, the CM-procedures described can only be performed if an MM-connection has been established between the mobile station and the network.

For GPRS, no connection has to be established, and thus the CM procedures for GPRS reflect this. Detailed SDL diagrams for SMC entities are contained in annex B.

5.2 Short Message Control states

The state transition diagrams for the MO and MT SMC entities on both the MS side and network side are contained in annex B.

5.2.1 SMC-CS states at the MS side of the radio interface

5.2.1.1 Mobile Originating Case

The states described in this clause are for an SMC entity in an MS handling mobile originating short message transfer and notification to the network that the mobile has memory available to receive one or more short messages (referred to below as "notification").

5.2.1.1.1 MO-Idle (State 0)

This state exists when the MO-SMC entity is in idle mode, or when an MO short message transfer or notification ends in a normal or abnormal way.

5.2.1.1.2 MO-MM-connection pending (State 1)

This state exists when the MO-SMC has requested the establishment of an MM-connection.

5.2.1.1.3 MO-Wait for CP-ACK (State 2)

This state exists after the MO-SMC has initiated the transfer of a CP-DATA message.

5.2.1.1.4 MO-MM-connection established (State 3)

This state exists when the MO-SMC has:

- received the acknowledgement, CP-ACK; or
- received the message CP-DATA (including sending of the associated CP-ACK).

5.2.1.2 Mobile Terminating case

The states described in this subclause are for an SMC entity in an MS handling mobile terminating short message transfer.

5.2.1.2.1 MT-Idle (State 0)

This state exists when the MT-SMC entity is in idle mode, or when a short message transfer ends in a normal or abnormal way.

5.2.1.2.2 MT-Wait for CP-ACK (State 2)

This state exists after the MT-SMC has initiated the transfer of a CP-DATA message.

5.2.1.2.3 MT-MM-connection established (State 3)

This state exists when the MT-SMC has:

- received the acknowledgement, CP-ACK; or
- received the message CP-DATA (including sending of the associated CP-ACK).

5.2.2 SMC-GP states at the MS side of the radio interface

5.2.2.1 Mobile Originating Case

The states described in this clause are for an SMC-GP entity in a GPRS MS handling mobile originating short message transfer and notification to the network that the mobile has memory available to receive one or more short messages (referred to below as "notification").

5.2.2.1.1 MO-Idle (State 0)

This state exists when the MO-SMC entity is in idle mode, or when an MO short message transfer or notification ends in a normal or abnormal way.

5.2.2.1.2 MO-GMM-connection pending (State 1) (~~UMTS~~ Iu mode only)

This state exists when the MO-SMC has requested the establishment of an PS signalling connection.

5.2.2.1.3 MO-Wait for CP-ACK (State 2)

This state exists after the MO-SMC has initiated the transfer of a CP-DATA message.

5.2.2.1.4 MO-Wait for CP-Data (State 3)

This state exists when the MO-SMC has received the acknowledgement, CP-ACK.

5.2.2.2 Mobile Terminating case

The states described in this subclause are for an SMC-GP entity in an GPRS MS handling mobile terminating short message transfer.

5.2.2.2.1 MT-Idle (State 0)

This state exists when the MT-SMC entity is in idle mode, or when a short message transfer ends in a normal or abnormal way.

5.2.2.2.2 MT-Wait for RP-ACK (State 1)

This state exists after the MT-SMC has received the message CP-DATA (including sending of the associated CP-ACK)

5.2.2.2.3 MT-Wait for CP-ACK (State 2)

This state exists when the MT-SMC has initiated the transfer of the CP DATA message.

5.2.3 SMC-CS states at the network side of the radio interface

5.2.3.1 Mobile Originating Case

The states described in this subclause are for an SMC entity in an MSC handling both mobile originating short message transfer and notification to the network that the mobile has memory available to receive one or more short messages (referred to below as "notification").

5.2.3.1.1 MO-Idle (State 0)

This state exists when the MO-SMC entity is in idle mode, or when a short message transfer or notification ends in a normal or abnormal way.

5.2.3.1.2 MO-Wait for CP-ACK (State 2)

This state exists after the MO-SMC has initiated the transfer of a CP-DATA message.

5.2.3.1.3 MO-MM-connection established (State 3)

This state exists when the SMC has:

- received the acknowledgement, CP-ACK; or
- received the message CP-DATA (including sending of the associated CP-ACK).

5.2.3.2 Mobile Terminating Case

The states described in this subclause are for an SMC entity in an MSC handling mobile terminating short message transfer.

5.2.3.2.1 MT-Idle (State 0)

This state exists when the MT-SMC entity is in idle mode, or when a short message transfer ends in a normal or abnormal way.

5.2.3.2.2 MT-MM-connection pending (State 1)

This state exists when the MT-SMC has requested an MM-connection for mobile terminating short message transfer.

5.2.3.2.3 MT-Wait for CP-ACK (State 2)

This state exists after the SMC has initiated the transfer of a CP-DATA message.

5.2.3.2.4 MT-MM-connection established (State 3)

This state exists when the SMC has:

- received the acknowledgement, CP-ACK; or
- received the message CP-DATA (including sending of the associated CP-ACK).

5.2.4 SMC-GP states at the network side of the radio interface

5.2.4.1 Mobile Originating Case

The states described in this subclause are for an SMC-GP entity in an SGSN handling both mobile originating short message transfer and notification to the network that the mobile has memory available to receive one or more short messages (referred to below as "notification").

5.2.4.1.1 MO-Idle (State 0)

This state exists when the MO-SMC entity is in idle mode, or when a short message transfer or notification ends in a normal or abnormal way.

5.2.4.1.2 MO-Wait for RP-ACK (State 1)

This state exists after the MO-SMC has received the message CP-DATA (including sending of the associated CP-ACK).

5.2.4.1.3 MO-Wait for CP-ACK(State 2)

This state exists when the SMC hasreceived the RP acknowledgement, RP-ACK

5.2.4.2 Mobile Terminating Case

The states described in this subclause are for an SMC-GP entity in an SGSN handling mobile terminating short message transfer.

5.2.4.2.1 MT-Idle (State 0)

This state exists when the MT-SMC entity is in idle mode, or when a short message transfer ends in a normal or abnormal way.

5.2.4.2.2 MT-Wait for CP-ACK (State 1)

This state exists after the SMC has initiated the transfer of a CP-DATA message.

5.2.4.2.3 MT-Wait for CP DATA (State 2)

This state exists when the SMC has received the acknowledgement, CP-ACK.

5.3 Short Message Control procedures

The procedures needed for short message control are:

- connection establishment procedures;
- RP Data Unit (RPDU) transfer procedures;
- connection release procedures; and
- procedures for abnormal cases.

The procedures of subclause 5.3 are described with respect to one particular instance of an SMC entity. Different SMC entities are identified by their Transaction Identifier. Messages with Transaction Identifiers that do not correspond to this particular instance of the SMC entity are not treated by it.

5.3.1 MM-connection establishment for circuit switched service

When an SMC entity is in the Idle state and transfer of an RPDU is requested, the peer to peer connection between the MM-sublayers in the MS and the network (MSC) has to be established.

The SMC entity on the originating side requests the MM-sublayer to establish an MM-connection, and enters the MM-Connection Pending state.

After completion of the MM-connection establishment, a confirmation is given to the originating side to indicate that the MM sublayer is ready for RPDU transfer.

The MM-connection establishment is indicated to the SMC entity at the destination side when the CP-DATA message has been received by the MM-sublayer (in line with 24.008). The destination side SMC entity then sends a CP-ACK and enters the MM-Connection Established state.

5.3.2.1 RPDU transfer for circuit switched service

In ~~GSM~~A/Gb mode, when an SMC entity in the MM-Connection Pending state is informed that an MM-connection has been established, the SMC entity forwards the CP-DATA message containing the RPDU, sets the timer TC1* and enters the Wait for CP-ACK state.

In ~~UMTS~~Iu mode, when an SMC-GP entity in the MS side is in the Idle state and transfer of an RPDU is requested, the SMC-GP entity on the originating side requests the MM-sublayer to establish an PS signalling connection, and enters the GMM-Connection Pending state.

In ~~UMTS~~Iu mode, in the MS, after completion of the PS signalling connection establishment, a confirmation is given to the originating side to indicate that the MM sublayer is ready for RPDU transfer.

In ~~UMTS~~Iu mode, in the MS, after confirmation of the PS signalling connection establishment, , the SMC-GP entity on the originating side forwards the CP-DATA message to the GMM sublayer. This contains the RPDU, and also the SMC-GP entity sets the timer TC1* and enters the Wait for CP-ACK state.

In ~~UMTS~~Iu mode, when an SMC-GP entity in the network side is in Idle state and transfer of an RPDU is requested, the SMC-GP entity on the originating side forwards the CP-DATA message to the GMM sublayer. This contains the RPDU, and also the SMC-GP entity sets the timer TC1* and enters the Wait for CP-ACK state.

The value of TC1* may vary with the length of the CP-DATA message and the channel type that is being used for its transmission. However, the value of TC1* shall be sufficiently great to allow the lower layers to transmit the CP-DATA and CP-ACK messages and to allow for some retransmissions of layer 2 frames.

If an SMC entity in the Wait for CP-ACK state gets an indication that the CP-DATA message has probably been lost (e.g. due to dedicated channel assignment, hand over, assignment failure, hand over failure, or a SAPI 3 data link failure) then, as an implementation option, that SMC entity may reduce the time until expiry of TC1*.

If the timer TC1* expires in the Wait for CP-ACK state, the CP-DATA message is retransmitted and the state Wait for CP-ACK is re-entered. The maximum number of CP-DATA message retransmissions is an implementation option but shall be either 1, 2 or 3. If the timer TC1* expires after the maximum number of retransmission attempts, an error indication is passed to SM-RL and an MM-connection release request is passed to the MM-sublayer. The Idle state is then entered.

On receipt of the CP-ACK message in the Wait for CP-ACK state, the SMC resets the timer TC1* and enters the MM-Connection Established state.

In ~~GSM~~A/Gb mode, when receiving a CP-DATA message in the MM-Connection Established state, the SMC entity checks the parameters relevant to the CP protocol. If these are valid, the RPDU is passed to the SM-RL, the CP-ACK message is sent and the state MM-Connection Established is re-entered.

In ~~UMTS~~Iu mode, when receiving a CP-DATA message from the GMM sublayer, the SMC-GP entity checks the parameters relevant to the CP protocol. If these are valid, the RPDU is passed to the SM-RL, the CP-ACK message is sent.

If an SMC entity in the Idle state is unable to accept a CP-DATA message, it sends a CP-ERROR message followed by an MM-connection release request and then enters the Idle state.

When receiving a MNSMS-DATA-Req primitive in the MM-Connection Established state, the SMC entity forwards a CP-DATA message containing the RPDU to the MM-sublayer, sets the timer TC1* and enters the Wait for CP-ACK state.

5.3.2.2 RPDU transfer for GPRS

When an SMC-GP entity is in the Idle state and transfer of an RPDU is requested, the SMC-GP entity on the originating side forwards the CP-DATA message to the LLC sublayer. This contains the RPDU, and also the SMC-GP entity sets the timer TC1* and enters the Wait for CP-ACK state.

The value of TC1* may vary with the length of the CP-DATA. However, the value of TC1* shall be sufficiently great to allow the lower layers to transmit the CP-DATA and CP-ACK messages and to allow for some re-transmissions of layer 2 frames.

If an SMC entity in the Wait for CP-ACK state gets an indication that the CP-DATA message has probably been lost then, as an implementation option, that SMC-GP entity may reduce the time until expiry of TC1*.

If the timer TC1* expires in the Wait for CP-ACK state, the CP-DATA message is retransmitted and the state Wait for CP-ACK is re-entered. The maximum number of CP-DATA message re-transmissions is an implementation option but shall be either 1, 2 or 3. If the timer TC1* expires after the maximum number of retransmission attempts, an error indication is passed to SM-RL. The Idle state is then entered.

On receipt of the CP-ACK message in response to the CP-DATA (RP DATA) message in the Wait for CP-ACK state, the SMC-GP resets the timer TC1* and enters the Wait for CP DATA state.

On receipt of the CP-ACK message in response to the CP-DATA (RP ACK) message in the Wait for CP-ACK state, the SMC-GP resets the timer TC1* and enters the Idle State.

When receiving a CP-DATA message form the LLC sublayer, the SMC-GP entity checks the parameters relevant to the CP protocol. If these are valid, the RPDU is passed to the SM-RL, the CP-ACK message is sent.

If an SMC entity in the Idle state is unable to accept a CP-DATA message, it sends a CP-ERROR message and then enters the Idle state.

5.3.3 Release of MM and CM connections

With the exception of error situations, release of the MM and CM connection is controlled by the SM-RL.

When an SMC entity in the Wait for CP-ACK state receives a release request from SM-RL, this request is stored until the next state (either MM Connection Established or Idle) is entered. If the Idle state is entered, the request is discarded. If the MM Connection Established state is entered, or if the SMC entity receives a release request from SM-RL in this state, an MM-connection release request is sent to the MM-sublayer and the SMC entity enters the Idle state.

5.3.4 Abnormal cases

Abnormal cases that shall be handled by the SMC entity in any state can be classified into five cases:

- **Upper Layer Abort:** Errors occurring in the SM-RL may cause the SM-RL to send an MNSMS-ABORT Request to the SMC entity.
- **CP-Layer Abort:** Errors occurring within the SMC entity itself may require termination of all activities related to that transaction identifier.
- **Lower Layer Abort:** Errors occurring within the layers beneath the CP-layer may cause an MMSM-ERROR Indication or a GMMSMS-ERROR Indication to be sent to the SMC entity.
- **CP-Layer Protocol Errors:** Errors occurring within the protocol exchange between the SMC entities may result in the sending of a CP-ERROR message between the entities.
- **Lower Layer Release:** Events occurring within the layers beneath the CP layer may cause an MMSM-REL Indication to be sent to the SMC entity.

When the CM-sublayer in the network receives an Upper Layer Abort, it may form and send the CP-ERROR message to release the connection. Irrespective of whether or not the CP-ERROR message was sent, an MM-connection release request, without indication of release cause, is passed to the MM-sublayer. The SMC entity in the network then enters the Idle state.

When the CM-sublayer in the MS receives an Upper Layer Abort and if the MM connection exists, it shall form and send the CP-ERROR message. Irrespective of whether or not the CP-ERROR message was sent, an MM-connection release request, without indication of release cause, is passed to the MM-sublayer. The SMC entity in the mobile station then enters the Idle state.

In the case of a CP-Layer Abort, an error indication is passed to SM-RL. If possible, a CP-ERROR message is sent to the partner SMC entity to indicate the error situation. Then the SMC entity enters the Idle state.

In the case of a Lower Layer Abort, the SMC entity passes an error indication to SM_RL, an MM-connection release request is passed to the MM-sublayer, and the SMC entity immediately enters the Idle state.

In the case of the reception of a CP-ERROR message from the partner SMC entity, an error indication is passed to SM-RL, an MM-connection release request, without indication of release cause, is passed to the MM-sublayer, and the SMC entity enters the Idle state.

In the case of a lower layer release, the SMC entity passes an MNSMS-ERROR Indication to SM-RL and then enters the Idle state.

In all cases, if the timer TC1* is running, it is reset.

It is possible that the CP-ACK of a short message transfer might not be received (e.g. due to hand over). If the first CP-ACK (acknowledging the CP-DATA that carried the first RPDU) is not received the reception of CP-DATA may be interpreted as the reception of the awaited CP-ACK and CP-DATA message.

5.4 Concatenating short message or notification transfers

If an entity has more than one short message or notification to send, then it is useful to maintain the Radio Resource (RR) connection in between transfers for circuit switched service. For mobile terminated short messages this is simple because the network decides when, and whether, to release the RR connection. However, for mobile originated transfers, the network does not know whether or not the mobile has more messages to transfer.

If another short message or a memory available notification is to be sent, an originating SMR entity in the MS may choose to continue to use the same RR connection. When the MS chooses to use the same RR connection, then:

- the MS shall transmit a CM SERVICE REQUEST for the new CM connection before the final CP-ACK (e.g. the one that acknowledges the CP-DATA that carried the RP-ACK) for the old MM connection is transmitted;
- before transmission of the first CP-DATA on the new MM connection, the MS shall transmit the CP-ACK for the old MM connection;
- the Transaction Identifier used on the new MM connection shall be different to that used on the old MM connection; and
- the MS shall not initiate establishment of the new MM connection before the final CP-DATA (e.g. the one carrying the RP-ACK) has been received.

NOTE: When an MS sends successive memory available notifications and/or mobile originated short messages on different RR connections, the MS is strongly recommended to use different Transaction Identifiers for the old and new MM connections.

It is possible that the final CP-ACK of a short message transfer may not be received (e.g. due to transmission errors and/or hand overs). For mobile terminated transfers, if the CP-ACK is lost, the reception of a CP-DATA with a different transaction identifier and carrying an RPDU shall be interpreted as the implicit reception of the awaited CP-ACK followed by the reception of the new CP-DATA message. For mobile originated transfers, if the CP-ACK is lost, the reception of a CM SERVICE REQUEST followed by a CP-DATA with a different transaction identifier and carrying an RPDU shall be interpreted as the implicit reception of the awaited CP-ACK followed by the reception of the new CP-DATA message.

*** Next Modified Section ***

Annex A (informative): Arrow diagrams

Arrow diagram A1:

The diagram shows CS MO-message transfer by means of interlayer service primitives and the actual messages being transferred between the layer entities.

Arrow diagram A2:

The diagram shows CS MT-messaging by means of interlayer service primitives and the actual messages being transferred between the layer entities in ~~GSM~~A/Gb mode.

Arrow diagram A5:

The diagram shows GPRS MO-message transfer by means of interlayer service primitives and the actual messages being transferred between the layer entities.

- MNSMS-primitives indicate services provided by CM to SM-RL.
- LLSMS-primitives indicate services provided by LLC to CM.
- CP-DATA is the CM-message carrying SM-RP data units.
- CP-ACK acknowledge CP-DATA reception on CM.

Arrow diagram A6:

The diagram shows GPRS MT-message transfer by means of interlayer service primitives and the actual messages being transferred between the layer entities in ~~GSM~~A/Gb mode.

- MNSMS-primitives indicate services provided by CM to SM-RL.
- LLSMS-primitives indicate services provided by LLC to CM.
- CP-DATA is the CM-message carrying SM-RP data units.
- CP-ACK acknowledge CP-DATA reception on CM.

Arrow diagram A7:

The diagram shows ~~UMTS~~ Iu mode PS MO-message transfer by means of interlayer service primitives and the actual messages being transferred between the layer entities.

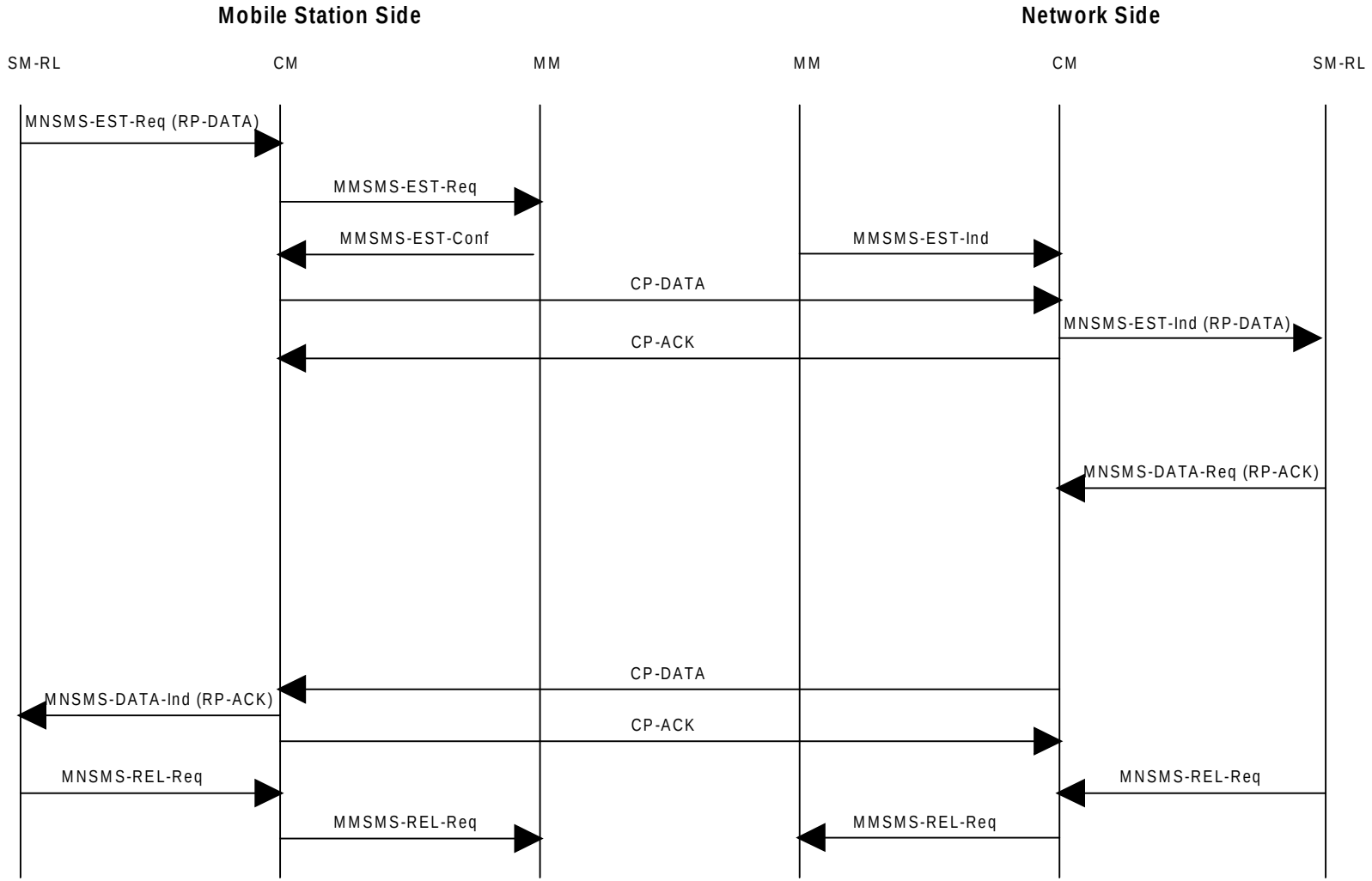
- MNSMS-primitives indicate services provided by CM to SM-RL.
- PMMSMS-primitives indicate services provided by GMM to CM.
- CP-DATA is the CM-message carrying SM-RP data units.
- CP-ACK acknowledge CP-DATA reception on CM.

Arrow diagram A8:

The diagram shows ~~UMTS~~ Iu mode PS MT-messaging by means of interlayer service primitives and the actual messages being transferred between the layer entities.

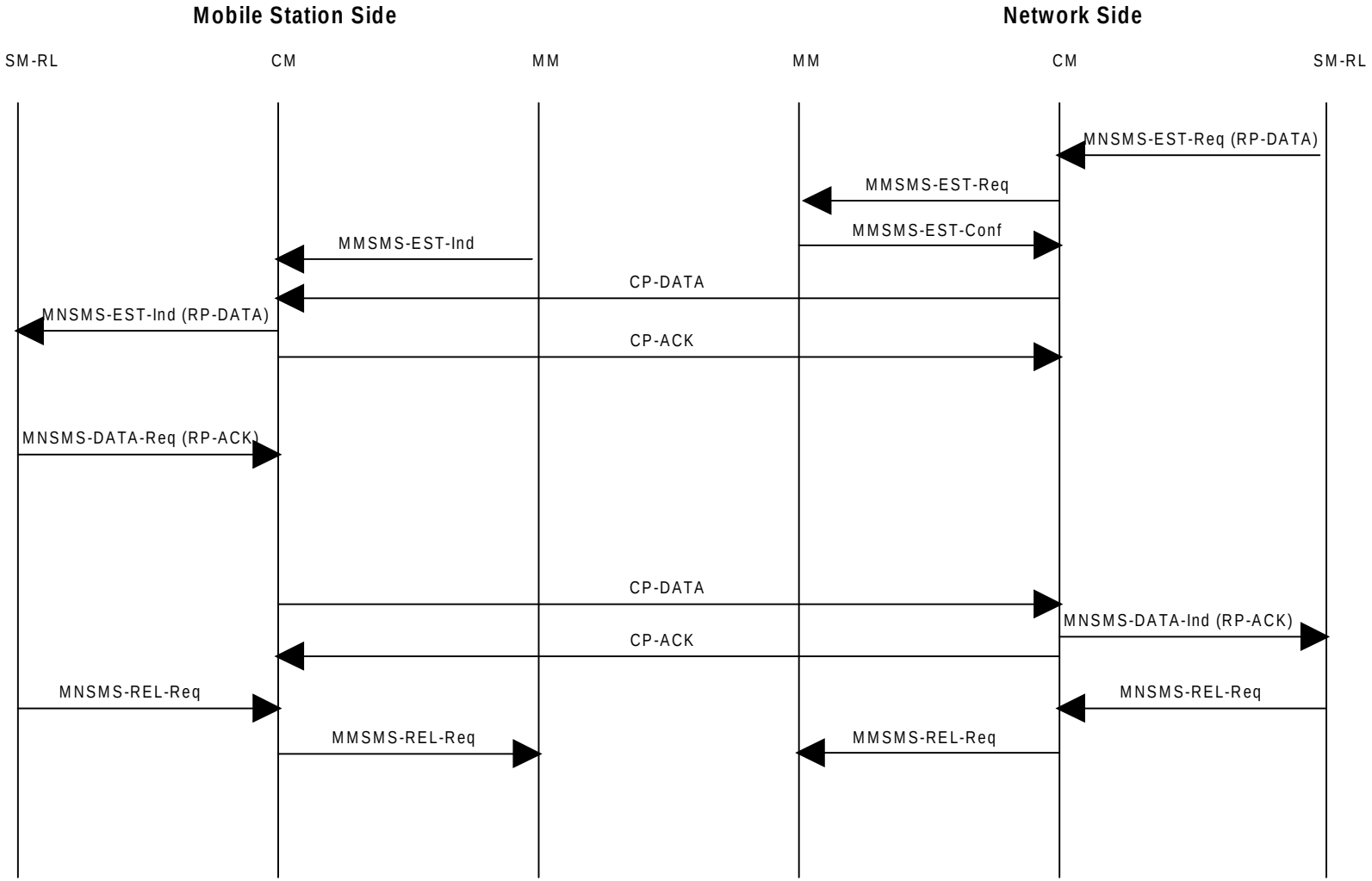
- MNSMS-primitives indicate services provided by CM to SM-RL.
- PMMSMS-primitives indicate services provided by GMM to CM.
- CP-DATA is the CM-message carrying SM-RP data units.
- CP-ACK acknowledge CP-DATA reception on CM.

Mobile Originated Messaging on CM-sublayer



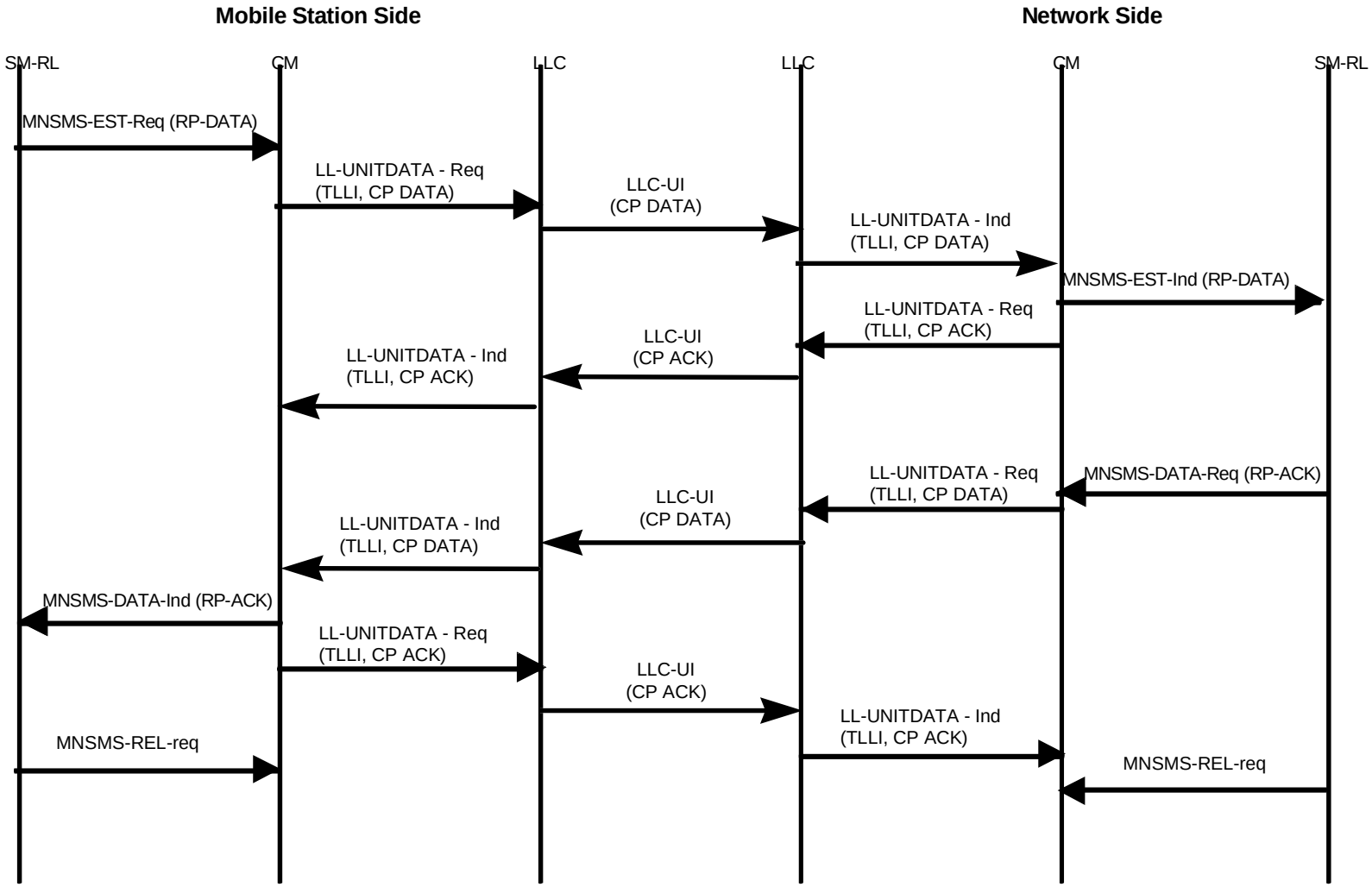
Arrow diagram A1

Mobile Terminated Messaging on CM-sublayer



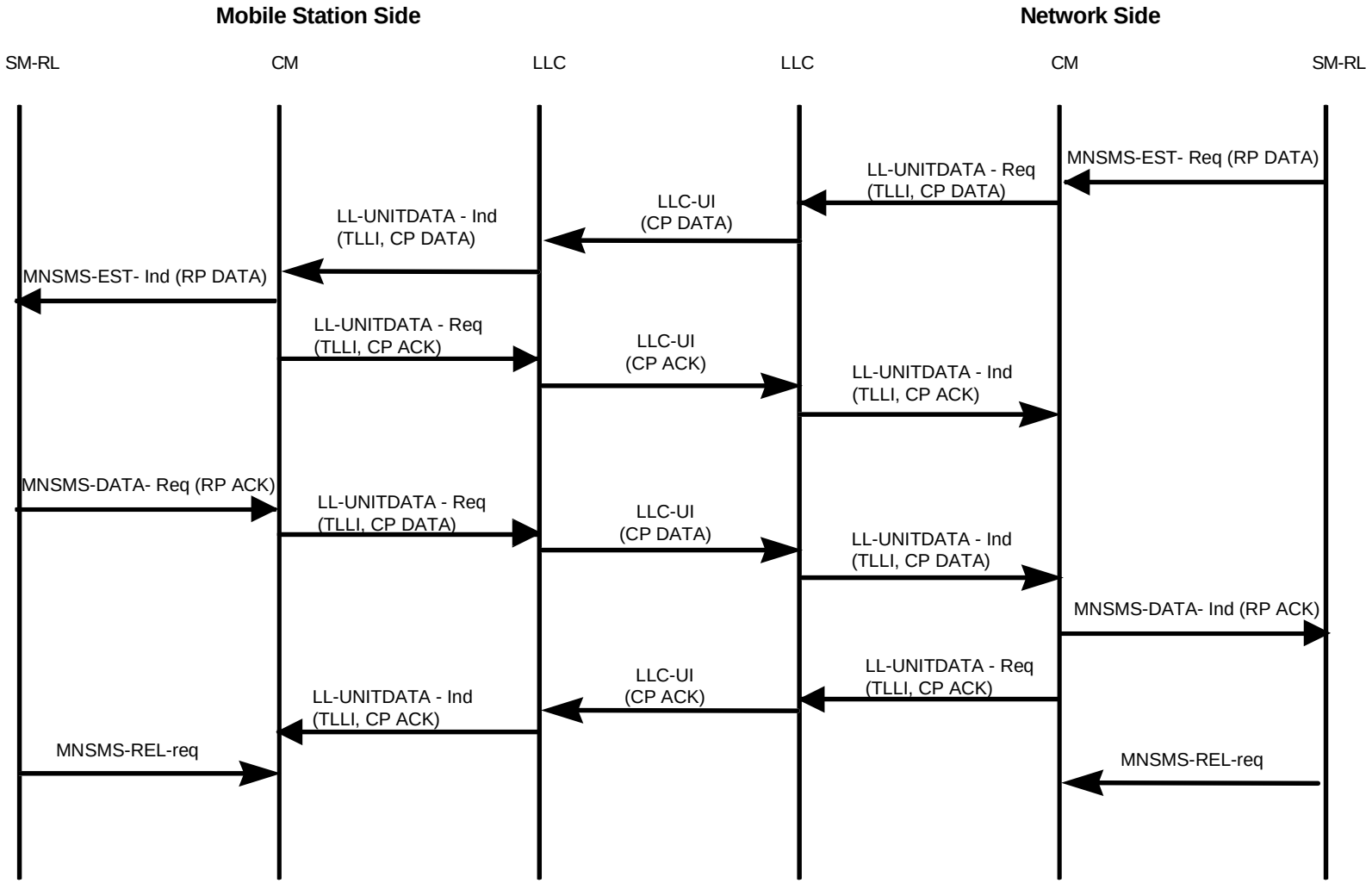
Arrow diagram A2

GPRS Mobile Originated Messaging on CM-sublayer in ~~GSM~~A/Gb mode



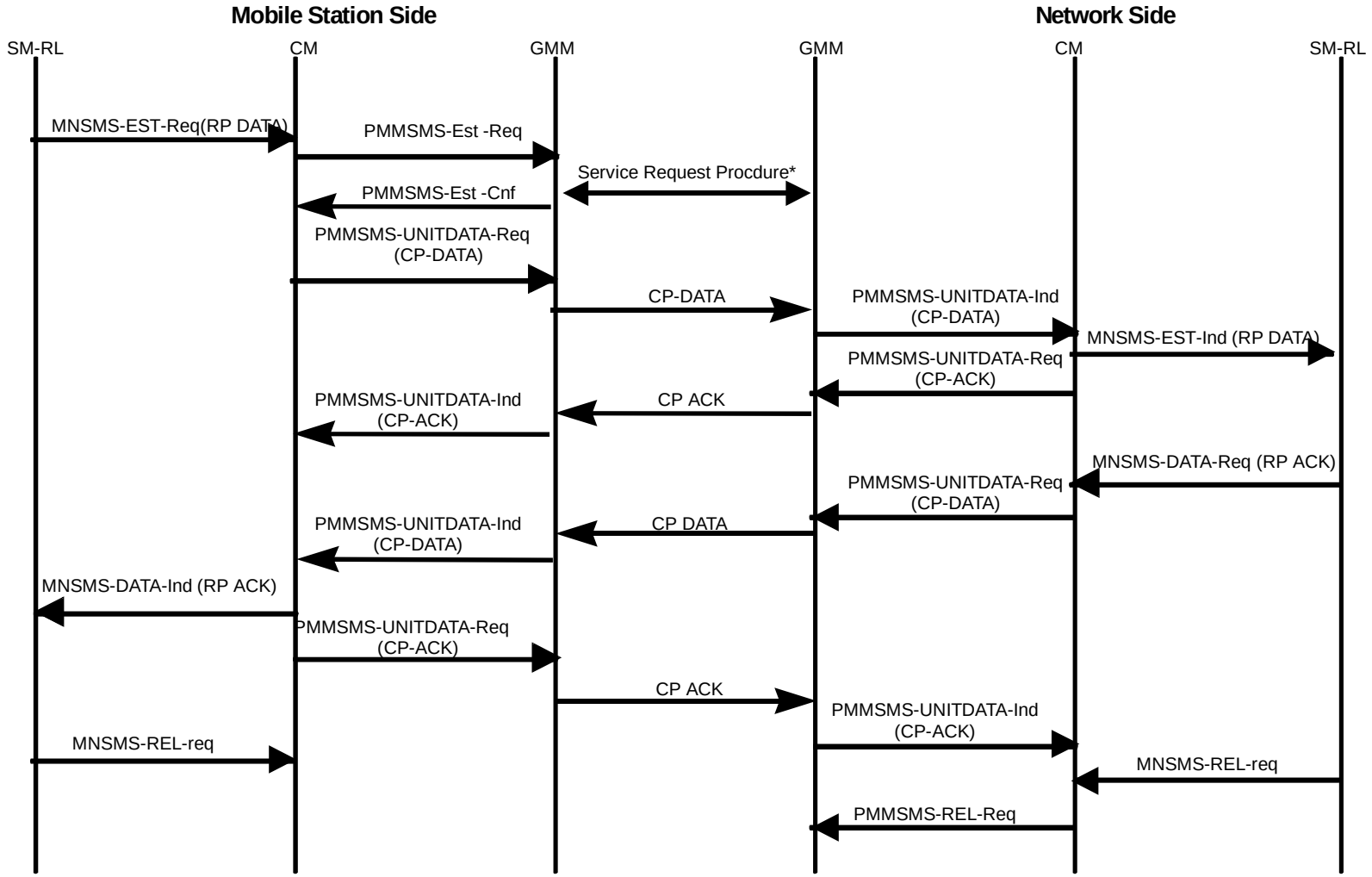
Arrow diagram A5

GPRS Mobile Terminated Messaging on CM-sublayer in ~~GSM~~A/Gb mode



Arrow diagram A6

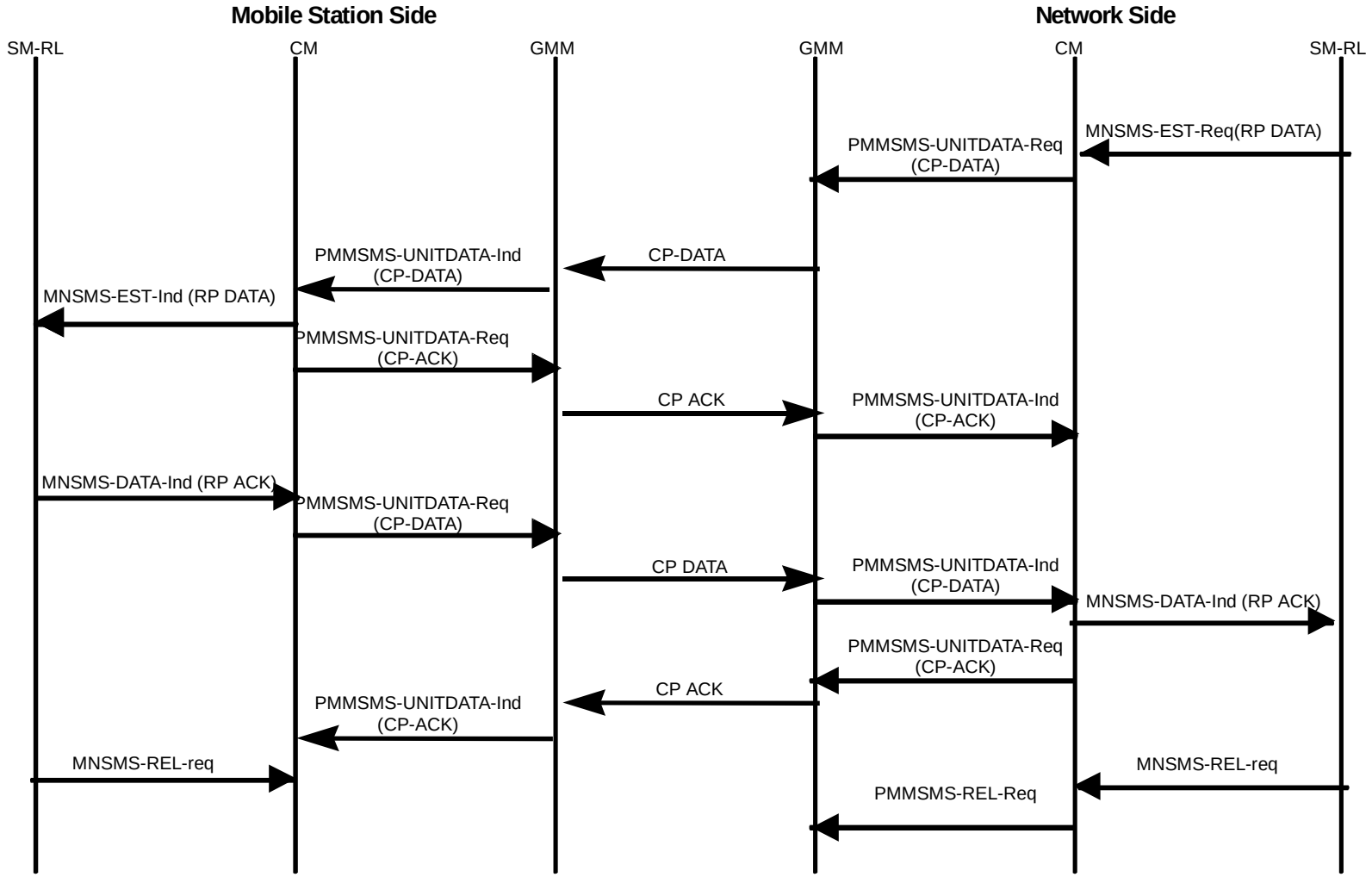
GPRS Mobile Originated Messaging on CM-sublayer in ~~UMTS~~Iu mode



NOTE: Service Request Procedure may not be initiated

Arrow diagram A7

GPRS Mobile Terminated Messaging on CM-sublayer in ~~UMTS~~Iu mode



Arrow diagram A8

CR-Form-v3

CHANGE REQUEST

⌘ **23.122** **CR** **10** ⌘ rev **R1** ⌘ Current version: **3.4.2** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM ☐ ME/UE **X** Radio Access Network ☐ Core Network **X**

Title:	⌘	Correction of terminology, "In UMTS", "In GSM"
Source:	⌘	Rapporteur (Nokia)
Work item code:	⌘	TEI
Date:	⌘	14.11.2000
Category:	⌘	**F**
Release:	⌘	R99

Use one of the following categories:
F *(essential correction)*
A *(corresponds to a correction in an earlier release)*
B *(Addition of feature),*
C *(Functional modification of feature)*
D *(Editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:
2 *(GSM Phase 2)*
R96 *(Release 1996)*
R97 *(Release 1997)*
R98 *(Release 1998)*
R99 *(Release 1999)*
REL-4 *(Release 4)*
REL-5 *(Release 5)*

Reason for change:	⌘	The terms "In GSM", "In UMTS", "(GSM only)" and "(UMTS only)" have been agreed to be changed to ones which will be applicable also in later releases. SA1, SA2 (NP-000560) and GERAN (NP-000532) have been liaised with and they agree with this proposal.
Summary of change:	⌘	"In UMTS" -> "In Iu mode" "In GSM" -> "In A/Gb mode" "(GSM only)" -> "(A/Gb mode only)" "(UMTS only)" -> "(Iu mode only)"
Consequences if not approved:	⌘	Incorrect usage of the term UMTS to mean UTRAN and more complex Rel 4 specification when new functionality is introduced.

Clauses affected:	⌘			
Other specs affected:	⌘	☐ Other core specifications ☐ Test specifications ☐ O&M Specifications	⌘	23.060, 24.008
Other comments:	⌘	This change is preparing R99 for the introduction of GERAN in later releases. More work in the same area will be needed for Rel 4 Table of contents has not been updated yet.		

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3GPP TS 23.122 V3.4.2 (2000-11)

Technical Specification

3rd Generation Partnership Project;
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Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The present document specifies functions related to Mobile Station (MS) in idle mode and within the 3GPP system.

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

This 3GPP TS gives an overview of the tasks undertaken by the Core network protocols of a Mobile Station (MS) when in idle mode, that is, switched on but not having a dedicated channel allocated. It also describes the corresponding network functions. The idle mode functions are also performed by a GPRS MS as long as no dedicated channel is allocated to the MS.

This 3GPP TS outlines how the requirements of the 22 series Technical Specifications (especially GSM 22.011) on idle mode operation shall be implemented. Further details are given in 3GPP TS 24.008.

Clause 2 of this 3GPP TS gives a general description of the idle mode process. Clause 3 outlines the main requirements and technical solutions of those requirements. Clause 4 describes the processes used in idle mode. There is inevitably some overlap between these clauses.

1.1 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] 3GPP TS 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[2] 3GPP TS 22.001: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Principles of circuit telecommunication services supported by a Public Land Mobile Network (PLMN)".

[3] 3GPP TS 22.002: "3rd Generation Partnership Project;Technical Specification Group Services and System Aspects; Bearer Services (BS) supported by a GSMPublic Land Mobile Network (PLMN)".

[4] 3GPP TS 22.003: "3rd Generation Partnership Project;Technical Specification Group Services and System Aspects; Circuit Teleservices supported by a Public Land Mobile Network (PLMN)".

[5] 3GPP TS 22.004: "3rd Generation Partnership Project;Technical Specification Group Services and System Aspects; General on supplementary services".

[6] 3GPP TS 02.06: "Digital cellular telecommunications system (Phase 2+); Types of Mobile Stations (MS)".

[7] 3GPP TS 02.07: "Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) features".

[8] 3GPP TS 02.09: "Digital cellular telecommunications system (Phase 2+); Security aspects".

[9] 3GPP TS 22.011: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Service accessibility".

[10] 3GPP TS 22.016: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; International Mobile station Equipment Identities (IMEI)".

[11] 3GPP TS 02.17: "Digital cellular telecommunications system (Phase 2+); Subscriber identity modules Functional characteristics".

[12] 3GPP TS 22.024: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Description of Charge Advice Information (CAI)".

[13] 3GPP TS 22.030: "3rd Generation Partnership Project;Technical Specification Group Services and System Aspects;Man-Machine Interface (MMI) of the User Equipment (UE)".

[14] 3GPP TS 02.40: "Digital cellular telecommunications system (Phase 2+); Procedures for call progress indications".

[15] 3GPP TS 22.041: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Operator Determined Barring (ODB)".

[16] 3GPP TS 22.081: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Line identification Supplementary Services;Stage 1".

[17] 3GPP TS 22.082: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects;Call Forwarding (CF) supplementary services - Stage 1".

[18] 3GPP TS 22.083: "3rd Generation Partnership Project;Technical Specification Group Services and System Aspects; Call Waiting (CW) and Call Holding (HOLD); Supplementary Services - Stage 1".

[19] 3GPP TS 22.084: "3rd Generation Partnership Project;Technical Specification Group Services and System Aspects; MultiParty (MPTY) Supplementary Services - Stage 1".

[20] 3GPP TS 22.085: "3rd Generation Partnership Project;Technical Specification Group Services and System Aspects; Closed User Group (CUG) Supplementary Services - Stage 1".

[21] 3GPP TS 22.086: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Advice of Charge (AoC) Supplementary Services - Stage 1".

[22] 3GPP TS 22.088: "3rd Generation Partnership Project;Technical Specification Group Services and System Aspects; Call Barring (CB) Supplementary Services - Stage 1".

[23] 3GPP TS 24.008: "3rd Generation Partnership Project;Universal Mobile Telecommunications System; Mobile radio interface layer 3 specification, Core Network Protocols - Stage 3".

[24] 3GPP TS 05.02: "Digital cellular telecommunications system (Phase 2+); Multiplexing and multiple access on the radio path".

[25] 3GPP TS 05.08: "Digital cellular telecommunications system (Phase 2+); Radio subsystem link control".

[26] 3GPP TS 22.060: "3rd Generation Partnership Project;Technical Specification Group Services and System Aspects; General Packet Radio Service (GPRS); Service description, Stage 1".

[27] 3GPP TS 23.060: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; General Packet Radio Service (GPRS); Service description;Stage 2".

[28] 3GPP TS 03.64: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Overall description of the GPRS Radio Interface; Stage 2".

[29] 3GPP TS 02.56: "Digital cellular telecommunications system (Phase 2+); GSM Cordless Telephony System (CTS); Service Description; Stage 1".

[30] 3GPP TS 03.56: "Digital cellular telecommunications system (Phase 2+); GSM Cordless Telephony System (CTS); CTS Architecture Description; Stage 2".

[31] 3GPP TS 25.101: "3rd Generation Partnership Project (3GPP) Technical Specification Group (TSG) RAN WG4 UE Radio transmission and Reception (FDD)".

[32] 3GPP TS 25.304: "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; UE Procedures in Idle Mode".

[33] 3GPP TS 25.331: "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; RRC Protocol Specification".

[34] 3GPP TS 04.18:"Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification, Radio Resource Control Protocol".

[35] 3GPP TS 03.22: "Digital cellular telecommunications system (Phase 2+); Functions related to Mobile Station (MS) in idle mode and group receive mode".

[36] 3GPP TS 21.905: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects Vocabulary for 3GPP Specifications".

[37] 3GPP TS 11.11: "Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module - Mobile Equipment (SIM - ME) interface".

1.2 Definitions and abbreviations

For the purposes of the present document the abbreviations given in 3GPP TS 01.04 and 3GPP TS 21.905 apply.

~~(GSM only)~~(A/Gb mode only): Indicates this clause or subclause applies only to GSM system. For multi system case this is determined by the current serving radio access network.

(~~UMTS~~ Iu mode only): Indicates this clause or subclause applies only to UMTS system. For multi system case this is determined by the current serving radio access network.

Acceptable Cell: This is a cell that the MS may camp on to make emergency calls. It must satisfy criteria which is defined for ~~GSM~~ A/Gb mode in 3GPP TS 03.22 and for ~~UMTS~~ Iu mode in 3GPP TS 25.304.

Access Technology: The access technology associated with a PLMN. The MS uses this information to determine what type of radio carrier to search for when attempting to select a specific PLMN (e.g., GSM, UMTS or GSM COMPACT). A PLMN may support more than one access technology.

Allowable PLMN: This is a PLMN which is not in the list of forbidden PLMNs in the MS.

Available PLMN: This is a PLMN where the MS has found a cell that satisfies conditions (ii) and (iv) of subclause 3.2.1 in 3GPP TS 03.22. For ~~UMTS~~ Iu mode the criteria is specified in 3GPP TS 25.304.

Camped on a cell: The MS (ME if there is no SIM) has completed the cell selection/reselection process and has chosen a cell from which it plans to receive all available services. Note that the services may be limited, and that the PLMN may not be aware of the existence of the MS (ME) within the chosen cell.

Current serving cell: This is the cell on which the MS is camped.

CTS MS: An MS capable of CTS services is a CTS MS.

GPRS MS: An MS capable of GPRS services is a GPRS MS.

Home PLMN: This is a PLMN where the MCC and MNC of the PLMN identity match the MCC and MNC of the IMSI. Matching criteria are defined in Annex A.

In ~~GSM~~A/Gb mode,...: Indicates this paragraph applies only to GSM System. For multi system case this is determined by the current serving radio access network.

~~In UMTS~~In Iu mode,...: Indicates this paragraph applies only to UMTS System. For multi system case this is determined by the current serving radio access network.

Localised Service Area (LSA): A localised service area consists of a cell or a number of cells. The cells constituting a LSA may not necessarily provide contiguous coverage.

Location Registration (LR): An MS which is IMSI attached to non-GPRS services only performs location registration by the Location Updating procedure. A GPRS MS which is IMSI attached to GPRS services or to GPRS and non-GPRS services performs location registration by the Routing Area Update procedure only when in a network of network operation mode I. Both procedures are performed independently by the GPRS MS when it is IMSI attached to GPRS and non-GPRS services in a network of network operation mode II or III (see 3GPP TS 23.060).

MS: Mobile Station. This specification makes no distinction between MS and UE.

Network Type: The network type associated with HPLMN or a PLMN on the PLMN selector (see GSM 11.11). The MS uses this information to determine what type of radio carrier to search for when attempting to select a specific PLMN. A PLMN may support more than one network type.

Registered PLMN (RPLMN): This is the PLMN on which certain LR outcomes have occurred (see table 1).

Registration: This is the process of camping on a cell of the PLMN and doing any necessary LRs.

Registration Area: A registration area is an area in which mobile stations may roam without a need to perform location registration. The registration area corresponds to location area (LA) for performing location updating procedure and it corresponds to routing area for performing the routing area update procedure.

The PLMN to which a cell belongs (PLMN identity) is given in the system information transmitted on the BCCH (MCC + MNC part of LAI).

Selected PLMN: This is the PLMN that has been selected according to subclause 3.1, either manually or automatically.

SIM: Subscriber Identity Module (see 3GPP TS 02.17). This specification makes no distinction between SIM and USIM.

SoLSA exclusive access: Cells on which normal camping is allowed only for MS with Localised Service Area (LSA) subscription.

Suitable Cell: This is a cell on which an MS may camp. It must satisfy criteria which is defined for ~~GSM~~ A/Gb mode in 3GPP TS 03.22 and for ~~UMTS~~ Iu mode in 3GPP TS 25.304.

Visited PLMN of home country: This is a PLMN, different from the home PLMN, where the MCC part of the PLMN identity is the same as the MCC of the IMSI.

2 General description of idle mode

When an MS is switched on, it attempts to make contact with a public land mobile network (PLMN). The particular PLMN to be contacted may be selected either automatically or manually.

The MS looks for a suitable cell of the chosen PLMN and chooses that cell to provide available services, and tunes to its control channel. This choosing is known as "camping on the cell". The MS will then register its presence in the registration area of the chosen cell if necessary, by means of a location registration (LR), GPRS attach or IMSI attach procedure.

If the MS loses coverage of a cell, or find a more suitable cell, it reselects onto the most suitable cell of the selected PLMN and camps on that cell. If the new cell is in a different registration area, an LR request is performed.

If the MS loses coverage of a PLMN, either a new PLMN is selected automatically, or an indication of which PLMNs are available is given to the user, so that a manual selection can be made.

Registration is not performed by MSs only capable of services that need no registration.

The purpose of camping on a cell in idle mode is fourfold:

a) It enables the MS to receive system information from the PLMN.

b) If the MS wishes to initiate a call, it can do this by initially accessing the network on the control channel of the cell on which it is camped (with the exceptions defined in 3GPP TS 03.22 subclauses 3.5.3 and 3.5.4 and 3GPP TS 25.304).

c) If the PLMN receives a call for the MS, it knows (in most cases) the registration area of the cell in which the MS is camped. It can then send a "paging" message for the MS on control channels of all the cells in the registration area. The MS will then receive the paging message because it is tuned to the control channel of a cell in that registration area, and the MS can respond on that control channel.

d) It enables the MS to receive cell broadcast messages.

If the MS is unable to find a suitable cell to camp on, or the SIM is not inserted, or if it receives certain responses to an LR request (e.g., "illegal MS"), it attempts to camp on a cell irrespective of the PLMN identity, and enters a "limited service" state in which it can only attempt to make emergency calls.

~~In GSM~~In A/Gb mode, if the CTS MS is in CTS mode only or in automatic mode with CTS preferred, it will start by attempting to find a CTS fixed part on which it is enrolled

The idle mode tasks can be subdivided into 4 processes:

- PLMN selection;
- Cell selection and reselection;
- Location registration;
- CTS fixed part selection ~~(GSM only)~~(A/Gb mode only).

~~In GSM~~In A/Gb mode, to make this initial CTS fixed part selection, the MS shall be enrolled on at least one fixed part.

The relationship between these processes is illustrated in figure 1 in clause 5. The states and state transitions within each process are shown in figures 2 to 4 in clause 5.

3 Requirements and technical solutions

The following subclauses list the main requirements of idle mode operation and give an outline of the technical solution.

3.1 PLMN selection and roaming

The MS normally operates on its home PLMN (HPLMN). However a visited PLMN (VPLMN) may be selected, e.g., if the MS loses coverage. There are two modes for PLMN selection:

i) Automatic mode - This mode utilizes a list of PLMNs in priority order. The highest priority PLMN which is available and allowable is selected.

ii) Manual mode - Here the MS indicates to the user which PLMNs are available. Only when the user makes a manual selection does the MS try to obtain normal service on the VPLMN.

There are two cases:

- International Roaming - This is where the MS receives service on a PLMN of a different country than that of the HPLMN.
- National Roaming - This is where the MS receives service from a PLMN of the same country as that of the HPLMN, either anywhere or on a regional basis. The MS makes a periodic search for the HPLMN while national roaming.

To prevent repeated attempts to have roaming service on a not allowed LA, when the MS is informed that an LA is forbidden, the LA is added to a list of "forbidden LAs for roaming" which is stored in the MS. This list is deleted when the MS is switched off or when the SIM is removed. Such area restrictions are always valid for complete location areas independent of possible subdivision into GPRS routing areas. The structure of the routing area identifier (3GPP TS 23.003) supports area restriction on LA basis.

If a "PLMN not allowed" message is received by an MS in response to an LR request from a VPLMN, that VPLMN is added to a list of "forbidden PLMNs" in the SIM and thereafter that VPLMN will not be accessed by the MS when in automatic mode. A PLMN is removed from the "forbidden" list if, after a subsequent manual selection of that PLMN, there is a successful LR. This list is retained when the MS is switched off or the SIM is removed. The HPLMN shall not be stored on the list of "forbidden PLMNs".

~~In GSM~~In A/Gb mode, an ME not supporting SoLSA may consider a cell with the escape PLMN code (see 3GPP TS 23.073) to be a part of a PLMN belonging to the list of "forbidden PLMNs".

Optionally the ME may store in its memory an extension of the forbidden PLMN list. The contents of the extension of the list shall be deleted when the MS is switched off or the SIM is removed.

3.2 Regional provision of service

An MS may have a "regionally restricted service" where it can only obtain service on certain LAs. If such an MS attempts to camp on a cell of an LA for which it does not have service entitlement, when it does an LR request, it will receive an "LA not allowed" message. In this case:

- The MS stores the forbidden LA identity (LAI) in a list of "forbidden LAIs for regional provision of service", to prevent repeated access attempts on a cell of the forbidden LA. This list is deleted when the MS is switched off or the SIM is removed. If the MS cannot find a suitable cell, the MS performs the PLMN selection procedure starting at subclause 4.4.3.1 A or B.

~~In GSM~~In A/Gb mode, a cell may be reserved for SoLSA exclusive access (see 3GPP TS 24.008 and 04.60). An MS is only allowed to camp normally on such a cell if it has a Localised Service Area subscription to the cell. Other MS may camp for limited service.

NOTE: ~~In GSM~~In A/Gb mode, in a SoLSA exclusive cell the MCC+MNC code is replaced by an unique escape PLMN code (see 3GPP TS 23.073), not assigned to any PLMN, in SI3 and SI4. An MS not supporting SoLSA may request for location update to an exclusive access cell. In this case the location attempt is rejected with the cause "PLMN not allowed" and the escape PLMN code is added to the list of the "forbidden PLMNs".

3.3 Borders between registration areas

If the MS is moving in a border area between registration areas, it might repeatedly change between cells of different registration areas. Each change of registration area would require an LR, which would cause a heavy signalling load and increase the risk of a paging message being lost. The access stratum shall provide a mechanism to limit this effect.

3.4 Access control

3.4.1 Access control

Due to problems in certain areas, Network Operators may decide to restrict access from some MSs (e.g., in case of congestion), and for this reason an access control mechanism shall be provided.

3.4.2 Forbidden LA for regional provision of service

When the MS is camped on a cell, the LA of which belongs to the list of forbidden LA for regional provision of service, the MS is not allowed to initiate establishment of a CM connection except for an emergency call; it may respond to paging. Also, the MS is not allowed to request GPRS services when camped on a cell of a LA of which belongs to the list of forbidden LA.

3.5 No suitable cell (limited service state)

There are a number of situations in which the MS is unable to obtain normal service from a PLMN. These include:

a) Failure to find a suitable cell of the selected PLMN;

b) No SIM in the MS;

c) A "PLMN not allowed" response to an LR;

d) An "illegal MS", "illegal ME" or "IMSI unknown in HLR" response to an LR; (Any SIM in the ME is then considered "invalid".)

e) A "GPRS not allowed“ response to an LR of a GPRS MS attached to GPRS services only. (The cell selection state of GPRS MSs attached to GPRS and non-GPRS depends on the outcome of the location updating.)

(In automatic PLMN selection mode, events (a), (c) and (e) would normally cause a new PLMN selection, but even here, the situation may arise when no PLMNs are available and allowable for use).

Under any of these conditions, the MS attempts to camp on an acceptable cell, irrespective of its PLMN identity, so that emergency calls can be made if necessary. When in the limited service state with a valid SIM, the MS shall search for available and allowable PLMNs in the manner described in subclause 4.4.3.1 and when indicated in the SIM also as described in subclause 4.4.3.4. No LR requests are made until a valid SIM is present and either a suitable cell is found or a manual network reselection is performed. In the limited service state the presence of the MS need not be known to the PLMN on whose cell it has camped.

There are also other conditions under which only emergency calls may be made. These are shown in table 2 in clause 5.

3.6 CTS fixed part selection ~~(GSM only)~~(A/Gb mode only)

In CTS mode only or in automatic mode with CTS preferred, the CTS MS normally operates on a CTS fixed part on which the mobile station is already enrolled. If the CTS MS loses CTS coverage in these modes, it shall attempt periodically to select again a CTS fixed part.

To select a CTS fixed part, the CTS MS shall listen to the CTSBCH frequencies of all the fixed parts on which the MS is currently enrolled.

If the CTS MS is moving in a border area between one area with CTS coverage and one without it, it might repeatedly require CTS attachments and LU on the PLMN. To prevent this, the criteria C1_CTS and C2_CTS (defined in 3GPP TS 05.08 subclause 11.1) are used. To attach to a CTS FP, the C1_CTS criterion shall be greater than zero. When the C2_CTS criterion falls below zero, the CTS MS shall consider itself to be no more under CTS coverage.

4 Overall process structure

4.1 Process goal

The aim of the idle mode processes is to ensure that the registered PLMN is the selected PLMN.

4.2 States description

Each of the processes of PLMN selection, cell selection and location registration can be described by a set of states. The overall state of the mobile is thus a composite of the states of the three processes. In some cases, an event which causes a change of state in one process may trigger a change of state in another process, e.g., camping on a cell in a new registration area triggers an LR request. The relationship between the processes is illustrated in figure 1 in clause 5.

The states in which the MS may be, for each of the processes, are described below and illustrated in figures 2 to 4 in clause 5. For many of the states, a fuller description can be found in other Technical Specifications, and a reference to the Technical Specification is given after the state description.

In the event of any conflict between the diagrams and the text in the present document, the text takes precedence.

4.3 List of states

4.3.1 List of states for the PLMN selection process

4.3.1.1 List of states for automatic mode (figure 2a)

A1 Trying RPLMN - The MS is trying to perform a Location Registration on the registered PLMN.

A2 On PLMN - The MS has successfully registered on a PLMN.

A3 Trying PLMN - The MS is trying to register on a PLMN in the ordered list of PLMNs.

A4 Wait for PLMNs to appear - There are no allowable and available PLMNs at present and the MS is waiting for one to appear.

A5 HPLMN search in progress - The MS is trying to find if the HPLMN is available.

A6 No SIM - There is no SIM in the MS, or certain LR responses have been received.

4.3.1.2 List of states for manual mode (figure 2b)

M1 Trying registered PLMN - The MS is trying to perform a Location Registration on the registered PLMN.

M2 On PLMN - The MS has successfully registered on a PLMN.

M3 Not on PLMN - The MS has failed to register on the selected PLMN.

M4 Trying PLMN - The MS is trying to register on a user selected PLMN.

M5 No SIM - There is no SIM in the MS, or certain LR responses have been received.

4.3.2 List of states for location updating (figure 4)

The states are entered depending on responses to location update (LU) requests.

4.3.3 List of states for location registration (figure 4)

The states are entered depending on responses to location registration (LR) requests. Independent update states exist for GPRS and for non-GPRS operation in MSs capable of GPRS and non-GPRS services.

L1 Updated - The MS enters this state if an LR request is accepted. The update status is set to "updated". The GPRS and the non-GPRS update state of a MS may enter "updated“ as a result of combined signalling or as a result of individual signalling depending on the capabilities of the network.

L2 Idle, No IMSI - The MS enters this state if an LR request is rejected with cause:

a) IMSI unknown in HLR;

b) illegal ME;

c) illegal MS;

d) GPRS services and non-GPRS services not allowed;

or if there is no SIM. All update states of a MS enter this state regardless whether received by individual or combined signalling for events b) and c). Event a) has no influence on the GPRS update state. Events b), c) and d) results in "Roaming not allowed“ for the GPRS update state.

If a SIM is present, the non-GPRS update status of the SIM is set to "Roaming not allowed".

L3 Roaming not allowed - The MS enters this state if it receives an LU reject message with the cause:

a) PLMN not allowed;

b) Location area not allowed;

c) Roaming not allowed in this location area.

All update states of the MS are set to "Roaming not allowed" regardless whether received by individual or combined signalling. The behaviour of the MS in the roaming not allowed state is dependent on the LR reject cause as shown in table 2 in clause 5. Additionally:

- in automatic mode, "PLMN not allowed" and "roaming not allowed in this location area" cause the Automatic Network Selection procedure of subclause 4.4.3.1.1 to be started; it is also caused by "GPRS not allowed“ when received by a MS capable of GPRS only;

- in manual mode, "PLMN not allowed" and "roaming not allowed" cause the Manual Network Selection procedure of subclause 4.4.3.1.2 to be started; it is also caused by "GPRS not allowed“ when received by MS capable of GPRS only.

L4 Not updated - The MS enters this state if any LR failure not specified for states L2 or L3 occurs, in which cases the MS is not certain whether or not the network has received and accepted the LR attempt. The non-GPRS update status on the SIM and/or the GPRS update status are set to "not updated" depending on the specific location registration procedure and their outcome.

NOTE This clause does not describe all the cases. For more details refer to 3GPP TS 24.008 [23]

4.4 PLMN selection process

4.4.1 Introduction

There are two modes for PLMN selection, automatic and manual. These are described in subclauses 4.4.3 below and illustrated in figures 2a to 2b in clause 5.

4.4.2 Registration on a PLMN

The MS shall perform registration on the PLMN if the MS is capable of services which require registration. In both automatic and manual modes, the concept of registration on a PLMN is used. An MS successfully registers on a PLMN if:

a) The MS has found a suitable cell of the PLMN to camp on; and

b) An LR request from the MS has been accepted in the registration area of the cell on which the MS is camped (see table 1).

4.4.3 PLMN selection

The registration on the selected PLMN and the location registration are only necessary if the MS is capable of services which require registration. Otherwise, the PLMN selection procedures are performed without registration.

The “HPLMN Selector with Access Technology”, “User Controlled PLMN Selector with Access Technology” and “Operator Controlled PLMN Selector with Access Technology” data fields in the SIM include associated access technologies for each PLMN entry, see GSM 11.11 [32]. The PLMN/access technology combinations are listed in priority order. If an entry includes more than one access technology, then no priority is defined for the preferred access technology and the priority is an implementation issue.

The MS shall not use the PLMN codes contained in the “HPLMN Selector with Access Technology” data field.

NOTE: To allow provision for multiple HPLMN codes, the HPLMN access technologies are stored on the SIM together with PLMN codes. This version of the specification does not support multiple HLPMN codes and the “HPLMN Selector with Access Technology” data field is only used by the MS to get the HPLMN access technologies. The HPLMN code is the PLMN code included in the IMSI.

NOTE: Different GSM frequency bands (eg. 900, 1800, 1900, 400) are all considered GSM access technology. An MS supporting more than one band should scan all the bands it’s supports when scanning for GSM frequencies. However GSM COMPACT systems which use GSM frequency bands but with the CBPCCH broadcast channel are considered as a separate access technology from GSM.

4.4.3.1 At switch-on or recovery from lack of coverage

At switch on, the MS selects the registered PLMN (if it is available) using all access technologies that the MS is capable of and attempts to perform a Location Registration. The MS shall start its search using the access technology type stored in the “RPLMN Last Used Access Technology” data field on the SIM. If the “RPLMN Last Used Access Technology” is not available then an MS capable of GSM access technology shall start its search using GSM access technology.

On recovery from lack of coverage, the MS selects the registered PLMN (if it is available) using all access technologies that the MS is capable of and, if necessary (see subclause 4.5.2) attempts to perform a Location Registration.

EXCEPTION: ~~In GSM~~In A/Gb mode or GSM COMPACT, an MS with voice capability, shall not search for CPBCCH carriers, unless the "RPLMN Last Used Access Technology" field is available in the SIM and indicates GSM COMPACT. ~~In GSM~~In A/Gb mode or GSM COMPACT, an MS not supporting packet services shall not search for CPBCCH carriers.

If successful registration is achieved, the MS indicates the selected PLMN.

If there is no registered PLMN, or if registration is not possible due to the PLMN being unavailable or registration failure, the MS follows one of the following two procedures depending on its operating mode.

EXCEPTION: If registration is not possible on recovery from lack of coverage due to the registered PLMN being unavailable, a MS attached to GPRS services may, optionally, continue looking for the registered PLMN for an implementation dependent time.

NOTE 1: A MS attached to GPRS services should use the above exception only if one or more PDP contexts are currently active.

4.4.3.1.1 Automatic Network Selection Mode Procedure

The MS selects and attempts registration on other PLMNs, if available and allowable, in the following order:

i) HPLMN (if not previously selected);

ii) each PLMN in the "User Controlled PLMN Selector with Access Technology" data field in the SIM (in priority order);

iii) each PLMN in the "Operator Controlled PLMN Selector with Access Technology" data field in the SIM (in priority order);

iv) other PLMN/access technology combinations with received high quality signal in random order;

v) other PLMN/access technology combinations in order of decreasing signal quality.

When following the above procedure the following requirements apply:

a) ~~In GSM~~In A/Gb mode or GSM COMPACT, an MS with voice capability shall ignore PLMNs for which the MS has identified at least one cell that do not offer voice service. (~~In GSM~~In A/Gb mode, this is indicated by the CELL_BAR_QUALIFY_2 parameter).

b) ~~In GSM~~In A/Gb mode or GSM COMPACT, an MS with voice capability , or an MS not supporting packet services shall not search for CPBCCH carriers.

c) In ii and iii, the MS should limit its search for the PLMN to the access technology or access technologies associated with the PLMN in the appropriate PLMN Selector with Access Technology list (User Controlled or Operator Controlled selector list). An MS using a SIM without access technology information storage (i.e. the "User Controlled PLMN Selector with Access Technology" and the "Operator Controlled PLMN Selector with Access Technology" data fields are not present) shall instead use the "PLMN Selector" data field, for each PLMN in the "PLMN Selector" data field, the MS shall search for all access technologies it is capable of and shall assume GSM access technology as the highest priority radio access technology.

d) In iv and v, the MS shall search for all access technologies it is capable of, before deciding which PLMN to select.

e) In ii, and iii, a packet only MS which supports GSM COMPACT, but using a SIM without access technology information storage (i.e. the "User Controlled PLMN Selector with Access Technology" and the "Operator Controlled PLMN Selector with Access Technology" data fields are not present) shall instead use the "PLMN Selector" data field, for each PLMN in the "PLMN Selector" data field, the MS shall search for all access technologies it is capable of and shall assume GSM COMPACT access technology as the lowest priority radio access technology.

f) In i, the MS shall search for all access technologies it is capable of. The MS shall start its search using the access technologies stored in the "HPLMN Selector with Access Technology" data field on the SIM in priority order as

defined in section 4.4.3 (i.e. the PLMN/access technology combinations are listed in priority order, if an entry includes more than one access technology then no priority is defined for the preferred access technology and the priority is an implementation issue).

g) In i, an MS using a SIM without access technology information storage (i.e. the “HPLMN Selector with Access Technology” data field is not present) shall search for all access technologies it is capable of and shall assume GSM access technology as the highest priority radio access technology. A packet only MS which supports GSM COMPACT using a SIM without access technology information storage shall also assume GSM COMPACT access technology as the lowest priority radio access technology.

NOTE: Requirements a) and b) apply also to requirement d), so a GSM voice capable MS should not search for GSM COMPACT PLMNs, even if capable of GSM COMPACT.

NOTE: Requirements a) and b) apply also to requirement f), so a GSM voice capable MS should not search for GSM COMPACT PLMNs, even if this is the only access technology on the “HPLMN Selector with Access Technology” data field on the SIM. Also PLMNs not offering voice services should be ignored by voice capable GSM mobiles.

NOTE: High quality signal is defined in the appropriate AS specification.

If successful registration is achieved, the MS indicates the selected PLMN.

If registration cannot be achieved because no PLMNs are available and allowable, the MS indicates "no service" to the user, waits until a new PLMN is available and allowable and then repeats the procedure.

If there were one or more PLMNs which were available and allowable, but an LR failure made registration on those PLMNs unsuccessful or an entry in a forbidden LAI list prevented a registration attempt, the MS selects the first such PLMN again and enters a limited service state.

4.4.3.1.2 Manual Network Selection Mode Procedure

The MS indicates whether there are any PLMNs, which are available using all supported access technologies. This includes "Forbidden PLMNs" and PLMNs which only offer services not supported by the MS. An MS which supports GSM COMPACT shall also indicate GSM COMPACT PLMNs (which use PBCCH).

If displayed, PLMNs meeting the criteria above are presented in the following order:

i)- HPLMN;

ii)- PLMNs contained in the " User Controlled PLMN Selector with Access Technology " data field in the SIM (in priority order);

iii)- PLMNs contained in the "Operator Controlled PLMN Selector with Access Technology" data field in the SIM (in priority order);

iv)- other PLMN/access technology combinations with received high quality signal in random order;

v)- other PLMN/access technology combinations in order of decreasing signal quality.

In ii and iii, an MS using a SIM without access technology information storage (i.e. the “User Controlled PLMN Selector with Access Technology” and the “Operator Controlled PLMN Selector with Access Technology” data fields are not present) shall instead present the PLMNs contained in the “PLMN Selector” data field in the SIM (in priority order).

~~In GSM~~In A/Gb mode or GSM COMPACT, if a PLMN does not support voice services then this shall be indicated to the user.

The user may select his desired PLMN and the MS then initiates registration on this PLMN using the access technology chosen by the user for that PLMN or using the highest priority available access technology for that PLMN, if the associated access technologies have a priority order. (This may take place at any time during the presentation of PLMNs). For such a registration, the MS shall ignore the contents of the forbidden LAI and PLMN lists.

NOTE: It is an MS implementation option whether to indicate access technologies to the user. If the MS does display access technologies, then the access technology used should be the access technology chosen by the user for that PLMN. If the MS does not display access technologies, then the access technology chosen for a particular PLMN should be the highest priority available access technology for that PLMN, if the associated access technologies have a priority order.

If the user does not select a PLMN, the selected PLMN shall be the one that was selected before the PLMN selection procedure started. If no such PLMN was selected or that PLMN is no longer available, then the MS shall attempt to camp on any acceptable cell and enter the limited service state.

NOTE: High quality signal is defined in the appropriate AS specification.

4.4.3.2 User reselection

At any time the user may request the MS to initiate reselection and registration onto an available PLMN, according to the following procedures, dependent upon the operating mode.

4.4.3.2.1 Automatic Network Selection Mode

The MS selects and attempts registration on PLMNs, if available and allowable, in all of its bands of operation in accordance with the following order:

i) HPLMN;

ii) PLMNs contained in the " User Controlled PLMN Selector with Access Technology" data field in the SIM (in priority order) excluding the previously selected PLMN;

iii) PLMNs contained in the "Operator Controlled PLMN Selector with Access Technology" data field in the SIM (in priority order) excluding the previously selected PLMN;

iv) other PLMN/access technology combinations with the received high quality signal in random order excluding the previously selected PLMN;

v) other PLMN/access technology combinations, excluding the previously selected PLMN in order of decreasing signal quality or, alternatively, the previously selected PLMN may be chosen ignoring its signal quality;

vi) The previously selected PLMN.

The previously selected PLMN is the PLMN which the MS has selected prior to the start of the user reselection procedure.

NOTE: If the previously selected PLMN is chosen, and registration has not been attempted on any other PLMNs, then the MS is already registered on the PLMN, and so registration is not necessary.

When following the above procedure the requirements a), b), c), e), f), g) in section 4.4.3.1.1 apply: Requirement d) shall apply as shown below:

d) In iv, v, and vi, the MS shall search for all access technologies it is capable of before deciding which PLMN to select.

NOTE: High quality signal is defined in the appropriate AS specification.

4.4.3.2.2 Manual Network Selection Mode

The Manual Network Selection Mode Procedure of subclause 4.4.3.1.2 is followed.

4.4.3.3 In VPLMN of home country

The MS shall periodically attempt to obtain service on its HPLMN by scanning in accordance with the requirements that are applicable to i) as defined in the Automatic Network Selection Mode in clause 4.4.3.1.1. For this purpose, a value T minutes may be stored in the SIM, T is either in the range 6 minutes to 8 hours in 6 minute steps or it indicates that no periodic attempts shall be made. If no value is stored in the SIM, a default value of 30 minutes is used.

The attempts to access the HPLMN shall be as specified below:

a) The periodic attempts shall only be performed in automatic mode when the MS is roaming in its home country;

b) After switch on, a period of at least 2 minutes and at most T minutes shall elapse before the first attempt is made;

c) The MS shall make an attempt if the MS is on the VPLMN at time T after the last attempt;

d) Periodic attempts shall only be performed by the MS while in idle mode;

e) If the HPLMN is not found, the MS shall remain on the VPLMN.

4.4.3.4 Investigation Scan for higher prioritized PLMN

The support of this procedure is mandatory if the ME supports GSM COMPACT and otherwise optional.

A MS capable of both GSM voice and packet service shall, when indicated in the SIM, investigate if there is service from a higher prioritized PLMN not offering GSM voice service, either HPLMN or a PLMN in a "PLMN Selector with Access Technology " data field on the SIM.

The MS shall scan for PLMNs in accordance with the requirements described for automatic network selection mode in subclause 4.4.3.1.1 that are applicable to i), ii) and iii) with the exception of requirement a) and b) in subclause 4.4.3.1. Requirement a) and b) that are specified for automatic network selection mode in subclause 4.4.3.1 shall be ignored during the investigation scan.

If indicated on the SIM, the investigation scan shall be performed:

i) After each successful PLMN selection and registration is completed, when the MS is in idle mode. This investigation scan may rely on the information from the already performed PLMN selection and may not necessarily require a rescan

ii) When the MS is unable to obtain normal service from a PLMN, (limited service state) see subclause 3.5.

The investigation scan is restricted to automatic selection mode and shall only be performed by an MS that is capable of both voice and packet data. It shall only be performed if the selected PLMN is not already the highest prioritized PLMN in the current country. (HPLMN in home country, otherwise according to PLMN selector lists)

The MS shall return to RPLMN after the investigation scan is performed.

If a higher prioritized PLMN not offering GSM voice service is found, this shall be indicated to the user. The MS shall not select the PLMN unless requested by the user.

4.4.4 Abnormal cases

If there is no SIM in the MS, if there is an authentication failure, or if the MS receives an "IMSI unknown in HLR", "illegal ME" or "illegal MS" response to an LR request, then effectively there is no selected PLMN ("No SIM" state). In these cases, the states of the cell selection process are such that no PLMN selection information is used. No further attempts at registration on any PLMN are made until the MS is switched off and on again, or a SIM is inserted.

When in Automatic Network Selection mode and the MS is in the "not updated" state with one or more suitable cells to camp on; then after the maximum allowed unsuccessful LR requests (controlled by the specific attempt counters) the MS may continue (or start if it is not running) the user reselection procedure of 4.4.3.2 1.

4.4.5 Roaming not allowed in this LA

If in either PLMN selection mode the LR response "Roaming not allowed in this LA" is received:

The PLMN Automatic or Manual Mode Selection Procedure of subclause 4.4.3.1 are followed, depending on whether the MS is in automatic or manual mode. (This requirement applies to all MSs.)

4.5 Location registration process

4.5.1 General

When the MS is switched on and capable of services requiring registration, the action taken by the location registration process is as follows:

a) SIM present and no LR needed (because of the status of the stored registration area identity and "attach" flag): The MS is in the update state UPDATED;

b) SIM present and LR needed: A LR request is made;

c) No SIM present: The MS enters the update state Idle, NO IMSI.

In case b) above, and subsequently whenever a LR request is made, the MS enters a state depending on the outcome of the LR request, as listed in subclause 4.3.2 above. In case c) the GPRS and the non-GPRS update state enters "IDLE, NO IMSI".

Whenever the MS goes to connected mode and then returns to idle mode again, the MS selects the appropriate state.

4.5.2 Initiation of Location Registration

An LR request indicating Normal Updating is made when, in idle mode,

- the MS changes cell while being in the update state NOT UPDATED; (for MS capable of GPRS and non-GPRS services when at least one of both update states is NOT UPDATED)
- the MS detects that it has entered a new registration area, i.e., when the received registration area identity differs from the one stored in the MS, and the LAI or the PLMN identity is not contained in a list of forbidden LAIs or PLMN identities respectively, while being in one of the following update states:
  - UPDATED;
  - NOT UPDATED;
  - ROAMING NOT ALLOWED.
- the Periodic Location Updating Timer expires while being in the non-GPRS update state NOT UPDATED (triggers Location Updating);
- the Periodic Routing Area Update timer expires while being in the GPRS update state NOT UPDATED (triggers Routing Area Update);
- a manual network reselection has been performed, an acceptable cell of the selected PLMN is present, and the MS is not in the UPDATED state on the selected PLMN.

An LR request indicating Periodic Location Updating is made when, in idle mode, the Periodic Location Updating timer expires while being in the non-GPRS update state UPDATED.

An LR request indicating Periodic Routing Area Update is made when the Periodic Routing Area Update timer expires while being in the GPRS update state UPDATED.

An LR request indicating IMSI attach is made when the MS is activated in the same location area in which it was deactivated while being in the non-GPRS update state UPDATED, and the system information indicates that IMSI attach/detach shall be used.

A GPRS attach is made by a GPRS MS when activated and capable of services which require registration. Depending on system information about GPRS network operation mode MSs capable of GPRS and non-GPRS services perform combined or non-combined location registration procedures. When the combined routing area update or GPRS attach is accepted with indication "MSC not reachable“ or is not answered the MS performs also the corresponding location

updating procedure or falls back to a GPRS only MS. When the combined routing area update or GPRS attach is rejected with cause "GPRS not allowed“ the GPRS update state is "IDLE, NO IMSI“ and the MS performs the corresponding location updating procedure or falls back to a GPRS only MS.

Furthermore, an LR request indicating Normal Location Updating is also made when the response to an outgoing request shows that the MS is unknown in the VLR or SGSN, respectively.

Table 2 in clause 5 summarizes the events in each state that trigger a new LR request. The actions that may be taken while being in the various states are also outlined in table 2.

A GPRS MS which is both IMSI attached for GPRS and non-GPRS services and which is capable of simultaneous operation of GPRS and non-GPRS services shall perform Routing Area Update in connected mode when it has entered a new routing area which is not part of a LA contained in the list of forbidden LAIs.

4.5.3 Periodic Location Registration

A Periodic Location Updating timer (for non-GPRS operation) and a Periodic Routing Area Update timer (for GPRS operation) with the following characteristics shall be implemented in the MS (MS capable of GPRS and non-GPRS operation shall implement both timers):

i) Upon switch on of the MS or when the system information indicates that periodic location registration shall be applied, and the timer is not running, the timer shall be loaded with a random value between 0 and the broadcast or signalled time-out value and started.

ii) The time-out value for the Periodic Location Updating timer shall be within the range of 1 deci-hour to 255 deci-hours with a granularity of 1 deci-hour.

iii) When the timer reaches its expiry value, it shall be initiated with respect to the relevant time-out value, and the MS shall initiate the Periodic Location Registration corresponding to the expired timer.

iv) The Periodic Location Updating timer shall be prevented from triggering Periodic Location Updating during connected mode. When the MS returns to idle mode, the Periodic Location Updating timer shall be initiated with respect to the broadcast time-out value, then started. Thereafter, the procedure in iii) shall be followed.

v) The Periodic Routing Area Update timer shall be prevented from triggering the Periodic Routing Area Update during Ready state. At transition from Ready to Standby state the Periodic Routing Area Update timer shall be initiated with respect to its time-out value, then started. Thereafter, the procedure in iii) shall be followed.

vi) If the MS performs a successful combined Routing Area Update the Periodic Location Updating timer shall be prevented from triggering the Periodic Location Updating until the MS starts using Location Updating procedure, for example because of a changed network operation mode or the MS uses non-GPRS services only.vii) When a change in the time-out value occurs (at a change of serving cell or a change in the broadcast time-out value or a change in the signalled time-out value), the related timer shall be reloaded so that the new time to expiry will be: "old time to expiry" modulo "new time-out value".

4.5.4 IMSI attach/detach operation

The system information will contain an indicator indicating whether or not IMSI attach/detach operation is mandatory to use in the cell. The MS shall operate in accordance with the received value of the indicator.

A GPRS MS shall perform GPRS attach/detach procedures independent of the value of the IMSI attach/detach indicator. When a GPRS MS has to perform IMSI attach/detach independent of GPRS procedures (for example GPRS network operation mode 2) the handling described in the paragraph above applies.

When IMSI attach/detach operation applies, a MS shall send the IMSI detach message to the network when the MS is powered down or the SIM is removed while being in the update state UPDATED. The IMSI detach message will not be acknowledged by the network.

When the MS returns to the active state, the MS shall perform an LR request indicating IMSI attach, provided that the MS still is in the same registration area. If the registration area has changed, an LR request indicating Normal Location Updating according to subclause 4.5.2 shall be performed.

4.6 Service indication ~~(GSM only)~~(A/Gb mode only)

This is an indication to the user that service or CTS service is available.

The service indication should be set if the following conditions are all satisfied:

a) Cell Selection: Camped on a suitable cell and in updated state, or in connected mode having been camped on a suitable cell.

b) Location registration: In updated state, for MSs capable of services requiring registration.

A specific CTS service indication should be set when the CTS MS is attached to a CTS FP.

However due to the fact that there may be some transitory changes of state, the service indication is permitted to continue to be set for up to 10 seconds after the above conditions cease to be met. Also the service indication is permitted to take up to 1 second to be set after the above conditions are met.

4.7 Pageability of the mobile subscriber

An MS is required to listen to all paging messages that could address it (see 3GPP TS 05.02), when the following conditions are all satisfied:

- A SIM is inserted.
- The MS is camped on a cell.
- The MS is not in state "Idle, No IMSI".
- The MS is not performing the task to search for available PLMNs. (Whenever possible during this task, the MS should listen for paging.). However, when the MS is camped on a cell, is registered in a PLMN and is performing its regular search for the HPLMN, as specified in 3GPP TS 22.011, then it shall listen to all paging messages that could address it.

NOTE: ~~In GSM~~In A/Gb mode, during cell reselection there is a certain period when the MS is no longer camped on the old cell but must decode the full BCCH or CPBCCH before camping on the new cell. This leads to a period of slightly more than 8 51 frame multiframes when the MS will not necessarily be pageable.

4.8 MM Restart Procedure

In some cases, e.g. on change of SIM data, there is a need for the MM to be restarted without the need for user intervention.

To perform the procedure the MS shall behave as if the SIM is removed and afterwards a new SIM is inserted.

5 Tables and Figures

Table 1: Effect of LR Outcomes on PLMN Registration

Location Registration Task State	Registration Status	Registered PLMN is
Updated	Successful	Indicated in the stored registration area identity
Idle, No IMSI	Unsuccessful	No registered PLMN (3)
Roaming not allowed:		
a) PLMN not allowed	Unsuccessful	No registered PLMN
b) LA not allowed	Indeterminate(1)	No registered PLMN
c) Roaming not allowed in this LA	Indeterminate (2)	No registered PLMN
Not updated	Unsuccessful	No registered PLMN

1) The MS will eventually either enter a different state when the registration status will be determined, or fail to be able to camp on a cell, when registration will be unsuccessful.

2) The MS will select the HPLMN if in automatic mode and will enter Automatic Network Selection Mode Procedure of subclause 4.4.3.1. If in manual mode, the MS will display the list of available PLMNs and follow the Manual Network Selection Mode Procedure of subclause 4.4.3.1.2 If the appropriate process does not result in registration, the MS will eventually enter the limited service state.

3) A MS may have different update states for GPRS and non-GPRS. A PLMN is registered when at least one of both update states is updated.

NOTE 1: MSs capable of GPRS and non-GPRS services may have different registration status for GPRS and for non-GPRS.

NOTE 2: The registered PLMN is determined by looking at the stored registration area identity and stored location registration status.

Table 2: LR Process States and Allowed Actions

Location registration task state	New LR request when				Normal Calls Supported (1)	Paging responded to
	Changing Cell	Changing registration area	Changing PLMN	Other		
Null (4)	No	Yes	Yes	No	No	No
Updated, (5)	No	Yes	Yes	(2)	Yes	Yes
Idle, No IMSI (7)	No	No	No	No	No	No
Roaming not allowed:						
a) Idle, PLMN not allowed	No	No	Yes	No	No	Optional if with IMSI
b) Idle, LA not allowed	No	Yes(6)	Yes	No	No	Optional if with IMSI
c) Idle, Roaming not allowed in this LA	No	Yes(6)	Yes	No	No	Optional if with IMSI
Not updated	Yes	Yes	Yes	(2)&(3)	(3)	Yes if with IMSI

1): Emergency calls may always be made, subject to access control permitting it.
2): A new LR is made when the periodic registration timer expires.
3): If a normal call request is made, an LR request is made. If successful the updated state is entered and the call may be made.
4): The MS is in the null state from switch on until it has camped on a cell and either made an LR attempt or decided that no LR attempt is needed.
5): In this state, IMSI detach is performed if the MS is deactivated and the BCCH indicates that IMSI attach/detach shall be used. An LR request indicating IMSI attach is performed if the MS is activated in the same registration area in which it was deactivated while being in this state.
6): A GPRS MS shall not perform a new LR when the new routing area is part of a LA contained in a list of forbidden LA.
7): The GPRS registration status "Idle, no IMSI“ is entered when LR is rejected with cause "GPRS not allowed“. The non-GPRS registration status „Idle, no IMSI“ is entered when the cause "IMSI unknown in HLR“ is received.

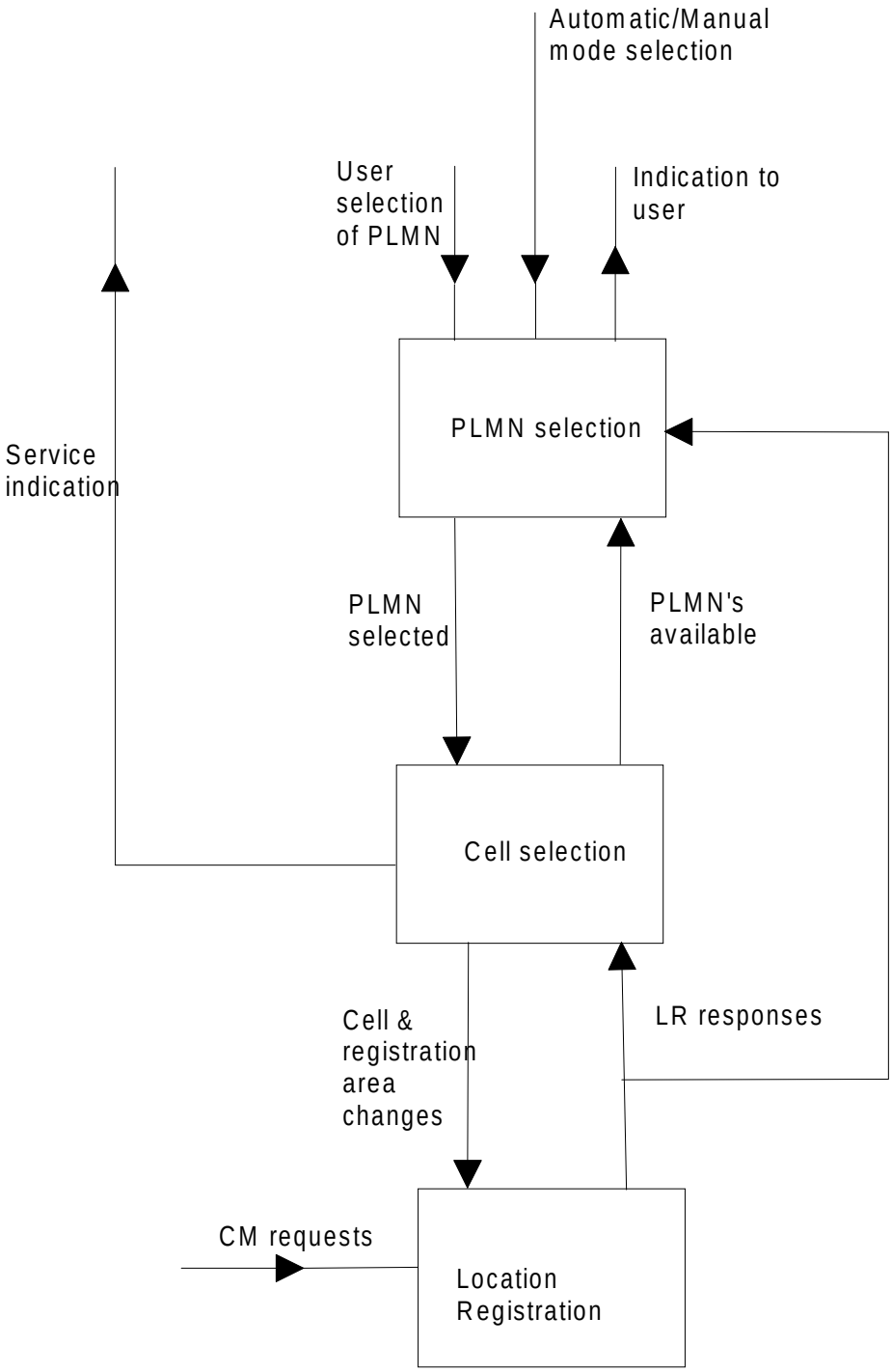
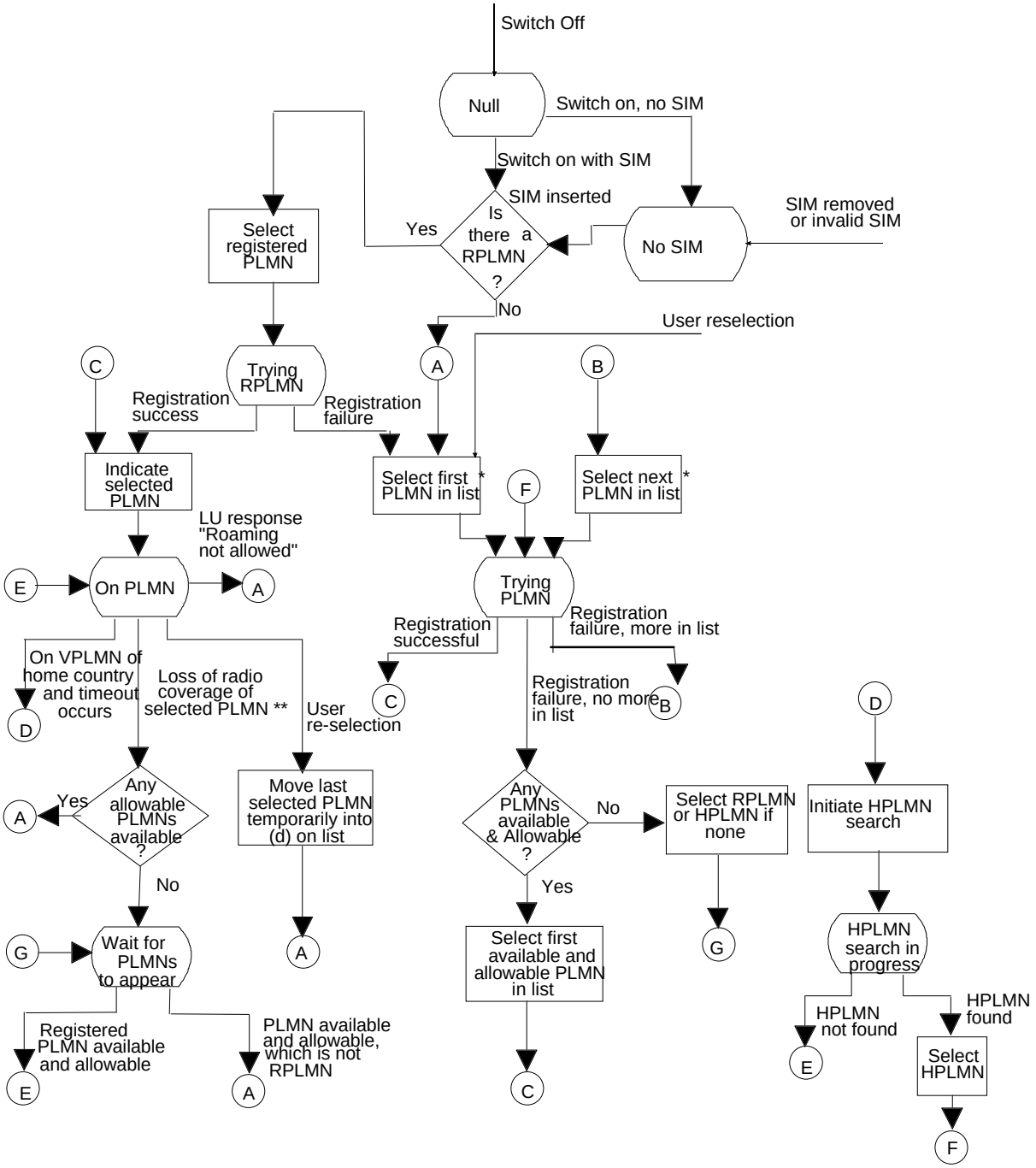


Figure 1: Overall Idle Mode process



* "List" consists of (in order)

a) HPLMN
b) Each PLMN in SIM list in priority order
c) All other PLMNs above -85 dBm in random order
d) Other PLMNs in decreasing order of signal strength

) Provided they are "available" and "allowable"

** Includes effective loss of coverage due to LAs being forbidden in all potentially suitable cells

Figure 2a: PLMN Selection State diagram (automatic mode)

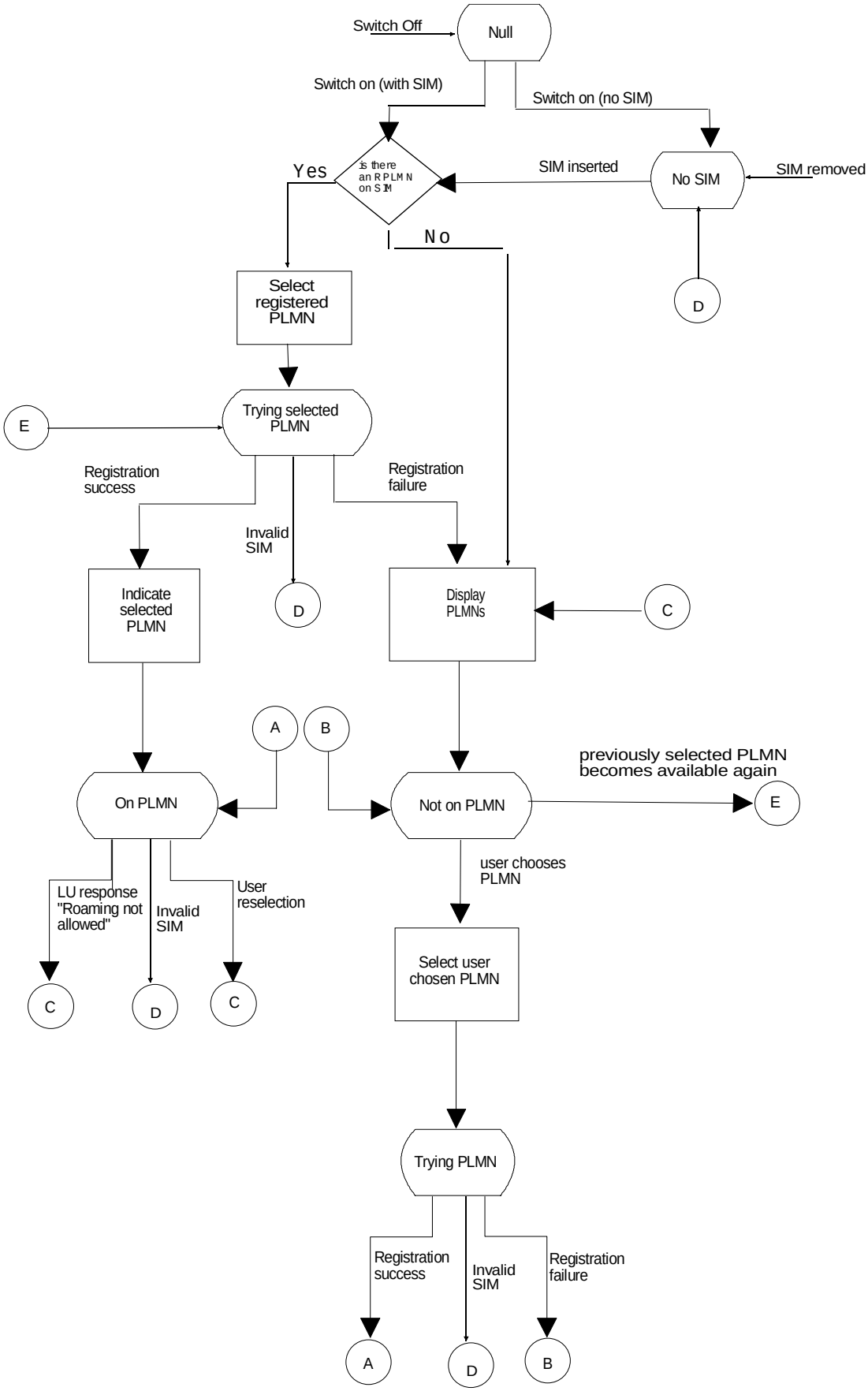
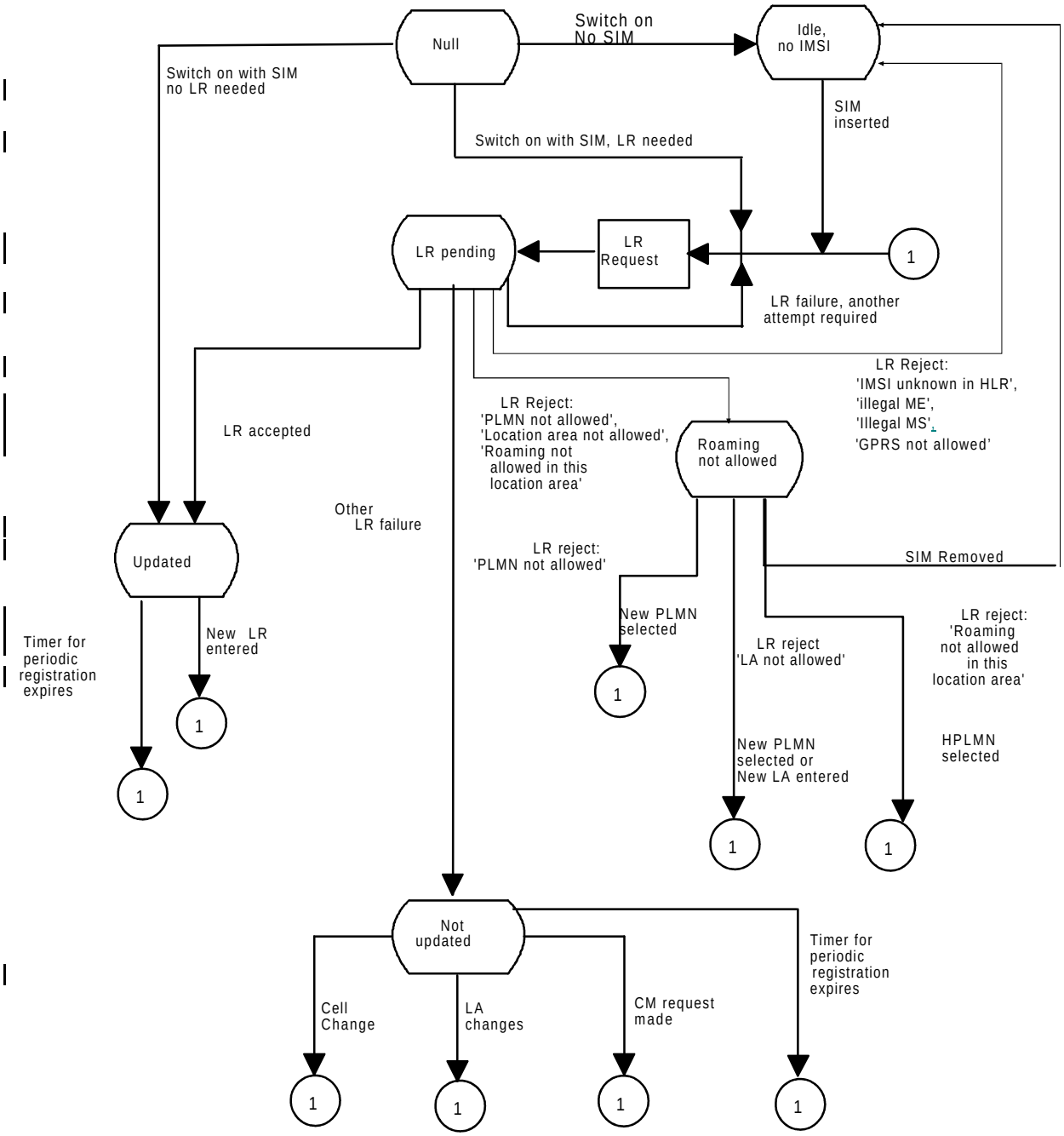


Figure 2b: PLMN Selection State diagram (manual mode)



NOTE 1: Whenever the MS goes to connected mode and then returns to idle mode again the MS selects appropriate state.

NOTE 2: A MS capable of GPRS and non-GPRS services has two Task State machines one for GPRS and one for non-GPRS operation.

Figure 3: Location Registration Task State diagram

Annex A (normative): HPLMN Matching Criteria

With the introduction of PCS1900 with the regulatory mandate to allocate 3-digit MNC codes, additional functionality is required to identify the HPLMN.

Assumptions

An MNC code shall consist of 2 or 3 decimal digits. In NA PCS1900, all SIMs shall store 3 digit MNCs.

Any network using a 2 digit MNC code shall broadcast the hexadecimal code "F" in place of the 3rd digit.

For PCS1900 for North America, regulations mandate that a 3-digit MNC shall be used; however during a transition period, a 2 digit MNC may be broadcast by the Network and, in this case, the 3rd digit of the SIM is stored as 0 (this is the 0 suffix rule).

With the exception of North America during the transition period:

a) Within a single country (or area identified by a MCC) all networks shall broadcast a 2 digit MNC code, or all networks shall broadcast a 3 digit MNC code. A mixture of broadcast 2 and 3 digit MNC codes is not permitted within a single country (or area identified by a MCC).

b) A network which broadcasts a 2 digit MNC code, will issue SIMs with a 2 digit MNC code in the IMSI on the SIM. A network which broadcasts a 3 digit MNC code, will issue SIMs with a 3 digit MNC code in the IMSI on the SIM.

Definitions and abbreviations

BCCH-MCC The MCC part of the LAI read from System Information type 3 messages broadcast on the BCCH by the network.

BCCH-MNC The MNC part of the LAI read from System Information type 3 messages broadcast on the BCCH by the network.

SIM-MCC The MCC part of the IMSI read from the SIM.

SIM-MNC The MNC part of the IMSI read from the SIM.

HPLMN Matching Criteria in mobiles which don't support PCS1900 for NA:

Figure A.1 illustrates the logic flow described below. The text below is normative. Figure A.1 is informative.

(1) The MS shall compare using all 3 digits of the SIM-MCC with the BCCH-MCC. If the values do not match, then the HPLMN match fails.

NOTE: If the MCC codes match, then the number of digits used for the SIM-MNC must be the same as the number of digits used for the BCCH-MNC.

(2) The MS shall read the 3rd digit of the BCCH-MNC. If the 3rd digit is Hex F, then proceed to step (4).

(3) The MS shall compare using all 3 digits of the SIM-MNC with the BCCH-MNC. If the values match, then the HPLMN match succeeds, otherwise the HPLMN match fails.

(4) The MS shall compare using just the 1st 2 digits the SIM-MNC with the BCCH-MNC. If the values match, then the HPLMN match succeeds, otherwise the HPLMN match fails.

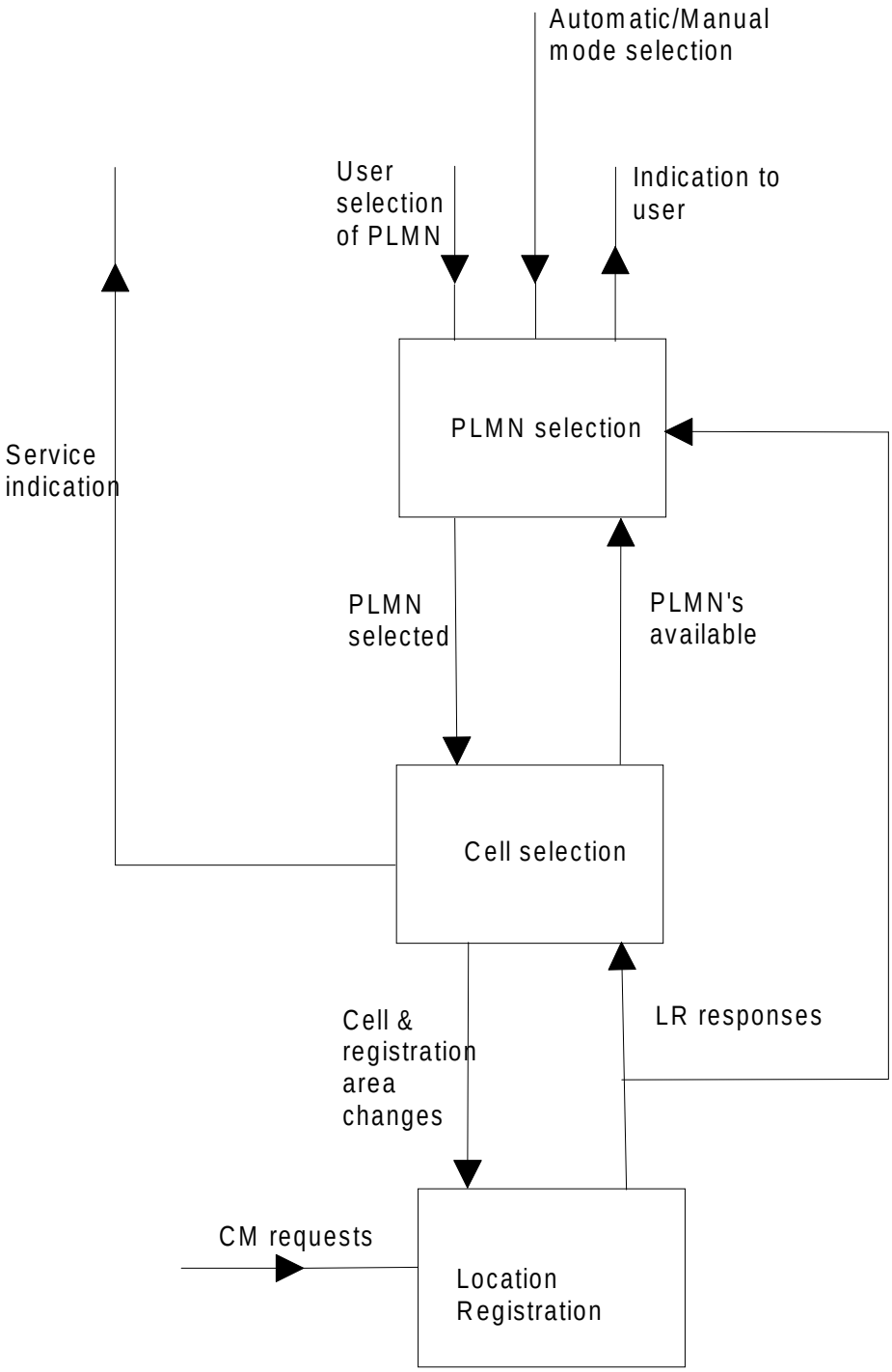


Figure A.1: HPLMN Matching Criteria Logic Flow for mobiles which support GSM and DCS1800 (informative)

HPLMN Matching Criteria for mobiles which support PCS1900 for NA:

Figure A.2 illustrates the logic flow described below. The text below is normative. Figure A.2 is informative.

(1) The MS shall compare using all 3 digits the SIM-MCC with the BCCH-MCC. If the values do not match, then the HPLMN match fails.

(2) The MS shall read the 3rd digit of the BCCH-MNC. If the 3rd digit is Hex F, then proceed to step (4).

(3) The MS shall compare using all 3 digits the SIM-MNC with the BCCH-MNC. If the values match, then the HPLMN match succeeds, otherwise the HPLMN match fails.

NOTE: These rules (1) – (3) are the same as for mobiles which don't support PCS1900 for NA, except step (4) is different.

(4) The MS shall determine if the BCCH-MCC lies in the range 310-316 (i.e., whether this network is a PCS1900 for NA network). If the BCCH-MCC lies outside the range 310-316, then proceed to step (6).

(5) The MS shall compare the 3rd digit of the SIM-MNC with '0'. If the 3rd digit is not '0' then the HPLMN match fails.

NOTE: This is the '0' suffix rule.

(6) The MS shall compare using just the 1st 2 digits of the SIM-MNC with the BCCH-MNC. If the values match, then the HPLMN match succeeds, otherwise the HPLMN match fails.

NOTE: When PCS1900 for NA switches over to broadcasting 3 digit MNCs in **all** networks, then the additional requirements for PCS1900 for NA can be deleted.

Guidance for Networks in PCS1900 for NA

There may be some problems in the transition period from broadcasting 2 MNC digits to broadcasting 3 MNC digits. Here are some guidelines to avoid these problems.

(1) Existing network codes. Operators who currently use a 2 digit BCCH-MNC **xy** should use the new code **xy0**.

(2) New operators allocated 3 digit MNC codes with the same 1st 2 digits as an existing operator shall not use a 3rd digit of 0.

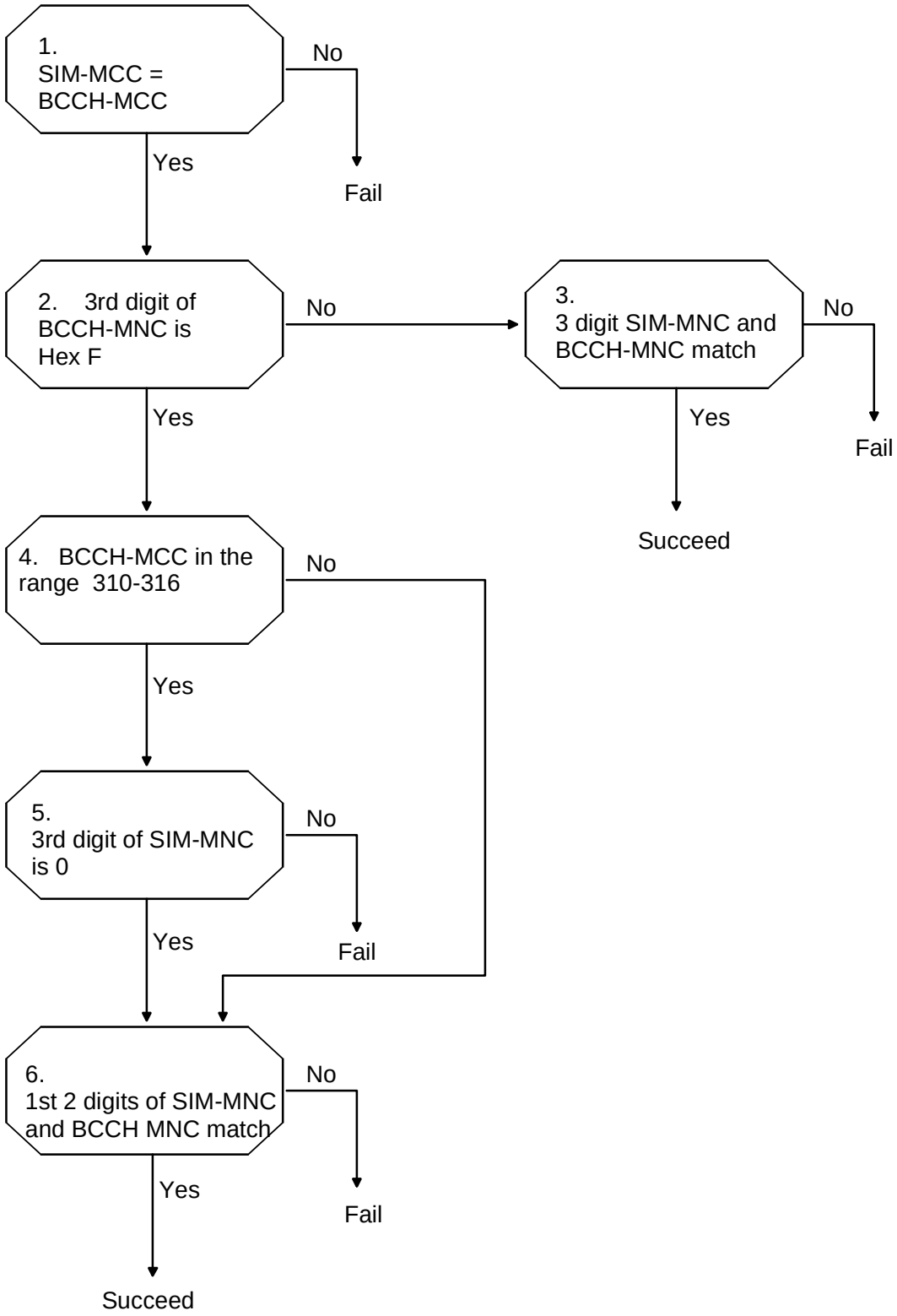


Figure A.2: HPLMN Matching Criteria Logic Flow for mobiles which support PCS1900 for NA (informative)

Annex B (informative): Change history

TSG#	Tdoc	SPEC	VERS	CR	REV	PHASE	CAT	NEW_VERS	SUBJECT	comment
		03.22	8.2.0			R99			Split of 03.22/R99 to 03.22 and 23.122	
CN#6		23.122	0.0.0			R99		3.0.0		Was approved in the TSGN#6 plenary
CN#4	**N1-99573**	**23.102**	**3.0.0**	**001**		**R99**	**F**	**3.1.0**	**PLMN selection for GPRS mobiles**	**Mirrored from CRA032r2 REMOVED in V3.1.1, where it is not approved by SMG2**
CN#6	N1-99D13	23.122	3.0.0	002		R99	A	3.1.0	Correction of Figure A.2 in Annex A	Mirrored from CR006r1for 23.022
CN#7	N1-000546	23.122	3.1.1	004	1	R99	D	3.2.0	UMTS references in 23.122	Correction of references
CN#8	N1-000796	23.122	3.2.0	003	5	R99	F	3.3.0	Modification of PLMN Selection Procedures to support UMTS+COMPACT Network Selection	WI: GSM / UMTS interworking **Note** As a result of two conflicting CRs N1-000796 is merged with the existing text in V.3.2.0 by the rapporteur
CN#9	NP-000443/ N1-001020	23.122	3.3.0	009	2	R99	F	3.4.0	Clarifications of the PLMN Selection procedures for UMTS and COMPACT.	
		23.122	3.4.0					3.4.1	Correction of text in version3.4.0 (There was text to be deleted in section 4.4.3.2.1 bullet point 2)	23.Oct.2000 Implementation correction
		23.122	3.4.1					3.4.2	Correction of a systematic search for "TS" and replace it with "3GPP TS" has gone wrong as much more than the TSs for Technical Specifications have been changed also.	1 Nov..2000 Implementation correction