ETSI TS 123 018 V5.10.0 (2006-09)

Technical Specification

**Digital cellular telecommunications system (Phase 2+);
Universal Mobile Telecommunications System (UMTS);
Basic Call Handling;
Technical realization
(3GPP TS 23.018 version 5.10.0 Release 5)**

GLOBAL SYSTEM FOR
MOBILE COMMUNICATIONS

Reference

RTS/TSGC-0423018v5a0

Keywords

GSM, UMTS

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00   Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

Individual copies of the present document can be downloaded from:
http://www.etsi.org

The present document may be made available in more than one electronic version or in print. In any case of existing or perceived difference in contents between such versions, the reference version is the Portable Document Format (PDF). In case of dispute, the reference shall be the printing on ETSI printers of the PDF version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at
http://portal.etsi.org/tb/status/status.asp

If you find errors in the present document, please send your comment to one of the following services:
http://portal.etsi.org/chaircor/ETSI_support.asp

Copyright Notification

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://webapp.etsi.org/IPR/home.asp).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

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

The present document may refer to technical specifications or reports using their 3GPP identities, UMTS identities or GSM identities. These should be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between GSM, UMTS, 3GPP and ETSI identities can be found under http://webapp.etsi.org/key/queryform.asp .

Contents

Foreword

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

The present document specifies the technical realization of the handling of calls originated by a 3G mobile subscriber and calls directed to a 3G mobile subscriber, up to the point where the call is established 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   Indicates a TSG approved Release 1999 document under change control;

4   Indicate a TSG approved Release 4 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 specification;

1   Scope

The present document specifies the technical realization of the handling of calls originated by a UMTS or GSM mobile subscriber and calls directed to a UMTS or GSM mobile subscriber, up to the point where the call is established. Normal release of the call after establishment is also specified.

In the present document, the term MS is used to denote a UMTS UE or GSM MS, as appropriate.

The handling of DTMF signalling and Off-Air Call set-up (OACSU) are not described in the present document.

The details of the effects of UMTS or GSM supplementary services on the handling of a call are described in the relevant 3GPP TS 23.07x, 3GPP TS 23.08x and 3GPP TS 23.09x series of specifications.

The specification of the handling of a request from the HLR for subscriber information is not part of basic call handling, but is required for both CAMEL (3GPP TS 23.078 [12]) and optimal routeing (3GPP TS 23.079 [13]). The use of the Provide Subscriber Information message flow is shown in 3GPP TS 23.078 [12] and 3GPP TS 23.079 [13].

The specification of the handling of data calls re-routed to a SIWFS is described in 3GPP TS 23.054 [8].

The logical separation of the MSC and VLR (shown in clauses 4, 5 and 7), and the messages transferred between them (described in clause 8) are the basis of a model used to define the externally visible behaviour of the MSC/VLR, which is a single physical entity. They do not impose any requirement except the definition of the externally visible behaviour.

If there is any conflict between the present document and the corresponding stage 3 specifications (3GPP TS 24.008 [26], 3GPP TS 25.413 [27], 3GPP TS 48.008 [2] and 3GPP TS 29.002 [29]), the stage 3 specification shall prevail.

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. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1]   3GPP TS 43.020: "Security related Network Functions".

[2]   3GPP TS 48.008: "Mobile Switching Centre - Base Station System (MSC - BSS) interface Layer 3 specification".

[3]   GSM 12.08: "Digital cellular telecommunications system (Phase 2+); Subscriber and equipment trace".

[4]   3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[5]   3GPP TS 23.003: "Numbering, addressing and identification".

[6]   3GPP TS 23.012: "Location management procedures".

[7]   3GPP TS 23.032: "Universal Geographical Area Description (GAD)".

[8]   3GPP TS 23.054: "Description for the use of a Shared Inter Working Function (SIWF) in a GSM; Stage 2".

[9]   3GPP TS 23.060: "General Packet Radio Service (GPRS); Service description; Stage 2".

[10] 3GPP TS 23.066: "Support of GSM Mobile Number Portability (MNP); Stage 2".

[11] 3GPP TS 23.072: "Call deflection Supplementary Service; Stage2".

[12] 3GPP TS 23.078: "Customized Applications for Mobile network Enhanced Logic (CAMEL); Stage 2".

[13] 3GPP TS 23.079: "Support of Optimal Routeing (SOR); Technical realization; Stage 2".

[14] 3GPP TS 23.081: "Line identification Supplementary Services; Stage 2 ".

[15] 3GPP TS 23.082: "Call Forwarding (CF) Supplementary Services; Stage 2".

[16] 3GPP TS 23.083: "Call Waiting (CW) and Call Hold (HOLD) Supplementary Service; Stage 2".

[17] 3GPP TS 23.084: "Multi Party (MPTY) Supplementary Service; Stage 2".

[18] 3GPP TS 23.085: "Closed User Group (CUG) Supplementary Service; Stage 2".

[19] 3GPP TS 23.086: "Advice of Charge (AoC) Supplementary Service; Stage 2".

[20] 3GPP TS 23.087: "User-to-User Signalling (UUS) Supplementary Service; Stage 2".

[21] 3GPP TS 23.088: "Call Barring (CB) Supplementary Service; Stage 2".

[22] 3GPP TS 23.091: "Explicit Call Transfer (ECT) supplementary service; Stage 2".

[23] 3GPP TS 23.093: "Technical realization of Completion of Calls to Busy Subscriber (CCBS); Stage 2".

[24] 3GPP TS 23.116: "Super-charger technical realization; Stage 2".

[25] 3GPP TS 23.135: "Multicall supplementary service; Stage 2".

[25a] 3GPP TS 23.195: "Provision of UE Specific Behaviour Information to Network Entities".

[26] 3GPP TS 24.008: "Mobile radio interface Layer 3 specification; Core network protocols; Stage 3".

[27] 3GPP TS 25.413: "UTRAN Iu interface RANAP signalling".

[28] 3GPP TS 27.001: "General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".

[29] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".

[30] 3GPP TS 29.007: "General requirements on interworking between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN)".

[31] 3GPP TS 29.010: "Information Element Mapping between Mobile Station - Base Station System (MS - BSS) and Base Station System - Mobile-services Switching Centre (BSS - MSC) Signalling Procedures and the Mobile Application Part (MAP)".

[32] 3GPP TS 33.102: "3G Security; Security architecture ".

[33] ITU-T Recommendation Q.761 (1999): " Signalling System No. 7 - ISDN User Part functional description ".

[34] ITU-T Recommendation Q.762 (1999): "Signalling System No. 7 - ISDN User Part general functions of messages and signals".

[35] ITU-T Recommendation Q.763 (1999): "Signalling System No. 7 - ISDN User Part formats and codes".

[36] ITU-T Recommendation Q.764 (1999): " Signalling System No. 7 – ISDN user part signalling procedures".

[37] ITU-T Recommendation Q.850 (1996): "Usage of cause and location in the Digital Subscriber Signalling System No. 1 and the Signalling System No. 7 ISDN User Part".

[38]   3GPP TS 23.172: "Technical realization of Circuit Switched (CS) multimedia service ; UDI/RDI fallback and service modification; Stage 2"

3   Definitions and abbreviations

3.1   Definitions

For the purposes of the present document, the following terms and definitions apply:

A subscriber: the calling mobile subscriber

B subscriber: the mobile subscriber originally called by the A subscriber

C subscriber: the subscriber to whom the B subscriber has requested that calls be forwarded
The C subscriber may be fixed or mobile.

Location Information: information to define the whereabouts of the MS, and the age of the information defining the whereabouts

PLMN Bearer Capability: information transferred over the UMTS or GSM access interface to define the information transfer capabilities to be used between the MS and the network for a circuit-switched connection

3.2   Abbreviations

For the purposes of the present document, the following abbreviations apply:

A&O	Active & Operative
ACM	Address Complete Message
ANM	ANswer Message
AoC	Advice of Charge
BC	Bearer Capability
BOIC-exHC&BOIZC	Barring of Outgoing International Calls except those directed to the HPLMN Country & Barring of Outgoing InterZonal Calls
BOIZC	Barring of Outgoing InterZonal Calls
BOIZC-exHC	Barring of Outgoing InterZonal Calls except those directed to the HPLMN Country
CCBS	Completion of Calls to Busy Subscriber
CFB	Call Forwarding on Busy
CFNRc	Call Forwarding on mobile subscriber Not Reachable
CFNRy	Call Forwarding on No Reply
CFU	Call Forwarding Unconditional
CLIP	Calling Line Identity Presentation
CLIR	Calling Line Identity Restriction
COLP	COnnected Line identity Presentation
COLR	COnnected Line identity Restriction
CUG	Closed User Group
CW	Call Waiting
FTN	Forwarded-To Number
FTNW	Forwarded-To NetWork
GMSCB	Gateway MSC of the B subscriber
GPRS	General Packet Radio Service
HLC	Higher Layer Compatibility
HLRB	The HLR of the B subscriber
HPLMNB	The HPLMN of the B subscriber
IAM	Initial Address Message
IPLMN	Interrogating PLMN - the PLMN containing GMSCB
IWU	Inter Working Unit
LLC	Lower Layer Compatibility
MO	Mobile Originated
MPTY	MultiParTY
MT	Mobile Terminated

NDUB	Network Determined User Busy
NRCT	No Reply Call Timer
PLMN BC	(GSM or UMTS) PLMN Bearer Capability
PRN	Provide Roaming Number
PUESBINE	Provision of User Equipment Specific Behaviour Information to Network Entities
SCUDIF	Service Change and UDI/RDI Fallback
SGSN	Serving GPRS support node
SIFIC	Send Information For Incoming Call
SIFOC	Send Information For Outgoing Call
SIWF	Shared Inter Working Function
SIWFS	SIWF Server. SIWFS is the entity where the used IWU is located.
SRI	Send Routeing Information
UDUB	User Determined User Busy
UESBI-Iu	User Equipment Specific Behaviour Information over the Iu interface
VLRA	The VLR of the A subscriber
VLRB	The VLR of the B subscriber
VMSCA	The Visited MSC of the A subscriber
VMSCB	The Visited MSC of the B subscriber
VPLMNA	The Visited PLMN of the A subscriber
VPLMNB	The Visited PLMN of the B subscriber

4 Architecture

Subclauses 4.1 and 4.2 show the architecture for handling a basic MO call and a basic MT call. A basic mobile-to-mobile call is treated as the concatenation of an MO call and an MT call.

4.1 Architecture for an MO call

A basic mobile originated call involves signalling between the MS and its VMSC via the BSS, between the VMSC and the VLR and between the VMSC and the destination exchange, as indicated in figure 1.

In figure 1 and throughout the present document, the term BSS is used to denote a GSM BSS or a UTRAN, as appropriate.
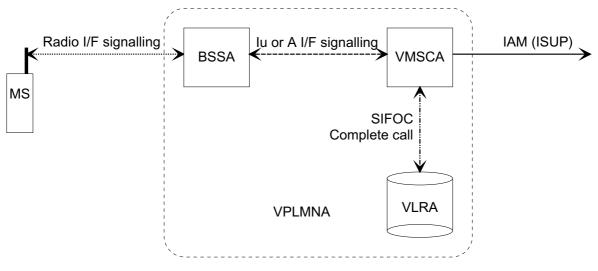
Figure 1: Architecture for a basic mobile originated call

In figure 1 and throughout the present document, the term ISUP is used to denote the telephony signalling system used between exchanges. In a given network, any telephony signalling system may be used.

When the user of an MS wishes to originate a call, the MS establishes communication with the network using radio interface signalling, and sends a message containing the address of the called party. VMSCA requests information to handle the outgoing call (SIFOC) from VLRA, over an internal interface of the MSC/VLR. If VLRA determines that the outgoing call is allowed, it responds with a Complete Call. VMSCA:

- establishes a traffic channel to the MS; and

- constructs an ISUP IAM using the called party address and sends it to the destination exchange.

NOTE: When the non-loop method is used for data calls, the IAM is sent to the SIWFS.

4.2 Architecture for an MT call

A basic mobile terminated call involves signalling as indicated in figure 2. Communication between VMSCB and the MS is via the BSS, as for the mobile originated case. If VPLMNB supports GPRS and the Gs interface between VLRB and the SGSN is implemented (see 3GPP TS 23.060 [9]) and there is an association between VLRB and the SGSN for the MS, the paging signal towards the MS goes from VMSCB via VLRB and the SGSN to the BSS. The IPLMN, containing GMSCB, is in principle distinct from HPLMNB, containing HLRB, but the practice for at least the majority of current UMTS or GSM networks is that a call to an MS will be routed to a GMSC in HPLMNB.
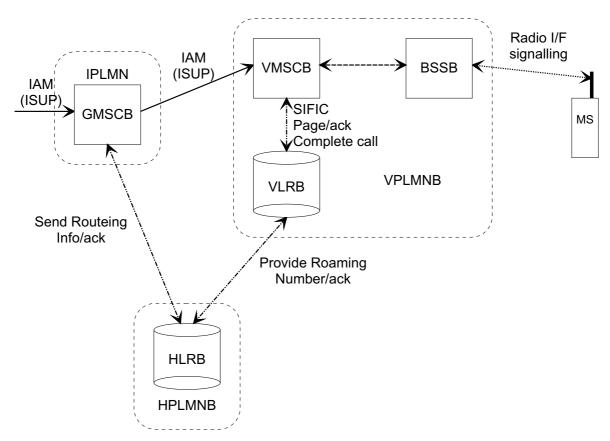
Figure 2: Architecture for a basic mobile terminated call
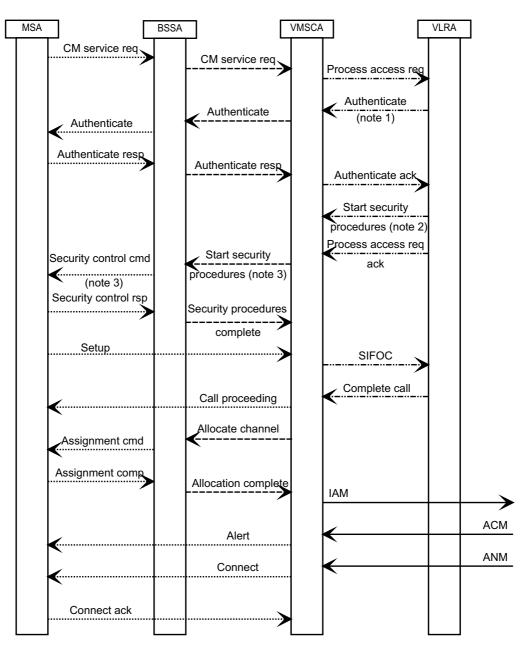
When GMSCB receives an ISUP IAM, it requests routeing information from HLRB using the MAP protocol. HLRB requests a roaming number from VLRB, also using the MAP protocol, and VLRB returns a roaming number in the Provide Roaming Number Ack. HLRB returns the roaming number to GMSCB in the Send Routeing Info ack. GMSCB uses the roaming number to construct an ISUP IAM, which it sends to VMSCB. When VMSCB receives the IAM, it requests information to handle the incoming call (SIFIC) from VLRB, over an internal interface of the MSC/VLR. If VLRB determines that the incoming call is allowed, it requests VMSCB to page the MS. VMSCB pages the MS using radio interface signalling. When the MS responds, VMSCB informs VLRB in the Page ack message. VLRB instructs VMSCB to connect the call in the Complete call, and VMSCB establishes a traffic channel to the MS.

5 Information flows

In this clause and clause 7, the terms "security procedures" and "security control" denote the UMTS ciphering and integrity protection mechanism defined in 3GPP TS 33.102 [32] or the GSM ciphering mechanism defined in 3GPP TS 43.020 [1], as appropriate.

5.1 Information flow for an MO call

An example information flow for an MO call is shown in figure 3; many variations are possible. Signalling over the radio interface between MSA and BSSA or VMSCA is shown by dotted lines; signalling over the Iu interface (for UMTS) or the A interface (for GSM) between BSSA and VMSCA is shown by dashed lines; signalling over the B interface between VMSCA and VLRA is shown by chain lines; and ISUP signalling between VMSCA and the destination exchange is shown by solid lines.

NOTE 1: Authentication may occur at any stage during the establishment of an MO call; its position in this message flow diagram is an example.

NOTE 2: Security procedures may be initiated at any stage after authentication; the position in this message flow diagram is an example.

NOTE 3: If ciphering is not required for a GSM connection, the MSC may send a CM service accept towards the MS; optionally it may instead send a "start ciphering" request indicating that no ciphering is required. This option is not available for a UMTS connection [ffs].

NOTE 4: The network may request the IMEI from the MS, and may check the IMEI, at any stage during the establishment of an MO call, either as part of the procedure to start security procedures or explicitly after security procedures have started; this is not shown in this message flow diagram.

Figure 3: Information flow for a basic mobile originated call

When the user wishes to originate a call, MSA establishes a signalling connection with BSSA, and sends a Connection Management (CM) service request to BSSA, which relays it to VMSCA. VMSCA sends a Process Access Request to VLRA. VLRA may then initiate authentication, as described in 3GPP TS 33.102 [32] for UMTS and 3GPP TS 43.020 [1] for GSM. VLRA may also initiate security procedures at this stage, as described in 3GPP TS 33.102 [32] for UMTS 3GPP TS 43.020 [1] for GSM. If the user originates one or more new MO calls in a multicall configuration, MSA sends a CM service request through the existing signalling connection for each new call.

If VLRA determines that MSA is allowed service, it sends a Process Access Request ack to VMSCA. If VMSCA has received a Start security procedures message from VLRA, the Process Access Request ack message triggers a Start security procedures message towards BSSA; otherwise VMSCA sends a CM Service Accept message towards BSSA.

If BSSA receives a Start security procedures message from VMSCA, it initiates security procedures as described in 3GPP TS 33.102 [32] for UMTS and 3GPP TS 43.020 [1] for GSM; when security procedures have been successfully initiated, MSA interprets this in the same way as a CM Service Accept. If security procedures are not required at this stage, BSSA relays the CM Service Accept to MSA.

When MSA has received the CM Service Accept, or security procedures have been successfully initiated, MSA sends a Set-up message containing the B subscriber address via BSSA to VMSCA. MSA also uses the Set-up message to indicate the bearer capability required for the call; VMSCA translates this bearer capability into a basic service, and determines whether an interworking function is required. VMSCA sends to VLRA a request for information to handle the outgoing call, using a Send Info For Outgoing Call (SIFOC) message containing the B subscriber address.

If VLRA determines that the call should be connected, it sends a Complete Call message to VMSCA. VMSCA sends a Call Proceeding message via BSSA to MSA, to indicate that the call request has been accepted, and sends an Allocate channel message to BSSA, to trigger BSSA and MSA to set up a traffic channel over the radio interface. The Call Proceeding message includes bearer capability information if any of the negotiable parameters of the bearer capability has to be changed. When the traffic channel assignment process is complete (indicated by the Allocation complete message from BSSA to VMSCA), VMSCA constructs an ISUP IAM using the B subscriber address, and sends it to the destination exchange.

When the destination exchange returns an ISUP Address Complete Message (ACM), VMSCA sends an Alerting message via BSSA to MSA, to indicate to the calling user that the B subscriber is being alerted.
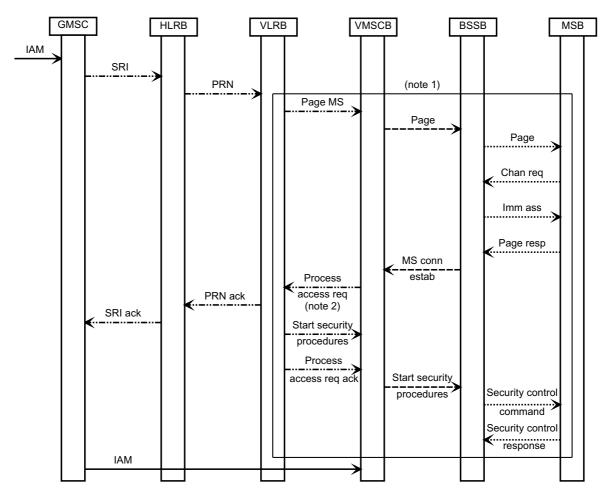
When the destination exchange returns an ISUP ANswer Message (ANM), VMSCA sends a Connect message via BSSA to MSA, to instruct MSA to connect the speech path.

The network then waits for the call to be cleared.

For an emergency call, a different CM service type (emergency call) is used, and the mobile may identify itself by an IMEI. It is a network operator option whether to allow an emergency call when the mobile identifies itself by an IMEI. Details of the handling are shown in clause 7.

5.2 Information flow for retrieval of routeing information for an MT call

The information flow for retrieval of routeing information for an MT call is shown in figure 4. ISUP signalling between the originating exchange and GMSCB, and between GMSCB and VMSCB is shown by solid lines; signalling over the MAP interfaces between GMSCB and HLRB and between HLRB and VLRB, and over the B interface between VLRB and VMSCB is shown by chain lines; signalling over the Iu interface (for UMTS) or the A interface (for GSM) between VMSCB and BSSB is shown by dashed lines; and signalling over the radio interface between BSSB and MSB is shown by dotted lines.

NOTE 1: If pre-paging is used, paging is initiated after VLRB has accepted the PRN message. The paging procedure is described in subclause 5.3.

NOTE 2: VMSCB starts the timer for the release of radio resources after it sends the Process Access Request message to VLRB. VMSCB releases the radio resource allocated for the MT call if the timer expires before the IAM is received.

Figure 4: Information flow for retrieval of routeing information for a basic mobile terminated call

When GMSCB receives an IAM, it analyses the called party address. If GMSCB can derive an HLR address from the B party address, it sends a request for routeing information (SRI) to HLRB. If GMSCB supports pre-paging (i.e. it is prepared to wait long enough for the SRI ack to allow pre-paging to be completed), it indicates this by an information element in the SRI message.
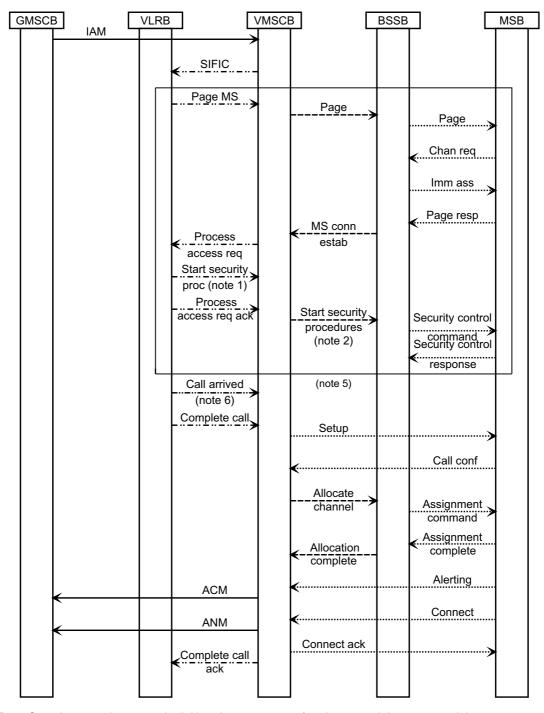
HLRB decides whether pre-paging is supported according to the following criteria:

- GMSCB has indicated that it supports pre-paging; and

- HLRB supports pre-paging (i.e. it is prepared to wait long enough for the PRN ack to allow pre-paging to be completed).

HLRB sends a request for a roaming number (PRN) to VLRB; if pre-paging is supported, it indicates this by an information element in the PRN message. VLRB returns the roaming number in the PRN ack, and HLRB relays the roaming number to GMSCB in the SRI ack. GMSCB constructs an IAM using the roaming number, and sends it to VMSCB.

5.3 Information flow for an MT call

An example information flow for an MT call is shown in figure 5; many variations are possible. ISUP signalling between GMSCB and VMSCB is shown by solid lines; signalling over the B interface between VMSCB and VLRB is shown by chain lines; signalling over the Iu interface (for UMTS) or the A interface (for GSM) between VMSCB and BSSB is shown by dashed lines; and signalling over the radio interface between VMSCB or BSSB and MSB is shown by dotted lines.

NOTE 1: Security procedures may be initiated at any stage after the network has accepted the page response; the position in this message flow diagram is an example.

NOTE 2: If Security procedures are not required, the MSC may send a Start security procedures message indicating that no ciphering is required.

NOTE 3: This message flow diagram assumes that the MS has already been authenticated on location registration. If this is not so (for the first MT call after VLR restoration), the network may initiate authentication after the MS responds to paging.

NOTE 4: The network may request the IMEI from the MS, and may check the IMEI, at any stage after the MS responds to paging, either as part of the procedure to start security procedures or explicitly after security procedures have been started; this is not shown in this message flow diagram.

NOTE 5: If a connection between MSCB and MSB has been established as a result of pre-paging, the paging procedure is not performed.

NOTE 6: If a connection between MSCB and MSB has been established as a result of pre-paging, VLRB sends the Call arrived message to MSCB to stop the guard timer for the release of the radio connection.

Figure 5: Information flow for a basic mobile terminated call

When VMSCB receives an IAM from GMSCB it sends to VLRB a request for information to handle the incoming call, using a Send Info For Incoming Call (SIFIC) message containing the roaming number received in the IAM.

If VLRB recognizes the roaming number, and MSB is allowed service, it sends a request to VMSCB to page MSB. If a radio connection between the network and MSB is already established, VMSCB responds immediately to the page request. If no radio connection exists, VMSCB sends a page request to BSSB, and BSSB broadcasts the page on the paging channel. If VPLMNB supports GPRS and the Gs interface between VLRB and the SGSN is implemented (see 3GPP TS 23.060 [9]) and there is a valid association between VLRB and the SGSN for the MS, the paging signal towards the MS goes from VMSCB via VLRB and the SGSN to the BSS.

If MSB detects the page, it sends a channel request to BSSB, which responds with an immediate assignment command, to instruct MSB to use the specified signalling channel. MSB then sends a page response on the signalling channel; BSSB relays this to VMSCB. VMSCB sends a Process access request message to VLRB to indicate that MSB has responded to paging. VLRB may then initiate authentication, as described in 3GPP TS 33.102 [32] for UMTS and 3GPP TS 43.020 [1] for GSM. VLRB may also initiate security procedures at this stage, as described in 3GPP TS 33.102 [32] for UMTS and 3GPP TS 43.020 [1] for GSM.

If VLRB determines that MSB is allowed service, it sends a Process access request ack to VMSCB. The Process access request ack message triggers a Start security procedures message towards BSSB; if VMSCB has not received a Start security procedures message from VLRB, the Start security procedures message indicates no ciphering.

VLRB then sends a Complete call message to VMSCB. VMSCB sends a Set-up message towards MSB. The Set-up message may include bearer capability information for the call.

When MSB receives the Set-up message from BSSB, it responds with a Call confirmed message. The Call Confirmed message includes bearer capability information if any of the negotiable parameters of the bearer capability has to be changed. When VMSCB receives the Call confirmed message via BSSB, it sends an Allocate channel message to BSSB. BSSB instructs MSB to tune to a traffic channel by sending an Assignment command. When MSB has tuned to the specified traffic channel it responds with an Assignment complete, message, which BSSB relays to VMSCB as an Allocation complete, and sends an Alerting message to indicate that the called user is being alerted. VMSCB sends an ACM to GMSCB, which relays it to the originating exchange.

When the called user answers, MSB sends a Connect message, which BSSB relays to VMSCB. VMSCB:

- responds with a Connect ack message towards MSB;

- sends an ANM to GMSCB, which relays it to the originating exchange;

- sends a Complete call ack to VLRB.

The network then waits for the call to be cleared.

6 Principles for interactions with supplementary services

This clause specifies the principles used to describe the invocation of the GSM or UMTS supplementary services which were standardized when the present document was drafted. Registration, erasure, activation, deactivation and interrogation are call-independent operations; they are therefore outside the scope of the present document. Descriptions may be found in the stage 2 specifications for each supplementary service.

In the modelling used in the present document, each supplementary service which a network entity supports is managed by a supplementary service handler, which handles data in the entity in which it runs. The call handling processes defined in the present document use the data to define the contents of messages to other entities. The basic call handling processes defined in the present document interact with the supplementary service handlers as shown in the SDL diagrams and the supporting text. If a network entity does not support a supplementary service, it bypasses the interaction with the handler for that supplementary service. Exceptions to this general principle are described later in this clause.

6.1 Call Deflection service (3GPP TS 23.072)

The basic call handling processes ICH_MSC and ICH_VLR interact with the CD supplementary service (3GPP TS 23.072 [11]) as described in subclauses 7.3.1 and 7.3.2 respectively.

6.2 Line identification services (3GPP TS 23.081)

6.2.1 Calling Line Identification Presentation (CLIP)

The basic call handling processes ICH_VLR and ICH_MSC interact with the processes CLIP_MAF001 and CLIP_MAF002 (3GPP TS 23.081 [14]) as described in subclauses 7.3.1 and 7.3.2.

6.2.2 Calling Line Identification Restriction (CLIR)

The basic call handling processes OCH_MSC and OCH_VLR interact with the processes CLIR_MAF004 and CLIR_MAF003 (3GPP TS 23.081 [14]) as described in subclauses 7.1.1 and 7.1.2.

6.2.3 Connected Line Identification Presentation (COLP)

The basic call handling processes OCH_MSC and OCH_VLR interact with the processes COLP_MAF006 and COLP_MAF005 (3GPP TS 23.081 [14]) as described in subclauses 7.1.1 and 7.1.2.

The basic call handling processes MT_GMSC and ICH_MSC interact with the process COLP_MAF039 (3GPP TS 23.081 [14]) as described in subclauses 7.2.1 and 7.3.1.

6.2.4 Connected Line Identification Restriction (COLR)

The basic call handling processes ICH_VLR and ICH_MSC interact with the processes COLR_MAF040 and COLR_MAF041 (3GPP TS 23.081 [14]) as described in subclauses 7.3.2 and 7.3.1.

6.3 Call forwarding services (3GPP TS 23.082)

6.3.1 Call Forwarding Unconditional (CFU)

The basic call handling process SRI_HLR interacts with the process MAF007(3GPP TS 23.082 [15]) as described in subclause 7.2.2.

6.3.2 Call Forwarding on mobile subscriber Busy (CFB)

The basic call handling process ICH_VLR interacts with the process MAF008 (3GPP TS 23.082 [15]) as described in subclause 7.3.2.

6.3.3 Call Forwarding on No Reply (CFNRy)

The basic call handling process ICH_VLR interacts with the process MAF009 (3GPP TS 23.082 [15]) as described in subclause 7.3.2.

6.3.4 Call Forwarding on mobile subscriber Not Reachable (CFNRc)

The basic call handling processes SRI_HLR and ICH_VLR interact with the process MAF010 (3GPP TS 23.082 [15]) as described in subclauses 7.2.2 and 7.3.2.

6.4 Call wait (3GPP TS 23.083)

The basic call handling process ICH_VLR interacts with the process MAF013 (3GPP TS 23.083 [16]) as described in subclause 7.3.2. Further details of the handling of call waiting are given in subclauses 7.3.1 and 7.3.2.

6.5 Call hold (3GPP TS 23.083)

Invocation of call hold before a basic call has been established will be rejected.

The basic call handling processes OCH_MSC and ICH_MSC interact with the procedures Process_Hold_Request and Process_Retrieve_Request as described in subclauses 7.1.1 and 7.3.1.

6.6 Multiparty (3GPP TS 23.084)

Invocation of multiparty before a basic call has been established will be rejected.

6.7 Closed user group (3GPP TS 23.085)

The basic call handling process OCH_VLR interacts with the process CUG_MAF014 (3GPP TS 23.085 [18]) as described in subclause 7.1.2.

The basic call handling process SRI_HLR interacts with the process CUG_MAF015 (3GPP TS 23.085 [18]) as described in subclause 7.2.2.

The interactions between call forwarding and CUG (3GPP TS 23.085 [18]) are handled as described in subclause 7.2.2.6.

6.8 Advice of charge (3GPP TS 23.086)

The interactions between Advice of Charge (3GPP TS 23.086 [19]) and MO calls are handled as described in subclauses 7.1.1 and 7.1.2.

The interactions between Advice of Charge (3GPP TS 23.086 [19]) and MT calls are handled as described in subclauses 7.3.1 and 7.3.2.

6.9 User-to-user signalling (3GPP TS 23.087)

The basic call handling processes OCH_MSC, OCH_VLR, MT_GMSC and ICH_MSC interact with the UUS supplementary service as described in subclauses 7.1.1, 7.1.2, 7.2.1 and 7.3.1 respectively.

6.10 Call barring (3GPP TS 23.088)

6.10.1 Barring of outgoing calls

The basic call handling process OCH_VLR interacts with the processes MAF017, MAF018 and MAF020 (3GPP TS 23.088 [21]) as described in subclause 7.1.2.

6.10.2 Barring of incoming calls

The basic call handling process SRI_HLR interacts with the processes MAF022 and MAF023 (3GPP TS 23.088 [21]) as described in subclause 7.2.2.

6.11 Explicit Call Transfer (3GPP TS 23.091)

There is no interaction between Explicit Call Transfer and the basic call handling described in the present document.

6.12 Completion of Calls to Busy Subscriber (3GPP TS 23.093)

The basic call handling processes OCH_MSC, OCH_VLR, MT_GMSC, SRI_HLR, PRN_VLR, ICH_MSC and ICH_VLR interact with the CCBS supplementary service as described in subclauses 7.1.1, 7.1.2, 7.2.1, 7.2.2, 7.2.3, 7.3.1 and 7.3.2respectively.

6.13 Multicall (3GPP TS 23.135)

The basic call handling processes OCH_MSC, OCH_VLR, ICH_MSC & ICH_VLR interact with the Multicall supplementary service as described in subclauses subclauses 7.1.1, 7.1.2, 7.3.1 and 7.3.2respectively.

7 Functional requirements of network entities

The text in this clause is a supplement to the definition in the SDL diagrams; it does not duplicate the information in the SDL diagrams.

The entities described in this clause interwork with other entities over four different types of interface:

- The Iu interface, used to interwork between the MSC and the UTRAN or the UMTS UE;

- The A interface, used to interwork between the MSC and the GSM BSS or the GSM MS;

- The C, D & F interfaces, used to interwork between the MSC & HLR (C), VLR & HLR (D) and MSC & EIR (F);

- Telephony signalling interfaces, used to interwork between an MSC and another exchange.

The protocols used over the Iu interface are RANAP, which is specified in 3GPP TS 25.413 [27], for interworking with the UTRAN and DTAP, which is specified in 3GPP TS 24.008 [26], for interworking with the MS.

The protocols used over the A interface are BSSMAP, which is specified in 3GPP TS 48.008 [2], for interworking with the BSS and DTAP, which is specified in 3GPP TS 24.008 [26], for interworking with the MS.

The protocol used over the C, D & F interfaces is MAP, which is specified in 3GPP TS 29.002 [29].

For the purposes of the present document, the protocol used over telephony signalling interfaces is ISUP, which is specified in ITU-T Recommendations Q.761[33], Q.762 [34], Q.763 [35] and Q.764 [36]; other telephony signalling systems may be used instead.

The present document shows the call handling application processes interworking with a protocol handler for each of the protocols listed above. Each protocol defines supervision timers. If a supervision timer expires before a distant entity responds to a signal, the handling is as defined in the appropriate protocol specification. In general, the protocol handler reports timer expiry to the application as an error condition or negative response. Where a timer is shown in the present document, therefore, it is an **application** timer rather than a **protocol** timer. Interworking with the protocol handlers uses functional signal names which do not necessarily have a one-to-one correspondence with the names of messages used in the protocols.

An MSC which receives an IAM from an originating exchange may react in three different ways:

- It acts as a transit exchange, i.e. it relays the IAM to a destination exchange determined by analysis of the called party address, and thereafter relays other telephony signalling between the originating and destination exchange until the connection is released. This behaviour is not specific to UMTS or GSM;

- It acts as a terminating exchange, i.e. it attempts to connect the call to an MS currently registered in the service area of the MSC;

- It acts as a GMSC, i.e. it interrogates an HLR for information to route the call. If the HLR returns routeing information, the MSC uses the routeing information from the HLR to construct an IAM, which it sends to a destination exchange determined by analysis of the routeing information from the HLR.

Annex A describes the method which the MSC uses to decide how to process the IAM.

The SDL diagrams in this clause show the handling for a number of optional features and services. If the handling consists only of a call to a procedure specific to the feature or service, the procedure call is omitted if the entity does not support an optional feature or service. If the handling consists of more than a call to a procedure specific to the feature or service, the text associated with each SDL diagram specifies the handling which applies if the entity does not support an optional feature or service. For simplicity of description, it is assumed that support for Operator Determined Barring and the Call Forwarding and Call Barring supplementary services is mandatory.

7.1 MO call

7.1.1 Functional requirements of serving MSC

7.1.1.1 Process OCH_MSC

The variable TCH allocated is global data, accessible to the procedure Establish_Originating_TCH_If_Required.

The procedures CCBS_Report_Not_Idle and CCBS_Check_Last_Call are specific to CCBS; they are specified in 3GPP TS 23.093 [23].

7.1.1.2 Procedure Process_Access_Request_MSC

Sheet 1: the processing starting with the input signal "Send UESBI-Iu to Access Network" is specific to PUESBINE. If the MSC does not support PUESBINE, this signal will not be received.

Sheet 1: the task "Convert IMEISV to UESBI" is defined in 3GPP TS 23.195 [25a].

Sheet 2: instead of using the explicit procedure Obtain_IMEI_MSC, the VMSC may encapsulate the request for the IMEI in the Start security procedures message; the BSS relays the response in the Security procedures complete message to the MSC.

Sheet 2: the VMSC maps the negative response received on the B interface to the appropriate reject cause according to the rules defined in 3GPP TS 29.010 [31].

Sheet 2: The Start security procedures message may indicate one of several ciphering algorithms, or (for GSM only) no ciphering.

Sheet 2, sheet 3: At any stage, the MS may terminate the transaction with the network by sending a CM service abort message.

Sheet 2, sheet 3: if the VMSC receives a Set-up message from the MS while the access request is being handled, the message is saved for processing after the access request has been handled.

7.1.1.3 Procedure OG_Call_Setup_MSC

Sheet 1: the variables Alerting sent, MS connected and Reconnect are global data, accessible to the procedures CCBS_Check_OG_Call, CCBS_OCH_Report_Failure, CCBS_OCH_Report_Success, CCBS_Check_If_CCBS_Possible, Send_Alerting_If_Required and Send_Access_Connect_If_Required.

Sheet 1: the variable UUS1 result sent is specific to UUS. This variable is accessible to all UUS specific procedures.

Sheet 1: the procedure UUS_OCH_Check_Setup is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 1: the VMSC converts the PLMN bearer capability negotiated between the VMSC and the MS to a basic service according to the rules defined in 3GPP TS 27.001 [28].

Sheet 1: the procedure CAMEL_N_CSI_CHECK_MSC is specific to CAMEL Phase 3 or later, it is specified in 3GPP TS 23.078 [12].

Sheet 1: the procedure Check_OG_Multicall_MSC is specific to Multicall; it is specified in 3GPP TS 23.135 [25]. If the VMSC does not support Multicall, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 1: the variable "On_Hold" is used only if the VMSC supports Call Hold.

Sheet 1, sheet 2, sheet 3, sheet 6: the procedure CCBS_OCH_Report_Failure is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 1, sheet 2, sheet 6, sheet 7, sheet 9: at any stage after the Set-up has been received, the MS may terminate the transaction with the network by sending a Release transaction request.

Sheet 2, sheet 3, sheet 4, sheet 5, sheet 6, sheet 7, sheet 8, sheet 9: signals are sent to and received from the process Subs_FSM as described in subclause 7.4.

Sheet 3: the procedure Set_CLI_Presentation_Indicator_MSC is specific to CLIR. If the VMSC does not support CLIR, processing continues from the "Yes" exit of the test "Result=Call allowed?".

Sheet 3: the procedure CAMEL_OCH_MSC_INIT is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 3: the procedure CAMEL_MO_Dialled_Services is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 3 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 3: the procedure CCBS_Check_OG_Call is specific to CCBS; it is specified in 3GPP TS 23.093 [23]. If the VMSC does not support CCBS, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 3: the procedure MOBILE_NUMBER_PORTABILITY_IN_OQoD is specific to Mobile Number Portability; it is specified in 3GPP TS 23.066 [10].

Sheet 3: the procedure UUS_OCH_Set_Info_In_IAM is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 3: the procedure CAMEL_Store_Destination_Address is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 3: the procedure CCBS_OCH_Report_Success is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 3, sheet 5: the procedure CAMEL_OCH_LEG1_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 4, sheet 7: the procedures CAMEL_Start_TNRy and CAMEL_Stop_TNRy are specific to CAMEL phase 2 or later; they are specified in 3GPP TS 23.078 [12].

Sheet 4: the task "UTU2Cnt := 0" is executed only if the VMSC supports UUS

Sheet 4: the procedure CAMEL_OCH_MSC_ALERTING is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 4 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 5: the procedure CAMEL_OCH_MSC_ANSWER is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 5: the procedure Set_COLP_Info_MSC is specific to COLP.

Sheet 5: the procedure Handle_AoC_MO_MSC is specific to AoC.

Sheet 5: the task "Store CW treatment indicator for this call if received in SII2" is executed only if the VMSC supports CAMEL phase 3 or later.

Sheet 5: The process CAMEL_OCH_LEG2_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 6: the procedures CCBS_Check_If_CCBS_Possible and CCBS_Activation_MSC are specific to CCBS; they are specified in 3GPP TS 23.093 [23]. The task "Store CCBS Result" is executed only if the VMSC supports CCBS. If the VMSC does not support CCBS, processing continues from the "CCBS Not Possible" exit of the test "CCBS Result".

Sheet 6, sheet 7: the procedure CAMEL_OCH_MSC_DISC3 is specific to CAMEL Phase 1; it is specified in 3GPP TS 23.078 [12].

Sheet 6, sheet 7: the procedure CAMEL_OCH_MSC_DISC4 is specific to CAMEL Phase 2 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 6, sheet 6: the procedure CAMEL_OCH_MSC1 is specific to CAMEL phase 2 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 2 or later, processing continues from the "No" exit of the test "Result=Reconnect?".

Sheet 6, sheet 7, sheet 9: the processing in the branch beginning with the Int_Release_Call input will occur only if the MSC supports CAMEL.

Sheet 7, sheet 9: the procedure UUS_MSC_Check_UUS1_UUI is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 8: the input signal TNRy expired and all the subsequent processing are specific to CAMEL phase 2 or later, and will occur only if the VMSC supports CAMEL phase 2 or later. The procedure CAMEL_OCH_MSC2 is specified in 3GPP TS 23.078 [12].

Sheet 8: the input signal User To User is specific to UUS; it is discarded if the VMSC does not support UUS.

Sheet 8: the procedures UUS_MSC_Check_UUS2_UUI_to_MS and UUS_MSC_Check_UUS2_UUI_to_NW are specific to UUS; they are specified in 3GPP TS 23.087 [20].

Sheet 9: the procedure CAMEL_OCH_MSC_DISC1 is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL, processing continues from the "No" exit of the test "Result=CAMEL handling?".

Sheet 9: the procedure CAMEL_OCH_MSC_DISC2 is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL, processing continues from the "No" exit of the test "Result=CAMEL handling?".

Sheet 10: the procedure Process_Hold_Request is specific to Call Hold; it is specified in 3GPP TS 23.083[16].

Sheet 10: the procedure Process_Retrieve_request is specific to Call Hold; it is specified in 3GPP TS 23.083[16].

7.1.1.4   Procedure Obtain_IMSI_MSC

The MS may terminate the transaction with the network while the VMSC is waiting for the MS to return its IMSI. If a CC connection has not been established, the MS uses CM Service Abort; otherwise it uses a Release, Release Complete or Disconnect. The VMSC aborts the transaction with the VLR and returns an aborted result to the parent process.

7.1.1.5   Procedure Authenticate_MSC

The MS may terminate the transaction with the network while the VMSC is waiting for the MS to respond to an authentication request. If a CC connection has not been established, the MS uses CM Service Abort; otherwise it uses a Release, Release Complete or Disconnect. The VMSC aborts the transaction with the VLR and returns an aborted result to the parent process.

7.1.1.6   Procedure Obtain_IMEI_MSC

The Send IMEI request to the MS specifies the IMEISV as the requested identity.

The MS may terminate the transaction with the network while the VMSC is waiting for the MS to return its IMEI. If a CC connection has not been established, the MS uses CM Service Abort; otherwise it uses a Release, Release Complete or Disconnect. The VMSC aborts the transaction with the VLR and returns an aborted result to the parent process.

7.1.1.7   Procedure Check_IMEI_MSC

The MS may terminate the transaction with the network while the VMSC is waiting for the MS to return its IMEI. If a CC connection has not been established, the MS uses CM Service Abort; otherwise it uses a Release, Release Complete or Disconnect. The VMSC aborts the transaction with the VLR and returns an aborted result to the parent process.

The MS may terminate the transaction with the network while the VMSC is waiting for the result of the IMEI check from the EIR. If a CC connection has not been established, the MS uses CM Service Abort; otherwise it uses a Release, Release Complete or Disconnect. The VMSC aborts the transaction with the VLR and returns an aborted result to the parent process.

7.1.1.8   Procedure Establish_Originating_TCH_If_Required

7.1.1.9   Procedure Set_CLI_Presentation_Indicator_MSC

The MS may terminate the transaction with the network by sending a Release transaction message while a response is awaited from the process CLIR_MAF004. The message is saved for processing after return from the procedure.

7.1.1.10   Procedure Send_Alerting_If_Required

The test "Backward call indicator=no indication" refers to the called party's status field in the backward call indicators parameter of the ISUP Address Complete message which triggered the call of the procedure Send_Alerting_If_Required.

The procedures UUS_MSC_Check_UUS1_UUI and UUS_OCH_Set_Alert_And_Connect_Param are specific to UUS; they are specified in 3GPP TS 23.087 [20]. If the VMSC does not support UUS, processing continues from the "Yes" exit of the test "Result=Pass?".

If no useful information would be carried in the Progress message, it is not sent.

7.1.1.11   Procedure Set_COLP_Info_MSC

The MS may terminate the transaction with the network by sending a Release transaction message while a response is awaited from the process COLP_MAF006. The message is saved for processing after return from the procedure.

7.1.1.12   Procedure Send_Access_Connect_If_Required

The test "Acknowledgement required" refers to the result returned by the procedure Handle_AoC_MSC. If the VMSC does not support AoC, processing continues from the "No" exit of the test "Acknowledgement required".

The procedure UUS_OCH_Set_Alert_And_Connect_Param is specific to UUS, it is specified in 3GPP TS 23.087 [20]. If the VMSC does not support UUS, processing continues from the "Yes" exit of the test "Result=Pass?".

If no useful information would be carried in the Facility message, it is not sent.

7.1.1.13   Procedure Handle_AoC_MO_MSC

The charging parameters and the Boolean variable Acknowledgement required are global data which can be read by the parent process.

7.1.1.14 Procedure TCH_Check

Process OCH_MSC   OCH_MSC1(1)

Process in the MSC to
handle an outgoing call request

Idle

Signals from the left
are from the BSS

CM
service
request

Process_
Access_
Request_MSC

Result=
Pass? — No

Yes

Wait_For_
Setup

Setup   CM
                                               Service
                                               Abort

See TS 23.093 —— CCBS_Report_
                 Not_Idle

TCH allocated:=
False

OG_Call_
Setup_MSC

See TS 23.093 —— CCBS_Check_
                 Last_Call

Release
call
resources

Idle

Figure 6: Process OCH_MSC

Procedure Process_Access_Request_MSC   PAR_MSC1(3)

Procedure in the MSC
to handle a request from
the MS for system access

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the VLR.

Process
Access
Request

Wait_For_
PAR_Result

Provide
IMSI

Obtain_IMSI_
MSC

Result=
Pass?

No

Result:=
Fail

Yes

Wait_For_
PAR_Result

Authenticate

Authenticate_
MSC

Result=
Pass?

No

Result:=
Fail

Yes

Wait_For_
PAR_Result

Trace
Subscriber
Activity

Tracing
Active:=
TRUE

Wait_For_
PAR_Result

Wait_For_
PAR_Result

CM
service
abort

Abort

Result:=
Fail

Start
security
procedures

Ciphering
Required:=
True

Wait_For_
PAR_Result

Provide
IMEI

Obtain_IMSI_
MSC

Result=
Pass?

No

Result:=
Fail

Yes

Wait_For_
PAR_Result

Send UESBI-Iu
to Access Network

Convert IMEISV
to UESBI-Iu

See 3GPP TS 23.195

UESBI-Iu

Wait_For_
PAR_Result

Figure 7a: Procedure Process_Access_Request_MSC (sheet 1)

Procedure Process_Access_Request_MSC PAR_MSC2(3)

Procedure in the MSC to handle a request from the MS for system access

Wait_For_ PAR_Result

Signals to/from the left are to/from the BSS; signals to/from the right are to/from the VLR.

Abort

Process Access Request negative response

Process Access Request ack

CM Service type = Page Response?

Yes

No

Ciphering required

False

True

CM Service type = Page Response?

Yes

No

Map negative response to reject cause

Release transaction

CM Service Reject

Result:= Fail

Start security procedures

CM Service Accept

Wait_For_ TMSI_ Reallocation

CM service abort

Provide IMEI

Setup

Check IMEI

Abort

Forward New TMSI

Use Existing TMSI

Obtain_IMEI_ MSC

Check_IMEI_ MSC

Map negative response to reject cause

Abort

Result= Pass?

No

No

Result= Pass?

CM Service Reject

Reallocate TMSI

Result:= Fail

Yes

Yes

Result:= Fail

Result:= Pass

Result:= Fail

Result:= Fail

Wait_For_ TMSI_ Reallocation

Wait_For_ TMSI_ Reallocation

Wait_For_ TMSI_Ack

Figure 7b: Procedure Process_Access_Request_MSC (sheet 2)

Figure 7c: Procedure Process_Access_Request_MSC (sheet 3)

Figure 8a: Procedure OG_Call_Setup_MSC (sheet 1)

Procedure OG_Call_Setup_MSC OCS_MSC2(11)

Figure 8b: Procedure OG_Call_Setup _MSC (sheet 2)

Procedure OG_Call_Setup_MSC

OCS_MSC3(11)

Procedure in the originating VMSC
to set up an outgoing call after a Setup
message has been received from the MS

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the destination exchange
unless otherwise marked.

Figure 8c: Procedure OG_Call_Setup _MSC (sheet 3)

ETSI

Figure 8d: Procedure OG_Call_Setup _MSC (sheet 4)

Procedure OG_Call_Setup_MSC   OCS_MSC5(11)

Procedure in the originating VMSC
to set up an outgoing call after a Setup
message has been received from the MS

Signals from the left
are from the BSS;
signals to the right
are to the process
Subs_FSM

Figure 8e: Procedure OG_Call_Setup _MSC (sheet 5)

Procedure OG_Call_Setup_MSC OCS_MSC6(11)

Procedure in the originating VMSC
to set up an outgoing call after a Setup
message has been received from the MS

Wait_For_
ACM

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the destination exchange
unless otherwise marked.

Release
transaction

Release | From
destination
exchange

From gsmSSF

Int_Release
Call

CCBS_OCH_
Report_Failure | See TS 23.093

CCBS_Check_
If_CCBS_
Possible | See TS 23.093

See TS 23.093

CCBS_OCH_
Report_Failure

Store CCBS
Result

CAMEL Phase 2
or higher
supported?

CAMEL Phase 2
or higher
supported?

No   Yes

No   Yes

Yes | Release cause=
No answer
from user?

No

CAMEL_OCH_
MSC_DISC3

CAMEL_OCH_
MSC_DISC4

CAMEL_OCH_
MSC_DISC3

CAMEL_OCH_
MSC1

4

No   Result=
Reconnect? | See TS 23.078

Release
transaction

Yes

3

CCBS
Possible

CCBS
Result

CCBS Not
Possible

Release

Release
transaction

CCBS_
Activation_
MSC | See TS 23.093

Release

Call setup
failed | To Subs_FSM

⊗

Figure 8f: Procedure OG_Call_Setup _MSC (sheet 6)

Procedure OG_Call_Setup_MSC OCS_MSC7(11)

Procedure in the originating VMSC
to set up an outgoing call after a Setup
message has been received from the MS

Wait_For_Connect_Ack
Wait_For_Answer

Release
transaction

Release

From gsmSSF

Int_Release
Call

CAMEL Phase 2
or higher
supported?

CAMEL Phase 2
or higher
supported?

No   Yes

No   Yes

Yes

Release cause=
No answer from user?

No

4

CAMEL_OCH_
MSC_DISC3

CAMEL_OCH_
MSC_DISC4

CAMEL_OCH_
MSC_DISC3

CAMEL_OCH_
MSC1

See TS 23.078

Release
transaction

UUS_MSC_
Check_
UUS1_UUI

See TS 23.087

No

Result=
Reconnect?

Yes

See TS 23.087

UUS_MSC_
Check_
UUS1_UUI

3

Release

Release
transaction

Release

Call setup
failed

To Subs_FSM

⊗

Signals to/from the left are to/from the BSS;
signals to/from the right
are to/from the destination exchange
unless otherwise marked.

Figure 8g: Procedure OG_Call_Setup _MSC (sheet 7)

Procedure OG_Call_Setup_MSC OCS_MSC8(11)

Procedure in the originating VMSC
to set up an outgoing call after a Setup
message has been received from the MS

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the destination exchange
unless otherwise marked.

Figure 8h: Procedure OG_Call_Setup _MSC (sheet 8)

Procedure OG_Call_Setup_MSC OCS_MSC9(11)

Procedure in the originating VMSC
to set up an outgoing call after a Setup
message has been received from the MS

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the destination exchange
unless otherwise marked.

Wait_For_Clear

Release transaction

Release

from gsmSSF

Int_Release Call

UUS_MSC_ Check_ UUS1_UUI — See TS 23.087

UUS_MSC_ Check_ UUS1_UUI — See TS 23.087

Release transaction

CAMEL_OCH_ MSC_DISC1 — See TS 23.078

CAMEL_OCH_ MSC_DISC2 — See TS 23.078

Result= Reconnect?
Yes
No

Result= CAMEL handling?
Yes
No

Yes

Result= CAMEL handling?
No

3

Release

Release transaction

Release

Call cleared — To Subs_FSM

Figure 8i: Procedure OG_Call_Setup _MSC (sheet 9)

ETSI

Procedure OG_Call_Setup_MSC OCS_MSC10(11)

Procedure in the originating VMSC to set up an outgoing call after a Setup message has been received from the MS

Signals to/from the left are to/from the BSS

Figure 8j: Procedure OG_Call_Setup _MSC (sheet 10)

ETSI

Procedure OG_Call_Setup_MSC OCS_MSC11(11)

Procedure in the originating VMSC
to set up an outgoing call after a Setup
message has been received from the MS

Signals from the left
are from the BSS;
signals to the right
are to the Subs_FSM process.

Wait_For_
Clear

ECT
request

MPTY
request

ECT
request

MPTY
request

Wait_For_
Clear

Figure 8k: Procedure OG_Call_Setup _MSC (sheet 11)

ETSI

Procedure Obtain_IMSI_MSC OIMSI_M1(1)

Procedure in the MSC
to obtain the IMSI from the MS
and relay it to the VLR

Signals to/from the left
are to/from the BSS;
Signals to/from the right
are to/from the VLR

Send
IMSI

Wait_For_
IMSI

Send IMSI
ack

Release
transaction

Send IMSI
negative
response

Release
transaction

Provide
IMSI ack

Abort

Result:=
Pass

Result:=
Aborted

Figure 9: Procedure Obtain_IMSI_MSC

Procedure Authenticate_MSC   AUT_MSC 1(1)

Procedure in the MSC
to obtain an authentication
response from the MS
and relay it to the VLR

Signals to/from the left
are to/from the BSS;
Signals to/from the right
are to/from the VLR

Authenticate

Wait_For_
Auth_Response

| Authenticate ack | Release transaction | Authenticate negative response |

Authenticate ack

Abort

Authenticate negative response

Release transaction

Wait_For_
Auth_Result

Result:=
Aborted

| Authentication accepted | Authentication rejected |

Authentication rejected

Result:=
Pass

Figure 10: Procedure Authenticate_MSC

Procedure Obtain_IMEI_MSC   OIMEI_M1(1)

Procedure in the MSC
to obtain the IMEI from the MS
and relay it to the VLR

Signals to/from the left
are to/from the BSS;
Signals to/from the right
are to/from the VLR

Send
IMEI

Wait_For_
IMEI

Send IMEI
ack

Release
transaction

Send IMEI
negative
response

Release
transaction

Provide
IMEI ack

Abort

Result:=
Pass

Result:=
Aborted

Figure 11: Procedure Obtain_IMEI_MSC

Procedure Check_IMEI_MSC CIMEI_M1(1)

Procedure in the MSC to check the IMEI and relay the result to the VLR

Signals to/from the left are to/from the BSS; signals to/from the right are to/from the VLR unless marked otherwise.

IMEI available? — Yes

No

Send IMEI

Wait_For_ IMEI

CM service abort

Send IMEI negative response

Send IMEI ack

Release transaction

Check IMEI — To EIR

Abort

Wait_for_ Check_IMEI_ Result

Result:= Aborted

Release transaction

Check IMEI negative response — From EIR

Check IMEI ack — From EIR

Abort

Check IMEI negative response

Check IMEI ack

Result:= Aborted

Result:= Pass

Figure 12: Procedure Check_IMEI_MSC

ETSI

Procedure Establish_Originating_TCH_If_Required   EOTCIR1(1)

Procedure in the originating VMSC
to establish a Traffic Channel
if one has not been established
for this call

Signals to/from the left
are to/from the BSS;
signals to the right are
to the process Subs_FSM

TCH_Check

Result

Use existing   Allocate   Aborted, Fail   Reject

Allocate
channel

Wait_For_
Allocation_
Complete

Release   Allocation   Allocation
transaction   failure   complete

Release
transaction

Result:=   Result:=   Result:=   Result:=   Result:=
Pass   Fail   Pass   Fail   Rejected

Call setup   Call setup
failed   failed

Figure 13: Procedure Establish_Originating_TCH_If_Required

Procedure Set_CLI_Presentation_Indicator_MSC CAIND_M1(1)

Procedure in the MSC to determine the CLI presentation indicator value

Signals to/from the right are to/from the process CLIR_MAF004

Initiate handling of CLIR

Wait_For_ CLIR_Info

Release transaction — From BSS

Clear call

Continue call handling

Result:= Call not allowed

Result:= Call allowed

Figure 14: Procedure Set_CLI_Presentation_Indicator_MSC

Procedure Send_Alerting_If_Required   SALTIR1(1)

Procedure to send an
Alerting message to the MS
if one is required for this call

Signals to the left
are to the BSS

True ── Alerting sent

False

True ── Access
Connect
sent

False

Yes ── ◇ ── Backward call indicator=
no indication?

No

See TS 23.087 ─ ─ UUS_MSC_
Check_
UUS1_UUI

UUS_OCH_Set_
Alert_And_
Connect_Param ─ ─ See TS 23.087

Result=
Pass? ── No

Yes

Progress

Alerting

Alerting sent:=
True

Result:=
Pass

Result:=
Fail

Figure 15: Procedure Send_Alerting_If_Required

ETSI

Procedure Set_COLP_Info_MSC COINF_M1(1)

Procedure in the MSC
to determine the COLP
information to be sent to the MS

Signals to/from the right
are to/from the process
COLP_MAF006

Initiate
handling
of COLP

Wait_For_
COLP_Info

Release
transaction — From BSS

Continue
call
handling

Release — From
destination
exchange
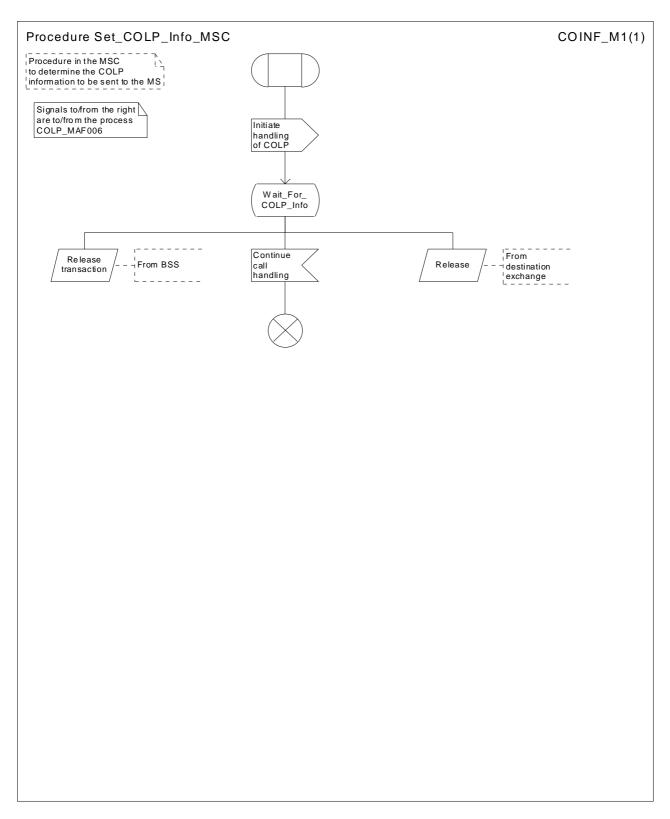
Figure 16: Procedure Set_COLP_Info_MSC

Procedure Handle_AoC_MO_MSC AoCMO_M1(1)
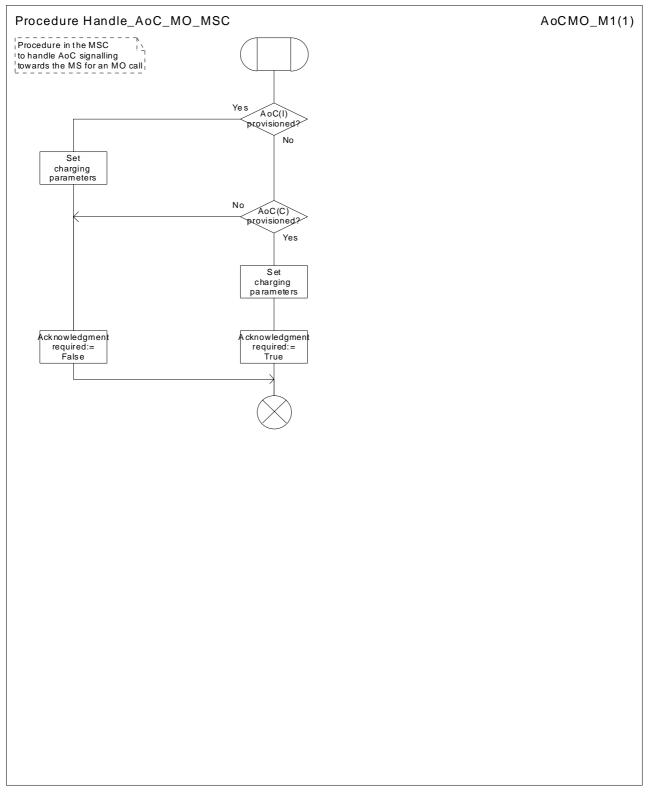
Figure 17: Procedure Handle_AoC_MO_MSC

Procedure Send_Access_Connect_If_Required SACONIR1(1)

Procedure to send a
Connect message
to the MS
if one is required for this call

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the destination exchange

True MS False
connected

UUS_OCH_
Set_Alert_And_ ¬ See TS 23.087
Connect_Param

Facility Connect

No Acknowledgment No Acknowledgment
required? required?
Yes Yes

Start AoC Start AoC
acknowledgment acknowledgment
timer timer

Wait_For_ Wait_For_
AoC_Ack_F AoC_Ack_C

Charging Release AoC Charging Release Connect AoC
Parameters transaction acknowledgment Parameters transaction Ack acknowledgment
ack timer expired ack timer expired

Release Release
transaction transaction

Release Release

Result:= Result:= Result:= Result:=
Facility Fail Connect Fail
sent sent

Figure 18: Procedure Send_Access_Connect_If_Required

Procedure TCH_Check   TCH_Ch1(1)

Procedure in originating or terminating
VMSC to check if a trafic channel has
been established for this call.

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the process
Subs_FSM

No ← Is call speech?

Yes

Non speech TCH required

Speech TCH required

Wait_For_TCH_Result

From GMSC -- Release

Release transaction

Allocate TCH

TCH available

TCH already allocated

Result:= Aborted

Result := Fail

Result := Allocate

Result := Use existing

Result := Reject

⊗

Figure 19: Procedure OCH_VLRTCH_Check

7.1.2 Functional requirements of VLR

7.1.2.1 Process OCH_VLR

7.1.2.2 Procedure Process_Access_Request_VLR

Sheet 1: the processing starting with the test "IMEISV stored" and finishing with the output signal "Send UESBI-Iu to RNC" is specific to PUESBINE. If the VLR does not support PUESBINE, the processing starts with the test "Identity known?"

Sheet 1: it is a network operator decision (subject to MoU requirements) how often an MS should be authenticated.

Sheet 1: it is a network operator decision (subject to MoU requirements) how often an MS should be authenticated.

Sheet 2: the process Subscriber_Present_VLR is described in 3GPP TS 29.002 [29].

Sheet 2: it is a network operator decision (subject to MoU requirements) whether a GSM connection should be ciphered. A UMTS connection shall always be ciphered.

Sheet 3: it is a network operator decision (subject to MoU requirements) how often an IMEI should be checked.

Sheet 3, sheet 4, sheet 5: the procedure CCBS_Report_MS_Activity is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 5: it is a network operator decision whether emergency calls are allowed from an ME with no SIM.

7.1.2.3 Procedure OG_Call_Subscription_Check_VLR

Sheet 1: it is an implementation option to carry out the check for operator determined barring of all outgoing calls before the check on provisioning of the requested basic service.

Sheet 1: the procedure Check_OG_Multicall_VLR is specific to Multicall; it is specified in 3GPP TS 23.135 [25]. If the VMSC does not support Multicall, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 1: the procedure OG_CUG_Check is specific to CUG. If the VLR does not support CUG, processing continues from the "Yes" exit of the test "Result=Call allowed?".

Sheet 1: the procedure Get_LI_Subscription_Info_MO_VLR is specific to CLIR and COLP. If the VLR supports neither CLIR nor COLP, the procedure call is omitted.

Sheet 1: the procedure Get_AoC_Subscription_Info_VLR is specific to AoC.

Sheet 1: the procedure UUS_OCH_Check_Provision is specific to UUS; it is specified in 3GPP TS 23.087 [20]. If the VMSC does not support UUS, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 2: the procedure CAMEL_OCH_VLR is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the VLR does not support CAMEL, processing continues from connector 1 to the call to the procedure Check_OG_Barring.

Sheet 2: the negative response "call barred" indicates whether the reason is operator determined barring or supplementary service barring, according to the result returned by the procedure Check_OG_Barring.

7.1.2.4 Procedure Obtain_Identity_VLR

It is a network operator decision whether open (non ciphered) identification of the MS by its IMSI is allowed.

7.1.2.5 Procedure Obtain_IMSI_VLR

7.1.2.6 Procedure Authenticate_VLR

Sheet 1: the number of unused authentication sets which triggers the VLR to request further authentication sets from the HLR is an operator option.

7.1.2.7 Procedure Obtain_Authentication_Sets_VLR

7.1.2.8 Procedure Start_Tracing_VLR

7.1.2.9 Procedure Check_IMEI _VLR

If the response from the EIR to a request to check an IMEI is:

- blacklisted, then service is not granted;

- greylisted, then service is granted, but the network operator may decide to initiate tracing;

- whitelisted, then service is granted.

7.1.2.10 Procedure Obtain_IMEI_VLR

7.1.2.11 Process Fetch_Authentication_Sets_VLR

7.1.2.12 Procedure Check_BAOC

Sheet 1: if the VLR receives an Abort message from the MSC while it is awaiting a response from the process MAF017, the message is saved for handling after return from the procedure.

7.1.2.13 Procedure OG_CUG_Check

If the VLR receives an Abort message from the MSC while it is awaiting a response from the process MAF014, the message is saved for handling after return from the procedure.

7.1.2.14 Procedure Get_LI_Subscription_Info_MO_VLR

If the VLR does not support CLIR, it omits the signal interchange with the process CLIR_MAF003.

If the VLR does not support COLP, it omits the signal interchange with the process COLP_MAF005.

If the VLR receives an Abort message from the MSC while it is awaiting a response from the process CLIR_MAF003 or the process COLP_MAF005, the message is saved for handling after return from the procedure.

7.1.2.15 Procedure Get_AoC_Subscription_Info_VLR

The indicator of whether or not AoC is provisioned is global data which can be read by the parent process.

7.1.2.16 Procedure Check_OG_Barring

Sheet 3: if the VLR receives an Abort message from the MSC while it is awaiting a response from the process MAF018 or MAF019, the message is saved for handling after return from the procedure.

7.1.2.17 Process Update_Location_VLR

The procedure Update_HLR_VLR is described in 3GPP TS 23.012 [6].

Process OCH_VLR   OCH_VLR1(1)

Process in the VLR
to handle an outgoing
(MO) call setup request

Signals to/from the left
are to/from the MSC.

Idle

Process
Access
Request

Process_
Access_
Request_VLR

Result=   No
Pass

Yes

Wait_For_   Idle
SIFOC

Send Info   Abort
For Outgoing
Call

Idle

Yes   Emergency
call?

No

Complete   OG_Call_
Call   Subscription_
Check_VLR

Idle   Idle

Figure 7.1.2.1: Process OCH_VLR

Procedure Process_Access_Request_VLR PAR_VLR1(5)

Procedure in the VLR
to handle a request from
the MS for system access

Signals to/from the left
are to/from the MSC

IMEISV stored? — Yes

No

Obtain_IMEI_VLR

Result=Pass? — No

Yes

Result:=Aborted

Send UESBI-Iu to Access Network

Identity known? — No

Yes

Obtain_Identity_VLR

Result=Pass? — Yes / No

Identity=IMEI? — Yes

No

Result=Fail? — No

Yes

Authentication required? — No

Yes

Authenticate_VLR

Result=Pass? — No

Yes

IMSI detached:=False

Confirmed by Radio Contact:=True

Set negative response: System Failure

Set negative response: Unidentified Subscriber

Result:=Aborted

2   1   3   3

Figure 7.1.2.2a: Procedure Process_Access_Request_VLR (sheet 1)

ETSI

Figure 7.1.2.2b: Procedure Process_Access_Request_VLR (sheet 2)

Procedure Process_Access_Request_VLR   PAR_VLR3(5)

Procedure in the VLR
to handle a request from
the MS for system access

Signals to the left
are to the MSC.

④   ⑤

Start
security
procedures

Identity:=
IMSI

Process
Access
Request ack

No — IMEI check
required? — Yes

Check_
IMEI_VLR

Result=
Pass? — No

Yes

TMSI
reallocation
required? — No

Yes

CCBS_Report_
MS_Activity --- See TS 23.093

Result=
Fail? — No

Yes

Forward
New TMSI

Use
Existing
TMSI

IMSI
detached:=
True

Result:=
Aborted

Freeze
existing
TMSI

Result:=
Pass

Set negative
response:
Illegal
Equipment

Wait_For_
TMSI_Ack

⊗   ③   ⊗

Figure 7.1.2.2c: Procedure Process_Access_Request_VLR (sheet 3)

Procedure Process_Access_Request_VLR PAR_VLR4(5)

Procedure in the VLR
to handle a request from
the MS for system access

Signals from the left
are from the MSC.

2

Result=
Aborted? — Yes → Result:=
Aborted

No

Result=
Procedure
Error? — Yes

No

Set negative
response:
System
Failure

Result=
Unknown
Subscriber? — Yes

No

Result=
Unidentified
Subscriber? — Yes

No

Set negative
response:
Unidentified
Subscriber

Set negative
response:
Illegal
Subscriber

3

Wait_For_
TMSI_Ack

Forward
New TMSI
ack

Forward
New TMSI
negative
response

Unfreeze
existing
TMSI

CCBS_Report_
MS_Activity — See TS 23.093

Result:=
Pass

Figure 7.1.2.2d: Procedure Process_Access_Request_VLR (sheet 4)

Procedure Process_Access_Request_VLR   PAR_VLR5(5)

Procedure in the VLR
to handle a request from
the MS for system access

Signals to the left
are to the MSC.

(3)

CM service type
=Emergency call? → No

Yes

Emergency call
setup allowed
without SIM?

No →

Yes

No ← IMEI
required?

Yes

Obtain_
IMEI_VLR

Result=
Pass? → No

Yes

Identity:=
IMEI

Result=
Fail? → Yes

No

Process
Access
Request ack

Process Access
Request
negative
response

See TS 23.093 -- CCBS_Report_
MS_Activity

Result:=
Pass

Result:=
Aborted

Result:=
Fail

⊗

⊗

⊗

Figure 7.1.2.2e: Procedure Process_Access_Request_VLR (sheet 5)

ETSI

Figure 7.1.2.3a: Procedure OG_Call_Subscription_Check_VLR (sheet 1)

Procedure OG_Call_Subscription_Check_VLR OCSCVLR 2(2)

Procedure in the VLR
to perform subscription
checks for an outgoing call

Signals to the left
are to the MSC

1

CAMEL_
OCH_VLR ---- See TS 23.078

Result=
Fail? — Yes

No

Check_OG_
Barring

Call
barred? — Yes

No

Set negative
response:
Call barred

Complete
Call

Send Info
For Outgoing
Call negative
response

Figure 7.1.2.3b: Procedure OG_Call_Subscription_Check _VLR (sheet 2)

Procedure Obtain_Identity_VLR OID_VLR1(1)

Procedure in the VLR
to obtain the identity of an MS

```
                            Identity=
                  Yes         IMSI?
                               No

                          Identification
                          allowed?
                  No          Yes

                          Obtain_
                          IMSI_VLR

                                        No
                          Result=
                          Pass?
                               Yes

                  No       IMSI
                          known?
                               Yes

      Result:=         Result:=         Result:=
       Fail             Pass            Aborted

        ⊗               ⊗               ⊗
```

Figure 7.1.2.4: Procedure Obtain_Identity_VLR

ETSI

Procedure Obtain_IMSI_VLR OIMSI_V1(1)

Process in the VLR
to obtain the IMSI
from the MS via the MSC

Signals to/from the left
are to/from the MSC.

Provide
IMSI

Wait_For_
IMSI

Provide
IMSI ack

Abort

Result:=
Pass

Result:=
Aborted

Figure 7.1.2.5: Procedure Obtain_IMSI_VLR

Figure 7.1.2.6a: Procedure Authenticate_VLR (sheet 1)

Figure 7.1.2.6b: Procedure Authenticate_VLR (sheet 2)

Procedure Obtain_Authentication_Sets_VLR OAS_VLR1(2)

Procedure in the VLR
to obtain authentication
sets from the HLR

Signals to/from the right
are to/from the HLR

Send
Authentication
Info

Wait_For_
Authentication_
Sets

Send
Authentication
Info ack

Send
Authentication
Info negative
response

Empty
result?

Yes

No
Unknown
Subscriber?

No

Yes

Authentication
sets available
in VLR?

No

Yes

Re-use
old
sets?

Yes

No

Result:=
Pass

Result:=
Procedure
Error

Result:=
Unknown
Subscriber

Figure 7.1.2.7a: Procedure Obtain_Authentication_Sets_VLR (sheet 1)

Procedure Obtain_Authentication_Sets_VLR OAS_VLR2(2)

Procedure in the VLR
to obtain authentication
sets from the HLR

Signals to/from the left
are to/from the MSC;
Signals to/from the right
are to/from the HLR

Wait_For_
Authentication_
Sets

Abort

Abort

Abort

Authentication
sets available?

No

Yes

Yes Re-use
old
sets?

No

Result:=
Aborted

Result:=
Pass

Result:=
Procedure
Error

Figure 7.1.2.7b: Procedure Obtain_Authentication_Sets_VLR (sheet 2)

Procedure Start_Tracing_VLR ST_TR_V1(1)

Procedure in the VLR
to request the MSC to
start activity tracing

Signals to the left
are to the MSC.

Tracing active? — No

Yes

Trace Subscriber Activity

Figure 7.1.2.8: Procedure Start_Tracing_VLR

Procedure Check_IMEI_VLR   CIMEI_V1(1)

Procedure in the VLR
to request the MSC to
check an IMEI

Signals to/from the left
are to/from the MSC

Check
IMEI

Wait_For_
Check_IMEI_
Result

Abort

Check
IMEI negative
response

Check
IMEI ack

Service
granted?   No

Yes

Result:=
Aborted

Result:=
Fail

Result:=
Pass

Figure 7.1.2.9: Procedure Check_IMEI_VLR

Procedure Obtain_IMEI_VLR   OIMEI_V1(1)

Process in the VLR
to obtain the IMSI
from the MS via the MSC

Signals to/from the left
are to/from the MSC

Provide
IMEI

Wait_For_
IMEI

Provide
IMEI ack

Abort

Store IMEISV

Result:=
Pass

Result:=
Aborted

Figure 7.1.2.10: Procedure Obtain_IMEI _VLR

ETSI

Process Fetch_Authentication_Sets_VLR FAS_VLR 1(1)

Process in the VLR
to retrieve authentication
sets from the HLR
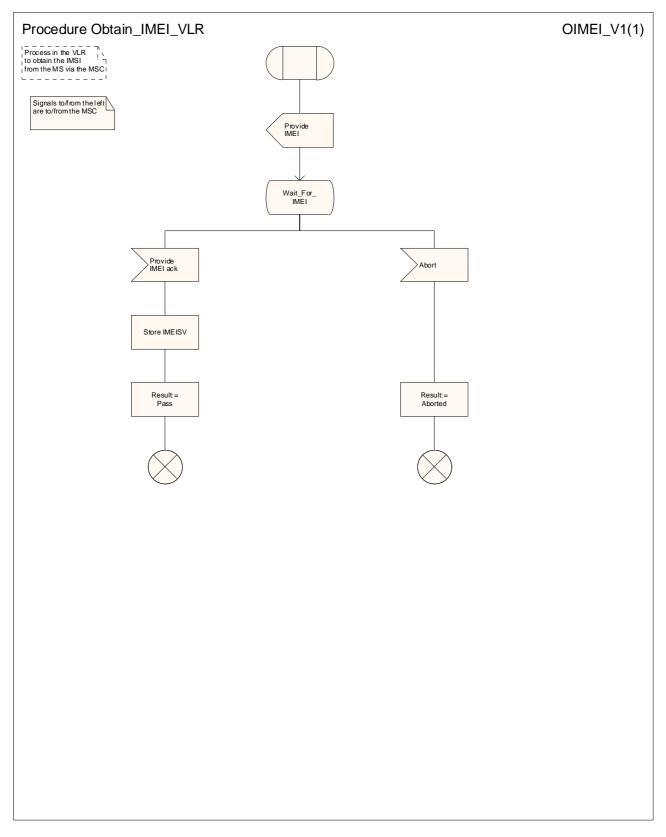
Obtain_
Authentication_
Sets_VLR
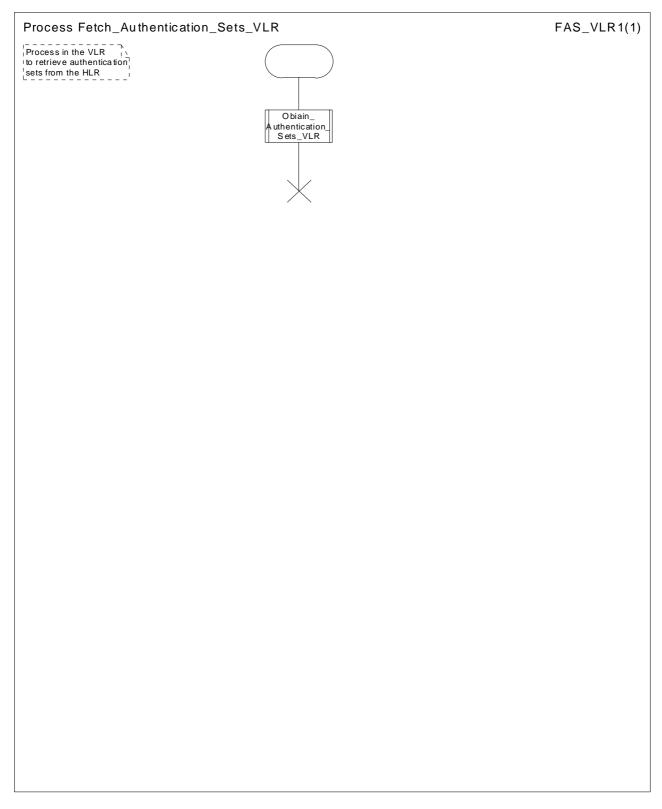
Figure 7.1.2.11: Process Fetch_Authentication_Sets_VLR

Procedure Check_BAOC CBAOC1(1)

Procedure to check call
request against ODBAOC
and SS BAOC

Signals to/from the right
are to/from the process
MAF017

Operator determined BAOC
imposed?

Yes

No

Result:=
Call barred
(ODB)

Initiate
handling
of BAOC

Wait_For_
BAOC_
Response

From MSC — Abort

Continue
call
handling

Yes

Call
barred?

No

Result:=
Call barred
(SS barring)

Result:=
Call allowed
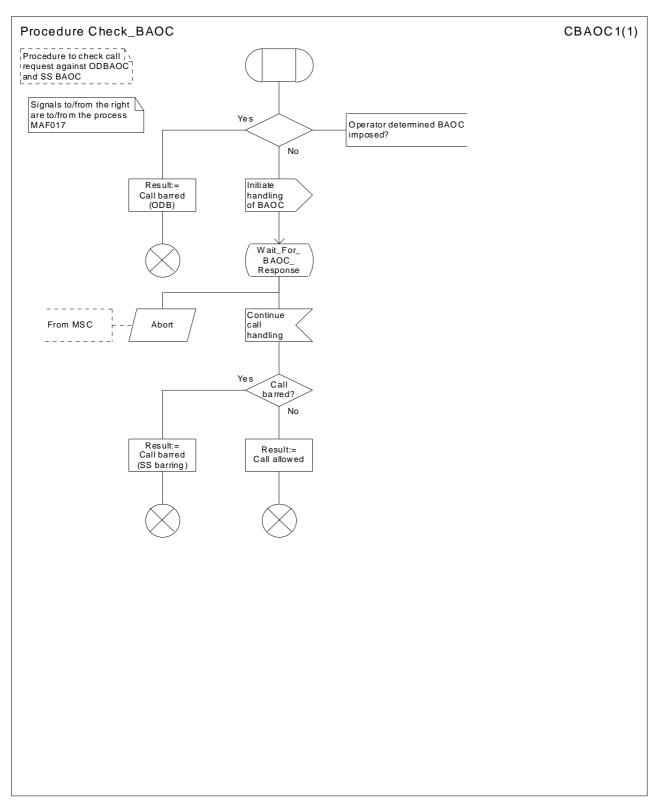
Figure 7.1.2.12: Procedure Check_BAOC

Procedure OG_CUG_Check   OG_CUG1(1)

Procedure to carry out
CUG authorisation check
for an outgoing (MO) call

Signals to/from the right
are to/from the process
CUG_MAF014

outgoing
call
request

Wait_For_
CUG_Response

From MSC — Abort

response
to call
request

complete call
(conditional
CUG info)

reject
call
(cause)

Result:=
Call allowed

Result:=
Call barred

Figure 7.1.2.13: Procedure OG_CUG_Check

Procedure Get_LI_Subscription_Info_MO_VLR GLI_MOV1(1)

Procedure in the VLR
to retrieve subscription
information for the CLIR
& COLP line identification
services for an MO call

Initiate
handling
of CLIR ----- To process CLIR_MAF003

Wait_For_
CLIR_Info

From MSC | Abort | Continue
call
handling <---- From process CLIR_MAF003

Initiate
handling
of COLP ----- To process COLP_MAF005

Wait_For_
COLP_Info

From MSC | Abort | Continue
call
handling <---- From process COLP_MAF005

Figure 7.1.2.14: Procedure Get_LI_Subscription_Info_MO_VLR

Procedure Get_AoC_Subscription_Info_VLR GAOCI_V1(1)

Procedure in the VLR
to determine the subscription
to Advice of Charge services

Figure 7.1.2.15: Procedure Get_AoC_Subscription_Info_VLR

Procedure Check_OG_Barring COB1(3)

Procedure to check call
request against SS barring
and ODB categories

Figure 7.1.2.16a: Procedure Check_OG_Barring (sheet 1)

Procedure Check_OG_Barring COB2(3)

Procedure to check call
request against SS barring
and ODB categories

Figure 7.1.2.16b: Procedure Check_OG_Barring (sheet 2)
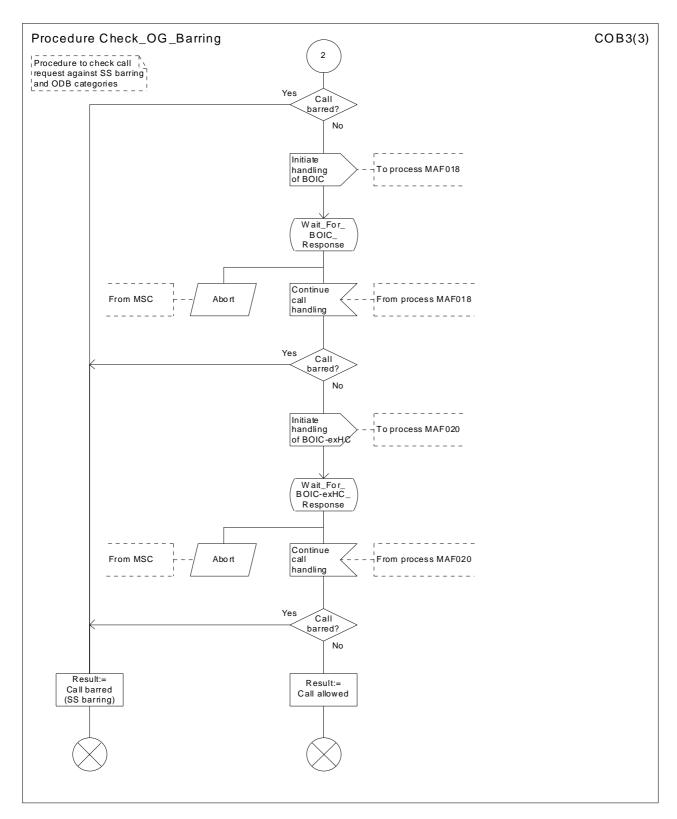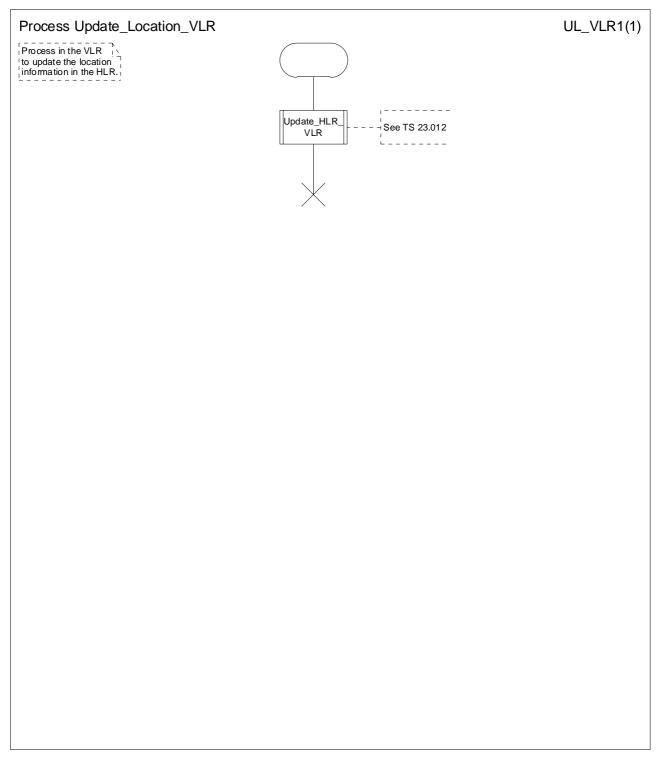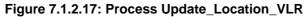
Figure 7.1.2.16c: Procedure Check_OG_Barring (sheet 3)

Process Update_Location_VLR   UL_VLR1(1)

Process in the VLR
to update the location
information in the HLR.

Update_HLR_
VLR   - - - - -   See TS 23.012

Figure 7.1.2.17: Process Update_Location_VLR

7.2 Retrieval of routeing information for MT call

7.2.1 Functional requirements of GMSC

7.2.1.1 Process MT_GMSC

Sheet 1: the variables ACM sent, Answer sent, Network connect sent, Reconnect and Resume call are global data, accessible to the procedures CCBS_MT_GMSC_Check_CCBS Possible, CCBS_Set_Diagnostic_For_Release, Obtain_Routeing_Address, Send_ACM_If_Required, Send_Answer_If_Required and Send_Network_Connect_If_Required.

Sheet 1: the variable UUS CF interaction is specific to UUS; it is accessible to all UUS specific procedures in the GMSC.

Sheet 1: the procedure MNP_MT_GMSC_Set_MNP_Parameters is specific to Mobile Number Portability; it is specified in 3GPP TS 23.066 [10].

Sheet 1: the procedure OR_Set_ORA_Parameters is specific to Support of Optimal Routeing; it is specified in 3GPP TS 23.079 [13].

Sheet 1: the procedure CAMEL_Set_ORA_Parameters is specific to CAMEL; it is specified in 3GPP TS 23.078 [12].

Sheet 1: the parameters "Reference address", "OR" and "Own PLMN" are passed to the procedure Obtain_Routeing_Address only if the GMSC supports Optimal Routeing. The parameter "Destination address" is returned by the procedure Obtain_Routeing_Address only if the GMSC supports Optimal Routeing of mobile-to-mobile calls. The Send Routeing Info negative response information element received in the execution of the procedure Obtain_Routeing_Address is global data, available to the parent process.

Sheet 1: the suggested mapping from values of the Send Routeing Info negative response information element to values of the ISUP release cause (see ITU-T Recommendation Q.850 [37]) is shown in table 1. The mapping used is a matter for the network operator, depending on the telephony signalling system used.

**Table 1: Suggested mapping of Send Routeing Info (SRI)
negative responses to ISUP release causes**

SRI negative response	ISUP release cause number	ISUP release cause name
Absent subscriber	20	Subscriber absent
Bearer service not provisioned	57	Bearer capability not authorized
Call barred (ODB)	21	Call rejected
Call barred (SS barring)	21	Call rejected
CUG reject (Called party SS interaction violation)	21	Call rejected
CUG reject (Incoming calls barred within CUG)	55	Incoming calls barred within CUG
CUG reject (Subscriber not member of CUG)	87	User not member of CUG
CUG reject (Requested basic service violates CUG constraints)	87	User not member of CUG
Data missing	111	Protocol error, unspecified
Facility not supported	69	Requested facility not implemented
Forwarding violation	21	Call rejected
Number changed	22	Number changed
System failure	111	Protocol error, unspecified
Teleservice not provisioned	57	Bearer capability not authorized
Unexpected data value	111	Protocol error, unspecified
Unknown subscriber	1 26	Unallocated (unassigned) number Misrouted call to a ported number (note)
NOTE: If the Diagnostic parameter indicates "NPDB mismatch", MNP can require a specific ISUP release cause value, according to National Coding Standard, to indicate "Misrouted call to a ported number", depending on national regulations. North American GSM Number Portability (NAGNP) requires the SRI negative response "unknown subscriber" to be treated differently under certain conditions. If the IAM received from the originating exchange contained the HPLMN routing number for NAGNP then the SRI negative response "unknown subscriber" shall be mapped to ISUP release cause number 26 "Misrouted call to a ported number"; under all other conditions the SRI negative response "unknown subscriber" shall be mapped to ISUP release cause number 1 "Unallocated (unassigned) number".		

Sheet 1: it is an operator option whether to send an Address Complete message if the Number Portability Database returns a routeing number. If the GMSC sends an Address Complete message, it shall include the called party's status field of the Backward call indicator set to "no indication".

Sheet 1: the called party address sent in the IAM to the process MT_CF_MSC is the Forwarded-to number received in the Perform Call Forwarding ack.

Sheet 1: the procedure CAMEL_Store_Destination_Address is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 1: it is an operator option whether to send an Address Complete message if the HLR returns forwarding information. If the GMSC sends an Address Complete message, it shall include the called party's status field of the Backward call indicator set to "no indication".

Sheet 1, sheet 8: the process CAMEL_MT_LEG1_GMSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 2: the procedures CAMEL_Start_TNRy and CAMEL_Stop_TNRy are specific to CAMEL phase 2 or later; they are specified in 3GPP TS 23.078 [12].

Sheet 2, sheet 3: the procedure CAMEL_MT_MSC_ALERTING is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL phase 4 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 2, sheet 3: the procedure CAMEL_MT_GMSC_ANSWER is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL, processing continues from the "Pass" exit of the test "Result".

Sheet 2, sheet 3: the task "Set destination address parameter" is executed only if the GMSC supports Optimal Routeing of mobile-to-mobile calls.

Sheet 3: the procedure Handle_COLP_Forwarding_Interaction is specific to COLP.

Sheet 4: the input signal Resume Call Handling and all the subsequent processing on this sheet are specific to Support of Optimal Routeing, and will occur only if the GMSC supports Optimal Routeing. The procedure OR_Handle_RCH is specified in 3GPP TS 23.079 [13].

Sheet 4, sheet 6: the procedure CCBS_MT_GMSC_Check_CCBS_Possible is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 5: the input signal TNRy expired and all the subsequent processing are specific to CAMEL phase 2 or later, and will occur only if the GMSC supports CAMEL phase 2 or later. The procedure CAMEL_MT_GMSC_DISC5 is specified in 3GPP TS 23.078 [12].

Sheet 6: the procedure CAMEL_MT_GMSC_DISC3 is specific to CAMELphase 1; it is specified in 3GPP TS 23.078 [12].

Sheet 6: the procedures CAMEL_MT_GMSC_DISC4 and CAMEL_MT_GMSC_DISC6 are specific to CAMEL phase 2 or later, they are specified in 3GPP TS 23.078 [12].

Sheet 6: the procedure CCBS_Set_Diagnostic_For_Release is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 6, sheet 7: the processing in the branch beginning with the Int_Release_Call input will occur only if the MSC supports CAMEL.

Sheet 7: the procedure CAMEL_MT_GMSC_DISC1 is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL, processing continues from the "No" exit of the test "Result=CAMEL handling?".

Sheet 7: the procedure CAMEL_MT_GMSC_DISC2 is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL, processing continues from the "Normal handling" exit of the test "Result?".

 Sheet 7: after the GMSC has sent an IAM to the destination VMSC or the forwarded-to exchange (via the process MT_CF_MSC), it acts as a relay for messages received from the originating exchange and the destination VMSC or the process MT_CF_MSC. Any message other than Address Complete, Connect, Answer or Release causes no change of state in the process MT_GMSC.

Sheet 8: the procedure CAMEL_MT_LEG2_GMSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

7.2.1.2 Procedure Obtain_Routeing_Address

Sheet 1: the procedure MOBILE_NUMBER_PORTABILITY_IN_TQoD is specific to Mobile Number Portability; it is specified in 3GPP TS 23.066 [10].

Sheet 1: the procedure CCBS_MT_GMSC_Check_CCBS_Call is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 1: the procedure CLI_MT_GMSC is specific to Enhanced CLI Handling. It is specified in 3GPP TS 23.081 [14].

Sheet 1: for SCUDIF calls, the message Send Routeing Info shall include the ISDN BC of both the preferred and the less preferred service, as specified in 3GPP TS 23.172 [38].

Sheet 2: the procedure SCUDIF_Negative_SRI_Response_Handling is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. If the GMSC does not support SCUDIF, processing continues from the "Fail" exit of the test "Result".

Sheet 2: the procedure OR_Handle_SRI_Negative_Response is specific to Support of Optimal Routeing. It is specified in 3GPP TS 23.079 [13]. If the GMSC does not support Optimal Routeing, processing continues from the "No" exit of the test "Result=Pass?".

Sheet 2: the test "Error=Unknown subscriber" refers to the negative response value received from the HLR.

Sheet 2: the procedure MOBILE_NUMBER_PORTABILITY_IN_QoHR is specific to Mobile Number Portability; it is specified in 3GPP TS 23.066 [10].

Sheet 3: the procedure SCUDIF_Check_Service_Availability is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. If the GMSC does not support SCUDIF, processing continues from the "continue" exit of the test "Result ?".

Sheet 3: the procedure CAMEL_MT_GMSC_INIT is specific to CAMEL; it is specified in 3GPP TS 23.078 [12].

Sheet 3: the procedure SCUDIF_Check_Service_Compatibility is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38].

Sheet 4: the procedure SCUDIF_Check_Service_Compatibility is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38].

Sheet 4: the procedure CCBS_MT_GMSC_Check_CCBS_Indicators is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 4: the task "Store Forwarding Interrogation Required indicator" is executed only if the GMSC supports Optimal Routeing.

Sheet 4: The test "MSRN contains a Routeing Number" is executed only if the SRF solution for call related MNP is used. If the SRF solution for call related MNP is not used, processing continues from the "No" exit of the test "MSRN contains a Routeing Number".

Sheet 4: the procedure MNP_MT_GMSC_Check_MNP_Indicators is specific to Mobile Number Portability; it is specified in 3GPP TS 23.066 [10].

Sheet 5: the procedure CAMEL_MT_GMSC_Notify_CF is specific to CAMEL phase 2 or later; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL phase 2 or later, processing continues from the "Continue" exit of the test "Result".

Sheet 5: the procedure SCUDIF_Check_Service_Compatibility is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38].

Sheet 6: the task "BOR:=OR" is executed only if the GMSC supports Optimal Routeing of mobile-to-mobile calls.

Sheet 6: the procedures CCBS_MT_GMSC_Remove_Indicators_Store_FWT is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 6: the procedure Route_Permitted is specific to Support of Optimal Routeing. It is specified in 3GPP TS 23.079 [13]. If the GMSC does not support Optimal Routeing, processing continues from the "True" exit of the test "Route permitted".

Sheet 6: the procedure CAMEL_MT_MSC_DISC3 is specific to CAMEL phase 1; it is specified in 3GPP TS 23.078 [12].

Sheet 6: the procedure CAMEL_MT_GMSC_DISC4 is specific to CAMEL Phase 2 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 6: the task "OR:= True" is executed only if the GMSC supports Optimal Routeing of mobile-to-mobile calls.

7.2.1.3 Procedure Send_ACM_If_Required

If no useful information would be carried in the Call Progress message, it is not sent.

7.2.1.4 Procedure Send_Answer_If_Required

If no useful information would be carried in the Call Progress message, it is not sent.

7.2.1.5 Procedure Send_Network_Connect_If_Required

If no useful information would be carried in the Call Progress message, it is not sent.

7.2.1.6 Procedure Handle_COLP_Forwarding_Interaction_MSC

The originating exchange or the destination exchange may release the call while a response is awaited from the process COLP_MAF039. The message is saved for processing after return from the procedure.

7.2.1.7 Procedure Activate_CF_Process

The processing in the branch beginning with the Int_Release_Call input will occur only if the MSC supports CAMEL.

7.2.1.8 Process MT_CF_MSC

Sheet 1: the procedure CAMEL_CF_MSC_INIT is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 1, sheet 4: the procedure CAMEL_CF_Dialled_Services is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL phase 3 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 1, sheet 3, sheet 4: the procedure CAMEL_OCH_MSC1 is specific to CAMEL phase 2 or later; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL phase 2 or later, processing continues from the "Yes" exit of the test "Result=Reconnect?".

Sheet 1: the procedure MOBILE_NUMBER_PORTABILITY_IN_OQoD is specific to Mobile Number Portability; it is specified in 3GPP TS 23.066 [10].

Sheet 1: the procedure CAMEL_Store_Destination_Address is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 1, sheet 3: the procedure CAMEL_OCH_MSC_DISC3 is specific to CAMEL phase 1; it is specified in 3GPP TS 23.078 [12].

Sheet 1, sheet 3: the procedure CAMEL_OCH_MSC_DISC4 is specific to CAMEL Phase 2 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 1, sheet 6: the procedure CAMEL_MT_CF_LEG1_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 2: the procedures CAMEL_Start_TNRy and CAMEL_Stop TNRy are specific to CAMEL phase 2 or later; they are specified in 3GPP TS 23.078 [12].

Sheet 2: the procedure CAMEL_CF_MSC_ANSWER is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL, processing continues from the "Pass" exit of the test "Result?".

Sheet 2: the procedure UUS_MSC_Clear_UUS is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 2: the procedure CAMEL_CF_MSC_ALERTING is specific to CAMEL phase 4 or later; it is specifed in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL phase 4 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 3: the procedure CAMEL_Stop_TNRy is specific to CAMEL phase 2 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 3: the processing in the branch beginning with the Int_O_Release input will occur only if the MSC supports CAMEL.

Sheet 4: the input signal TNRy expired and all the subsequent processing are specific to CAMEL phase 2 or later, and will occur only if the GMSC supports CAMEL phase 2 or later. The procedure CAMEL_OCH_MSC2 is specified in 3GPP TS 23.078 [12].

Sheet 5: the procedure CAMEL_OCH_MSC_DISC1 is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL, processing continues from the "No" exit of the test "Result=CAMEL handling?".

Sheet 5: the procedure CAMEL_OCH_MSC_DISC2 is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the MSC does not support CAMEL, processing continues from the "No" exit of the test "Result=Reconnect?" .

Sheet 5: the processing in the branch beginning with the Int_O_Release input will occur only if the MSC supports CAMEL.

Sheet 5: after the process MT_CF_MSC has sent an IAM to the forwarded-to exchange, it acts as a relay for messages received from the parent process and the forwarded-to exchange. Any message other than Address Complete, Connect, Answer or Release causes no change of state in the process MT_GMSC.

Sheet 6: the process CAMEL_MT_CF_LEG2_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

7.2.1.9 Macro CUG_Support_Check_GMSC

Process MT_GMSC   MT_GMSC1(9)

Process in the GMSC to handle a mobile-terminated call request

Signals to/from the left are to/from the originating exchange; signals to/from the right are to/from the destination MSC unless marked otherwise

Idle

Initial Address

CUG_Support_ Check_GMSC

1

Reconnect:= True

ACM sent:=False
Answer sent:=False
Network connect sent:=False
Reconnect:=False
Resume call:=False
UUS CF Interaction:=False

See TS 23.066 ┄ MNP_MT_GMSC_ Set_MNP_ Parameters

OR_Set_ORA_ Parameters ┄ See TS 23.079

CAMEL_Set_ ORA_Parameters ┄ See TS 23.078

4

Figure 36a: Process MT_GMSC (sheet 1)

Process MT_GMSC MT_GMSC2(9)

Process in the GMSC to handle a mobile-terminated call request

Signals to/from the left are to/from the originating exchange; signals to/from the right are to/from the destination MSC unless marked otherwise

(4)

Obtain_Routeing_Address
(Called party address, Reference address, OR, Own PLMN, Routeing address, Destination address, Result)

Result?

Fail

Aborted

Pass

Routeing Number

Forward

Leg1_only

Leg1_status := Set-up

Set cause

See TS 23.078 ----- CAMEL_MT_ LEG1_GMSC (Leg1_status)

Release

Idle

Release call resources

Initial Address (Routeing Address)

Initial Address (Routeing Address)

Initial Address (Routeing Address)

----- To process MT_CF_MSC

Idle

See TS 23.078 ----- CAMEL_Store_ Destination_ Address (OR, False)

CAMEL_Store_ Destination_ Address (OR, False) ----- See TS 23.078

Send_ACM_ If_Required

Send_ACM_ If_Required ----- To originating exchange

Wait_For_ ACM

Wait_For_ Forward_ACM

Figure 36b: Process MT_GMSC (sheet 2)
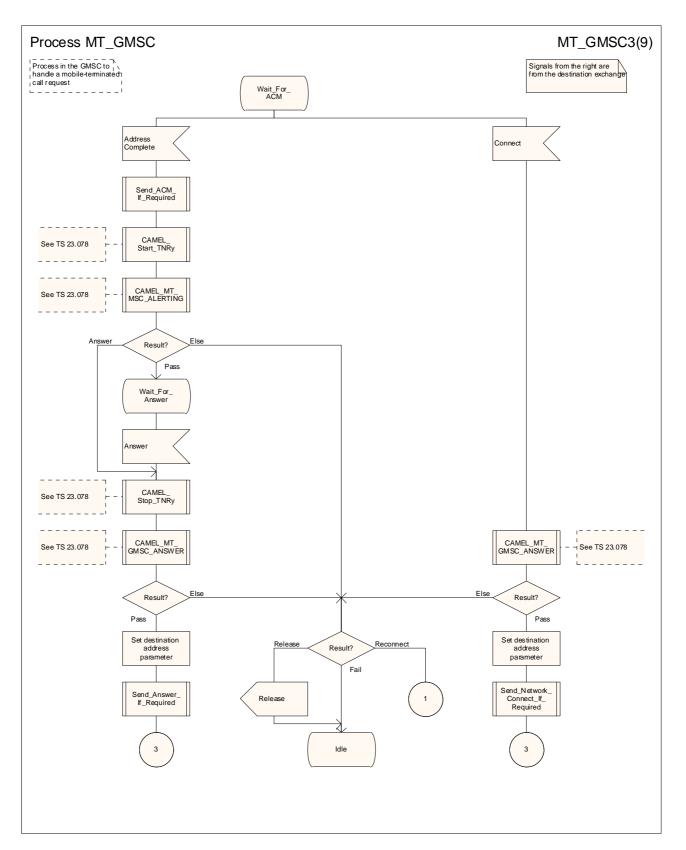
Figure 36c: Process MT_GMSC (sheet 3)

Process MT_GMSC MT_GMSC4(9)

Process in the GMSC to handle a mobile-terminated call request

Wait_For_ Forward_ACM

Signals from the right are from the process MT_CF_MSC

Address Complete

Connect

Send_ACM_ If_Required

See TS 23.078 ┄ CAMEL_MT_ MSC_ALERTING

Result?
Answer | Else
Pass

Wait_For_ Forward_ Answer

Answer

See TS 23.078 ┄ CAMEL_MT_ GMSC_ANSWER

CAMEL_MT_ GMSC_ANSWER ┄ See TS 23.078

Result?
Else | Pass

Result?
Else | Pass

Handle_COLP_ Forwarding_ Interaction_MSC

Handle_COLP_ Forwarding_ Interaction_MSC

Result?
Release | Reconnect
Fail

Set COLP presentation indicator

Set COLP presentation indicator

Release

1

Set destination address parameter

Idle

Set destination address parameter

Send_Answer_ If_Required

Send_Network_ Connect_If_ Required

3

3

Figure 36d: Process MT_GMSC (sheet 4)

Process MT_GMSC MT_GMSC5(9)

Process in the GMSC to handle a mobile-terminated call request

Wait_For_ACM, Wait_For_Answer

Signals to/from the right are to/from the destination MSC unless marked otherwise

Resume Call Handling

Refer to TS 23.079 for message contents

CCBS_MT_GMSC_ Check_CCBS_ Possible

See TS 23.093

Resume call:- True

See TS 23.078

CAMEL_ Stop_TNRy

OR_Handle_ RCH

See TS 23.079

Result= Fail?
Yes
No

Result= Release?
Yes
No

Result= Refuse?
Yes
No

Release

Result= Reconnect?
Yes
No

-

Wait_For_ Forward_ACM

1

Idle

Figure 36e: Process MT_GMSC (sheet 5)

Figure 36f: Process MT_GMSC (sheet 6)

Process MT_GMSC MT_GMSC7(9)

Process in the GMSC to handle a mobile-terminated call request

Wait_For_ACM,
Wait_For_Forward_ACM,
Wait_For_Answer,
Wait_For_Forward_Answer

Signals to/from the left are to/from the originating exchange; signals to/from the right are to/from the destination exchange or process MT_CF_MSC unless marked otherwise

Release

Release

From gsmSSF

Int_Release_Call

CCBS_MT_GMSC_Check_CCBS_Possible — See TS 23.093

CAMEL phase 2 or higher supported?

CAMEL phase 2 or higher supported?

No — Yes

No — Yes

Release cause=No answer from user? — Yes

No

2

CAMEL_MT_GMSC_DISC3

CAMEL_MT_GMSC_DISC6

CAMEL_MT_GMSC_DISC3

CAMEL_MT_GMSC_DISC4 — See TS 23.078

Release

Result=Reconnect?

No

Yes

CCBS_Set_Diagnostic_For_Release

Release

Release

1

Release

Release call resources

Idle

Figure 36g: Process MT_GMSC (sheet 7)

Process MT_GMSC   MT_GMSC8(9)

Process in the GMSC to handle a mobile-terminated call request

Signals to/from the left are to/from the originating exchange; signals to/from the right are to/from the destination exchange or the process MT_CF_MSC unless marked otherwise

Wait_For_ Clear

Release   Release   Int_Release_ Call   From gsmSSF

CAMEL_MT_ GMSC_DISC1   See TS 23.078   CAMEL_MT_ GMSC_DISC2   See TS 23.078

Result= CAMEL handling?   Yes   Reconnect   Result?   CAMEL handling   Release
No   Normal handling

Release   1   Release   Release

Release call resources

Wait_For_ Clear   Idle

Resume Call Handling

Wait_For_ACM, Wait_For_Forward_ACM, Wait_For_Answer, Wait_For_Forward_Answer, Wait_For_Clear

Set negative response: OR not allowed

*   *

Resume Call Handling negative response

-                          -

Wait_For_ Clear

-

Figure 36h: Process MT_GMSC (sheet 8)

Process MT_GMSC   MT_GMSC9(9)

Process in the GMSC to
handle a mobile-terminated
call request

(3)

CAMEL phase 4 or later
control relationship exists? ──No──────────┐

Yes

Leg1_status
:= Active

See TS 23.078 ┄ CAMEL_MT_
              LEG1_GMSC
              (Leg1_status)   Wait_For_
                                             Clear

See TS 23.078 ┄ CAMEL_MT_
              GMSC_LEG2

Idle

Figure 36i: Process MT_GMSC (sheet 9)

Procedure Obtain_Routeing_Address ORA1(6)

Procedure in a GMSC
to determine the address
to which a call should be routed

Procedure Obtain_Routeing_Address
FPAR IN Input address, Reference address,
Own PLMN
IN/OUT Routeing address,
Destination address, OR, Result

See TS 23.066 — MOBILE_NUMBER_ PORTABILITY_ IN_TQoD

Result= Number ported? — Yes → Routeing address:= routeing number → Result:= Routeing number → ⊗

No

See TS 23.093 — CCBS_MT_ GMSC_Check_ CCBS_Call

Reconnect — True → (1)

False

See TS 23.081 — CLI_MT_ GMSC

Pre-paging supported in GMSC?

No

Yes → Set Pre-paging supported

To HLR — Send Routeing Info

Wait_for_ Routeing_ Info

Figure 37a: Procedure Obtain_Routeing_Address (sheet 1)

Procedure Obtain_Routeing_Address ORA2(6)

Procedure in a GMSC
to determine the address
to which a call should be routed

Signals to/from the left
are to/from the originating exchange;
signals to/from the right
are to/from the HLR

Wait_for_
Routeing_
Info

Release

Result:=
Aborted

⊗

Send
Routeing
Info negative
response

SCUDIF_negative_
SRI_response_
handling

See TS 23.172

Result

Pass

Fail

Retry

4

OR_Handle_SRI_
Negative_Response
(Own PLMN)

See TS 23.079

Send Routeing Info

Wait_for_
Routeing_
Info

Result=
Pass?

Yes

No

Result:=Pass

Error=
Unknown
subscriber?

No

⊗

Yes

See TS 23.066

MOBILE_NUMBER_
PORTABILITY_
IN_QoHR

Result=
Number
ported?

No

Yes

Routeing
address:=
routeing number

Result:=Fail

Result:=
Routeing
number

⊗

⊗

Figure 37b: Procedure Obtain_Routeing_Address (sheet 2)

Procedure Obtain_Routeing_Address ORA3(6)

Procedure in a GMSC
to determine the address
to which a call should be routed

Wait_for_
Routeing_
Info

Send
Routeing   From HLR
Info ack

SCUDIF_Check_   See TS 23.172
Service_Availability

4   Result?   second_SRI

Continue

Network Signal Info:=
less preferred service

CAMEL   1   Send Routeing Info
supported?

No
MSRN   Yes   Wait_for_
received?   Routeing_
Info

No   CAMEL_MT_   See TS 23.078
3   GMSC_INIT

Result=
MSRN   Yes

No   3

Result=
Aborted

Yes   No

Result =   Yes
Leg1_only?

Result:=   Result :=   5
Aborted   Leg1_only

⊗   ⊗

SCUDIF_Check_   See TS 23.172
Service_Compatibility

2

Figure 37c: Procedure Obtain_Routeing_Address (sheet 3)

ETSI

Procedure Obtain_Routeing_Address   ORA4(6)

Procedure in a GMSC
to determine the address
to which a call should be routed

Figure 37d: Procedure Obtain_Routeing_Address (sheet 4)

Procedure Obtain_Routeing_Address   ORA5(6)

Procedure in a GMSC
to determine the address
to which a call should be routed

Figure 37e: Procedure Obtain_Routeing_Address (sheet 5)

Figure 37f: Procedure Obtain_Routeing_Address (sheet 6)

Procedure Send_ACM_If_Required   SACMIR1(1)

Procedure to send an
Address Complete Message
to the preceding exchange if
one is required for this call

Signals to the left
are to the originating exchange

True ← ACM sent → False

True ← Network connect sent → False

Call Progress   Address Complete

ACM sent:= True

Figure 38: Procedure Send_ACM_If_Required

Procedure Send_Answer_If_Required   SANMIR 1(1)

Procedure to send an
Answer Message
to the preceding exchange if
one is required for this call

Signals to the left
are to the originating exchange

Answer
sent

True

False

Network
connect
sent

True

False

Call
Progress

Answer

Answer sent:=
True

Figure 39: Procedure Send_Answer_If_Required

Procedure Send_Network_Connect_If_Required SNCONIR1(1)

Procedure to send a
Connect Message
to the preceding exchange if
one is required for this call

Signals to the left
are to the originating exchange

Network
connect
sent — True / False

Answer
sent — True / False

ACM
sent — True / False

Call
Progress

Answer

Connect

Answer sent:=
True

Connect sent:=
True

Figure 40: Procedure Send_Network_Connect_If_Required

Procedure Handle_COLP_Forwarding_Interaction_MSC   COINT_M1(1)

Procedure in the GMSC or VMSC
to handle the interaction between
COLP and Call Forwarding

Signals to/from the right
are to/from the process
COLP_MAF039

Initiate
handling
of COLP

Wait_For_
COLP_Info

Release | From originating exchange
or destination exchange

continue
call
handling
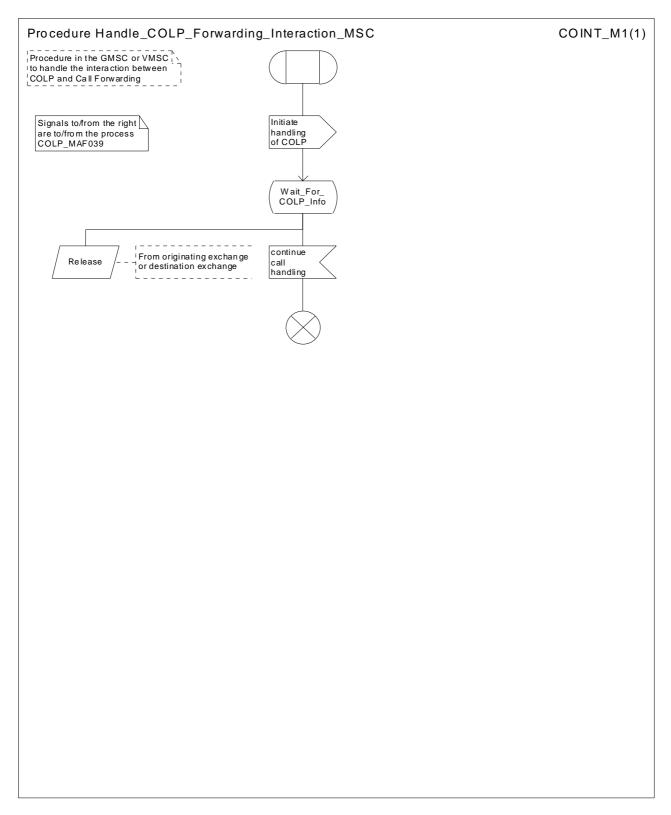
Figure 41: Procedure Handle_COLP_Forwarding_Interaction_MSC

Procedure Activate_CF_Process   ACFP1(1)

Procedure in the MSC
to initiate the process which
handles call forwarding

Signals to/from the left
are to/from the originating exchange;
signals to/from the right
are to/from the process MT_CF_MSC
unless marked otherwise

Perform call
forwarding
(BOR, FTN)

Wait_For_
CF_Response

Release

Perform call
forwarding ack

Perform call
forwarding
negative
response

Int_Release_
Call   From gsmSSF

CF
cancelled

CF
cancelled

Result:=
Fail

Result:=
Pass

Result:=
Fail

Result:=
Release

Figure 42: Procedure Activate_CF_Process

Process MT_CF_MSC   MTCFMSC1(6)

Figure 43a: Process MT_CF_MSC (sheet 1)

Figure 43b: Process MT_CF_MSC (sheet 2)

Process MT_CF_MSC   MTCFMSC3(6)
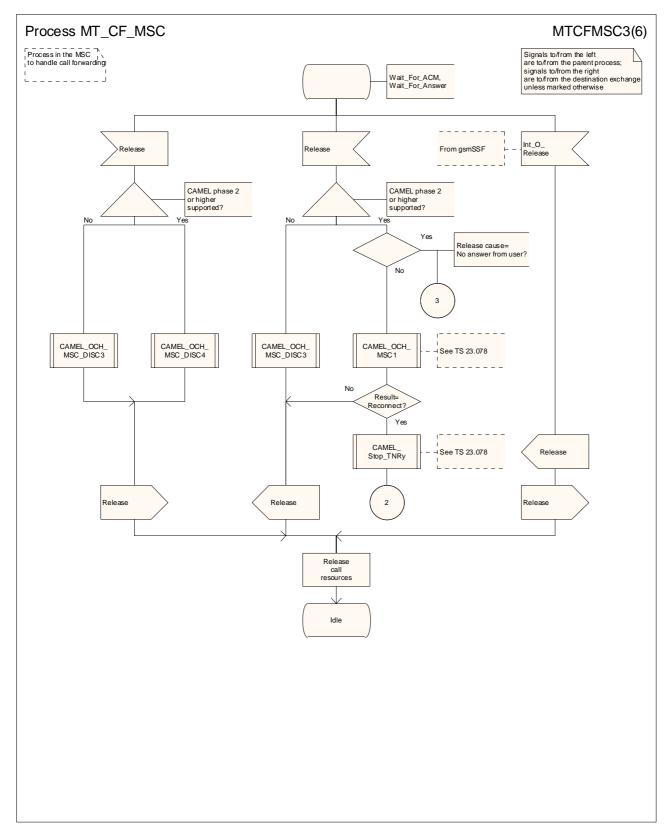
Figure 43c: Process MT_CF_MSC (sheet 3)
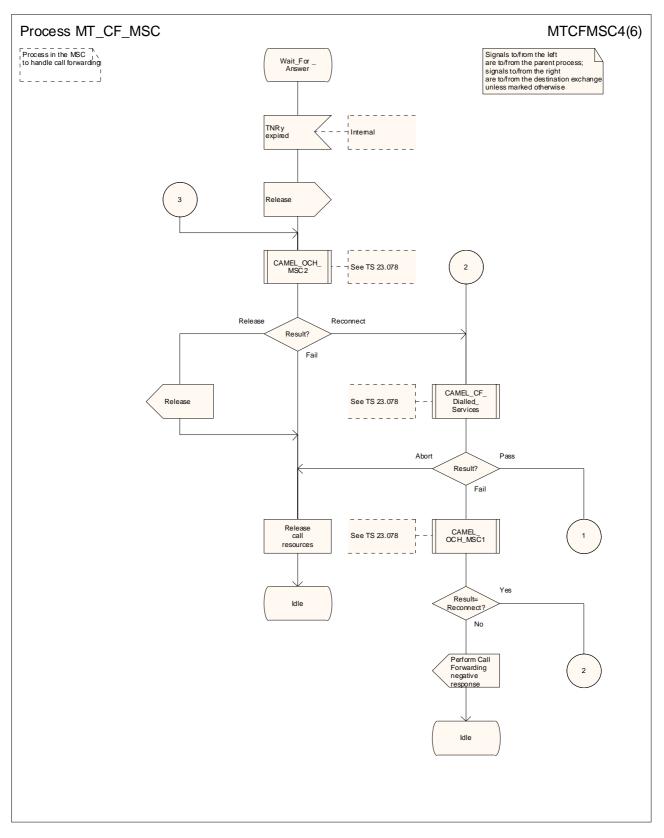
Figure 43d: Process MT_CF_MSC (sheet 4)
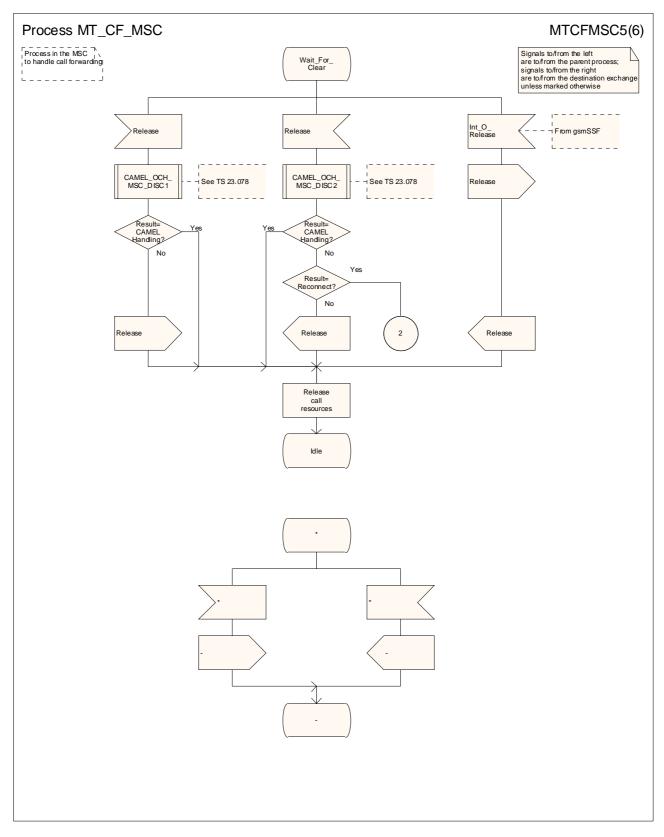
Figure 43e: Process MT_CF_MSC (sheet 5)

Process MT_CF_MSC MTCFMSC6(6)

Process in the MSC
to handle call forwarding

A

CAMEL phase 4 or later
control relationship exists? ──── No ────┐

Yes

See TS 23.078 ┤ CAMEL_MT_
CF_LEG2_MSC

Leg1_status
:= Active

Wait_For_
Clear

See TS 23.078 ┤ CAMEL_MT_
CF_LEG1_MSC
(Leg1_status)

Idle
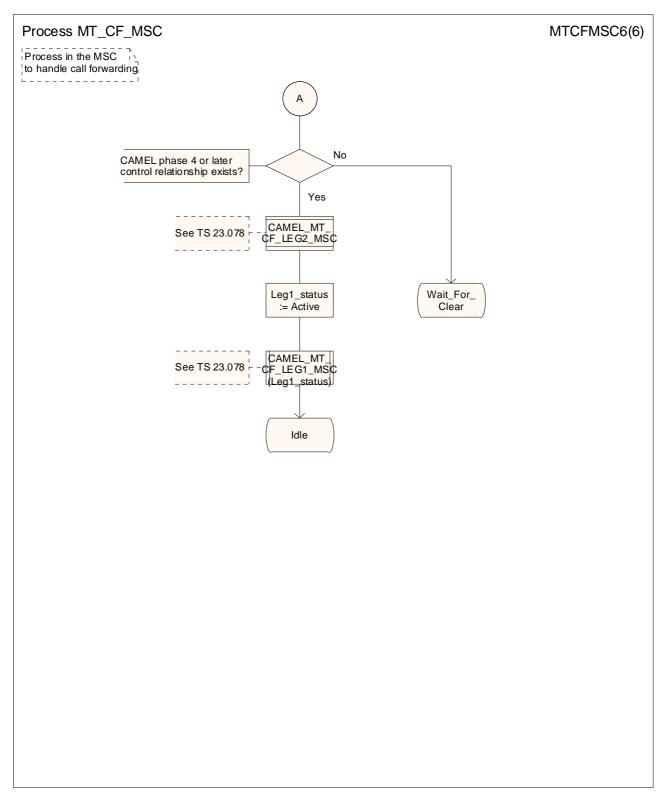
Figure 43f: Process MT_CF_MSC (sheet 6)

| Macrodefinition CUG_Support_Check_GMSC | CUG_SC1(1) |

Macro to check support of CUG in GMSC, if needed, and check if call can continue.

```
                              ┌───┬───┐
                              │   │   │
                              └───┴───┘
                                  │
                No      ╱ CUG info ╲      Yes
              ┌────────◇  present?  ◇────────┐
              │         ╲          ╱         │
              │                              │
              │                      ╱╲  GMSC ╱╲
              │                     ╱  supports  ╲
              │             Yes    ╱   CUG?       ╲
              ◇◄──────────────────╱                ╲
              │                                  No │
              │                                     │
              │             Yes    ╱ Outgoing ╲     │
              ◇◄──────────────────╱  Access    ╲◄───┘
              │                    ╲  present?  ╱
              │                     ╲          ╱
              │                           No │
              │                              │
           ╭──┴──╮                        ╭──┴──╮
          ╱ Pass  ╲                      ╱ Fail  ╲
          ╲       ╱                      ╲       ╱
           ╰─────╯                        ╰─────╯
```
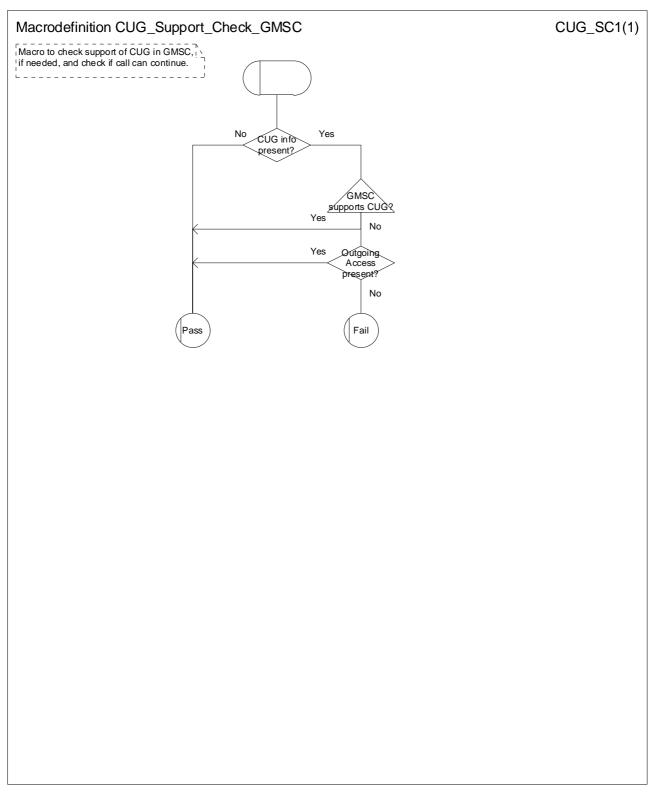
Figure 43bis: Macro CUG_Support_Check_GMSC

7.2.2 Functional requirements of HLR

7.2.2.1 Process SRI_HLR

Sheet 1: the procedures Check_Parameters, Subscription_Check_HLR, SCUDIF_Subscription_Check_HLR, Handle_OR_HLR_CF and CAMEL_HLR_INIT can set the negative response parameter which is used by the process

SRI_HLR to construct the Send Routeing Info negative response message. This negative response parameter is global data, accessible by the process SRI_HLR.

Sheet 1: the procedure Handle_OR_HLR_CF is specific to Support of Optimal Routeing; it is specified in 3GPP TS 23.079 [13]. If the HLR does not support Optimal Routeing, processing continues from the "No" exit of the test "Result=Forward?".

Sheet 1: the procedure SCUDIF_Subscription_Check_HLR is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. This procedure gets the result from the Subscription_Check_HLR procedure, and modifies it if needed. If the HLR does not support SCUDIF, the test "Result = Fail ?" applies to the result of the Subscription_Check_HLR procedure.

Sheet 1: the procedure CAMEL_HLR_INIT is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the HLR does not support CAMEL, processing continues from the "No" exit of the test"Result=Fail?".

Sheet 2: the procedure First_Forwarding_HLR can set the negative response parameter which is used by the process SRI_HLR to construct the Send Routeing Info negative response message. This negative response parameter is global data, accessible by the process SRI_HLR.

Sheet 2: the procedure CAMEL_CSI_Check_HLR is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the HLR does not support CAMEL, processing continues from the "No" exit of the test"Result=CSI active?".

Sheet 2: the procedure SCUDIF_CAMEL_CSI_Check_HLR is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. This procedure gets the result from the CAMEL_CSI_Check_HLR procedure, and modifies it if needed. If the HLR does not support SCUDIF, the test "Result = CSI Active ?" applies to the result of the CAMEL_CSI_Check_HLR procedure. If the HLR does not support CAMEL, processing continues from the "No" exit of the test "Result=CSI active?".

Sheet 2: the procedure CCBS_Handling_HLR is specific to CCBS; it is specified in 3GPP TS 23.093 [23]. If the HLR does not support CCBS, processing continues from the "Yes" exit of the test "Result = OK?".

Sheet 3: the procedure OR_HLR_Interrogate_VLR is specific to Optimal Routeing. It is specified in 3GPP TS 23.079 [13]. If the HLR does not support Optimal Routeing, processing continues from the "No" exit of the test "Result=Forward".

Sheet 3: the procedure SCUDIF_Set_Correct_PLMN_BC is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. If the HLR does not support SCUDIF, processing continues from the "Set_PLMN_BC" exit of the test "Result ?".

Sheet 3: if the HLR does not support Network Indication of Alerting, the test "Alerting pattern required" and the task "Set Alerting Pattern" are omitted.

Sheet 3: the procedure CLI_HLR_Set_CLI is specific to Enhanced CLI Handling. It is specified in 3GPP TS 23.081 [14].

Sheet 5: the procedure SCUDIF_Check_Second_Service_after_PRN is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. If the HLR does not support SCUDIF, processing continues from the "yes" exit of the test "Result = Continue ?".

Sheet 5: the procedure PRN_Error_HLR can set the negative response parameter which is used by the process SRI_HLR to construct the Send Routeing Info negative response message. This negative response parameter is global data, accessible by the process SRI_HLR.

Sheet 5: the procedure Forward_CUG_Check is specific to CUG. If the HLR does not support CUG, processing continues from the "Yes" exit of the test "Result=Call allowed?".

Sheet 6: the test "Forwarding enquiry" is specific to Support of Optimal Routeing. If the HLR does not support Optimal Routeing, processing continues from the "No" exit of the test.

Sheet 6: the procedure CAMEL_CSI_Check_HLR is specific to CAMEL; it is specified in 3GPP TS 23.078 [12]. If the HLR does not support CAMEL, processing continues from the "No" exit of the test "Result=CSI active?".

Sheet 6: the procedure SCUDIF_CAMEL_CSI_Check_HLR is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. This procedure gets the result from the CAMEL_CSI_Check_HLR procedure, and modifies it if needed. If the HLR does not support SCUDIF, the test "Result = CSI Active ?" applies to the result of the CAMEL_CSI_Check_HLR procedure. If the HLR does not support CAMEL, processing continues from the "No" exit of the test "Result=CSI active?".

Sheet 6: the procedure SCUDIF_Check_Second_Service_before_Negative_Response can set the negative response parameter which is used by the process SRI_HLR to construct the Send Routeing Info negative response message. This negative response parameter is global data, accessible by the process SRI_HLR.

Sheet 6: the procedure SCUDIF_Check_Second_Service_before_Negative_Response is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. If the HLR does not support SCUDIF, processing continues from the "Fail" exit of the test "Result ?".

Sheet 7: the procedures CAMEL_T_CSI_CHECK_HLR and CAMEL_O_CSI_CHECK_HLR are specific to CAMEL; they are specified in 3GPP TS 23.078 [12].

Sheet 7: the procedure CAMEL_D_CSI_CHECK_HLR is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 7: the procedure SCUDIF_Set_Second_Service_when_Forwarded is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. If the HLR does not support SCUDIF, processing continues from the "Yes" exit of the test "Result = Continue ?".

Sheet 7: the procedure SCUDIF_Check_Second_Service_when_Forwarded is specific to SCUDIF; it is specified in 3GPP TS 23.172 [38]. If the HLR does not support SCUDIF, processing continues from the "Yes" exit of the test "Result = Continue ?".

7.2.2.2   Procedure Check_Parameters

If any parameters required by the rules in clause 8 are missing from the message, the procedure sets the negative response to "Data missing". If any parameter has a value which is not in the set of values expected for the parameter, the procedure sets the negative response to "Unexpected data value".

7.2.2.3   Procedure Subscription_Check_HLR

The HLR derives the possible PLMN bearer capability to populate the parameter in the Provide Roaming Number request according to the rules defined in 3GPP TS 29.007 [30].

If the HLR is able to determine the PLMN bearer capability or equivalent ISDN compatibility information to be sent to the VLR in the Provide Roaming Number request, it applies the corresponding PLMN bearer service or teleservice for handling the call. If the HLR is not able to determine any compatibility information to be sent to the VLR in the Provide Roaming Number request, it applies a default basic service according to the requirements of the operator.

If the HLR receives Send Routeing Information from the gsmSCF and the HLR is not able to determine any compatibility information to be sent to the VLR in the Provide Roaming Number request, then the HLR shall apply basic service TS11.

> NOTE   The information element 'gsmSCF Initiated Call' in Send Routeing Information serves as an indication to the HLR that this Send Routeing Information is sent by the gsmSCF. Refer to 3GPP TS 23.078 [12].

It is an implementation option to carry out the check for operator determined barring of incoming calls before the check on provisioning of the requested basic service.

The test "gsmSCF Initiated Call?" is specific to CAMEL phase 4 or later. If the HLR does not support CAMEL phase 4 or later, processing continues from the "No" exit.

The negative response "Call barred" indicates whether the reason is operator determined barring or supplementary service barring, according to the result returned by the procedure Check_IC_Barring.

The negative response "CUG reject" indicates whether the reason is:

- Incoming calls barred within CUG;

- Requested basic service violates CUG constraints;

- Subscriber not member of CUG;

according to the cause returned by the procedure IC_CUG_Check.

7.2.2.4 Procedure First_Forwarding_HLR

The MS is not reachable if any of the following conditions is satisfied:

- The HLR has no location information for the subscriber.

- The subscriber record is marked as MS purged.

- The subscriber record is marked as MSC area restricted.

- The subscriber record is marked as Roaming Restricted due to Unsupported Feature.

- The subscriber is marked as deregistered because of subscription restrictions on roaming.

7.2.2.5 Procedure PRN_Error_HLR

The procedure CCBS_Report_PRN_Failure is specific to CCBS; it is specified in 3GPP TS 23.093 [23]. The procedure does not return a value; the following tests are on the value of the Provide Roaming Number negative response.

The procedure Super_Charged_SRI_Error_HLR is specific to Super-Charger; it is specified in 3GPP TS 23.116 [24]. If the HLR does not support Super-Charger, processing continues from the "No" exit of the test "Result=Purged?".

If the HLR does not support Optimal Routeing, processing starts with the test "Negative response=Facility not supported?".

7.2.2.6 Procedure Forward_CUG_Check

7.2.2.7 Void

7.2.2.8 Procedure Check_IC_Barring

7.2.2.9 Procedure IC_CUG_Check

7.2.2.10 Procedure Handle_CFU

The test "Normal call" refers to the value of the indicator returned by the process MAF007.

The procedure CAMEL_CHECK_SII2_CDTI is specific to CAMEL Phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL Phase 3 or later, processing continues from the "Yes" exit of the test "Result = Pass?".

7.2.2.11 Procedure Handle_CFNRc

The test "Mobile subscriber not reachable" refers to the value of the indicator returned by the process MAF010.

The procedure CAMEL_CHECK_SII2_CDTI is specific to CAMEL Phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL Phase 3 or later, processing continues from the "Yes" exit of the test "Result = Pass?".

Process SRI_HLR SRI_HLR1(7)

Process in the HLR to handle a request for routeing information

Signals to/from the left are to/from the GMSC or the gsmSCF; signals to/from the right are to/from the VLR

Idle

Send Routeing Info

Check_ Parameters

Result= Pass? — No

Yes

Subscription_ Check_HLR

SCUDIF_Subscription _Check_HLR ····· See TS 23.172

7

Result= Fail? — Yes

No

See TS 23.079 ····· OR_HLR_CF

6

Result= Fail? — Yes

No

Result= Forward? — Yes

No

See TS 23.078 ····· CAMEL_ HLR_INIT

Result= Fail? — Yes

No

3   1   2   1
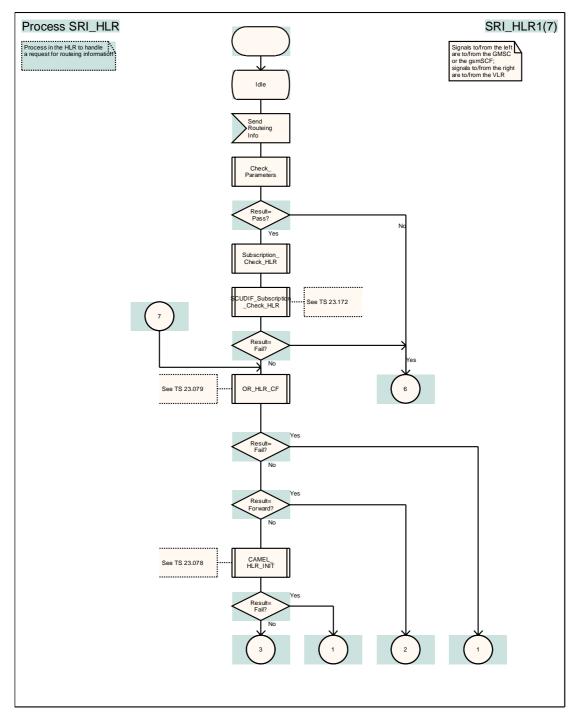
Figure 44a: Process SRI_HLR (sheet 1)

ETSI
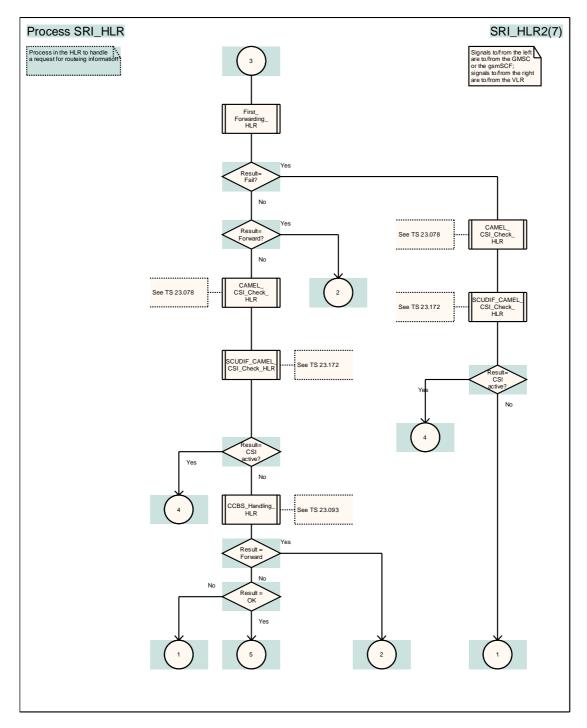
Figure 44b: Process SRI_HLR (sheet 2)

Figure 44c: Process SRI_HLR (sheet 3)

Process SRI_HLR SRI_HLR4(7)

Process in the HLR to handle
a request for routeing information

```
          ( 8 )
            |
Pre-paging  /\
supported  /  _____ No
in HLR?    \  /    Yes              |
            \/                      |
            |                       |
Pre-paging  /\                      |
supported  <  > ___ No _____|
in GMSC?    \/                      |
            |                       |
           Yes                      |
            |                       |
     [Set Pre-paging]               |
     [ supported   ]                |
            |                       |
            |<──────────────────────┘
            |
     [Provide   ]
     [Roaming   >
     [Number    ]
            |
      ( Wait_For_ )
      (  MSRN     )
```

Figure 44d: Process SRI_HLR (sheet 4)

Figure 44e: Process SRI_HLR (sheet 5)

Process SRI_HLR SRI_HLR6(7)

Process in the HLR to handle a request for routeing information

Figure 44f: Process SRI_HLR (sheet 6)

Process SRI_HLR SRI_HLR7(7)

Process in the HLR to handle a request for routeing information

(9)

Routeing address:= FTN

SCUDIF_Set_Second_ Service_when_ Forwarded ┄┄┄ See TS 23.172

Result= Continue?

No → (10)

Yes

Forwarding enquiry? — Yes

No

See TS 23.078 ┄┄┄ CAMEL_T_ CSI_CHECK_ HLR

See TS 23.078 ┄┄┄ CAMEL_O_ CSI_CHECK_ HLR

See TS 23.078 ┄┄┄ CAMEL_D_ CSI_CHECK_ HLR

SCUDIF_Check_ Second_Service_ when_Forwarded ┄┄┄ See TS 23.172

Result= Continue? — No → (7)

Yes

Send Routeing Info ack

Idle

Figure 44g: Process SRI_HLR (sheet 7)

Procedure Check_Parameters   Chk_Par1(1)

Procedure to check
the parameters of a
received message

All required
parameters present?   —No—→   Set negative
                                                                                 response:
Yes   Data missing

All parameter values
acceptable?   —No—→
                                          Set negative
Yes   response:
                                          Unexpected
                                          data value

Result:=   Result:=
Pass   Fail

Figure 45: Procedure Check_Parameters

Procedure Subscription_Check_HLR   SC_HLR1(1)

Procedure in the HLR
to make subscription
checks for a mobile-
terminated call

MS known? — No → Set negative response: Unknown subscriber

Yes

Number changed? — Yes → Set negative response: Number changed

No

See TS 29.007 --- Derive requested basic service

Requested service provisioned? — No

Yes

gsmSCF Initiated Call? — No → Set negative response: service not provisioned --- Bearer service or Teleservice

Yes

Suppress ICB? — Yes

No

Check_IC_ Barring

Result= Call barred? — Yes → Set negative response: Call barred

No

IC_CUG_ Check

Result= Call allowed? — No → Set negative response: CUG reject

Yes

Result:= Pass

Result:= Fail

Figure 46: Procedure Subscription_Check_HLR

Procedure First_Forwarding_HLR   FF_HLR1(1)

Procedure in the HLR
to handle call forwarding
before interrogation of the VLR

Handle_CFU

Result=
Fail?
Yes → Set negative
response:
Forwarding
violation
No

Result=
Forward?
Yes
No

MS not
reachable?
No
Yes

Handle_CFNRc

Result=
Fail?
Yes → Set negative
response:
Forwarding
violation
No

Result=
Forward?
No
Yes
Set negative
response:
Absent
subscriber

Result:=
Forward

Result:=
Continue

Result:=
Forward

Result:=
Fail

Figure 47: Procedure First_Forwarding_HLR

Procedure PRN_Error_HLR   PRN_E_H1(1)

Procedure in the HLR
to handle a negative response
for a roaming number request

CCBS_Report
PRN_Failure - - - See TS 23.093

Negative
response=OR   ──Yes──────────────────────┐
not allowed??   │
                                          Set negative
              No   response:
                                          OR not
                                          allowed

Negative
response=Facility   ──Yes──────────────────────┐
not supported?   │
                                          Set negative
              No   response:
                                          Facility not
                                          supported

              Yes──────────────── Negative
                                    response=Absent
                                    subscriber?
              No

Negative
response=No   ──No──────────────────────┐
roaming   │
number?   Set negative
              Yes   response:
                                         System
                                         failure

Handle_CFNRc   Handle_CFNRc

Fail   Forward   Forward   Fail
      Result?   Result?
         Not reachable   Not reachable

Set negative   Super_Charged_   Set negative
response: SRI_Error_   response:
Forwarding   HLR   Forwarding
violation   violation

              Yes──── Result=
                       Purged?

                          No

              Set negative
              response:
              Absent
              subscriber

                              Set negative
                              response:
                              System
                              failure

Result:=   Result:=   Result:=
Fail   Forward   Fail

  ⊗   ⊗   ⊗

Figure 48: Procedure PRN_Error_HLR

Procedure Forward_CUG_Check   FWD_CUG 1(1)

Procedure to carry out
CUG authorisation check
for a forwarded call

CUG info provided in
routeing information
request

No → CUG provisioned for forwarding subscriber against requested basic service

Yes

Perform Forwarding CUG authorisation ---- As defined in TS 23.085

CUG authorisation result

Pass

Fail

Result:=
Call allowed

Result:=
Call barred

Result:=
Call allowed

Update CUG info ---- As defined in TS 23.085

Figure 49: Procedure Forward _CUG_Check

Figure 50: Void

ETSI

Procedure Check_IC_Barring   CIB1(2)

Procedure to check call
request against SS barring
and ODB categories

Yes ────── Operator determined
BAIC imposed?

No

Yes ────── Operator determined
BIC-Roam imposed?

No

No ────── MS registered
in HPLMN
country?

Yes

1

Yes ────── Operator determined
BIC-RoamHZ
imposed?

No

No ────── MS registered
in HPLMN
zone?

Yes

Result:=
Call barred
(ODB)

⊗

1

Figure 51a: Procedure Check_IC_Barring (sheet 1)

Procedure Check_IC_Barring CIB2(2)

Procedure to check call request against SS barring and ODB categories

(1)

Initiate handling of BAIC ----- To process MAF022

Wait_For_ BAIC_ Response

Continue call handling <---- From process MAF022

Yes ← Call barred?

No

Initiate handling of BIC-Roam ----- To process MAF023

Wait_For_ BIC-Roam_ Response

Continue call handling <---- From process MAF023

Yes ← Call barred?

No

Result:= Call barred (SS barring)

Result:= Call allowed

⊗

⊗

Figure 51b: Procedure Check_IC_Barring (sheet 2)

ETSI

Procedure IC_CUG_Check IC_CUG1(1)

Figure 52: Procedure IC_CUG_Check

Procedure Handle_CFU   H_CFU1(1)

Procedure in the HLR
to handle Call Forwarding
Unconditional

Signals to/from the right
are to/from the process
MAF007

CAMEL_CHECK
_SII2_CDTI ─────── See TS 23.078

Result =
Pass ?   No

Yes

initiate
handling
of CFU

Wait_For_
CFU_Result

continue
call
handling

Error?   Yes

No

Normal
call?   Yes

No

Result:=   Result:=   Result:=
Fail   Forward   Continue

Figure 53: Procedure Handle_CFU

ETSI

Figure 54: Procedure Handle_CFNRc

7.2.3 Functional requirements of VLR

7.2.3.1 Process PRN_VLR

Sheet 1: the procedure Check_Parameters is specified in subclause 7.2.2.2.

Sheet 1: the test "Pre-paging allowed" takes the "yes" exit if:

- the information element "Pre-paging supported" was present in the Provide Roaming Number message; or

- as an operator option, the paging procedure can be completed before the minimum timer value for the Provide Roaming Number operation timer in the HLR has elapsed.

Sheet 1: the procedure Check_Reason_In_Serving_Network_Entity is specific to Super-Charger; it is specified in 3GPP TS 23.116 [24]. If the VLR does not support Super-Charger, processing continues from the "No" exit of the test "Result=Purged?".

Sheet 2, sheet 3, sheet 6, sheet 7: the procedure CAMEL_SET_SOA is specific to CAMEL; it is specified in 3GPP TS 23.078 [12].

Sheet 2, sheet 3, sheet 6, sheet 7: the task "Store alerting pattern (if received)" is executed only if the VLR supports the feature Network Indication of Alerting.

Sheet 2, sheet 3, sheet 6, sheet 7: the procedure CLI_PRN_VLR is specific to Enhanced CLI Handling. It is specified in 3GPP TS 23.081 [14].

Sheet 2, sheet 3, sheet 6, sheet 7: the procedure CCBS_Handle_PRN is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 3, sheet 4: the number of unused authentication sets which triggers the VLR to request further authentication sets from the HLR is an operator option.

Sheet 3, sheet 4: the process Fetch_Authentication_Sets_VLR is specified in subclause 7.1.2.11.

Sheet 4: the procedure Search_For_MS_VLR is specified in subclause 7.3.2.3.

Sheet 4: the test "Paging via SGSN possible" takes the "yes" exit if:

- the Gs interface is implemented; and

- there is an association established for the MS between the MSC/VLR and the SGSN.

Sheet 7, sheet 8: the state variables PAR pending, PAR successful and Fatal PAR error are global data, accessible to the matching instance of the process ICH_VLR, which is linked by the MSRN.

Sheet 8: this process communicates with the matching instance of the process ICH_VLR, which is linked by the MSRN.

Sheet 8: the test " Fatal PAR error?" takes the "Yes" exit if:

- the MS failed authentication; or

- the MS failed IMEI checking; or

- the HLR returned an "Unknown subscriber" error;

during the handling of the Process Access Request.

7.2.3.2 Process Restore_Subscriber_Data_VLR

7.2.3.3 Process PSI_VLR

Sheet 1: the procedure Check_Parameters is specified in subclause 7.2.2.2. If the HLR requests none of location information subscriber state, MS classmark and IMEI, the VLR treats this as a missing parameter.

Sheet 2: the test "Active retrieval required" takes the "Yes" exit if any one or more of current location, MS classmark or IMEI is indicated in the Provide Subscriber Info request.

7.2.3.4 Procedure Retrieve_Location_Info_VLR

The test "Retrieve location info from SGSN" takes the "Yes" exit if:

- the Gs interface is implemented; and

- there is an association established between the MSC/VLR and the SGSN.

The stored location information consists of:

- the service area ID (for UMTS) or cell ID (for GSM) of the cell in which the MS last established radio contact;

- the location number, geodetic information and geographical information derived from the service area ID or cell ID if the VLR is capable of doing so (the mapping from service area ID or cell ID to location number is network-specific and outside the scope of the UMTS and GSM standards);

- the age of the location information.

The output signal Send MS information towards the SGSN indicates that the required information is mobile location information.

The received location information consists of:

- the service area ID (for UMTS) or cell ID(for GSM) received in the paging response message or in the Send MS Information ack;

- the location number, geodetic information and geographical information derived from the service area ID or cell ID if the VLR is capable of doing so (the mapping from cell ID to location number is network-specific and outside the scope of the UMTS and GSM standards);

- the age of the location information.

The derivation of the location number, geodetic information and geographical information from the received service area ID or cell ID is a VLR operator option (the mapping from service area ID or cell ID to location number is network-specific and outside the scope of the UMTS and GSM standards).

7.2.3.5 Procedure Active_Info_Retrieval_VLR

Sheet 1: the test "Paging via SGSN possible" takes the "yes" exit if:

- the Gs interface is implemented; and

- the VLR configuration requires paging via the SGSN during VLR restoration.

Sheet 2: the output signal Page MS towards the SGSN includes or omits the Location area identity parameter depending on the availability of this information. If it is omitted, the signal Page MS is sent to every SGSN to which the VLR is connected.

The test "Report upon change of service area" takes the yes exit if the MSC has performed the Location Reporting Control procedure with the Request Type IE set to "change of service area" [26].

If the test "Report upon change of service area" takes the no exit, then the MSC shall perform a Location Reporting Control procedure with the Request Type IE set to "Direct".

Figure 55a: Process PRN_VLR (sheet 1)

Process PRN_VLR PRN_VLR2(8)

Process in the VLR to handle
a request for a roaming number

Signals to the left
are to the HLR.

(2)

IMSI
detached → True

False

Roaming
in LA
allowed? → No

Yes

MSRN
available? → No

Yes

MSC
per VLR

Set negative
response:
No roaming
number

Set negative
response:
Absent
subscriber

1 >1

Received MSC
number= Stored
MSC number? → Yes

(1)

No

Confirmed by
radio contact → False

True

Use received
MSC number
for MSRN

Use stored
MSC number
for MSRN

Allocate
MSRN

CAMEL_
SET_SOA — See TS 23.078

Store
compatibility
info — PLMN BC, ISDN BC,
ISDN LLC & ISDN HLC
(as available)

Store Alerting
Pattern
(if received)

CLI_PRN_
VLR — See TS 23.081

CCBS_Handle_
PRN — See TS 23.093

Provide
Roaming
Number ack

(6)

Figure 55b: Process PRN_VLR (sheet 2)

Process PRN_VLR PRN_VLR3(8)

③

Process in the VLR to handle
a request for a roaming number

Signals to the left
are to the HLR.

MSRN available

No → Set negative response: No roaming number → ①

Yes

Allocate MSRN

CAMEL_SET_SOA - - - See TS 23.078

Create IMSI record

Location info confirmed in HLR:= False - - - Only if >1 MSC per VLR

Confirmed by radio contact:=False;
Data confirmed by HLR:=False;
IMSI detached:=False

Allocate LMSI - - - If used by VLR

Store compatibility info - - - PLMN BC, ISDN BC, ISDN LLC & ISDN HLC (as available)

Store Alerting Pattern (if received)

CLI_PRN_VLR - - - See TS 23.081

⑥

Data confirmed by HLR?

False → More authentication sets needed? → Yes →
True

CCBS_Handle_PRN - - - See TS 23.093

Provide Roaming Number ack

No

Fetch_Authentication_Sets_VLR

Restore_Subscriber_Data_VLR

Idle

Figure 55c: Process PRN_VLR (sheet 3)

Figure 54d: Process PRN_VLR (sheet 4)

Process PRN_VLR

PRN_VLR5(8)

Process in the VLR to handle
a request for a roaming number

5

Create
IMSI
record

Location info
confirmed
in HLR:=
False

Only if >1 MSC
per VLR

Confirmed by radio contact:=False;
Data confimed by HLR:=False;
IMSI detached:=False

Allocate LMSI

If used
by VLR

Store
compatibility
info

PLMN BC, ISDN BC,
ISDN LLC & ISDN HLC
(as available)

Fetch_
Authentication_
Sets_VLR

Restore_
Subscriber_
Data_VLR

Search_For_
MS_VLR

Result=
Pass?

Yes

No

Absent
subscriber?

Yes

No

Set negative
response:
Absent
subscriber

1

7

Wait_For_
Access_
Request

Figure 54e: Process PRN_VLR (sheet 5)

ETSI

Process PRN_VLR

PRN_VLR6(8)

Process in the VLR to handle a request for a roaming number

Wait_For_ Access_ Request

Signals to the left are to the HLR; signals to/from the right are to/from the MSC unless shown otherwise.

Page MS via SGSN

Process Access Request

Page MS negative response

Page MS

To SGSN

Wait_For_ Access_ Request

MSRN available? — No — Yes

MSC per VLR

1 — Yes — >1

Received MSC number= Stored MSC number?

No

Confirmed by radio contact

False

Use received MSC number for MSRN

Use stored MSC number for MSRN

True

Allocate MSRN

CAMEL_ SET_SOA — See TS 23.078

Store compatibility info — PLMN BC, ISDN BC, ISDN LLC & ISDN HLC (as available)

Store Alerting Pattern (if received)

CLI_PRN_ VLR — See TS 23.081

CCBS_Handle_ PRN — See TS 23.093

Provide Roaming Number ack

8

Set negative response: System failure

Process Access Request negative response

Busy subscriber? — Yes — No

7

Absent Subscriber? — Yes — No

Set negative response: No roaming number

Set negative response: Absent subscriber

1

Figure 54f: Process PRN_VLR (sheet 6)

Process PRN_VLR   PRN_VLR7(8)

Process in the VLR to handle
a request for a roaming number

Signals to the left
are to the HLR.

(7)

MSRN
available? ───No───────────────────────────┐
    │
   Yes   Set negative
    │   response:
   MSC   No roaming
   per VLR   number
    │
1 ──┴────────── >1   │
    │   │   (1)
    │   Received MSC
    │   Yes number= Stored
    ├────────── MSC number?
    │   │
    │   No
    │   │
    │   False Confirmed by
    ├────────── radio contact
    │   │
    │   True
 Use received Use stored
 MSC number   MSC number
 for MSRN   for MSRN
    │   │
    └─────┬──────┘
          │
      Allocate
      MSRN
          │
      CAMEL_   ─ ─ See TS 23.078
      SET_SOA
          │
      Store   PLMN BC, ISDN BC,
      compatibility ISDN LLC & ISDN HLC
      info   (as available)
          │
      Store Alerting
      Pattern
      (if received)
          │
      CLI_PRN_   ─ ─ See TS 23.081
      VLR
          │
      CCBS_Handle_ ─ ─ See TS 23.093
      PRN
          │
      Provide
      Roaming
      Number ack
          │
      [   ] PAR pending:=False;
                    PAR successful:=False;
                    Fatal PAR error:=False
          │
      (Idle)

Figure 54g: Process PRN_VLR (sheet 7)

Process PRN_VLR   PRN_VLR8(8)

```
┌──────────────────────────────────┐
│ Process in the VLR to handle     │
│ a request for a roaming number   │
└──────────────────────────────────┘
```

```
┌────────────────────────────────┐
│ Signals to/from the left       │
│ are to/from the process ICH_VLR;│
│ signals to/from the right      │
│ are to/from the MSC            │
└────────────────────────────────┘
```

(8)

PAR pending:=
True

Process_
Access_
Request_VLR

Result=
Pass?   ── No

Yes

| PAR successful:=True | PAR successful:=False |

| PAR pending:=False | PAR pending:=False |

PAR
Completed

Fatal PAR
error?   ── No

Wait_For_
Call_Arrival

Yes

| Fatal PAR error:= True | Fatal PAR error:= False |

Call
arrived   Radio
                           connection
                           released

Call
arrived

PAR successful:=
False   PAR
                           Completed

Fatal PAR
error:= False

Idle   Idle

Figure 54h: Process PRN_VLR (sheet 8)

ETSI

Process Restore_Subscriber_Data_VLR   RSD_VLR1(1)

Process in the VLR
to restore subscriber data

Signals to/from the left
are to/from the HLR

Restore
Data

Wait_For_
Data

Restore
Data ack

Restore
Data negative
response

Update
Subscriber
Data

Update
HLR
number

Update MS
Not Reachable — — — If received
indicator   from HLR

Data
confirmed by
HLR:=True

Figure 56: Process Restore_Subscriber_Data_VLR

Figure 57a: Process PSI_VLR (sheet 1)

Process PSI_VLR   PSI_VLR2(2)

Process in the VLR to handle
a request from the HLR for
subscriber information

Signals to/from the left
are to/from the HLR;
signals to/from the right
are to/from the MSC

Wait_For_
MSC_Response

Obtain
Subscriber
Info ack

Subscriber
state
received?

No

Yes

Set
subscriber
state

Active
retrieval
required?

No

Yes

Location
info
requested?

No

Yes

Active_Info_
Retrieval_
VLR

Retrive_
Location_
Info_VLR

Provide
Subscriber
Info ack

Idle

Figure 57b: Process PSI_VLR (sheet 2)

Procedure Retrieve_Location_Info_VLR RLI_VLR1(1)

Procedure in the VLR
to retrieve location information
for a subscriber

Signals to/from the right
are to/from the SGSN

Retrieve location
info from SGSN?

Yes

No

Send MS
information

Location info:=
Stored
location info

Wait_For_
SGSN_Response

Send MS
Information
negative
response

Send MS
Information
ack

Location info:=
Stored
location info

Location info:=
Received
location info

Derive location number,
geodetic information and
geographical information

Figure 58: Procedure Retrieve_Location_Info_VLR

Procedure Active_Info_Retrieval_VLR   AIR_VLR1(2)

Procedure in the VLR
to retrieve the current
location information for a subscriber

Signals to/from the right
are to/from the MSC

Set information
required

Paging
via SGSN
possible?
— No

Yes

Set paging
via SGSN
possible

No — Location
area ID
known? — Yes

Page type=
Active information
retrieval

Search
for MS

Page type=
Active information
retrieval

Page MS

Wait_For_
Search_
Result

Wait_For_
Page_
Result

Figure 59a: Procedure Active_Info_Retrieval_VLR

Procedure Active_Info_Retrieval_VLR   AIR_VLR2(2)

Procedure in the VLR
to retrieve the current
location information for a subscriber

Wait_For_
Search_
Result

Search for
MS ack

Roaming
in LA
allowed?

No

Yes

Location
info
received?

Yes   No

Location info:=
Received
location info

Location info:=
Stored
location info

Subscriber
state:=Not
reachable

Location
info
received?

Yes   No

Location info:=
Received
location info

Location info:=
Stored
location info

Search
for MS
negative
response

Search
for MS
via SGSN

Page MS

Wait_For_
Search_
Result

Wait_For_
Page_
Result

Page MS
ack

Location
info
received?

Yes   No

Location info:=
Received
location info

Location info:=
Stored
location info

Page MS
negative
response

Page MS
via SGSN

Page MS

Wait_For_
Page_
Result

Figure 59b: Procedure Active_Info_Retrieval_VLR (sheet 2)

7.2.4 Functional requirements of MSC

7.2.4.1 Process Prepage_MSC

7.2.4.2 Procedure Prepaging_Page_MS_MSC

The test "MS connection exists" takes the "Yes" exit if there is a radio connection established between the MS and the network.

The test "MS busy" takes the "Yes" exit if the MS is engaged on a circuit-switched call.

The signal input "MS connection established" indicates that the MS has responded to paging, or sent a CM service request for anything other than a circuit-switched call, or completed the location registration procedure.

7.2.4.3 Prepaging_Search_For_MS_MSC

The test "MS connection exists" takes the "Yes" exit if there is a radio connection established between the MS and the network.

The test "MS busy" takes the "Yes" exit if the MS is engaged on a circuit-switched call.

The signal input "MS connection established" indicates that the MS has responded to paging, or sent a CM service request for anything other than a circuit-switched call, or completed the location registration procedure.

7.2.4.4 Process OSI_MSC

If the MS is engaged on a circuit-switched call, the state is busy, otherwise assumed idle.

7.2.4.5 Process RCL_MSC

This process runs when the MSC receives a Page MS message or a Search for MS message with a Page type indicating Active Info Retrieval.

7.2.4.6 Procedure Active_Info_Retrieval_Page_MSC

The test "MS connection exists" takes the "Yes" exit if there is a radio connection established between the MS and the network.

The test "GSM Access" takes the "Yes" exit if the MS is using a GSM radio access to communicate with the network.

The test "Report on change of service area?" takes the "Yes" exit if the MSC has performed the Location Reporting Control procedure (see 3GPP TS 25.413 [27]) with the Request Type IE set to "Change of service area".

If the test "Report on change of service area?" takes the "No" exit the MSC shall perform a Location Reporting Control procedure with the Request Type IE set to "Direct".

7.2.4.7 Procedure Active_Info_Retrieval_Search_MSC

The test "MS connection exists" takes the "Yes" exit if there is a radio connection established between the MS and the network.

The test "GSM Access" takes the "Yes" exit if the MS is using a GSM radio access to communicate with the network.

The test "Report on change of service area?" takes the "Yes" exit if the MSC has performed the Location Reporting Control procedure (see 3GPP TS 25.413 [26]) with the Request Type IE set to "Change of service area".

If the test "Report on change of service area?" takes the "No" exit the MSC shall perform a Location Reporting Control procedure with the Request Type IE set to "Direct".

7.2.4.8 Procedure Retrieve_IMEI_If_Required

If the IMEI is retrieved using an existing connection between the MS and the network (as opposed to a connection which has been set up for active information retrieval), the Release transaction signal is relayed to the MSC process which is supervising the existing connection.

Figure 60: Process Prepage_MSC

Figure 61: Procedure Prepaging_Page_MS_MSC

Procedure Prepaging_Search_For_MS_MSC   PPSMS_M1(1)

Figure 62: Procedure Prepaging_Search_For_MS_MSC

Process OSI_MSC   OSI_MSC1(1)

Process in the MSC to handle
a request from the VLR for
information on the subscriber's
location and state

Signals to/from the left
are to/from the VLR

Idle

Obtain
Subscriber
Info

Subscriber
state
requested?   No

Yes

Set
subscriber
state

Obtain
Subscriber
Info ack

Idle

Figure 63: Process OSI_MSC

Process AIR_MSC   AIR_MSC1(1)

Process in the MSC to retrieve
any one or more of the current location,
MS classmark and IMEI of a subscriber

Signals to/from the left
are to/from the VLR

Idle

Search for MS

Page MS

Active_Info_
Retrieval_
Search_MSC

Active_Info_
Retrieval_
Page_MSC

Idle

Figure 64: Process AIR_MSC

Procedure Active_Info_Retrieval_Page_MSC AIRP_MSC1(2)

Procedure in the MSC to page an MS in a specified location area for Active Location Retrieval

Signals to/from the left are to/from the BSS; signals to/from the right are to/from the VLR unless marked otherwise

Location area ID known? — No

Yes

MS connection exists? — Yes

No

Paging via SGSN possible? — No

Yes

In specified location area — Page

Page MS via SGSN

Retrieve_ IMEI_If_ Required

GSM Access? — Yes

No

Location info requested? — No

Yes

Report on change of service area? — Yes

No

Start Page response timer

Wait_For_ Page_ Response

Page response timer expired

MS connection established

CM Service Request — For circuit-switched call

Location Reporting Control

Wait_For_ Location_ Report

CM Service Request — To process OCH_MSC

Retrieve_ IMEI_If_ Required

Retrieve_ IMEI_If_ Required

Location Report

Release transaction

Location info:= Received location info

Set negative response: Absent subscriber

Set negative response: Unknown LAI

Page MS negative response

Page MS ack

Page MS ack

Page MS ack

Page MS negative response

Figure 65: Procedure Active_Info_Retrieval_Page_MSC

ETSI

Procedure Active_Info_Retrieval_Search_MSC   AIRS_MSC1(1)

Procedure in the MSC
to page an MS in all
location areas for Active
Location Retrieval

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the VLR
unless marked otherwise

MS connection exists? — Yes

No

Paging via SGSN possible? — No

Yes

In all location areas — Page

Search for MS via SGSN

Start Page response timer

Wait_For_ Page_ Response

Page response timer expired

MS connection established

CM Service Request — For circuit-switched call

CM Service Request — To process OCH_MSC

Retrieve_ IMEI_If_ Required

Retrieve_ IMEI_If_ Required

Release transaction

Set negative response: Absent subscriber

Search for MS negative response

Search for MS ack

Search for MS ack

Retrieve_ IMEI_If_ Required

GSM Access? — Yes

No

Location info requested? — No

Yes

Report on change of service area? — Yes

No

Location Reporting Control

Wait_For_ Location_ Report

Location Report

Location info:= Received location info

Search for MS ack

Figure 66: Procedure Active_Info_Retrieval_Search_MSC

Procedure Retrive_IMEI_If_Required RIIR1(1)

Procedure in the MSC
to retrieve the IMEI of the MS
if requested by the VLR

Signals to/from the left
are to/from the BSS

IMEI
requested?

No

Yes

Send
IMEI

Wait_For_
IMEI

IMEI

Release
transaction

IMEI:=
Received IMEI

Release
transaction

To supervising process,
if required

Figure 66bis: Procedure Retrieve_IMEI_If_Required

7.3 MT call

7.3.1 Functional requirements of serving MSC

7.3.1.1 Process ICH_MSC

Sheet 1: the rules for converting the ISDN BC/LLC/HLC to a bearer service or teleservice are specified in 3GPP TS 29.007 [30].

Sheet 1: the task "Store UUS information (if received)" is executed only if the VMSC supports UUS.

Sheet 1: the variables TCH allocated, ACM sent, Answer sent and Network connect sent are global data, accessible to the procedures Establish_Terminating_TCH_If_Required, Send_ACM_If_Required, Send_Answer_If_Required and Send_Network_Connect_If_Required.

Sheet 1: the variables UUS result sent, UUS1 implicit active, UUS1 explicit active, UUS2 active, UUS3 active and UUS CF interaction are specific to UUS. They are accessible to all UUS specific procedures.

Sheet 1: the handling starting with the input signal "Continue CAMEL handling" is specific to CAMEL phase 3 or later. If the VMSC does not support CAMEL phase 3 or later, this signal will not be received from the VLR.

Sheet 1: the procedure CAMEL_ICH_MSC_INIT is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 1: The variable "On_Hold" is used only if the VMSC supports Call Hold.

Sheet 1, sheet 4, sheet 9: the process CAMEL_ICH_LEG1_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 2: the procedure Process_Access_Request_MSC is specified in subclause 7.1.1.2.

Sheet 2: the signal input Complete Call will be received in the state Wait_For_Page_Request only if the MSC/VLR supports pre-paging.

Sheet 2, sheet 3: the suggested mapping from values of the Send Info For Incoming Call negative response information element to values of the ISUP release cause (see ITU-T Recommendation Q.850 [37]) is shown in table 2. The mapping used is a matter for the network operator, depending on the telephony signalling system used.

Table 2: Suggested mapping of Send Info For Incoming Call (SIFIC) negative responses to ISUP release causes

| SIFIC negative response	ISUP release cause number	ISUP release cause name
Absent subscriber	20	Subscriber absent
Busy subscriber	17	User busy
CUG reject (Called party SS interaction violation)	21	Call rejected
Forwarding violation	21	Call rejected
Impossible call completion	111	Protocol error, unspecified
No subscriber reply	19	No answer from user (user alerted)
System failure	111	Protocol error, unspecified
Unallocated roaming number	111	Protocol error, unspecified

Sheet 2, sheet 3, sheet 6, sheet 8, sheet 10, sheet 12: the procedure CAMEL_MT_GMSC_DISC4 is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 3 or later, processing continues from the "No" exit of the test "Result=Reconnect?".

Sheet 2, sheet 5, sheet 8, sheet 10, sheet 11, sheet 12: the procedure CAMEL_MT_GMSC_DISC6 is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 3: the procedure CAMEL_MT_GMSC_DISC5 is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 3 or later, processing continues from the "No" exit of the test "Result=Reconnect?".

Sheet 3: the procedure CD_Reject is specific to Call Deflection; it is specified in 3GPP TS 23.072 [11].

Sheet 3: the procedure Process_Call_Waiting is specific to Call Waiting; it is specified in 3GPP TS 23.083 [16].

Sheet 3: the task "Store CW treatment indicator for this call if received in SII2" is executed only if the VMSC supports CAMEL phase 3 or later.

Sheet 3: if the VMSC does not support CAMEL phase 3 or later, the procedure Complete_Call_In_MSC and the procedure Process_Call_Waiting will not return a "Reconnect" result.

Sheet 3: the processing in the branch starting with the input signal"Process Call Waiting" is specific to Call Wait. If the VMSC does not support Call Waiting, this signal will not be received from the VLR.

Sheet 3, sheet 10: the procedure CCBS_Set_Diagnostic_For_Release is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 3, sheet 5, sheet 6, sheet 11, sheet 12, sheet 13: the procedure CCBS_Check_Last_Call is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 3: the procedure UUS_ICH_Check_Support is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 4: the procedure CAMEL_ICH_LEG2_MSC isspecific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 9: the procedure CAMEL_ICH_LEG2_CF_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 5: the procedure CAMEL_Check_ORLCF_VMSC is specific to CAMEL phase 2 or later; it is specified in 3GPP TS 23.078 [12].

- If the VLR does not support CAMEL or no CAMEL information is available for the subscriber, then ORLCF may take place ('ORLCF' result from CAMEL_Check_ORLCF_VMSC).

- If CAMEL information is available for the subscriber and the GMSC supports the required CAMEL phase, then ORLCF may take place. The Resume Call Handling request shall include the relevant CAMEL information ('ORLCF' result from CAMEL_Check_ORLCF_VMSC).

- If CAMEL information is available for the subscriber but the GMSC does not support the required CAMEL phase, then ORLCF shall not take place ('VMSCCF' result from CAMEL_Check_ORLCF_VMSC).

Sheet 5: the procedure Handle_ORLCF_VMSC is specific to Support of Optimal Routeing. It is specified in 3GPP TS 23.079 [13]. If the VMSC does not support Optimal Routeing, processing continues from the "Continue" exit of the test "Result?".

Sheet 5, sheet 6, sheet 11: the procedures CD_Failure and CD_Success are specific to Call Deflection; they are specified in 3GPP TS 23.072 [11].

Sheet 6: the procedure CAMEL_MT_VMSC_Notify_CF is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 6: If the VMSC does not support CAMEL phase 3 or later, processing starts with the possible call of the procedure CCBS_Check_Last_Call.

Sheet 6: The task "set redirection information" includes the mapping of the MSISDN parameter received in the Send Info For Incoming Call ack message to the redirecting number of the IAM message and the setting of the presentation indicator of the redirecting number of the IAM message according to the value of the Redirecting presentation parameter received in the Send Info For Incoming Call ack message.

Sheet 6: it is an operator option whether to send an Address Complete message if the VLR returns forwarding information. If the VMSC sends an Address Complete message, it shall include the called party's status field of the Backward call indicator set to "no indication".

Sheet 6, sheet 8: the procedure Send_ACM_If_Required is specified in subclause 7.2.1.3.

Sheet 6: the procedure Activate_CF_Process is specified in subclause 7.2.1.7.

Sheet 6: the procedure UUS_ICH_Set_Info_In_IAM is specific to UUS, it is specified in 3GPP TS 23.087 [20].

Sheet 6: the called party address sent in the IAM to the process MT_CF_MSC is the Forwarded-to number received in the Perform Call Forwarding ack.

Sheet 6: the procedure CAMEL_Store_Destination_Address is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 7: The processing on this sheet is specific to CAMEL phase 3 or later. If the VMSC does not support CAMEL phase 3 or later, the input signal Int_Release Call will not be received.

Sheet 8: the procedure CAMEL_MT_GMSC_ANSWER is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 3 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 8: the procedure Handle_COLP_Forwarding_Interaction_MSC is specified in subclause 7.2.1.6.

Sheet 8: the procedure Send_Answer_If_Required is specified in subclause 7.2.1.4.

Sheet 8: the procedure Send_Network_Connect_If_Required is specified in subclause 7.2.1.5.

Sheet 8: the procedure CAMEL_MT_MSC_ALERTING is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 4 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 10: the procedure CCBS_MT_MSC_Check_Forwarding is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 11: the processing on this sheet is specific to CAMEL phase 3 or later. If the VMSC does not support CAMEL phase 3 or later, the input signal Send Info For MT Reconnected Call ack will not be received.

Sheet 11: the procedure Handle_ORLCF_VMSC is specific to OR; it is specified in 3GPP TS 23.079 [13]. If the VMSC does not support OR, processing continues from the "No" exit of the test "Result = Forwarding Failed?".

Sheet 13, sheet 14: the procedure CAMEL_MT_GMSC_DISC1 is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 13, sheet 14: the procedure CAMEL_MT_GMSC_DISC2 is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 3 or later, processing continues from the "No" exit of the test "Result=Reconnect?".

Sheet 13: the procedure UUS_MSC_Check_UUS1_UUI is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 14: after the VMSC has sent an IAM to the process MT_CF_MSC, it acts as a transparent relay for messages received from the GMSC and the process MT_CF_MSC. Any message other than Address Complete, Connect, Answer or Release causes no change of state in the process ICH_MSC.

Sheet 15: The processing on this sheet is specific to CAMEL phase 3 or later. If the VMSC does not support CAMEL phase 3 or later, the input signal Int_Release Call will not be received.

Sheet 16: the procedure Process_Hold_Request is specific to Call Hold; it is specified in 3GPP TS 23.083[16].

Sheet 16: the procedure Process_Retrieve_request is specific to Call_Hold; it is specified in 3GPP TS 23.083[16].

7.3.1.2 Procedure Page_MS_MSC

Sheet 1: the test "MS connection exists" takes the "Yes" exit if there is a radio connection established between the MS and the network.

Sheet 1: for an SMS or SS page, the test "Call still exists" takes the "Yes" exit if the SMS or SS transaction which led to the page still exists.

Sheet 1: the test "SMS or SS page" is not required for the handling of circuit-switched calls, because the VLR will always use a page type of "circuit-switched call", but the more generalized procedure Page_MS_MSC is equally applicable to paging for SMS delivery or network-initiated SS procedures.

Sheet 2: the procedure Check_MT_Multicall_MSC is specific to Multicall; it is specified in 3GPP TS 23.135 [25]. If the VMSC does not support Multicall, processing continues from the "Yes" exit of the test "Result=Not provisioned?".

Sheet 2: the test "Call in set-up" takes the "Yes" exit if the call on which the MS is engaged has not reached the established phase (called party answer).

Sheet 2: the test Call waiting" takes the "Yes" exit if a waiting call has been offered to the subscriber but the outcome of offering the call has not been determined.

Sheet 2: if there is one established call, the negative response Busy Subscriber (More calls possible) includes the basic service which applies for the established call. If there are two or more established calls (the Multicall case), the negative response Busy Subscriber (More calls possible) includes the basic service list which applies for the established calls (See 3GPP TS 23.135 [25]).

Sheet 3: the signal input "MS connection established" indicates that the MS has responded to paging, or sent a CM service request for anything other than a circuit-switched call, or completed the location registration procedure.

7.3.1.3 Procedure Search_For_MS_MSC

Sheet 1: the test "MS connection exists" takes the "Yes" exit if there is a radio connection established between the MS and the network.

Sheet 1: for an SMS or SS page, the test "Call still exists" takes the "Yes" exit if the SMS or SS transaction which led to the page still exists.

Sheet 1: the test "SMS or SS page" is not required for the handling of circuit-switched calls, because the VLR will always use a page type of "circuit-switched call", but the more generalized procedure Search_For_MS_MSC is equally applicable to paging for SMS delivery or network-initiated SS procedures.

Sheet 2: the procedure Check_MT_Multicall_MSC is specific to Multicall; it is specified in 3GPP TS 23.135 [25]. If the VMSC does not support Multicall, processing continues from the "Yes" exit of the test "Result=Not provisioned?".

Sheet 2: the test "Call in set-up" takes the "Yes" exit if the call on which the MS is engaged has not reached the established phase (called party answer).

Sheet 2: the test "Call waiting" takes the "Yes" exit if a waiting call has been offered to the subscriber but the outcome of offering the call has not been determined.

Sheet 2: if there is one established call, the negative response Busy Subscriber (More calls possible) includes the basic service which applies for the established call. If there are two or more established calls (the Multicall case), the negative response Busy Subscriber (More calls possible) includes the basic service list which applies for the established calls (See 3GPP TS 23.135 [25]).

Sheet 3: the signal input "MS connection established" indicates that the MS has responded to paging, or sent a CM service request for anything other than a circuit-switched call, or completed the location registration procedure.

7.3.1.4 Procedure Complete_Call_In_MSC

Sheet 1: the procedure Set_CLIP_Info_MSC is specific to CLIP.

Sheet 1: the VMSC derives the PLMN bearer capability required for the call according to the rules defined in 3GPP TS 29.007 [30].

Sheet 1, sheet 2: the VMSC and the MS may negotiate the bearer capability to be used for the call by the exchange of information in the Set-up and Call Confirmed messages.

Sheet 1: the procedure UUS_ICH_UUS1_Implicit_Active is specific to UUS, it is specified in 3GPP TS 23.087 [20].

Sheet 1: the procedure CCBS_Report_Not_Idle is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 2: the procedure Establish_Terminating_TCH_Multicall is specific to Multicall; it is specified in 3GPP TS 23.135 [25].

Sheet 2: the test "Result=Rejected?" can take the "Yes" exit only if the procedure Establish_Terminating_TCH_Multicall was called.

Sheet 2, sheet 3, sheet 4, sheet 5, sheet 6, sheet 7: the procedure CAMEL_MT_GMSC_DISC4 is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 3 or later, processing continues from the "No" exit of the test "Result=Reconnect?".

Sheet 2, sheet 3, sheet 6, sheet 9, sheet 10: the procedure CAMEL_MT_GMSC_DISC6 is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 2, sheet 5, sheet 9: the procedure CCBS_ICH_MSC_Report_Failure is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 3, sheet 5: the procedure CCBS_ICH_MSC_Report_Success is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 3: the procedure CAMEL_Start_TNRy is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 3: the procedure CAMEL_MT_MSC_ALERTING is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 4 or later, processing continues from the "Pass" exit of the test "Result?".

Sheet 3, sheet 6: the procedure UUS_ICH_Check_Support is specific to UUS, it is specified in 3GPP TS 23.087 [20]. If the VMSC does not support UUS, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 3: the task "UTU2Cnt:=0" is executed only if the VMSC supports UUS.

Sheet 3: the procedure Send_ACM_If_Required is specified in subclause 7.2.1.3.

Sheet 3, sheet 6: the procedure Establish_Terminating_TCH_Multicall is specific to Multicall; it is specified in 3GPP TS 23.135 [25]. If the VMSC does not support Multicall, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 4, sheet 7: the procedure Handle_AoC_MT_MSC is specific to AoC. If the VMSC does not support AoC, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 4, sheet 7: the procedure CAMEL_MT_GMSC_ANSWER is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VMSC does not support CAMEL phase 3 or later, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 4, sheet 7: the procedure Set_COL_Presentation_Indicator_MSC is specific to COLP.

Sheet 4: the procedure Send_Network_Connect_If_Required is specified in subclause 7.2.1.5.

Sheet 5, sheet 11: the processing in the branch starting with the input "CD Request" is specific to Call Deflection; if the VMSC does not support Call Deflection the input is discarded.

Sheet 5, sheet 11: the procedure Handling_CD_MSC is specific to Call Deflection; it is specified in 3GPP TS 23.072 [11].

Sheet 6: the procedure CAMEL_Stop_TNRy is called if the VMSC supports CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12].

Sheet 7: the procedure Send_Answer_If_Required is specified in subclause 7.2.1.4.

Sheet 8: the input signal "CAMEL TNRy expired" will be received only if the VMSC supports CAMEL phase 3 or later.

Sheet 8, sheet 11: the procedure UUS_ICH_Check_Forwarding is specific to UUS, it is specified in 3GPP TS 23.087 [20]. If the VMSC does not support UUS, processing continues from the "Yes" exit of the test "Result=Pass?".

Sheet 9, sheet 10: the procedure UUS_MSC_Check_UUS1_UUI is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 11: the procedures UUS_MSC_Check_UUS2_UUI_to MS and UUS_MSC_Check_UUS2_UUI_to NW are specific to UUS, they are specified in 3GPP TS 23.087 [20].

Sheet 11: the procedure CD_UUS_Interaction is specific to Call Deflection; it is specified in 3GPP TS 23.072 [11].

7.3.1.5 Void

7.3.1.6 Procedure Set_CLIP_Info_MSC

The originating exchange may release the call or the MS may terminate the transaction with the network by sending a Release transaction message while a response is awaited from the process CLIP_MAF002. The message is saved for processing after return from the procedure.

7.3.1.7 Void

7.3.1.8 Procedure Establish_Terminating_TCH_If_Required

The procedure TCH_Check is specified in subclause 7.1.1.14.

7.3.1.9 Procedure Handle_AoC_MT_MSC

7.3.1.10 Procedure Set_COL_Presentation_Indicator_MSC

The originating exchange may release the call or the MS may terminate the transaction with the network by sending a Release transaction message while a response is awaited from the process COLP_MAF041. The message is saved for processing after return from the procedure.

Process ICH_MSC ICH_MSC1(17)

Process in the MSC
to handle an incoming (MT) call

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the VLR
unless marked otherwise

Idle

Initial
Address ◁---- From GMSC

Convert ISDN BC/LLC/HLC
(if present) to bearer
service/teleservice & PLMN BC;
Store UUS information (if received)

Send Info
For Incoming
Call

ACM sent:=False;
Answer sent:=False;
BOR:=False;
Network connect sent:=False;
TCH allocated:=False;
UUS1 result sent:=False;
UUS1 implicit active:=False;
UUS1 explicit active:=False;
UUS2 active:=False;
UUS3 active:=False;
UUS CF interaction:=False;
Call answered := False;
On_Hold:=False

Wait_For_
Page_Request

Continue
CAMEL
Handling ◁

CAMEL_
ICH_MSC_
INIT ⊢-- See TS 23.078

Result?

Leg1_only   Reconnect   MSRN   Aborted   Fail

Leg1_status   Set Suppress   Set
:= Set-up   VT-CSI   cause

CAMEL_ICH_   Send Info For   Send Info   Release
LEG1_MSC   MT Reconnected   For Incoming
(Leg1_Status) Call   Call

Idle   Wait_For_   Wait_For_   Release call
              Reconnected_   Page_Request   resources
              Call_Result

See TS 23.078   Idle

Figure 67a: Process ICH_MSC (sheet 1)
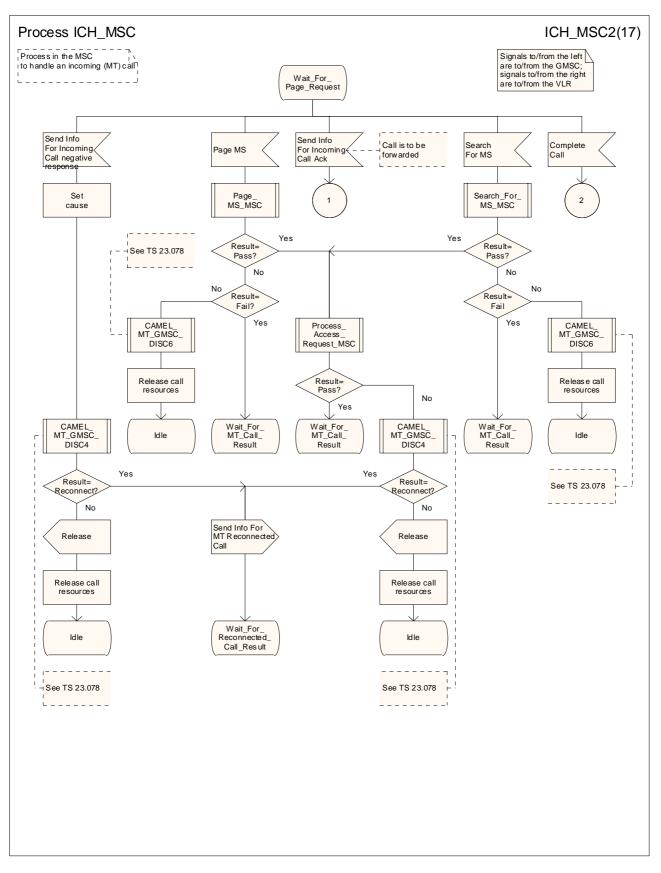
Figure 67b: Process ICH_MSC (sheet 2)

Process ICH_MSC ICH_MSC3(17)
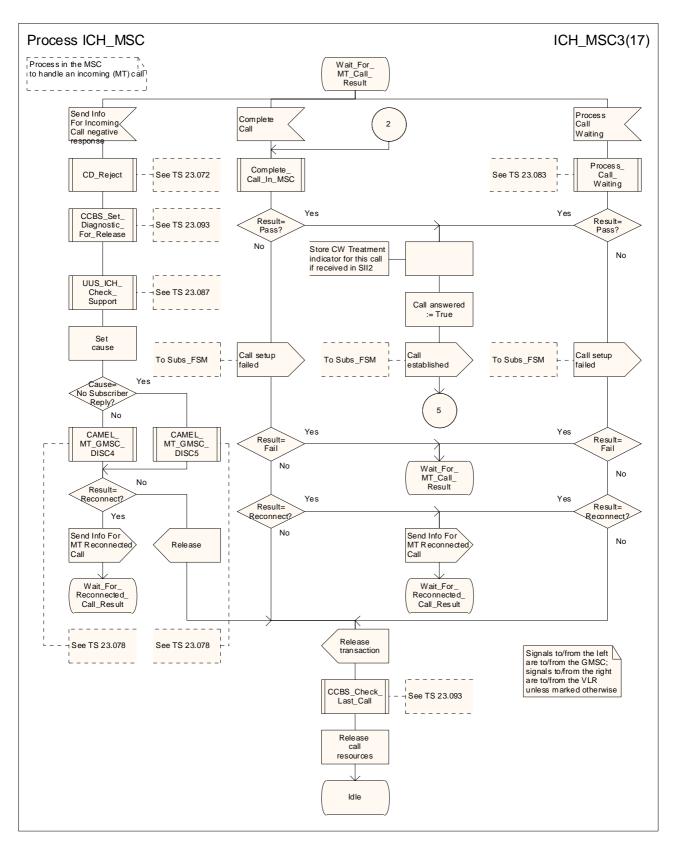
Figure 67c: Process ICH_MSC (sheet 3)

Process ICH_MSC   ICH_MSC4(17)

Process in the MSC
to handle an incoming (MT) call

5

CAMEL phase 4 or later
control relationship exists?

No

Yes

Leg1_status
:= Active

See TS 23.078 — CAMEL_ICH_
LEG1_MSC
(Leg1_Status)

Wait_For_
Clear

See TS 23.078 — CAMEL_ICH_
LEG2_MSC

Idle
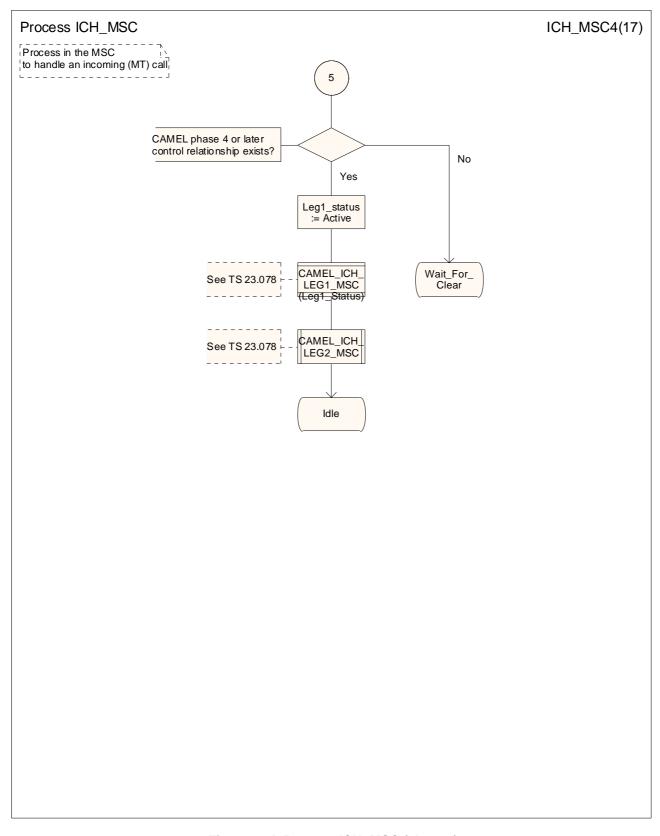
Figure 67d: Process ICH_MSC (sheet 4)

Figure 67e: Process ICH_MSC (sheet 5)

Process ICH_MSC ICH_MSC6(17)

Process in the MSC
to handle an incoming (MT) call

Signals to the right
are to the VLR
unless marked otherwise

(3)

Yes ◁──────── ⟨ Type of forwarding=
Reconnect? ⟩

No

CAMEL_
MT_VMSC_ ┤- See TS 23.078
Notify_CF

Yes ◁──────── ⟨ Result=
Reconnect? ⟩ (4)

No

CCBS_Check_
Last_Call ┤- See TS 23.093

Set
redirection
information

Send_ACM_
If_Required

Activate_
CF_Process

Fail ⟨ Result? ⟩ Pass

Release

Release

CAMEL_ UUS_ICH_
MT_GMSC_ ┤- See TS 23.078 Set_Info_ ┤- See TS 23.087
DISC4 In_IAM

Yes ◁──────── ⟨ Result= Initial
Reconnect? ⟩ Address To process MT_CF_MSC
Message
No

Send Info For CAMEL_Store_
MT Reconnected CD_Failure ┤- See TS 23.072 Destination_ ┤- See TS 23.078
Call Address
(False, True)

Wait_For_ CCBS_Check_ CD_Success ┤- See TS 23.072
Reconnected_ Last_Call ┤- See TS 23.093
Call_Result

Wait_For_
Idle Forward_ACM

Figure 67f: Process ICH_MSC (sheet 6)

ETSI

Process ICH_MSC   ICH_MSC7(17)

Process in the MSC
to handle an incoming (MT) call

Signals to/from the left
are to/from the GMSC;
signals to/from the right
are to/from the VLR
unless marked otherwise

Wait_For_MT_Call_Result,
Wait_For_Reconnected_Call_Result

Int_Release_
Call   ◁ - - - ┤ From gsmSSF

Abort

Release

Release
Transaction   - - - ┤ To BSS

Release
call
resources

Idle

Figure 67g: Process ICH_MSC (sheet 7)

Process ICH_MSC   ICH_MSC8(17)

Process in the MSC
to handle an incoming (MT) call

Signals to/from the left
are to/from the GMSC;
signals to/from the right
are to/from the process MT_CF_MSC
unless marked otherwise

Figure 67h: Process ICH_MSC (sheet 8)

Process ICH_MSC ICH_MSC9(17)

Process in the MSC
to handle an incoming (MT) call

⑦

CAMEL phase 4 or later
control relationship exists?

Yes No

Leg1_status
:= Active

See TS 23.078 CAMEL_ICH_
LEG1_MSC
(Leg1_Status)

Wait_For_
Clear

See TS 23.078 CAMEL_ICH_
LEG2_CF_MSC

Idle

Figure 67i: Process ICH_MSC (sheet 9)

Figure 67j: Process ICH_MSC (sheet 10)

Process ICH_MSC ICH_MSC11(17)

Process in the MSC
to handle an incoming (MT) call

Signals from the left
are from the GMSC;
signals from the right
are from the VLR

Wait_For_
Reconnected_
Call_Result

Send Info For MT
Reconnected
Call ack

Call
answered
True

False

Handle_
ORLCF_VMSC ── See TS 23.079

Result=
Accepted?
No Yes

Result=
Forwarding
Failed?
No

Yes

4

See TS 23.072 ── CD_Failure

CD_Success ── See TS 23.072

Wait_For_
Release_From_
GMSC

Release

CAMEL_
MT_GMSC_
DISC6 ── See TS 23.078

CCBS_Check_
Last_Call ── See TS 23.093

Release call
resources

Idle

Figure 67k: Process ICH_MSC (sheet 11)

Process ICH_MSC   ICH_MSC12(17)

Process in the MSC
to handle an incoming (MT) call

Signals to/from the left
are to/from the GMSC;
signals to/from the right
are to/from the BSS
unless marked otherwise

Figure 67I: Process ICH_MSC (sheet 12)

Process ICH_MSC   ICH_MSC13(17)

Process in the MSC
to handle an incoming (MT) call

Signals to/from the left
are to/from the GMSC;
signals to/from the right
are to/from the BSS
unless marked otherwise

Wait_For_Clear

Release

Release
transaction

UUS_MSC_
Check_
UUS1_UUI   See TS 23.087

CAMEL_
MT_GMSC_
DISC2   See TS 23.078

Release
transaction

Result=
Reconnect?   Yes

No

See TS 23.078   CAMEL_
MT_GMSC_
DISC1   See TS 23.087   UUS_MSC_
Check_
UUS1_UUI

Release   Send Info For
MT Reconnected
Call   To VLR

CCBS_Check_
Last_Call   See TS 23.093

Release
call
resources

To Subs_FSM   Call
cleared

Idle   Wait_For_
Reconnected_
Call_Result

Figure 67m: Process ICH_MSC (sheet 13)

ETSI

Figure 67n: Process ICH_MSC (sheet 14)

Process ICH_MSC ICH_MSC15(17)

Process in the MSC
to handle an incoming (MT) call

Signals to/from the left
are to/from the GMSC;
signals to/from the right
are to/from the process MT_CF_MSC
unless marked otherwise

Wait_For_Forward_ACM,
Wait_For_Forward_Clear

Int_Release_
Call ⟵----- From gsmSSF

Release

Release

Release
call
resources

Idle

Wait_For_
Clear

Int_Release_
Call ⟵----- From gsmSSF

Release
transaction ⟶---- To the BSS

Release

Release
call
resources

Call
cleared ⟶---- To Subs_FSM

Idle

Figure 67o: Process ICH_MSC (sheet 15)

Process ICH_MSC ICH_MSC16(17)

Process in the MSC
to handle an incoming (MT) call

Signals to/from the left
are to/from the BSS

Wait_For_
Clear

Hold
request

Retrieve
request

Hold
supported?

Hold
supported?

Yes   No

No   Yes

See 3G TS
23.083

Process_
Hold_
Request

Hold
reject

Retrieve
reject

Process_
Retrieve_
Request

See 3G TS
23.083

Wait_For_
Clear

Figure 67p: Process ICH_MSC (sheet 16)

Process ICH_MSC ICH_MSC17(17)

Process in the MSC
to handle an incoming (MT) call

Signals from the left
are from the BSS;
signals to the right
are to the Subs_FSM process.

Wait_For_
Clear

ECT
request

MPTY
request

ECT
request

MPTY
request

Wait_For_
Clear

Figure 67q: Process ICH_MSC (sheet 17)

Procedure Page_MS_MSC PAGE_M1(3)

Procedure in the MSC to page an MS in a specified location area

Signals to/from the left are to/from the BSS; signals to/from the right are to/from the VLR unless marked otherwise

Location area ID known? — No

Call still exists? — No

Set negative response: Unknown LAI

MS connection exists? — Yes

Set negative response: System Failure

Yes

Clear received:= False

SMS or SS page? — Yes

No

Paging via SGSN possible? — No

Yes

In specified location area — Page

Page MS via SGSN

Request call status --- To Subs_FSM

Set access connection status

Page MS negative response

Result:= Pass

Result:= Fail

Start Page response timer

Wait_For_ Page_ Response

Wait_For_ Call_Status

Figure 68a: Procedure Page_MS_MSC (sheet 1)

Figure 68b: Procedure Page_MS_MSC (sheet 2)

Procedure Page_MS_MSC PAGE_M3(3)

Figure 68c: Procedure Page_MS_MSC (sheet 3)

Procedure Search_For_MS_MSC   SRCH_M1(3)

Procedure in the MSC
to search for an MS
(page in all location areas)

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the VLR
unless marked otherwise

Call still exists? — No

Yes

MS connection exists? — Yes

No

Clear received:= False

SMS or SS page? — Yes

No

Paging via SGSN possible? — No

Yes

Search for MS via SGSN

Request call status — To Subs_FSM

Set negative response: System Failure

Page

In all location areas

Set access connection status

Search For MS negative response

Start Page response timer

Result:= Pass

Result:= Fail

Wait_For_ Search_ Response

Wait_For_ Call_Status

⊗

⊗

Figure 69a: Procedure Search_For_MS_MSC (sheet 1)
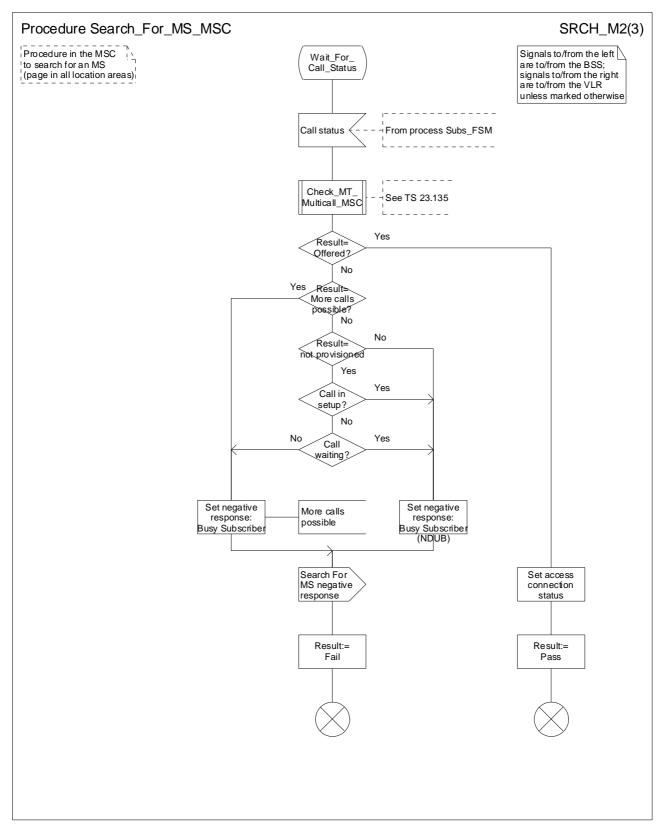
Figure 69b: Procedure Search_For_MS_MSC (sheet 2)

Procedure Search_For_MS_MSC SRCH_M3(3)
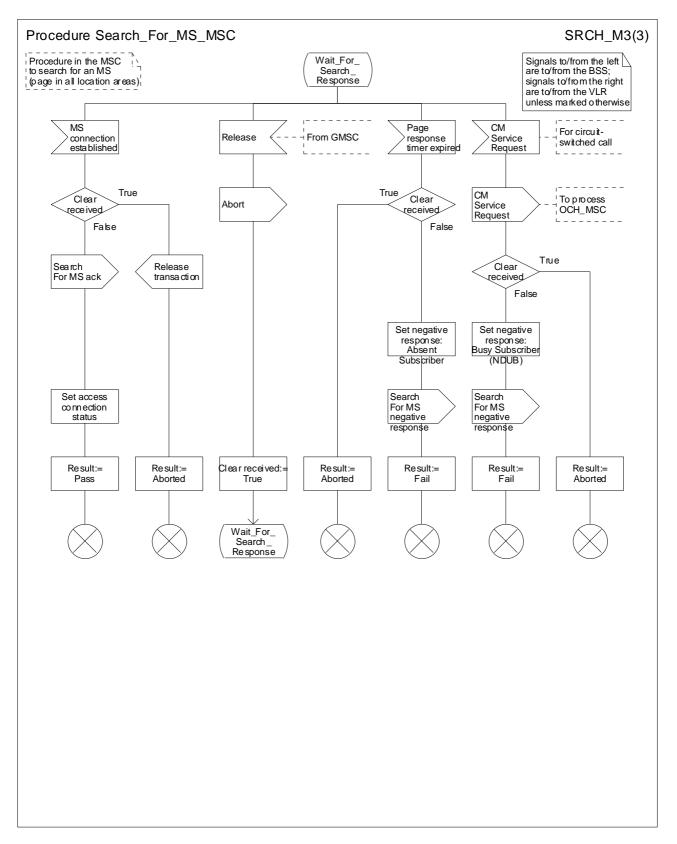
Figure 69c: Procedure Search_For_MS_MSC (sheet 3)

Procedure Complete_Call_In_MSC CCI_MSC1(11)

Procedure in the MSC
to complete an MT call
on request from the VLR

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the VLR
unless marked otherwise

Set_CLIP_
Info_MSC

Derive required
PLMN BC — See TS 29.007

Setup

UUS_ICH_UUS1_
Implicit_
Active — See TS 23.087

CCBS_Report_
Not_Idle — See TS 23.093

Wait_For_
Setup_
Response

Setup
failure

Int_Release_
Call — From gsmSSF

Set negative
response:
Absent
Subscriber

Complete
Call
negative
response

Result:=
Fail

⊗

Figure 70a: Procedure Complete_Call_In_MSC (sheet 1)
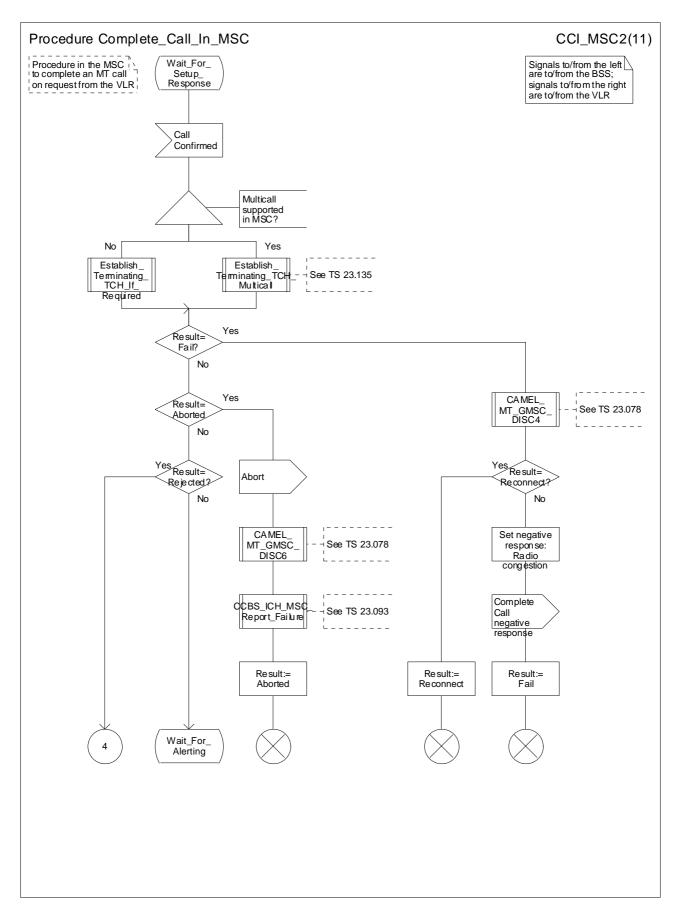
Figure 70b: Procedure Complete_Call_In_MSC (sheet 2)

Figure 70c: Procedure Complete_Call_In_MSC (sheet 3)

Procedure Complete_Call_In_MSC   CCI_MSC4(11)

Procedure in the MSC to complete an MT call on request from the VLR

Signals to/from the left are to/from the BSS; signals to/from the right are to/from the VLR unless marked otherwise

Figure 70d: Procedure Complete_Call_In_MSC (sheet 4)

Procedure Complete_Call_In_MSC CCI_MSC5(11)

Figure 70e: Procedure Complete_Call_In_MSC (sheet 5)

Procedure Complete_Call_In_MSC   CCI_MSC6(11)

Wait_for_
Answer

A

Connect

CAMEL_
Stop_TNRy ── See TS 23.078

UUS_ICH_
Check_
Support ── See TS 23.087

Result=
Pass? ──No──

Yes

Establish_
Terminating_
TCH_Multicall ── See TS 23.135

1

Result=
Pass? ──Yes──

No

5

Result=
Aborted? ──Yes──

No

See TS 23.078 ── CAMEL_
MT_GMSC_
DISC4

Yes── Result=
Reconnect?

Release   Abort

Abort   See TS 23.078 ── CAMEL_
MT_GMSC_
DISC6

Result:=
Reconnect   Result:=
Aborted   Result:=
Aborted

⊗   ⊗   ⊗

Figure 70f: Procedure Complete_Call_In_MSC (sheet 6)

ETSI

Procedure Complete_Call_In_MSC CCI_MSC7(11)

Procedure in the MSC to complete an MT call on request from the VLR

Signals to/from the left are to/from the BSS; signals to/from the right are to/from the VLR unless marked otherwise

Figure 70g: Procedure Complete_Call_In_MSC (sheet 7)

Procedure Complete_Call_In_MSC   CCI_MSC8(11)

Procedure in the MSC
to complete an MT call
on request from the VLR

Wait_for_
Answer

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the VLR
unless marked otherwise

No Reply
Call Timer
expired

CAMEL TNRy
expired

UUS_ICH_
Check_
Forwarding ---- See TS 23.087

Result=
Pass?   No

Yes

Set negative
response:
No subscriber
reply

Release
transaction

Complete
Call
negative
response

2

Release
transaction

Result:=
Fail

⊗

Figure 70h: Procedure Complete_Call_In_MSC (sheet 8)

Procedure Complete_Call_In_MSC CCI_MSC9(11)

Procedure in the MSC to complete an MT call on request from the VLR

Wait_For_Setup_Response, Wait_For_Alerting

Signals to/from the left are to/from the BSS; signals to/from the right are to/from the VLR unless marked otherwise

Release transaction

Release — From GMSC

CCBS_ICH_MSC Report_Failure — See TS 23.093

CAMEL_ MT_GMSC_ DISC6 — See TS 23.078

User busy? — No

CCBS_ICH_MSC Report_Failure — See TS 23.093

Yes

Set negative response: Busy subscriber (UDUB)

UUS_MSC_ Check_ UUS1_UUI — See TS 23.087

UUS_MSC_ Check_ UUS1_UUI — See TS 23.087

Complete Call negative response

Release — To GMSC

Release transaction

Abort

Result:= Fail

Result:= Aborted

Figure 70i: Procedure Complete_Call_In_MSC (sheet 9)

Procedure Complete_Call_In_MSC   CCI_MSC10(11)

Procedure in the MSC
to complete an MT call
on request from the VLR

Wait_For_
Answer

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the VLR
unless marked otherwise

Release
transaction

From GMSC → Release

See TS 23.087 ⊢ UUS_MSC_
Check_
UUS1_UUI

Release
transaction

User   No
busy? ─────────────────────

See TS 23.078 ⊢ CAMEL_
MT_GMSC_
DISC6

Yes

See TS 23.087 ⊢ UUS_ICH_
Check_
Forwarding

UUS_MSC_
Check_
UUS1_UUI   ⊢ See TS 23.087

No
Result=
Pass?

Release   ⊢ To GMSC

Yes

See TS 23.087 ⊢ UUS_MSC_
Check_
UUS1_UUI

Set negative
response:
Busy subscriber
(UDUB)

Abort

(1)

Complete
Call
negative
response

Result:=
Fail

Result:=
Aborted

⊗   ⊗

Figure 70j: Procedure Complete_Call_In_MSC (sheet 10)

Procedure Complete_Call_In_MSC CCI_MSC11(11)

Procedure in the MSC
to complete an MT call
on request from the VLR

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the VLR
unless marked otherwise

Wait_For_
Answer

CD Request

UUS_ICH_
Check_
Forwarding — See TS 23.087

Result=
Pass?

No

See TS 23.072 — CD_UUS_
Interaction

2

Yes

Handling_
CD_MSC — See TS 23.072

Complete
Call
negative
response

Result:=
Fail

Wait_For_Alerting,
Wait_For_Answer

Int_Release_
Call — From gsmSSF

Abort

Release
transaction

Release — To GMSC

Result:=
Aborted

Wait_For_
Answer

User to
User

User to
User

See TS 23.087 — UUS_MSC_
Check_UUS2_
UUI_to_NW

UUS_MSC_
Check_UUS2_
UUI_to_MS — See TS 23.087

Wait_For_
Answer

Figure 70k: Procedure Complete_Call_In_MSC (sheet 11)

Procedure Set_CLIP_Info_MSC   CAINF_M1(1)

Procedure in the MSC
to determine the CLIP
information to be sent to the MS

Signals to/from the right
are to/from the process
CLIP_MAF002

Initiate
handling
of CLIP

Wait_For_
CLIP_Info

Release
transaction   From BSS

Continue
call
handling

Release   From GMSC

Figure 71: Procedure Set_CLIP_Info_MSC

Figure 72: Void

Procedure Establish_Terminating_TCH_If_Required ETTCIR1(1)

Procedure in the terminating VMSC
to establish a Traffic Channel
if one has not been established
for this call

Signals to/from the left
are to/from the BSS;
signals to/from the right
are to/from the GMSC

TCH_Check

Result

| Fail | Use existing | Allocate | Reject | Aborted |

Result:=
Fail

Result:=
Pass

Allocate
channel

Result:=
Rejected

Result:=
Aborted

Wait_For_
Allocation_
Complete

Release
transaction

Allocation
failure

Allocation
complete

Release

Release
transaction

Release
transaction

Result:=
Fail

Result:=
Pass

Result:=
Aborted

Figure 73: Procedure Establish_Terminating_TCH_If_Required

Procedure Handle_AoC_MT_MSC   AOCMT_M1(1)

Procedure in the MSC
to handle AoC signalling
towards the MS for an MT call

Signals to/from the left
are to/from the BSS;
signals from the right
are from the AoC timer function.

```
                                          ┌─────────┐
                                          │         │
                                          └─────────┘
                                               │
                              Yes         ╱ AoC(I)  ╲
              ┌──────────────────────────<  provisioned? >
              │                           ╲          ╱
              │                               │ No
              │                               │
       ┌──────┴──────┐            No      ╱ AoC(C)  ╲
       │     Set     │<──────────────────<  provisioned? >
       │  charging   │                    ╲          ╱
       │ parameters  │                        │ Yes
       └──────┬──────┘                        │
              │                         ┌──────┴──────┐
         ╱────┴────╲                    │     Set     │
        ╱  Send     ╲                   │  charging   │
        ╲ Charging  ╱                   │ parameters  │
         ╲Parameters╱                   └──────┬──────┘
          ╲────┬────╲                          │
              │  └─────────────────┐      ╱────┴────╲
              │<───────────────────┘     ╱  Send     ╲
              │                          ╲ Charging  ╱
              │                           ╲Parameters╱
              │                            ╲────┬────╱
              │                                 │
              │                          ┌──────┴──────┐
              │                          │  Start AoC  │
              │                          │acknowledgment│
              │                          │    timer    │
              │                          └──────┬──────┘
              │                                 │
              │                          ╱Wait_For_ ╲
              │                         ( Charging_   )
              │                          ╲Parameters_╱
              │                            ╲  Ack  ╱
              │                      ┌──────────┼──────────┐
              │               ╲──────┴──╲  ╲────┴────╲  ╲────┴──────╲
              │               ╲Charging  ╲ ╲ Release  ╲ ╲AoC         ╲
              │               ╱Parameters╱ ╱connection╱ ╱acknowledgment╱
              │               ╱ack       ╱ ╲─────┬────╱ ╱timer expired ╱
              │               ╲────┬────╱       │      ╲──────┬───────╱
              │<──────────────────┘             │             │
              │                                 │        ╱────┴────╲
              │                                 │       ╱ Release   ╲
              │                                 │       ╲transaction╱
              │                                 │        ╲────┬────╱
              │                                 │<────────────┘
       ┌──────┴──────┐                   ┌──────┴──────┐
       │  Result:=   │                   │  Result:=   │
       │    Pass     │                   │    Fail     │
       └──────┬──────┘                   └──────┬──────┘
              │                                 │
             ⊗                                 ⊗
```

Figure 74: Procedure Handle_AoC_MT_MSC

ETSI

Procedure Set_COL_Presentation_Indicator_MSC   COIND_M1(1)

Procedure in the MSC
to determine the COL
presentation indicator value

Signals to/from the right
are to/from the process
COLR_MAF041

Initiate
handling
of COLR

Wait_For_
COLR_Info

Release
transaction   From BSS

Continue
call
handling

Release   From GMSC

Figure 75: Procedure Set_COL_Presentation_Indicator MSC

7.3.2 Functional requirements of VLR

7.3.2.1 Process ICH_VLR

Sheet 1: if the MSRN received in the Send Info For Incoming Call is not allocated or there is no IMSI record for the IMSI identified by the MSRN, this is treated as an unknown MSRN.

Sheet 1: the procedure CAMEL_ICH_VLR is specific to CAMEL phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the VLR does not support CAMEL phase 3 or later, processing continues from the possible call of the procedure CCBS_ICH_Set_CCBS_Call_Indicator.

Sheet 1: the procedure CCBS_ICH_Set_CCBS_Call_Indicator is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 1: the VLR derives the basic service required for the call according to the rules defined in 3GPP TS 29.007 [30].

Sheet 1, sheet 2, sheet 5: the procedure CCBS_ICH_VLR_Report_Failure is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 1, sheet 3: the procedure CCBS_ICH_Report_Not_Reachable is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 2: this process communicates with the matching instance of the process PRN_VLR, which is linked by the MSRN.

Sheet 2: the test "Paging via SGSN possible" takes the "yes" exit if:

- the Gs interface is implemented; and

- there is an association established for the MS between the MSC/VLR and the SGSN.

Sheet 3: the test "NDUB?" takes the "Yes" exit if the Page MS negative response or the Search for MS negative response had the value Busy Subscriber (NDUB).

Sheet 3: the procedure Get_CW_Subscription_Info_VLR is specific to Call Waiting. If the VLR does not support Call Waiting, processing continues from the "No" exit of the test "CW available?".

Sheet 3: the procedure Get_CW_Subscription_Info_Multicall_VLR is specific to Multicall; it is specified in 3GPP TS 23.135 [34]. If the VLR does not support both Multicall and Call Waiting, processing continues from the "No" exit of the test "CW available?".

Sheet 3: the VLR uses the basic service returned in the Page MS negative response or the Search for MS negative response Busy Subscriber (More calls possible) to determine whether call waiting is available.

Sheet 3: the procedure Get_LI_Subscription_Info_MT_VLR is specific to CLIP and COLR. If the VLR supports neither CLIP nor COLR, the procedure call is omitted.

Sheet3: the procedure Get_AoC_Subscription_Info_VLR is specific to AoC; it is specified in subclause 7.1.2.15.

Sheet 3 sheet 6: the procedure CLI_ICH_VLR_Add_CLI is specific to Enhanced CLI Handling. It is specified in 3GPP TS 23.081 [14].

Sheet 3: the procedure CCBS_ICH_Handle_NDUB is specific to CCBS; it is specified in 3GPP TS 23.093 [23]. If the VLR does not support CCBS, processing continues from the "Forward" exit of the test "Result".

Sheet 3: the procedure Process_Access_Request_VLR is specified in subclause 7.1.2.2.

Sheet 3: the output signal Page MS towards the SGSN includes the Location area identity parameter.

Sheet 3: if the VLR does not support CUG, handling continues from the "No" exit of the test "CUG info present?".

Sheet 4, sheet 6: the procedure CAMEL_CHECK_SII2_CDTI is specific to CAMEL Phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL Phase 3 or later, processing continues from the "Yes" exit of the test "Result = Pass?".

Sheet 5, sheet 6: the procedure CD_Authorization is specific to Call Deflection, it is specified in 3GPP TS 23.072 [11]. If the VLR does not support Call Deflection, processing continues from the "Yes" exit of the test "Result=Aborted?".

Sheet 5, sheet 6: the procedure CCBS_ICH_Handle_UDUB is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 6: the test "NDUB?" is executed only if the VLR supports CCBS. If the VLR does not support CCBS, processing continues from connector 5.

Sheet 7: the procedure CCBS_ICH_Set_CCBS_Target is specific to CCBS; it is specified in 3GPP TS 23.093 [23].

Sheet 7: the procedure Handle_CFNRc is specified in subclause 7.2.2.11.

Sheet 8: the procedure Forward_CUG_Check is specific to CUG; it is specified in subclause 7.2.2.6. If the VLR does not support CUG, processing continues from the "Yes" exit of the test "Result=Call allowed?".

Sheet 8: the procedures CAMEL_O_CSI_Check_VLR, and CAMEL_D_CSI_Check_VLR are specific to CAMEL phase 3 or later; they are specified in 3GPP TS 23.078 [12].

7.3.2.2 Void

7.3.2.3 Procedure Search_For_MS_VLR

The test "Paging via SGSN possible" takes the "yes" exit if:

- the Gs interface is implemented; and

- the VLR configuration requires paging via the SGSN during VLR restoration.

The output signal Page MS towards the SGSN omits the Location area identity parameter. It is sent to every SGSN to which the VLR is connected.

7.3.2.4 Procedure Get_CW_Subscription_Info_VLR

The VMSC may abort the transaction with the VLR while a response is awaited from the process MAF013. The message is saved for processing after return from the procedure.

7.3.2.5 Procedure Get_LI_Subscription_Info_MT_VLR

The VMSC may abort the transaction with the VLR while a response is awaited from the process CLIP_MAF001 or the process COLR_MAF040. The message is saved for processing after return from the procedure.

7.3.2.6 Procedure Handle_CFB

The test "Normal call busy" refers to the value of the indicator returned by the process MAF008.

The procedure CAMEL_CHECK_SII2_CDTI is specific to CAMEL Phase 3 or later; it is specified in 3GPP TS 23.078 [12]. If the GMSC does not support CAMEL Phase 3 or later, processing continues from the "Yes" exit of the test "Result = Pass?".

7.3.2.7 Procedure Handle_CFNRy

The test "Normal call" refers to the value of the indicator returned by the process MAF009.

Process ICH_VLR   ICH_VLR1(8)

Process in VLRB to
handle a request for information
for an incoming (MT) call

Signals to/from the left
are to/from the MSC

Idle

Send Info
For Incoming
Call

MSRN
known? ──No──┐

Yes

CAMEL_
ICH_VLR ─── See TS 23.078

Yes ── Result=
Fail?

No

CCBS_ICH_
Set_CCBS_ ─── See TS 23.093
Call_Indicator

Set negative
response:
Unallocated
Roaming Number

Idle   Data
                confirmed ──False──┐
                by HLR

                True

See TS 29.007 ─── Derive required   Set negative
                  basic service   response:
                                           System
                                           Failure

Yes ── IMSI   CCBS_ICH_VLR_
       detached?   Report_Failure ─── See TS 23.093

       No

No ── Roaming
      in LA
      allowed?

      Yes

CCBS_ICH_   Send Info
Report_Not_   For Incoming
Reachable   Call negative
                                            response

(1)   (10)   Idle

Figure 76a: Process ICH_VLR (sheet 1)

Process ICH_VLR

ICH_VLR2(8)

Process in VLRB to handle a request for information for an incoming (MT) call

Signals to the left are to the VMSC; Signals to/from the right are to/from the process PRN_VLR.

Figure 76b: Process ICH_VLR (sheet 2)

Figure 76c: Process ICH_VLR (sheet 3)

Process ICH_VLR ICH_VLR4(8)

Process in VLRB to handle a request for information for an incoming (MT) call

Wait_For_ Access_ Request

Process Access Request

Process_ Access_ Request_VLR

Result= Pass? — No

11

Yes

CUG info present? — Yes

No

Translate CUG interlock to index — As defined in TS 23.085

Success? — Yes

No

CAMEL_CHECK _SII2_CDTI

Result = Pass? — No

Yes

CFNRy A&O? — No

Yes

Provide NRCT value

Get_LI_ Subscription_ Info_MT_VLR

Get_AoC_ Subscription_ Info_VLR

See TS 23.081 — CLI_ICH_VLR_ Add_CLI

Complete Call

Wait_For_ Complete_Call_ Result

Signals to/from the left are to/from the VMSC.

CCBS_ICH_VLR_ Report_Failure — See TS 23.093

Idle

3

Set negative response: System failure

CCBS_ICH_VLR_ Report_Failure — See TS 23.093

Send Info For Incoming Call negative response

Idle

Figure 76d: Process ICH_VLR (sheet 4)

Process ICH_VLR   ICH_VLR5(8)

Process in VLRB to handle a request for information for an incoming (MT) call

Wait_for_ Complete_Call Result

Signals to/from the left are to/from the VMSC.

Complete Call ack

Abort

Complete Call negative response

Idle

Busy subscriber? — Yes → See TS 23.093 — CCBS_ICH_ Handle_UDUB

No

Absent subscriber? — Yes

No

Radio congestion? — Yes

No

No subscriber reply? — Yes

No

See TS 23.072 — CD_ Authorization

See TS 23.093 — CCBS_ICH_VLR_ Report_Failure

Result= Aborted? — No

Yes

Result= Fail? — No

Yes

Set negative response: Impossible call completion

Send Info For Incoming Call negative response

(6)   (1)   (5)

(7)

Idle

Figure 76e: Process ICH_VLR (sheet 5)

Process ICH_VLR

ICH_VLR6(8)

Process in VLRB to
handle a request for information
for an incoming (MT) call

Signals to/from the left
are to/from the VMSC.

4

CAMEL_CHECK
_SII2_CDTI — See TS 23.078

Result =
Pass?

Yez

No

CFNRy
A&O?

No

Yea

Set NRCT

CLI_ICH_VLR_
Add_CLI — See TS 23.081

Process
Call
Waiting

Wait_For_
PCW_Result

Process
Call
Waiting ack

Abort

Process
Call Waiting
negative
response

Idle

Busy
subscriber?

Yes

No

No
subscriber
reply?

Yes

NDUB?

Yes

No

9

See TS 23.072 — CD_
Authorization

Result=
Aborted?

No

Yes

Result=
Fail?

No

Set negative
response:
Impossible call
completion

CCBS_ICH_
Handle_UDUB — See TS 23.093

Yes

Send Info
For Incoming
Call negative
response

7

Idle

6

5

Figure 76f: Process ICH_VLR (sheet 6)

Figure 76g: Process ICH_VLR (sheet 7)

Figure 76h: Process ICH_VLR (sheet 8)

Figure 77: Void

Procedure Search_For_MS_VLR   SRCH_V1(1)

Procedure in the VLR
to search for an MS
(i.e. page in all location areas)

Signals to/from the left
are to/from the MSC

No ◄─── Paging via
           SGSN possible?

Yes

Set paging
via SGSN
possible

Search
For MS ─── Page type=
              Circuit-switched call

Wait_For_
Search_Result

Search For MS ack	Search For MS negative response	Abort	Search for MS via SGSN
Update Location Area ID			To SGSN ┄┄ Page MS
Result:= Pass	Result:= Fail	Result:= Aborted	Wait_For_ Search_Result

Figure 78: Procedure Search_For_MS_VLR

Procedure Get_CW_Subscription_Info_VLR   CWI_VLR1(1)

Procedure in the VLR
to retrieve subscription
information for the
Call Waiting service

Signals to/from the right
are to/from the process
MAF013

initiate
handling
of CW

Wait_For_
CW_Info

From MSC — — Abort   process
call
waiting
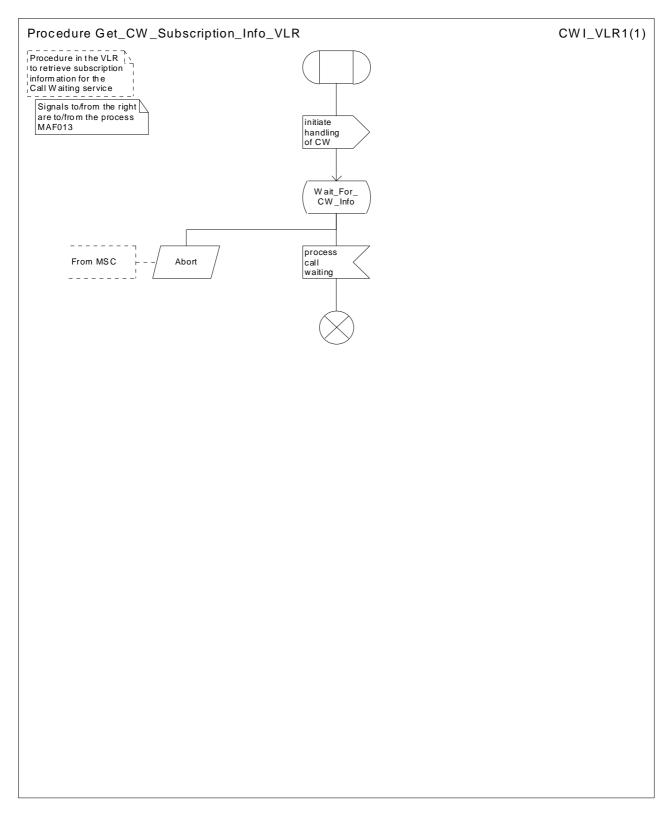
Figure 79: Procedure Get_CW_Subscription_Info_VLR

Procedure Get_LI_Subscription_Info_MT_VLR   GLI_MTV1(1)
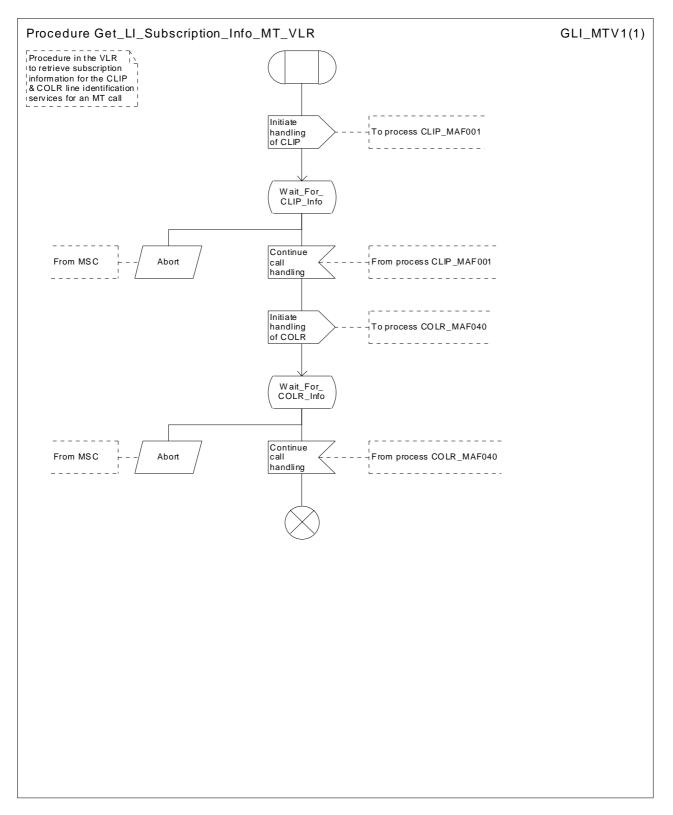
Figure 80: Procedure Get_LI_Subscription_Info_MT_VLR

Procedure Handle_CFB   H_CFB1(1)
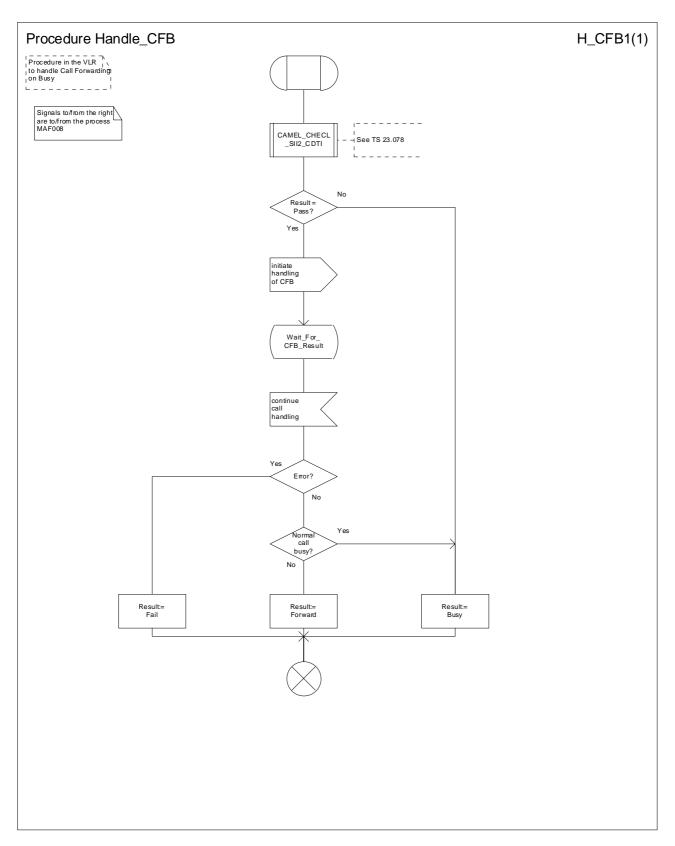
Figure 81: Procedure Handle_CFB

Procedure Handle_CFNRy   H_CFNRy1(1)

Procedure in the VLR
to handle Call Forwarding
on No subscriber Reply

Signals to/from the right
are to/from the process
MAF009

initiate
handling
of CFNRy

Wait_For_
CFNRy_Result

continue
call
handling

Error?
Yes   No

Normal
call?
No
Yes

Result:=
Fail

Result:=
No reply

Result:=
Forward
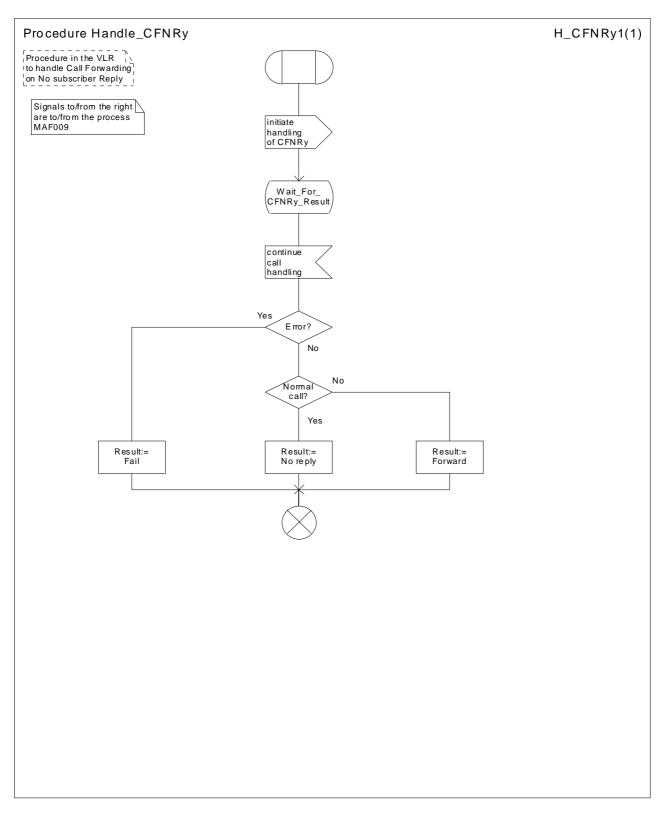
Figure 82: Procedure Handle_CFNRy

7.4 Subs_FSM

7.4.1 Functional requirements of serving MSC

7.4.1.1 Process Subs_FSM

One instance of the process Subs_FSM runs for each subscriber who is involved in at least one call. It monitors the state of any ongoing calls for that subscriber. The individual call control processes OCH_MSC and ICH_MSC submit supplementary service requests received from the MS to the process Subs_FSM, which then responds appropriately.

The process Subs_FSM interacts with the processes OCH_MSC and ICH_MSC as specified in subclauses 7.1.1 and 7.3.1.

Sheet 5, sheet 6, sheet 7, sheet 8, sheet 9, sheet 11, sheet 12, sheet 15: processing on this page will occur only if the VMSC supports HOLD.

Sheet 8: the procdure Handle_MPTY is specific to MPTY; it is specified in 3GPP TS 23.084 [17].

Sheet 8: the procedure Handle_ECT_Active is specific to ECT; it is specified in 3GPP TS 23.091 [22].
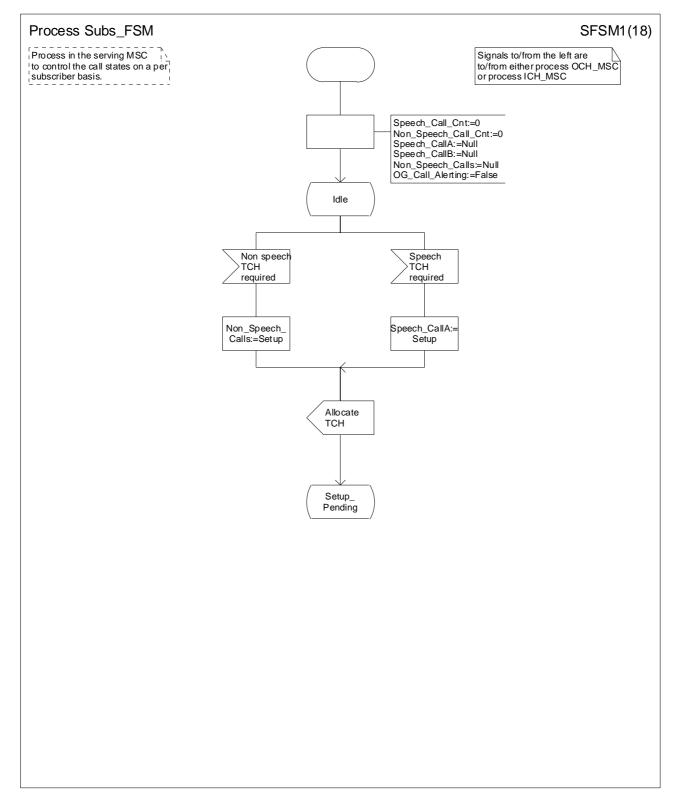
Sheet 10: processing on this page will occur only if the VMSC supports Multicall.

Sheet 12: the procedure Handle_ECT_Alerting is specific to ECT; it is specified in 3GPP TS 23.091 [22].

Sheet 13, sheet 14: processing on this page will occur only if the VMSC supports both HOLD and Multicall.

7.4.1.1.1 Macro Check_Ongoing_Calls

7.4.1.1.2 Macro Update_Non_Speech_Calls_Status

7.4.1.1.3 Macro Increment_Call_Counter

7.4.1.1.4 Macro Decrement_Call_Counter

Figure 83a: Process Subs_FSM (sheet 1)

Process Subs_FSM SFSM2(18)

Process in the serving MSC to control the call states on a per subscriber basis.

Signals to/from the left are to/from either process OCH_MSC or process ICH_MSC

Setup_ Pending

Call established

Call setup failed

Increment_ Call_Counter

Speech_CallA:=Null
Speech_CallB:=Null
Non_Speech_Calls:=Null

Non_Speech

Speech

Non_Speech_ Calls:=Active

Speech_CallA:= Active

Idle_ Data_Call_ Active

Call_Active

Idle

Figure 83b: Process Subs_FSM (sheet 2)

Figure 83c: Process Subs_FSM (sheet 3)

Process Subs_FSM   SFSM4(18)

Process in the serving MSC
to control the call states on a per
subscriber basis.

Signals to/from the left are
to/from either process OCH_MSC
or process ICH_MSC

Call_Active

Hold
request

Non speech
TCH
required

Speech
TCH
required

Call
cleared

Hold
ack

Allocate
TCH

TCH already
allocated

Decrement_
Call_Counter

Speech, Non_Speech

Check_
Ongoing_Calls

Calls_Ongoing   No_Calls_Ongoing

Yes   Ongoing
speech
call?

No

Speech_CallA:=
Held

Non_Speech_
Calls:=Setup

Speech_CallA:=
Null

Speech_CallA:=Null
Speech_CallB:=Null

Call_Held

Call_Active_
Data_Call_
Setup_Pending

Call_Active

Idle_
Data_Call_
Active

Idle

Figure 83d: Process Subs_FSM (sheet 4)

Process Subs_FSM

SFSM5(18)

Process in the serving MSC to control the call states on a per subscriber basis.

Signals to/from the left are to/from either process OCH_MSC or process ICH_MSC unless marked otherwise

Figure 83e: Process Subs_FSM (sheet 5)

Process Subs_FSM

SFSM6(18)

Process in the serving MSC to control the call states on a per subscriber basis.

Signals to/from the left are to/from either process OCH_MSC or process ICH_MSC unless marked otherwise

Call_Held

Speech TCH required

Non speech TCH required

Non-speech call using TCH?

No

Yes

TCH available

Allocate TCH

TCH available

Speech_CallB:= Setup

Non_Speech_ Calls:=Setup

Call_Held_ Setup_Pending

Call_Held_ Data_Call_ Setup_Pending

Figure 83f: Process Subs_FSM (sheet 6)

Process Subs_FSM   SFSM7(18)

Process in the serving MSC to control the call states on a per subscriber basis.

Signals to/from the left are to/from either process OCH_MSC or process ICH_MSC; signals from the right are internal MSC signals unless marked otherwise

Call_Held_
Call_Active

Retrieve
request

Non speech
TCH
required

Hold
request

Speech
TCH
required

Retrieve
reject

Allocate
TCH

TCH already
allocated

Non_Speech_
Calls:=Setup

Handle_
Timed_Call_
Swap

Se 3G TS
23.083

Call_Held_
Call_Active

Call_Held_Call_
Active_Data_Call
Setup_Pending

Call_Held_
Call_Active

Retr_req, T_Expr   Result?   Hold_Clr

Active_Clr

Call_Held_
Call_Active

Call_Held

Call_Active

Figure 83g: Process Subs_FSM (sheet 7)

Process Subs_FSM SFSM8(18)

Process in the serving MSC to control the call states on a per subscriber basis.

Signals to/from the left are to/from either process OCH_MSC or process ICH_MSC

Call_Held_ Call_Active

MPTY request

ECT request

MPTY supported?

ECT supported?

Yes

No

No

Yes

See TS 23.084

Handle_ MPTY

MPTY reject

ECT reject

Handle_ECT_ Active

See TS 23.091

Result

Call_Held_ Call_Active

Result

Fail

End

End_Active

End_Held

Fail

Pass

No

Non-speech call ongoing?

Yes

Idle

Idle_ Data_Call_ Active

Call_Active

Call_Held

Call_Held_ Call_Active

Idle

Call_Held_ Call_Active

Figure 83h: Process Subs_FSM (sheet 8)

Process Subs_FSM SFSM9(18)

Process in the serving MSC to control the call states on a per subscriber basis.

Signals to/from the left are to/from either process OCH_MSC or process ICH_MSC unless marked otherwise

Call_Held_ Call_Active

Call cleared - - - From held call - - - Call cleared

Speech_Call_Cnt:= Speech_Call_Cnt - 1

Decrement_ Call_Counter

Non_Speech Speech

Speech_CallA:=Active Speech_CallB:=Null

Update_Non_ Speech_ Calls_Status

Speech_CallB:= Null

Call_Active Call_Held_ Call_Active Call_Held

Figure 83i: Process Subs_FSM (sheet 9)

ETSI

Process Subs_FSM SFSM10(18)

Process in the serving MSC to control the call states on a per subscriber basis.

Signals to/from the left are to/from either process OCH_MSC or process ICH_MSC

Call_Active_ Data_Call_ Setup_Pending

Call established

Call setup failed

Call cleared

Retrieve request

Hold request

Non_Speech_Call_Cnt:= Non_Speech_Call_Cnt + 1

Retrieve reject

Hold ack

Non_Speech_ Calls:=Active

Update_Non_ Speech_ Calls_Status

Decrement_ Call_Count

Speech

Non_Speech

Non-speech call ongoing?

Yes

No

Speech_CallA:= Null

Update_Non_ Speech_ Calls_Status

Call_Active

Data_Call_ Active_ Setup_Pending

Setup_Pending

Call_Active_ Data_Call_ Setup_Pending

Call_Held_ Setup_Pending

Figure 83j: Process Subs_FSM (sheet 10)

Figure 83k: Process Subs_FSM (sheet 11)

Process Subs_FSM   SFSM12(18)

Process in the serving MSC
to control the call states on a per
subscriber basis.

Signals to/from the left are
to/from either process OCH_MSC
or process ICH_MSC

Call_Held_
Setup_Pending

| Alerting in progress | Hold request | Retrieve request | ECT request |

| Hold reject | Retrieve reject |

ECT
supported?

Yes   No

See TS 23.091 --- Handle_ECT_
Alerting

ECT
reject

Pass   Fail

Result

| OG_Call_ Alerting:=True | | OG_Call_ Alerting:=False | |

| Call_Held_ Setup_Pending | Call_Held_ Setup_Pending | Idle | Call_Held_ Setup_Pending |

Figure 84I: Process Subs_FSM (sheet 12)

ETSI

Process Subs_FSM   SFSM13(18)

Process in the serving MSC
to control the call states on a per
subscriber basis.

Signals to/from the left are
to/from either process OCH_MSC
or process ICH_MSC

Call_Held_Call_
Active_Data_Call_
Setup_Pending

Call
established

Call setup
failed

Hold
request

Retrieve
request

Non_Speech_Call_Cnt:=
Non_Speech_Call_Cnt + 1

See 3G TS
23.083

Handle_
Timed_Call_
Swap

Retrieve
reject

Non_Speech_
Calls:=Active

Update_Non_
Speech_
Calls_Status

Call_Held_Call_
Active_Data_Call_
Setup_Pending

Retr_req, T_Expr   Result   Hold_Clr

Active_Clr

Call_Held_
Call_Active

Call_Held_Call_
Active_Data_Call_
Setup_Pending

Call_Held_
Setup_Pending

Call_Active_
Data_Call_
Setup_Pending

Figure 84m: Process Subs_FSM (sheet 13)

Process Subs_FSM SFSM14(18)

Process in the serving MSC to control the call states on a per subscriber basis.

Signals to/from the left are to/from either process OCH_MSC or process ICH_MSC

Call_Held_Call_ Active_Data_Call_ Setup_Pending

From held call

Call cleared

Call cleared

Call cleared

From active call

Speech_Call_Cnt:= Speech_Call_Cnt - 1

Non_Speech_Call_Cnt:= Non_Speech_Call_Cnt - 1

Speech_Call_Cnt:= Speech_Call_Cnt - 1

Speech_CallA:=Active Speech_CallB:=Null

Yes

No

Speech call ongoing?

Speech_CallA:=Held Speech_CallB:=Null

Speech_CallB:= Null

Call_Active_ Data_Call_ Setup_Pending

Call_Held_Call_ Active_Data_Call_ Setup_Pending

Setup_Pending

Call_Held_ Data_Call_ Setup_Pending

Figure 84n: Process Subs_FSM (sheet 14)

Figure 84o: Process Subs_FSM (sheet 14)

Process Subs_FSM   SFSM16(18)

Process in the serving MSC
to control the call states on a per
subscriber basis.

Signals to/from the left are
to/from either process OCH_MSC
or process ICH_MSC

*

Request
call status

Call status

-

Figure 84p: Process Subs_FSM (sheet 14)

Process Subs_FSM SFSM17(18)

Process in the serving MSC to control the call states on a per subscriber basis.

Signals to/from the left are to/from either process OCH_MSC or process ICH_MSC

```
        ╭───────────╮
        │     *     │────  Except for the following states:
        ╰───────────╯      "Call Held Call Active"
              │            "Call Held Setup Pending"
              │
        ╭───────────╮
        │    ECT    │
        │  request  │
        ╰───────────╯
              │
         ╱───────────╲
        │     ECT     │
        │   reject    │
         ╲───────────╱
              │
              ▼
        ╭───────────╮
        │     -     │
        ╰───────────╯
```
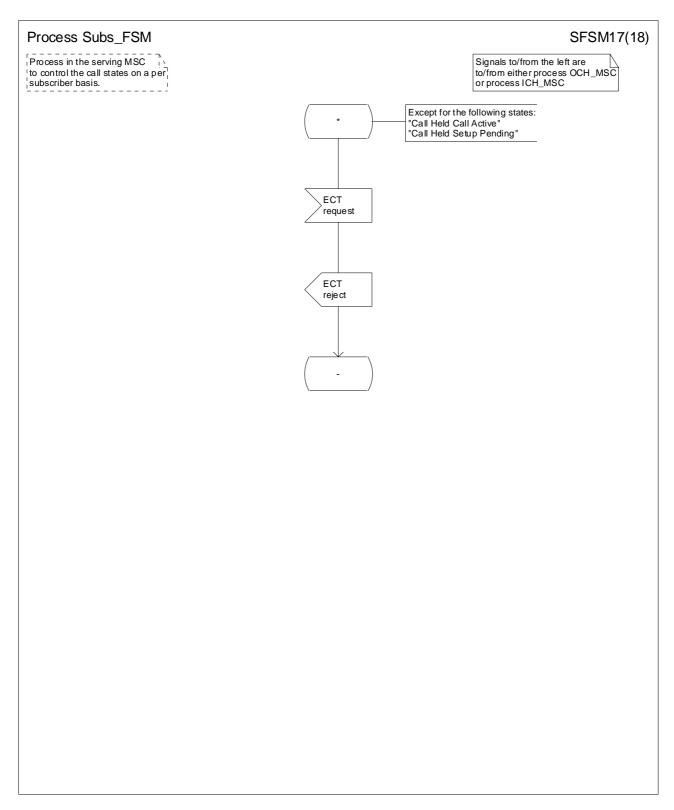
Figure 84q: Process Subs_FSM (sheet 14)

Process Subs_FSM   SFSM18(18)

Process in the serving MSC
to control the call states on a per
subscriber basis.

Signals to/from the left are
to/from either process OCH_MSC
or process ICH_MSC

*

Except for the following state:
"Call Held Call Active"

MPTY
request

MPTY
reject

-
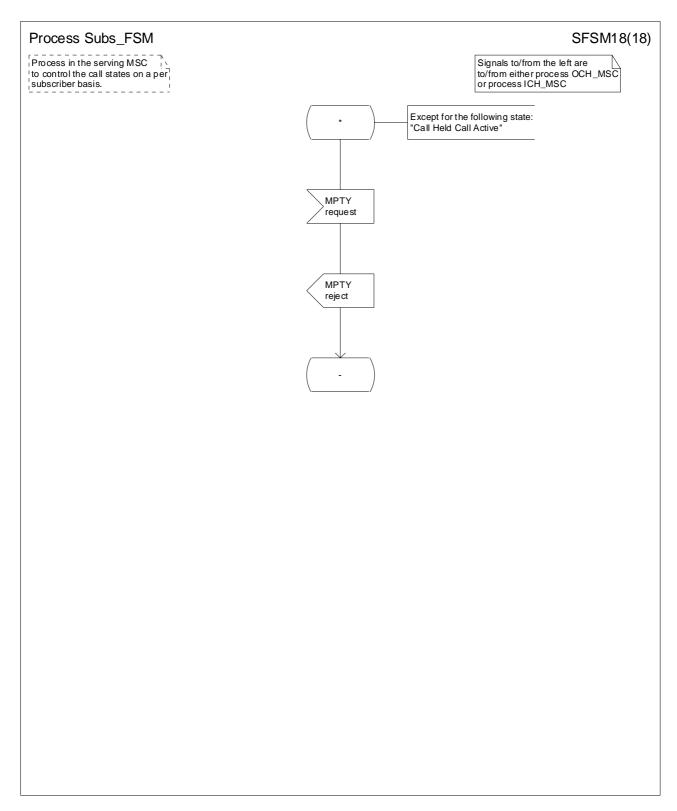
Figure 84r: Process Subs_FSM (sheet 14)

Macrodefinition Check_Ongoing_Calls COC1(1)

Macro to check if there are any speech
or non-speech calls remaining (and also
update the Non_Speech_Calls status variable.
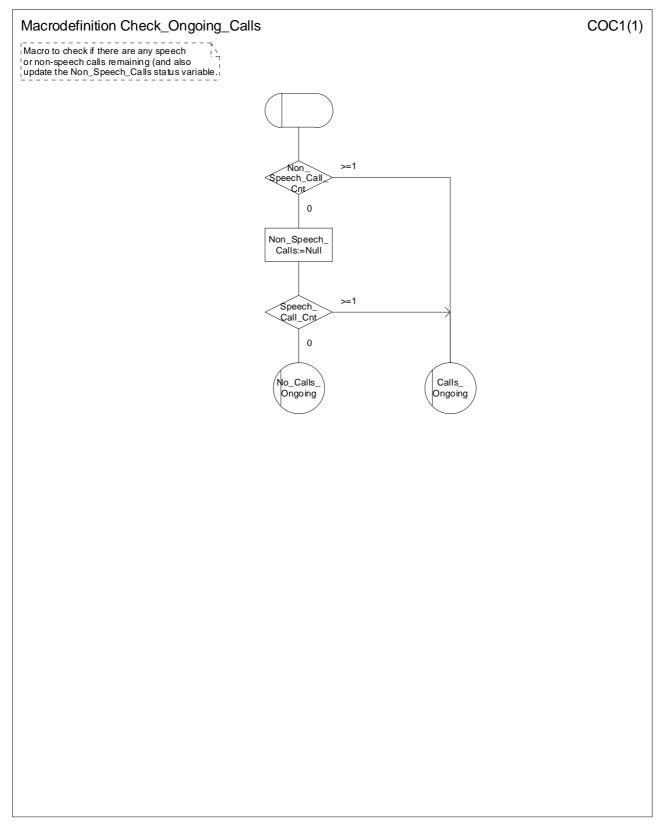
Figure 85: Macro Check_Ongoing_Calls

Macrodefinition Update_Non_Speech_Calls_Status   Upd_NSC_Stat1(1)

Macro to update the Non_Speeh_Calls
variable depending on whether there are
any non-speech calls ongoing or not.
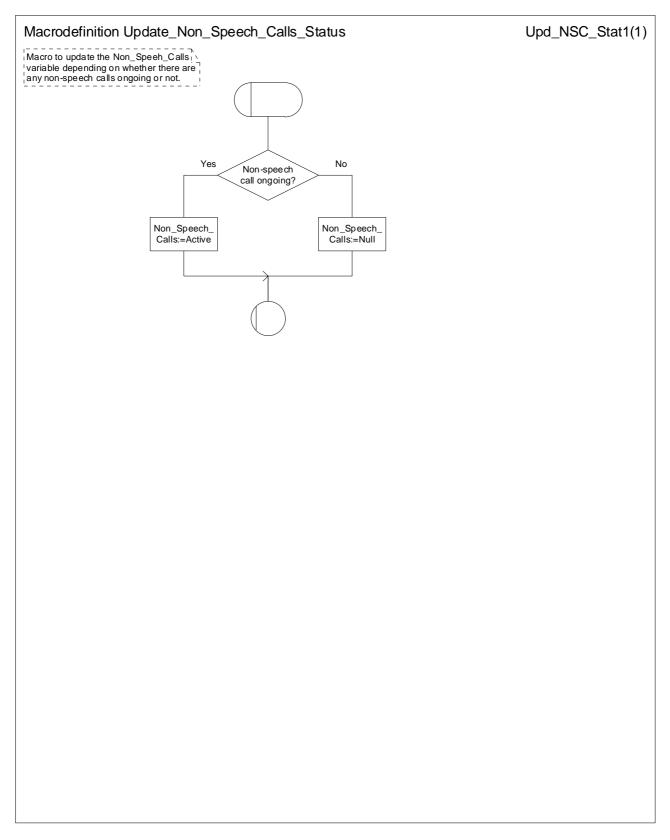
Figure 86: Macro Update_Non_Speech_Calls_Status

Macrodefinition Increment_Call_Counter   Inc_Call_Cnt1(1)

Macro to increment the correct counter
depedning on the type of the current call.

```
                    ┌──────────┐
                    │          │
                    └──────────┘
                         │
                 No   ╱Speech╲   Yes
              ┌────────  call?  ────────┐
              │        ╲      ╱         │
              │         ╲    ╱          │
     ┌────────┴────────┐           ┌────┴─────────────┐
     │Non_Speech_Call_Cnt:=│       │Speech_Call_Cnt=  │
     │Non_Speech_Call_Cnt + 1│     │Speech_Call_Cnt + 1│
     └────────┬────────┘           └────┬─────────────┘
              │                         │
            ╱Non_╲                   ╱Speech╲
           │Speech│                  │      │
            ╲────╱                    ╲────╱
```
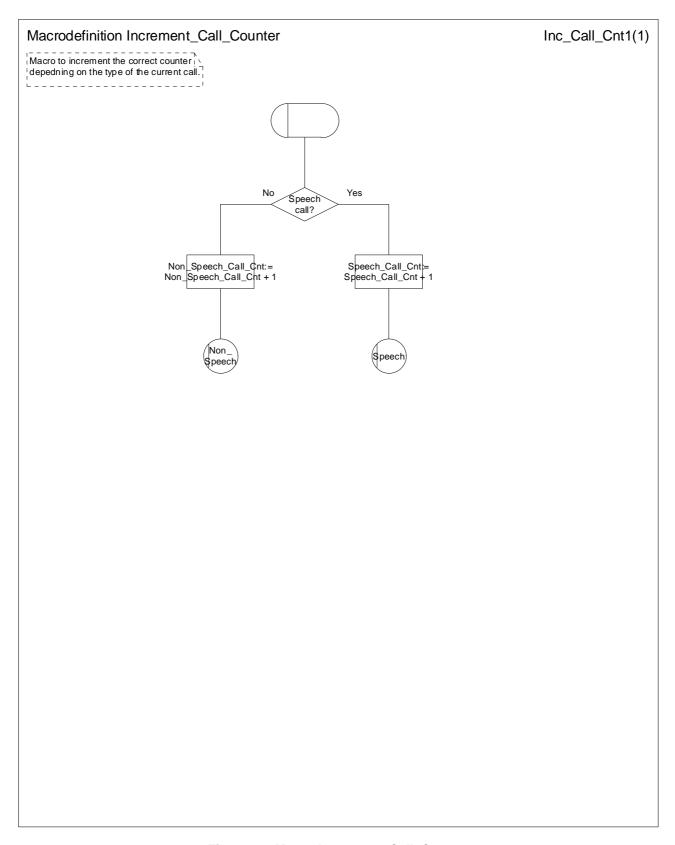
Figure 87: Macro Increment_Call_Counter

Macrodefinition Decrement_Call_Counter   Inc_Call_Cnt1(1)

```
┌─────────────────────────────────────────┐
│ Macro to decrement the correct counter   │
│ depedning on the type of the current call.│
└─────────────────────────────────────────┘
```

```
                        ┌──────╮
                        │   │  │
                        ╰──────┘
                           │
            No          ╱─────────╲         Yes
        ┌──────────────   Speech   ──────────────┐
        │              ╲  call?   ╱               │
        │               ╲───────╱                 │
 ┌──────┴────────────┐               ┌───────────┴──────┐
 │Non_Speech_Call_Cnt:=│              │Speech_Call_Cnt:=  │
 │Non_Speech_Call_Cnt - 1│            │Speech_Call_Cnt - 1│
 └──────┬────────────┘               └───────────┬──────┘
        │                                         │
      ╭───╮                                     ╭───╮
     ╱ Non_ ╲                                  ╱Speech╲
     ╲Speech ╱                                  ╲     ╱
      ╰───╯                                     ╰───╯
```
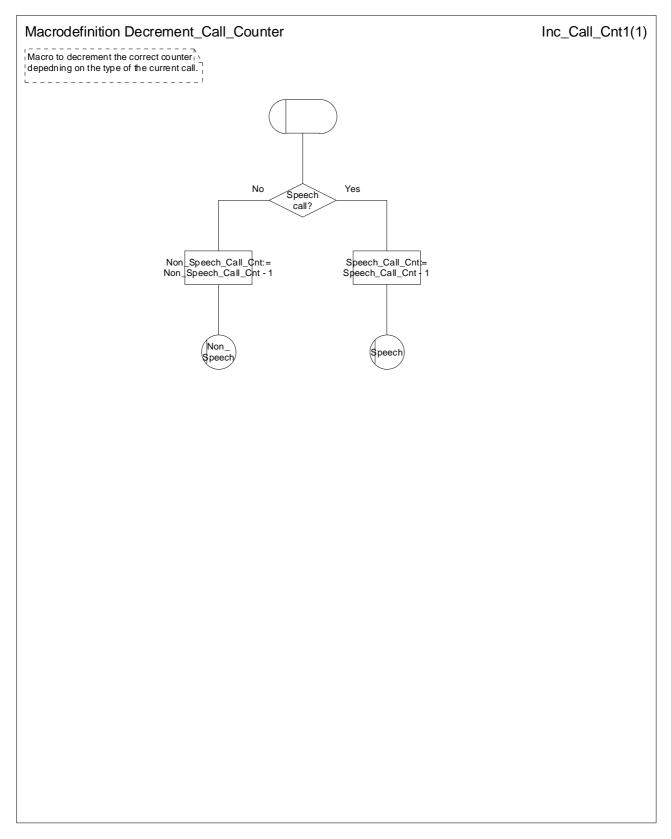
Figure 88: Macro Decrement_Call_Counter

8 Contents of messages

This clause specifies the content of each message shown in clauses 5 and 7, except for the following messages, which are not specific to call handling:

On the D interface (VLR-HLR):

- Abort;

- Activate Trace Mode;

- Authentication Failure Report;

- Insert Subscriber Data;

- Send Authentication Info;

- Send Authentication Info ack;

- Send Authentication Info negative response;

In the tables which follow, information elements are shown as mandatory (M), conditional (C) or optional (O). A mandatory information element shall always be present. A conditional information element shall be present if certain conditions are fulfilled; if those conditions are not fulfilled it shall be absent. An optional element may be present or absent, at the discretion of the application at the sending entity.

Some messages which are defined in this clause are used for other services or features. The specifications (referred to below as "derived specifications") for those services or features may simply refer to the present document for the definition of the message; in this case the requirements for the presence of each information element are as defined in this clause. If the specification for a service or feature requires information elements in a message additional to those specified in this clause, the requirements for the presence of the additional information elements are specified in the relevant specification. If the specification for a service or feature has different requirements for the presence of an information element in a message which is specified in this clause, then the following principles apply:

- If the information element is shown as mandatory in this clause, it shall always be present.

- If the information element is shown as conditional or optional in this clause, but mandatory in the derived specification, it shall always be present in the context of the service or feature defined in the derived specification.

- If the information element is shown as conditional or optional in this clause, and the conditions in the derived specification require the information element to be present, it shall be present even if the conditions in this clause do not require it to be present.

8.1 Messages on the B interface (MSC-VLR)

8.1.1 Abort

The following information element is required:

Information element name	Required	Description
Abort reason	M	Indicates the reason for the procedure being aborted.

8.1.2 Authenticate

The following information elements are required for authentication of a UMTS UE:

Information element name	Required	Description
RAND(I)	M	Random number challenge to be sent to the MS (3GPP TS 33.102 [32])
AUTN(I)	M	Authentication token to be sent to the MS (3GPP TS 33.102 [32])

The following information elements are required for authentication of a GSM MS:

Information element name	Required	Description
RAND	M	Random number challenge to be sent to the MS (3GPP TS 43.020 [1])
CKSN	M	Cipher key sequence number to be sent to the MS (3GPP TS 43.020 [1])

8.1.3   Authenticate ack

The following information element is required for authentication of a UMTS UE:

Information element name	Required	Description
RES(I)	M	Result returned by the MS (3GPP TS 33.102 [32])

The following information element is required for authentication of a GSM MS:

Information element name	Required	Description
SRES	M	Signature result returned by the MS (3GPP TS 43.020 [1])

8.1.4   Authenticate negative response

The negative response information element can take the following value:

- wrong network signature.

8.1.5   Call arrived

This message contains no information elements.

8.1.6   Check IMEI

This message contains no information elements.

8.1.7   Check IMEI ack

The following information element is required:

Information element name	Required	Description
Equipment status	M	Indicates whether the ME is black-listed, grey-listed or white-listed

8.1.8   Check IMEI negative response

The negative response information element can take the following values:

- System failure;

- Unknown equipment.

8.1.9 Complete Call

The following information elements are required:

Information element name	Required	Description
MSISDN	C	MSISDN of the MS for which the Complete Call is sent. Shall be present for an ordinary MO call, for an MT call and for an emergency call when the MS is registered in the VLR; otherwise shall be absent.
IMEI	C	IMEI of the mobile for which the Complete Call is sent. Shall be present for an emergency call when the mobile is identified only by its IMEI; otherwise shall be absent.
Category	C	Category of the MS for which the Complete Call is sent. Shall be present for an ordinary MO call and for an emergency call when the MS is registered in the VLR; otherwise shall be absent.
PLMN bearer capability	C	Shall be present for an MT call according to the rules defined in 3GPP TS 29.007 [30].
ISDN bearer capability	C	Shall be present for an MT call if it was received in the Provide Roaming Number; otherwise shall be absent.
ISDN low layer compatibility	C	Shall be present for an MT call if it was received in the Provide Roaming Number; otherwise shall be absent.
ISDN high layer compatibility	C	Shall be present for an MT call if it was received in the Provide Roaming Number; otherwise shall be absent.
CLIP provision	C	Indicates that CLIP is provisioned. Shall be present for an MT call if CLIP is provisioned; otherwise shall be absent.
CLIR override provision	C	Indicates that the CLIR override subscription option of CLIP is provisioned. Shall be present for an MT call if CLIP is provisioned with the CLIR override subscription option and the MS is registered in the HPLMN country; otherwise shall be absent.
CLIR provision	C	Indicates that CLIR is provisioned. Shall be present for an MO call if CLIR is provisioned; otherwise shall be absent.
CLIR mode	C	Indicates the mode in which CLIR is provisioned: permanent, temporary (default presentation allowed) or temporary (default presentation restricted). Shall be present for an MO call if CLIR is provisioned; otherwise shall be absent.
COLP provision	C	Indicates that COLP is provisioned. Shall be present for an MO call if COLP is provisioned; otherwise shall be absent.
COLR override provision	C	Indicates that the COLR override subscription option of COLP is provisioned. Shall be present for an MO call if COLP is provisioned with the COLR override subscription option and the MS is registered in the HPLMN country; otherwise shall be absent.
COLR provision	C	Indicates that COLR is provisioned. Shall be present for an MT call if COLR is provisioned; otherwise shall be absent.
No Reply Condition Timer	C	Value of timer to be used to determine the No subscriber reply condition. Shall be present for an MT call if the Call Forwarding on No Reply service is active and operative; otherwise shall be absent.
CUG index	C	For the definition of this IE, see 3GPP TS 23.085 [18]. May be present (as a network operator option) for an ordinary MO call if the call is a CUG call; shall be present for an MT call if the call is a CUG call; otherwise shall be absent.
CUG interlock	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present for an ordinary MO call if the call is a CUG call; otherwise shall be absent.
CUG outgoing access	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present for an ordinary MO call if the call is a CUG call with outgoing access; otherwise shall be absent.
Advice of Charge provision	C	Indicates whether Advice of Charge (Information) or Advice of Charge (Charging) is provisioned. Shall be present for an ordinary MO call or an MT call if Advice of Charge is provisioned; otherwise shall be absent.
Alerting Pattern	C	Shall be present for an MT call if it was received in the Provide Roaming Number and if the feature is supported by the MSC/VLR; otherwise shall be absent.

Information element name	Required	Description
NAEA preferred Carrier Id	O	The preferred carrier identity identifying the carrier to be used to route the interexchange call if the call requires routing via an interexchange carrier. This parameter may be included at the discretion of the VLR operator.

8.1.10 Complete Call ack

This message contains no information elements.

8.1.11 Complete Call negative response

The negative response information element can take the following values:

- Absent subscriber;

- Busy subscriber;

- No subscriber reply;

- Radio congestion.

8.1.12 Forward New TMSI

The following information element is required:

Information element name	Required	Description
TMSI	M	TMSI to be sent to the MS.

8.1.13 Forward New TMSI ack

This message contains no information elements.

8.1.14 Forward New TMSI negative response

The negative response information element can take the following value:

- TMSI reallocation failure.

8.1.15 Obtain Subscriber Info

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS for which information is required.
Subscriber state requested	C	Indicates that the VLR requires state information for the MS. Shall be present if state information is required; otherwise shall be absent.

8.1.16 Obtain Subscriber Info ack

The following information elements are required:

Information element name	Required	Description
Subscriber state	C	Indicates whether the MS is busy (i.e. engaged on a circuit-switched call) or assumed idle. Shall be present if the VLR requested state information; otherwise shall be absent.

8.1.17   Page MS

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS to be paged.
Location area ID	M	Location area in which the MS is to be paged.
Page type	M	Indicates whether the paging is for a circuit-switched call, MT SMS delivery, SS activity or Active Location Retrieval.
Requested information	C	Indicates the information requested by the VLR – one or more of: - Location; - MS classmark; - IMEI. Shall be present if the Page type is Active Information Retrieval; otherwise shall be absent.
Paging via SGSN possible	C	Indicates that paging via the SGSN is possible. Shall be present if the VLR determines that the MS can be paged via the SGSN; otherwise shall be absent.
TMSI	O	TMSI to be broadcast to identify the MS.

8.1.18   Page MS ack

The following information elements are required:

Information element name	Required	Description
Location area ID	M	Location area in which the MS responded to the page.
Serving cell ID	M	Identity of the cell in which the served subscriber is located. Shall be present if the MS uses GSM radio access; otherwise shall be absent.
Service area ID	C	Service area identity of the cell in which the served subscriber is located. Shall be present if the MS uses UMTS radio access; otherwise shall be absent.
MS classmark	M	MS classmark 2 as defined in 3GPP TS 24.008 [26].
IMEI (with software version)	C	IMEISV as defined in 3GPP TS 23.003 [5]. Shall be present if the IMEI was requested in the Page MS message and the MSC retrieved it from the MS; otherwise shall be absent.

8.1.19   Page MS negative response

The negative response information element can take the following values:

- Absent subscriber;

- Busy subscriber (More calls possible);

- Busy subscriber (NDUB);

- System failure;

- Unknown location area ID.

The Page MS negative response Busy subscriber (More calls possible) also indicates the basic service which applies for the established call.

8.1.20 Page MS via SGSN

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS to be paged.
eMLPP priority	O	Circuit-switched paging priority.
TMSI	O	TMSI to be broadcast to identify the MS.
Channel type	O	Type of channel required for the call.

8.1.21 Process Access Request

The following information elements are required:

Information element name	Required	Description
CM service type	M	Indicates the type of access required: normal MO call, emergency call or page response. Other values (short message service and SS request) defined for this IE are not considered in the present document.
Access connection status	M	Indicates whether or not the connection to the MS is ciphered and whether or not it is authenticated.
Current location area ID	M	Identity of the location area from which the access request was received.
Service area ID	C	Identity of the service area (for UMTS access) in use by the served subscriber. Shall be present for UMTS access; otherwise shall be absent.
Serving cell ID	C	Identity of the cell (for GSM access) in use by the served subscriber. Shall be present for GSM access; otherwise shall be absent.
IMSI	C	IMSI of the MS requesting the access. For normal MO call or page response, one of IMSI or TMSI shall be present. For emergency call, one of IMSI, TMSI or IMEI shall be present.
TMSI	C	TMSI of the MS requesting the access. For normal MO call or page response, one of IMSI or TMSI shall be present. For emergency call, one of IMSI, TMSI or IMEI shall be present.
IMEI	C	IMEI of the MS requesting the access. For normal MO call or page response, one of IMSI or TMSI shall be present. For emergency call, one of IMSI, TMSI or IMEI shall be present.
CKSN	C	Cipher key sequence number of the MS requesting the access. Shall be present if TMSI is present; otherwise shall be absent.

8.1.22 Process Access Request ack

The following information elements are required:

Information element name	Required	Description
IMSI	C	IMSI of the MS requesting the access. For normal MO call or page response, shall be present. For emergency call, one of IMSI or IMEI shall be present.
IMEI	C	IMEI of the MS requesting the access. For normal MO call or page response, shall be absent. For emergency call, one of IMSI or IMEI shall be present.
MSISDN	O	MSISDN of the MS requesting the access.

8.1.23   Process Access Request negative response

The negative response information element can take the following values:

- Roaming not allowed;

- System failure;

- Unidentified subscriber;

- Illegal equipment;

- Illegal subscriber.

8.1.24   Process Call Waiting

The following information elements are required:

Information element name	Required	Description
MSISDN	M	MSISDN of the MS for which the Process Call Waiting is sent.
PLMN bearer capability	C	Shall be present according to the rules defined in 3GPP TS 29.007 [30].
ISDN bearer capability	C	Shall be present if it was received in the Provide Roaming Number for the waiting call; otherwise shall be absent.
ISDN low layer compatibility	C	Shall be present if it was received in the Provide Roaming Number for the waiting call; otherwise shall be absent.
ISDN high layer compatibility	C	Shall be present if it was received in the Provide Roaming Number for the waiting call; otherwise shall be absent.
CLIP provision	C	Indicates that CLIP is provisioned. Shall be present if CLIP is provisioned; otherwise shall be absent.
CLIR override provision	C	Indicates that the CLIR override subscription option of CLIP is provisioned. Shall be present if CLIP is provisioned with the CLIR override subscription option and the MS is registered in the HPLMN country; otherwise shall be absent.
COLR provision	C	Indicates that COLR is provisioned. Shall be present if COLR is provisioned; otherwise shall be absent.
No Reply Condition Timer	C	Value of timer to be used to determine the No subscriber reply condition. Shall be present if the Call Forwarding on No Reply service is active and operative; otherwise shall be absent.
CUG index	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if the waiting call is a CUG call; otherwise shall be absent.
Advice of Charge provision	C	Indicates whether Advice of Charge (Information) or Advice of Charge (Charging) is provisioned. Shall be present if Advice of Charge is provisioned; otherwise shall be absent.

8.1.25   Process Call Waiting ack

This message contains no information elements.

8.1.26   Process Call Waiting negative response

The negative response information element can take the following values:

- Busy subscriber (UDUB);

- Busy subscriber (NDUB);

- No subscriber reply.

8.1.27   Provide IMEI

This message contains no information elements.

8.1.28 Provide IMEI ack

The following information element is required:

Information element name	Required	Description
IMEI	M	IMEISV (as defined in 3GPP TS 23.003 [5]) of the ME involved in the access request.

8.1.29 Provide IMSI

This message contains no information elements.

8.1.30 Provide IMSI ack

The following information element is required:

Information element name	Required	Description
IMSI	M	IMSI of the MS involved in the access request.

8.1.31 Radio connection released

This message contains no information elements.

8.1.32 Search For MS

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS to be paged in all location areas.
Page type	M	Indicates whether the paging is for a circuit-switched call, MT SMS delivery, SS activity or Active Location Retrieval.
Requested information	C	Indicates the information requested by the VLR – one or more of: - Location; - MS classmark; - IMEI. Shall be present if the Page type is Active Information Retrieval; otherwise shall be absent.
Paging via SGSN possible	C	Indicates that paging via the SGSN is possible. Shall be present if the VLR determines that the MS can be paged via the SGSN; otherwise shall be absent.
TMSI	O	TMSI to be broadcast to identify the MS.

8.1.33 Search For MS ack

The following information element is required:

Information element name	Required	Description
Location area ID	M	Location area in which the MS responded to the page.
Serving cell ID	C	Identity of the cell in which the served subscriber is located. Shall be present if the MS uses GSM radio access; otherwise shall be absent.
Service area ID	C	Service area identity of the cell in which the served subscriber is located. Shall be present if the MS uses UMTS radio access; otherwise shall be absent.
MS classmark	M	MS classmark 2 as defined in 3GPP TS 24.008 [26].
IMEI (with software version)	C	IMEISV as defined in 3GPP TS 23.003 [5]. Shall be present if the IMEI was requested in the Page MS message and the MSC retrieved it from the MS; otherwise shall be absent.

8.1.34   Search For MS negative response

The negative response information element can take the following values:

- Absent subscriber;

- Busy subscriber (More calls possible);

- Busy subscriber (NDUB);

- System failure.

The Search For MS negative response Busy subscriber (More calls possible) also indicates the basic service which applies for the established call.

8.1.35   Search for MS via SGSN

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS to be paged.
eMLPP priority	O	Circuit-switched paging priority.
TMSI	O	TMSI to be broadcast to identify the MS.
Channel type	O	Type of channel required for the call.

8.1.36   Send Info For Incoming Call

The following information elements are required:

Information element name	Required	Description
MSRN	M	Mobile Station Roaming Number received in the IAM.
Bearer service	C	Bearer service required for the MT call. Shall be present if the MSC was able to derive a bearer service from ISDN BC/LLC/HLC information received in the IAM; otherwise shall be absent.
Teleservice	C	Teleservice required for the MT call. Shall be present if the MSC was able to derive a teleservice from ISDN BC/LLC/HLC information received in the IAM; otherwise shall be absent.
Dialled number	C	Number dialled by the calling subscriber. Shall be present if it was received in the IAM; otherwise shall be absent.
Number of forwarding	C	Number of times the incoming call has already been forwarded. Shall be present if it was received in the IAM; otherwise shall be absent.
CUG interlock	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if it was received in the IAM; otherwise shall be absent.
CUG outgoing access	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if it was received in the IAM; otherwise shall be absent.

8.1.37   Send Info For Incoming Call ack

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the B subscriber.
Forwarded-to number	M	E.164 number of the C subscriber.
Forwarding reason	M	Indication of why the call has been forwarded (on call deflection, on mobile subscriber busy, on mobile subscriber not reachable or on no subscriber reply).
Notification to calling party	M	Indication of whether the calling party is to be notified that the call has been forwarded.
Notification to forwarding party	C	Indication of whether the forwarding party is to be notified that the call has been forwarded. Shall be present if the call is to be forwarded on mobile subscriber busy or on no subscriber reply; otherwise shall be absent.
Forwarded-to subaddress	C	Subaddress of the C subscriber (see 3GPP TS 23.003 [5]). Shall be present if a forwarded-to subaddress is stored in the VLR in association with the forwarded-to number; otherwise shall be absent.
Redirecting presentation	C	Indication of whether the MSISDN of B subscriber shall be presented to the C subscriber. Shall be present if the call is to be forwarded, otherwise shall be absent.
MSISDN	C	E.164 number which identifies the B subscriber. It will be used to create the redirecting number presented to the C subscriber. Shall be present if the call is to be forwarded, otherwise shall be absent.
CUG interlock	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if the VLR has determined that the forwarded call is to be treated as a CUG call in accordance with the rules in 3GPP TS 23.085 [18], otherwise shall be absent.
CUG outgoing access	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if the VLR has determined that the forwarded call is to be treated as a CUG call with outgoing access in accordance with the rules in 3GPP TS 23.085 [18], otherwise shall be absent.
NAEA preferred Carrier Id	O	The preferred carrier identity identifying the carrier to be used to route the interexchange call if the forwarded call requires routing via an interexchange carrier. This parameter may be included at the discretion of the VLR operator.

8.1.38   Send Info For Incoming Call negative response

The negative response information element can take the following values:

- Absent subscriber;

- Busy subscriber;

- CUG reject (Called party SS interaction violation);

- Forwarding violation;

- Impossible call completion;

- No subscriber reply;

- System failure;

- Unallocated roaming number;

8.1.39 Send Info For Outgoing Call

The following information elements are required:

Information element name	Required	Description
Called number	M	E.164 number of the call destination.
Bearer service	C	Bearer service required for the MO call, derived from the PLMN bearer capability information received in the set-up request from the MS. One of bearer service or teleservice shall be present.
Teleservice	C	Teleservice required for the MO call, derived from the PLMN bearer capability information received in the set-up request from the MS or from the emergency set-up request from the MS. One of bearer service or teleservice shall be present.
CUG index	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if it was received in the set-up request from the MS.
Suppress preferential CUG	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if it was received in the set-up request from the MS.
Suppress CUG outgoing access	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if it was received in the set-up request from the MS.

8.1.40 Send Info For Outgoing Call negative response

The negative response information element can take the following values:

- Bearer service not provisioned;

- Call barred (Operator determined barring);

- Call barred (Supplementary service barring);

- CUG reject (Inconsistent access information - index incompatible with basic service);

- CUG reject (Inconsistent access information - no CUG selected);

- CUG reject (Outgoing calls barred within the CUG);

- CUG reject (Unknown CUG index);

- Teleservice not provisioned.

8.1.40A Send UESBI-Iu to Access Network

The following information element is required:

Information element name	Required	Description
IMEI (with software version)	C	IMEISV as defined in 3GPP TS 23.003 [5].

8.1.41 Start security procedures

The following information elements are required for a UMTS connection:

Information element name	Required	Description
CK	M	Ciphering key to be used to cipher communication over the radio link (see 3GPP TS 33.102 [32]).
IK	M	Integrity key to be used to verify the integrity of messages transferred over the radio link (see 3GPP TS 33.102 [32]).

The following information elements are required for a GSM connection:

Information element name	Required	Description
Ciphering mode	M	Indicates whether ciphering of the radio connection is required, and if so which ciphering algorithm is to be used.
Kc	C	Ciphering key to be used if ciphering of the radio connection is required. Shall be present if the ciphering mode indicates that ciphering of the radio connection is required, otherwise shall be absent.

8.1.42   Trace subscriber activity

The following information elements are required:

Information element name	Required	Description
Trace reference	M	Reference number to be included with tracing reports which the VMSC sends to the OMC
Trace type	M	For the definition of this IE, see GSM 12.08 [3]

8.1.43   Use existing TMSI

This message contains no information elements.

8.2   Messages on the C interface (MSC-HLR)

8.2.1   Send Routeing Info

The following information elements are required:

Information element name	Required	Description
MSISDN	M	MSISDN of the B subscriber (see 3GPP TS 23.003 [5]).
Alerting Pattern	C	Shall be present if received in a Connect operation from the gsmSCF; otherwise shall be absent.
CUG interlock	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if the GMSC received it in the IAM and the GMSC supports CUG, otherwise shall be absent.
CUG outgoing access	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if the GMSC received it in the IAM and the GMSC supports CUG, otherwise shall be absent.
Number of forwarding	C	Number of times the incoming call has already been forwarded. Shall be present if it was received in the IAM; otherwise shall be absent.
ISDN BC	C	ISDN bearer capability. Shall be present if the GMSC received it in the IAM, otherwise shall be absent.
ISDN LLC	C	ISDN lower layer compatibility. Shall be present if the GMSC received it in the IAM, otherwise shall be absent.
ISDN HLC	C	ISDN higher layer compatibility. Shall be present if the GMSC received it in the IAM, otherwise shall be absent.
Pre-paging supported	C	Shall be present if the GMSC supports pre-paging, otherwise shall be absent.

8.2.2   Send Routeing Info ack

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the B subscriber (see 3GPP TS 23.003 [5]).
Roaming number	C	E.164 number required to route the call to VMSCB (see 3GPP TS 23.003 [5]). Shall be present if the HLR received it in the Provide Roaming Number ack and the call is not subject to early CF, otherwise shall be absent.
Forwarded-to number	C	E.164 number of the C subscriber. Shall be present if the HLR has determined that the call is to be forwarded, otherwise shall be absent.
Forwarded-to subaddress	C	Subaddress of the C subscriber (see 3GPP TS 23.003 [5]). Shall be present if the HLR has determined that the call is to be forwarded and a forwarded-to subaddress is stored in the HLR in association with the forwarded-to number, otherwise shall be absent.
Notification to calling party	C	Indication of whether the calling party is to be notified that the call has been forwarded. Shall be present if the HLR has determined that the call is to be forwarded, otherwise shall be absent.
Forwarding reason	C	Indication of why the call has been forwarded (unconditionally or on mobile subscriber not reachable). Shall be present if the HLR has determined that the call is to be forwarded, otherwise shall be absent.
Redirecting presentation	C	Indication of whether the MSISDN of B subscriber shall be presented to the C subscriber. Shall be present if the HLR has determined that the call is to be forwarded, otherwise shall be absent.
MSISDN	C	E.164 number which identifies the B subscriber (basic MSISDN). It will be used to create the redirecting number presented to the C subscriber. Shall be present if the HLR has determined that the call is to be forwarded, otherwise shall be absent.
CUG interlock	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if the HLR has determined that the call is to be treated as a CUG call in accordance with the rules in 3GPP TS 23.085 [18], otherwise shall be absent.
CUG outgoing access	C	For the definition of this IE, see 3GPP TS 23.085 [18]. Shall be present if the HLR has determined that the call is to be treated as a CUG call with outgoing access in accordance with the rules in 3GPP TS 23.085 [18], otherwise shall be absent.
NAEA preferred Carrier Id	O	The preferred carrier identity identifying the carrier to be used to route the interexchange call if the call requires routing via an interexchange carrier. This parameter may be included at the discretion of the HLR operator.

8.2.3   Send Routeing Info negative response

The negative response information element can take the following values:

- Absent subscriber;

- Bearer service not provisioned;

- Call barred (Operator determined barring);

- Call barred (Supplementary service barring);

- CUG reject (Called party SS interaction violation);

- CUG reject (Incoming calls barred within CUG);

- CUG reject (Requested basic service violates CUG constraints);

- CUG reject (Subscriber not member of CUG);

- Data missing;

- Facility not supported;

- Forwarding violation

- Number changed;

- System Failure;

- Teleservice not provisioned;

- Unexpected data value;

- Unknown subscriber.

8.3   Messages on the D interface (VLR-HLR)

8.3.1   Provide Roaming Number

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the B subscriber (see 3GPP TS 23.003 [5]).
MSC number	M	E.164 number which identifies VMSCB (see 3GPP TS 23.003 [5]).

MSISDN	O	E.164 number which identifies the B subscriber.
		It shall be present if the following 3 conditions are all satisfied:
		   1. the MSISDN is different from the basic MSISDN;
		   2. the subscriber has VT-CSI stored in HLR;
		   3. the VLR has indicated support for CAMEL Phase 3 or later.
		It may be present if the HLR requires it to be included in the call data record.

LMSI	C	Local Mobile Subscriber Identity. Shall be present if the LMSI was sent to HLRB at location updating.
PLMN bearer capability	C	Information to define the PLMN bearer capability required for the call. For alternate speech/fax, alternate speech/data or speech followed by data calls this information element shall contain two PLMN bearer capabilities, as specified in 3GPP TS 24.008. May be present if the HLR can determine the required PLMN bearer capability from ISDN compatibility information received in the Send Routeing Info message, or from the MSISDN if a multi-numbering scheme is used; otherwise shall be absent. If the ISDN BC and ISDN LLC IEs are present, the PLMN bearer capability IE shall be absent.
ISDN BC	C	ISDN bearer capability. May be present if the HLR received it in the Send Routeing Info message, otherwise shall be absent. If the PLMN bearer capability IE is present, the ISDN BC IE shall be absent.
ISDN LLC	C	ISDN lower layer compatibility. May be present if the HLR received it in the Send Routeing Info message, otherwise shall be absent. If the PLMN bearer capability IE is present, the ISDN LLC IE shall be absent.
ISDN HLC	C	ISDN higher layer compatibility. Shall be present if the HLR received it in the Send Routeing Info message, otherwise shall be absent.
Alerting Pattern	C	Shall be present if the HLR has determined an alerting category or an alerting level for the MT call configuration; otherwise shall be absent.
Pre-paging supported	C	Shall be present if the HLR has determined that pre-paging is supported in the GMSC and the HLR, otherwise shall be absent.

8.3.2 Provide Roaming Number ack

The following information element is required:

Information element name	Required	Description
Roaming number	M	E.164 number required to route the call to VMSCB (see 3GPP TS 23.003 [5]).

8.3.3 Provide Roaming Number negative response

The negative response information element can take the following values:

- Absent subscriber;

- Data missing;

- Facility not supported;

- No roaming number available;

- OR not allowed;

- Unexpected data value.

8.3.4 Provide Subscriber Info

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the subscriber for whom information is requested (see 3GPP TS 23.003 [5]).
LMSI	C	Local Mobile Subscriber Identity. Shall be present if the LMSI was sent to the HLR at location updating.
Requested information	M	Indicates which of the following information the HLR requires: - location information; - subscriber state; - IMEI (with software version); - MS classmark.
Active location retrieval requested	C	Indicates that the HLR requires active location retrieval. Shall be absent if the requested information does not indicate that the HLR requires location information.

8.3.5 Provide Subscriber Info ack

The following information elements are required:

Information element name	Required	Description
Location information	C	Information to define the location of the MS: see definition in subclause 8.3.5.1. Shall be present if location information was requested and is available; otherwise shall be absent.
Subscriber state	C	Indicates whether the MS is busy (i.e. engaged on a circuit-switched call), network determined not reachable (IMSI detached or roaming in a prohibited location area) or assumed idle. Shall be present if subscriber state was requested; otherwise shall be absent.
IMEI (with software version)	C	IMEISV as defined in 3GPP TS 23.003 [5]. Shall be present if the IMEI was requested, otherwise shall be absent.
MS classmark	C	MS classmark 2 as defined in 3GPP TS 24.008 [26]. Shall be present if the MS classmark was requested, otherwise shall be absent.

8.3.5.1 Location information

The compound information element Location information consists of the following subordinate information elements:

Information element name	Required	Description
Location number	C	For a definition of this information element, see ITU-T Recommendation Q.763 [35]. Shall be present if the VLR can derive it from the stored service area identity (for UMTS) or cell global identity (for GSM) or location area identity; otherwise shall be absent. The mapping from service area identity or cell ID and location area to location number is network-specific and outside the scope of the UMTS and GSM standards.
Service area ID	C	Service area identity of the cell in which the MS is currently in radio contact or in which the MS was last in radio contact. Shall be present if the MS uses UMTS radio access and the subscriber record is marked as confirmed by radio contact; otherwise shall be absent.
Cell ID	C	Cell global identity of the cell in which the MS is currently in radio contact or in which the MS was last in radio contact. Shall be present if the MS uses GSM radio access and the subscriber record is marked as confirmed by radio contact; otherwise shall be absent.
Geographical information	C	For a definition of this information element, see 3GPP TS 23.032 [7] . Shall be present if the VLR can derive it from the stored service area identity, cell global identity or location area identity; otherwise shall be absent.
Geodetic information	C	This information element corresponds to the Calling Geodetic Location defined in ITU-T Recommendation Q.763 [35]. Shall be present if the VLR can derive it from the stored service area identity, cell global identity or location area identity; otherwise shall be absent.
VLR number	O	E.164 number which identifies the VLR (see 3GPP TS 23.003 [5]). If the HLR receives it from the VLR it shall ignore it.
Age of location information	C	Measured in minutes. Shall be present if available in the MSC/VLR; otherwise shall be absent.
Current Location Retrieved	C	Shall be present when location information was obtained after a successful paging procedure for Active Location Retrieval.

8.3.6 Provide Subscriber Info negative response

The negative response information element can take the following values:

- Data missing;

- System failure;

- Unexpected data value.

8.3.7 Restore Data

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the subscriber for whom data are to be restored (see 3GPP TS 23.003 [5]).
LMSI	O	LMSI of the subscriber for whom data are to be restored (see 3GPP TS 23.003 [5]). May be included if required by the requesting VLR.

8.3.8 Restore Data ack

The following information elements are required:

Information element name	Required	Description
HLR number	M	E.164 number which identifies the HLR (see 3GPP TS 23.003 [5]).
MS not reachable flag	C	Indicates whether the VLR should notify the HLR when the MS next establishes radio contact. Shall be present if the corresponding indicator is set in the HLR record for the subscriber; otherwise shall be absent.

8.3.9 Restore Data negative response

The negative response information element can take the following values:

- System failure;

- Unknown subscriber.

8.4 Messages on the F interface (MSC-EIR)

8.4.1 Check IMEI

The following information element is required:

Information element name	Required	Description
IMEI	M	IMEI of the ME whose status is to be checked (see 3GPP TS 23.003 [5]).

8.4.2 Check IMEI ack

The following information element is required:

Information element name	Required	Description
Equipment status	M	Indicates whether the ME is black-listed, grey-listed or white-listed

8.4.3 Check IMEI negative response

The negative response information element can take the following value:

- Unknown equipment.

8.5 Messages on the MSC internal interface

This interface can carry ISUP messages received from the process MT_GMSC or the process ICH_MSC and to be forwarded to a destination exchange, and ISUP messages received from the destination exchange and to be forwarded to the process MT_GMSC or the process ICH_MSC. In addition, it carries the following inter-process messages.

8.5.1 CF cancelled

This message contains no information elements.

8.5.2   Perform Call Forwarding

The following information element is required:

Information element name	Required	Description
Forwarded-to number	M	E.164 number of the C subscriber.
OR call	M	Indicates whether the call which is to be forwarded was subject to basic OR as specified in 3GPP TS 23.079 [13]

8.5.3   Perform Call Forwarding ack

The following information element is required:

Information element name	Required	Description
Forwarded-to number	M	E.164 number of the C subscriber. Note: this number may be different from the Forwarded-to number received in the Perform Call Forwarding, as a result of CAMEL handling.

8.5.4   Perform Call Forwarding negative response

The negative response information element can take the following value:

- Call forwarding failed.

8.6   Messages on the VLR internal interface

This interface carries messages between corresponding instances of the processes PRN_VLR and ICH_VLR. The correlation between the process instances is done by the MSRN.

8.6.1   Call arrived

This message contains no information elements.

8.6.2   PAR completed

This message contains no information elements.

8.7 Messages on the Gs interface

8.7.1 Page MS

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS to be paged.
eMLPP priority	C	Circuit-switched paging priority. Shall be present if it was received in the Page MS via SGSN request or Search for MS via SGSN request; otherwise shall be absent.
TMSI	C	TMSI to be broadcast to identify the MS. Shall be present if it was received in the Page MS via SGSN request or Search for MS via SGSN request; otherwise shall be absent.
Location area identity	C	Location area identity of the location area where the mobile is registered, according to the subscriber data in the VLR. Shall be present if the VLR can supply it; otherwise shall be absent.
Channel type	C	Type of channel required for the call. Shall be present if it was received in the Page MS via SGSN request or Search for MS via SGSN request; otherwise shall be absent.

8.7.2 Send MS information

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS for which information is required.
Information requested	M	Information required for the specified MS.

8.7.3 Send MS information ack

The following information elements are required:

Information element name	Required	Description
IMSI	M	IMSI of the MS for which information is required.
Service area ID	C	Service area ID (for UMTS access) of the cell in which the MS last established radio contact. Shall be present if the MS uses UMTS access; otherwise shall be absent.
Cell ID	C	Cell ID (for GSM access) of the cell in which the MS last established radio contact. Shall be present if the MS uses GSM access; otherwise shall be absent.
Location information age	M (note)	Time in minutes since the MS last established a radio transaction
NOTE: Although they are optional in the protocol, these IEs are mandatory in this context.		

8.7.4 Send MS information negative response

The negative response information element can take the following value:

- No response from SGSN.

Annex A (informative): Handling of an IAM at an MSC

An MSC which receives an IAM from an originating exchange may react in three different ways:

- It acts as a transit exchange, i.e. it relays the IAM to a destination exchange determined by analysis of the called party address, and thereafter relays other telephony signalling between the originating and destination exchange until the connection is released. This behaviour is not specific to UMTS or GSM.

- It acts as a terminating exchange, i.e. it attempts to connect the call to an MS currently registered in the service area of the MSC.

- It acts as a GMSC, i.e. it interrogates an HLR for information to route the call. If the HLR returns routeing information, the MSC uses the routeing information from the HLR to construct an IAM, which it sends to a destination exchange determined by analysis of the routeing information from the HLR.

Sheet 1: when the MSC co-ordinating process has decided whether the MSC is to act as a terminating VMSC, a GMSC or a transit exchange, it forwards the IAM to an idle instance of the appropriate process.

Sheet 2: after the MSC co-ordinating process has sent an IAM to an instance of the process MT_GMSC or ICH_MSC, it acts as a transparent relay for messages received from the originating exchange and the process instance (denoted by "offspring"). After the MSC co-ordinating process has relayed a Release message, it returns to the idle state.

Sheet 2: after the MSC co-ordinating process has sent an IAM to a destination exchange, it acts as a transparent relay for messages received from the originating exchange and the destination exchange. After the MSC co-ordinating process has relayed a Release message, it returns to the idle state.

Process MSC_Coord   Coord_M1(2)

Process in the MSC to
handle an incoming IAM
and trigger the correct
application process

IDLE

Initial
Address   From
                 originating
                 exchange

Called party address
in MSRN range   No
for this MSC?

                       Yes

                                  No
                                              Incoming IAM was
                                              routed with routeing
                                              number for MNP?

                       Yes

                                       HLR address   No
Recover   derivable?
ported number
from IAM
                                              Yes

To process   Initial   Initial   To process   Initial   To destination
ICH_MSC   Address   Address   MT_GMSC   Address   determined by
                                                                                         routeing tables

                                      Relay_   Relay_
                                      Information_   Information_
                                      Internally   Externally

Figure 84a: Process MSC_Coord (sheet 1)
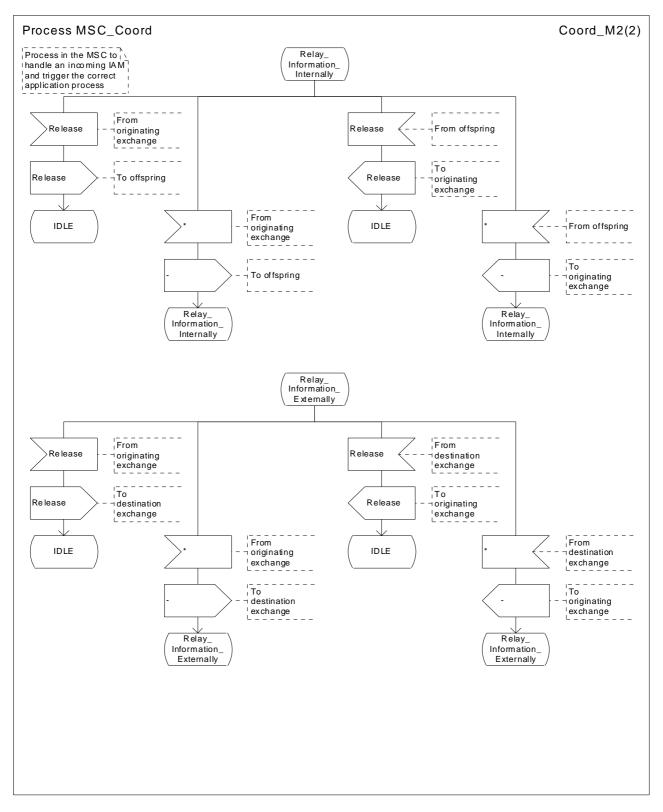
Figure 84b: Process MSC_Coord (sheet 2)

Annex B (informative): Change history

Change history						
TSG CN#	**Spec**	**CR**	**Phase**	**Version**	**New Version**	**Subject/Comment**
Apr 1999	GSM 03.18			7.0.0		Transferred to 3GPP CN1
CN#03	23.018				3.0.0	Approved at CN#03
CN#04	23.018	001		3.0.0	3.1.0	Notification of Call Forwarding to the gsmSCF
CN#05	23.018	002r4		3.1.0	3.2.0	Addition of the description for Pre-Paging
CN#05	23.018	006		3.1.0	3.2.0	Removal of TDP criteria from Resume Call Handling
CN#05	23.018	007r1		3.1.0	3.2.0	GMSC CAMEL phases in Provide Roaming Number
CN#05	23.018	023		3.1.0	3.2.0	Separation of success & failure cases for OR of late call forwarding
CN#05	23.018	024		3.1.0	3.2.0	Notification of Call Forwarding to the gsmSCF before activating call forwarding process
CN#06	23.018	004r2		3.2.0	3.3.0	Introduction of the Super-Charger Concept in TS 23.018
CN#06	23.018	027r3		3.2.0	3.3.0	Introduction of CAMEL Phase 3
CN#07	23.018	025r7		3.3.0	3.4.0	Addition of the description for Multicall
CN#07	23.018	026r2		3.3.0	3.4.0	Alternative solution for ALR
CN#07	23.018	030		3.3.0	3.4.0	Correction of the SDL diagrams for Pre-paging
CN#07	23.018	032r1		3.3.0	3.4.0	Inclusion of D-CSI check in HLR/VLR
CN#07	23.018	033		3.3.0	3.4.0	Initialization of Backward Call indicator
CN#07	23.018	034		3.3.0	3.4.0	Correction of the result of the procedure CAMEL_ICH_MSC_INIT
CN#07	23.018	037		3.3.0	3.4.0	Clarification of N-CSI in Core NW
CN#07	23.018	039r2		3.3.0	3.4.0	Replacement of references to GSM with references to UMTS
CN#07	23.018	043r1		3.3.0	3.4.0	Clarification of NPDB error detection and MNP specific call handling
CN#07	23.018	044		3.3.0	3.4.0	Setting the Destination Address for MO calls
CN#07	23.018	047		3.3.0	3.4.0	O-CSI and D-CSI checks for ORLCF calls
CN#07	23.018	048		3.3.0	3.4.0	Correction of CF Notification
CN#07	23.018	049		3.3.0	3.4.0	Introduction of Authentication Failure Report
CN#07	23.018	050r3		3.3.0	3.4.0	ISUP release cause value
CN#08	23.018	045r1		3.4.0	3.5.0	Correction of CAMEL Incoming Call Handling
CN#08	23.018	051r4		3.4.0	3.5.0	Improvement of Active Retrieval of Location Information procedure
CN#08	23.018	052r2		3.4.0	3.5.0	North American Service Provider Number Portability impacts for MNP
CN#09	23.018	053		3.5.0	3.6.0	Correction of connector numbering in process ICH_MSC
CN#09	23.018	054		3.5.0	3.6.0	Correction of the SDL diagram for Pre-paging
CN#09	23.018	056		3.5.0	3.6.0	Correction to process ICH_VLR
CN#09	23.018	057r3		3.5.0	3.6.0	Handling of the Call Diversion Treatment Indicator
CN#09	23.018	059r1		3.5.0	3.6.0	Modifications to procedure obtain routeing address.
CN#09	23.018	060		3.5.0	3.6.0	Corrections to process ICH_VLR
CN#09	23.018	061r2		3.5.0	3.6.0	Update of CAMEL references
CN#09	23.018	063r1		3.5.0	3.6.0	Correction of procedure Obtain_Routeing_Address for the reconnect case
CN#09	23.018	055r4	R4	3.6.0	4.0.0	Inclusion of call hold in basic call handling.

TSG CN#	Spec	CR	Phase	Version	New Version	Subject/Comment
CN#10	23.018	064	Rel-4	4.0.0	4.1.0	Tidying up of Process Subs_FSM and inter-process signals
CN#11	23.018	065	Rel-4	4.1.0	4.2.0	Incorporation of MPTY and ECT into the Subs_FSM process
CN#11	23.018	067	Rel-4	4.1.0	4.2.0	Removal of CW descriptions
CN#11	23.018	069	Rel-4	4.1.0	4.2.0	Paging not via the SGSN correction
CN#12	23.018	074	Rel-4	4.2.0	4.3.0	Initialization of variable to monitor activation of CSI's
CN#12	23.018	072	Rel-5	4.3.0	5.0.0	Handling of MultiCall in MPTY procedure
CN#13	23.018	077	Rel-5	5.0.0	5.1.0	Addition of missing process Update_Location_VLR
CN#13	23.018		Rel-5	5.0.0	5.1.0	Editorial clean up
CN#14	23.018	081	Rel-5	5.1.0	5.2.0	Handling of Reconnect on Leg2 Disconnect
CN#14	23.018	091r2	Rel-5	5.1.0	5.2.0	Corrections in the ATI mechanism description
CN#15	23.018	082r2	Rel-5	5.2.0	5.3.0	Introduction of CAMEL Phase 4
CN#15	23.018	088r2	Rel-5	5.2.0	5.3.0	Handling of CUG calls in non-supporting networks
CN#15	23.018	093r1	Rel-5	5.2.0	5.3.0	MSISDN in Provide Roaming Number in case of MSP
CN#15	23.018	098	Rel-5	5.2.0	5.3.0	Correction on the Active Location Retrieval description
CN#15	23.018	100r1	Rel-5	5.2.0	5.3.0	Transferring the MS classmark & IMEI to the gsmSCF
CN#17	23.018	109r1	Rel-5	5.3.0	5.4.0	Determining the basic service for MT calls
CN#17	23.018	110	Rel-5	5.3.0	5.4.0	Minor corrections to Process ICH_MSC
CN#17	23.018	111	Rel-5	5.3.0	5.4.0	Setting of Leg1_Status variable
CN#18	23.018	112r1	Rel-5	5.4.0	5.5.0	Clarification of requirements for the presence of IEs in messages
CN#19	23.018	118	Rel-5	5.5.0	5.6.0	Correction in the ATI mechanism description
CN#20	23.018	115r2	Rel-5	5.6.0	5.7.0	Stopping No_Answer timer in the case of forwarding notification
CN#20	23.018	122	Rel-5	5.6.0	5.7.0	Release Result from CAMEL_MT_GMSC_Notify_CF
CN#20	23.018	124	Rel-5	5.6.0	5.7.0	Addition of procedure to retrieve UE-specific behaviour data
CN#21	23.018	128	Rel-5	5.7.0	5.8.0	Corrections to "Early UE" handling
CN#21	23.018	133	Rel-5	5.7.0	5.8.0	HLR Interrogation for SCUDIF calls
CN#23	23.018	134	Rel-5	5.8.0	5.9.0	Incorrect implementation of CR 133
CN#23	23.018	136r1	Rel-5	5.8.0	5.9.0	Default Basic Service for gsmSCF-initiated calls
CT#33	23.018	0152	Rel-5	5.9.0	5.10.0	Correction to the IC_CUG_Check Procedure

Change history

History

Document history		
V5.3.0	March 2002	Publication
V5.4.0	September 2002	Publication
V5.5.0	December 2002	Publication
V5.6.0	March 2003	Publication
V5.7.0	June 2003	Publication
V5.8.0	September 2003	Publication
V5.9.0	March 2004	Publication
V5.10.0	September 2006	Publication