Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Basic call handling; Technical realization
(3GPP TS 23.018 version 7.5.0 Release 7)
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Foreword

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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. Trunk Originated call is also modelled.

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 routing (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 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.

[2] 3GPP TS 48.008: "Mobile Switching Centre - Base Station System (MSC - BSS) interface Layer 3 specification".
[3] 3GPP TS 52.008: "Telecommunication management; GSM subscriber and equipment trace".
[6] 3GPP TS 23.012: "Location management procedures".
[7] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".
[8] Void
[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".
3GPP TS 23.078: "Customized Applications for Mobile network Enhanced Logic (CAMEL); Stage 2".

3GPP TS 23.079: "Support of Optimal Routing (SOR); Technical realization; Stage 2".

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

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

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

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

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

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

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

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

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

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

3GPP TS 23.116: "Supercharger technical realization; Stage 2".

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

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

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

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

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

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

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)".

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)".

3GPP TS 33.102: "3G Security; Security architecture".


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
- CFNRe: 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
- HPLMN: 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
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](image)

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.

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 VPLMN 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 HPLMN, 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 HPLMN.

![Figure 2: Architecture for a basic mobile terminated call](image)

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.

4.3 Architecture for a TO call

A basic trunk originated call involves signalling between the PSTN and the PLMN’s MSC, as indicated in figure x. The originating exchange may also be another MSC of the same or different PLMN.
The MSC may also be connected to PBX but that is outside the scope of this document. In the PBX case same modelling applies but the PBX signalling is different to ISUP.

![Architecture for a basic trunk originated call](image)

**Figure 4.3.1: Architecture for a basic trunk originated call**

In figure x 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.

The MSC receives a setup (IAM) message from the originating exchange. The MSC analyses the called party number and routes the call to an appropriate destination. If the called party number is an MSISDN the gateway MSC functionality is activated. If the MSISDN belongs to another PLMN (or is ported out), the call is routed to another PLMN. If the called number is a PSTN number then the call is routed to (appropriate) PSTN operator. There may be other destinations also.

## 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 [fff].

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 and 3GPP TS 43.020 [1] for GSM. If the user originates one or more new MO calls in a multica...
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, and when the MAP RELEASE_RESOURCES message is received from the GMSC.

NOTE 3: If an ISUP REL message is received at the GMSC between sending of SRI and receiving of SRI ack, the GMSC does not send IAM to the VMSC. Instead a MAP Release_Resources message may be sent to the VMSC.

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.

### 5.2.1 Mobile Terminating Roaming Retry Call

The information flow for mobile terminating roaming retry call is shown in figure 4a. It applies to a mobile terminating call while the called mobile is simultaneously moving from an old to a new MSC, if the GMSC, the HLR and the old terminating VMSC support the MT Roaming Retry procedure.

In that case, upon receipt of:

- an ISUP IAM message which was preceded by a MAP Cancel Location procedure or by a Send Identification procedure for a super-charger subscriber, or
- a MAP Cancel Location procedure or Send Identification procedure for a super-charger subscriber while ongoing paging,

the old VMSC shall instruct the GMSC to resume terminating call procedure by sending a MAP Resume Call Handling message. The GMSC shall then release the ISUP connection to the old VMSC, terminate any open CAP dialogue, and retry the terminating call setup towards the new MSC by sending an additional SRI to the HLR. This second SRI request leads to obtaining a roaming number from the new MSC towards which the call can then be delivered (possibly after new CAMEL interactions).
GMSC

HLR

Old VMSC/VLR

New VMSC/VLR

MS

SRI (B, GMSC@, call Ref., Roaming retry)¹

PRN (call ref., GMSC@, Roaming retry)²

PRN ACK (MSRN)

SRI ACK

IAM (MSRN)

Paging

Update Location

Cancel Location³

Cancel Location Ack

New VMSC/VLR may delay setup until location update procedure finishes.⁸

2nd SRI (B, basic call interrogation)⁵

RLC

2nd SRI ACK (MSRN')⁷

IAM (MSRN')

Insert Subscriber Data (multiple)

Insert Subscriber Data (continued)

Update Location Ack

PRN

PRN ACK (MSRN')⁷

Normal MT call procedure follows.

Old MSC stops paging timer and inform GMSC

LocUpdate Accept

TMSI Realloc Cmplt

Setup

Call Confirmed

Further procedures related to location update. E.g. ciphering, TMSI reallocation.

Further procedures related to location update. E.g. ciphering, TMSI reallocation.

LocUpdate

Authentication Procedure

Old MSC stops paging timer and inform GMSC

2nd SRI (B, basic call interrogation)⁵

REL

ACK

RCH (call reference, roaming retry)⁴

Normal MT call procedure follows.

Old MSC stops paging timer and inform GMSC

LocUpdate

Authentication Procedure

HLR delays the sending of PRN until location update procedure finishes.⁶

Insert Subscriber Data (continued)

Update Location Ack

PRN

PRN ACK (MSRN')⁷

Normal MT call procedure follows.

Old MSC stops paging timer and inform GMSC

LocUpdate

Authentication Procedure

HLR delays the sending of PRN until location update procedure finishes.⁶

Insert Subscriber Data (continued)

Update Location Ack

PRN

PRN ACK (MSRN')⁷

Normal MT call procedure follows.

Old MSC stops paging timer and inform GMSC

LocUpdate

Authentication Procedure

HLR delays the sending of PRN until location update procedure finishes.⁶

Insert Subscriber Data (continued)

Update Location Ack

PRN

PRN ACK (MSRN')⁷

Normal MT call procedure follows.
Figure 4a: Information flow for a mobile terminating roaming retry call

1. A GMSC supporting the "mobile terminating roaming retry" feature includes the Call Reference Number, the GMSC address and the MT Roaming Retry Supported IE in the first SRI sent to the HLR.

2. A HLR supporting the "mobile terminating roaming retry" feature includes the Call Reference Number, the GMSC address and the MT Roaming Retry Supported IE in the PRN sent to the MSC/VLR if received in the SRI.

3. Receipt of the MT Roaming Retry Supported IE in the PRN indicates that the GMSC supports the Resume Call Handling procedure and the mobile terminating roaming retry feature. Upon receipt of the ISUP IAM message which was preceeded by a MAP Cancel Location message or by a MAP Send Identification message for a super-charger subscriber, or upon receipt of the MAP Cancel Location message or MAP Send Identification message for super-charger subscriber while paging, the old MSC/VLR stops paging, if paging was on-going, and if it supports the "mobile terminating roaming retry" feature and did receive the MT Roaming Retry Supported IE in the PRN, sends an RCH message to the GMSC with the MT Roaming Retry IE.

4. Upon receipt of the RCH message with the MT roaming retry IE, the GMSC acknowledges the RCH message, releases the call towards the old MSC/VLR, terminates T-CSI dialog with the SCP, if any exists, using T-Abandon EDP, and re-sends a new SRI to the HLR (still a 'basic call' interrogation type) using a new call reference number.

5. To avoid looping, the new SRI shall be sent without the Roaming Retry Supported IE. Furthermore, the GMSC shall use an appropriate high value for the timer supervising receipt of SRI ACK. Note that the Suppress T-CSI field is not set since the Mobile Terminating procedure is restarted from the beginning including the handling of CAMEL interaction on T-CSI (this is because T-CSI treatments may end differently if old and new MSCs are not in the same PLMN or in the same geographical area, e.g. different charging rates or regional service subscription).

6. Upon receipt of a SRI request or PRN ack (regardless of the PRN response from the old VLR) during an on-going Update Location procedure, the HLR delays the sending of the PRN to the new VLR till completion of the Update Location procedure.

7. Receipt of the MSRN’ from the new MSC/VLR enables the GMSC to relay the call towards the new MSC/VLR.

8. If the IAM message is received before the Location Update procedure is completed with the MS, the new MSC may delay the setup of the call until the completion of the Location Update procedure or start at once the normal terminating call procedure. In the former case, if the Location Update is received with the "follow-on" indication and if the VMSC supports the "follow-on" indication, the incoming IAM may either be handled as a waiting call or forwarded as Busy (CFB), depending on the state of the "follow-on" call and the subscriber's subscription data.

Similarly, a HLR supporting the "mobile terminating roaming retry" feature should wait for the completion of any on-going Location Update procedure when processing other terminating requests e.g. MAP-SEND-ROUTING-INFO-FOR-SM, MAP-SEND-ROUTING-INFO-FOR-LCS, MAP-ANY-TIME-INTERROGATION. More generally, this also applies to all TCAP transactions that the HLR may have to open toward a VLR (e.g. USSD, PSI).

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. However, if no radio connection exists, VMSCB sends a page request to BSSB, and BSSB broadcasts the page on the paging channel. If VPLMN 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, instructing MSB to use the specified 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 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 7.3.2 respectively.

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 7.1.1, 7.1.2, 7.3.1 and 7.3.2 respectively.

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 routing information, the MSC uses the routing information from the HLR to construct an IAM, which it sends to a destination exchange determined by analysis of the routing 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, 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 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 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 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

Figure 6: Process OCH_MSC
Procedure Process_Access_Request_MSC

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

Figure 7a: Procedure Process_Access_Request_MSC (sheet 1)
Procedure Process_Access_Request_MSC

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

Wait_For_PAR_Result

Abort

Process Access Request negative response

CM Service type= Page Response?

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

Result:= Pass?

Yes

No

Result:= Fail

Wait For TMSI Reallocation

Result:= Fail

Wait For TMSI Ack

Yes

No

Result:= Pass

Yes

No

Result:= Fail

Yes

No

Result:= Fail

Yes

No

Result:= Fail

Figure 7b: Procedure Process_Access_Request_MSC (sheet 2)
Procedure Process_Access_Request_MSC

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

Figure 7c: Procedure Process_Access_Request_MSC (sheet 3)
**Procedure OG_Call_Setup_MSC**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alerting sent = False</td>
<td>Release transaction</td>
</tr>
<tr>
<td>Backward call indicator = No indication</td>
<td></td>
</tr>
<tr>
<td>MS connected = False</td>
<td></td>
</tr>
<tr>
<td>Reconnect = False</td>
<td></td>
</tr>
<tr>
<td>UUS1 result sent = False</td>
<td></td>
</tr>
<tr>
<td>On Hold = False</td>
<td></td>
</tr>
<tr>
<td>CAMEL_invocation = False</td>
<td></td>
</tr>
</tbody>
</table>

![Procedure Diagram](image)

Figure 8a: Procedure OG_Call_Setup_MSC (sheet 1)
Procedure OG_Call_Setup_MSC

Wait For MO_Call Result

Complete Call

Send Info For Outgoing Call negative response

Abort

Convert PLMN BC to channel requirement

Call Proceeding

Release transaction

Establish, Originating, TCH if Required

Result Pass?

No

Yes

See TS 23.093

CCBS_OCH_Report_Failure

1

See TS 23.008

CCBS_OCH_Report_Failure

Figure 8b: Procedure OG_Call_Setup_MSC (sheet 2)
Figure 8c: Procedure OG_Call_Setup_MSC (sheet 3)
Procedure OG_Call_Setup_MSC

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_ACMM

Address Complete

CAMEL Start_TNRy

Send Alerting If Required

No

Result = Pass?

Yes

Release

Release transaction

Result?

Pass

Fail

Call setup failed

Release transaction

UTU2Cnt:=0

Alerting in progress

Wait_For_Answer

ECT request

To Subs_FSM

To Subs_FSM

Result?

Pass

Reconnect

Answer

To Subs_FSM

ECT request

Wait_For_Answer

Stop_TNRy

Figure 8d: Procedure OG_Call_Setup_MSC (sheet 4)
Procedure OG_Call_Setup_MSC

1. CAMEL_OCH_MSC_ANSWER
   - Result=Pass?
     - Yes
       - Set_COLP_Info_MSC
     - No
       - Result-Reconnect?
         - Yes
           - Handle_AoC_MO_MSC
         - No
           - Send_Access_Connect_If_Required
             - Result=Fail?
               - Yes
                 - Wait_For_Connect_Ack
               - No
                 - Result=Connect sent?
                   - Yes
                     - Connect Ack
                   - No
                     - MS connected:= True

2. Store CW treatment indicator for this call if received in SII2

3. Call established
   - No
     - Wait_For_Clear
   - Yes
     - CAMEL_OCH_LEG2_MSC
   - Leg1_Status := Active

Figure 8e: Procedure OG_Call_Setup_MSC (sheet 5)
Procedure OG_Call_Setup_MSC

- 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 8f: Procedure OG_Call_Setup_MSC (sheet 6)
Procedure **OG_Call_Setup_MSC**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Release transaction</td>
</tr>
<tr>
<td>2</td>
<td>CAMEL Phase 2 or higher supported?</td>
</tr>
<tr>
<td>3</td>
<td>Release transaction</td>
</tr>
</tbody>
</table>
| 4    | Release cause=
|      | No answer from user? |
| 5    | Reconnect? |
| 6    | Result=
|      | Yes |
| 7    | Release transaction |
| 8    | Call setup failed |

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

Procedure in the originating VMSC
' 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

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 8i: Procedure OG_Call_Setup_MSC (sheet 9)
Procedure OG_Call_Setup_MSC

Procedure in the originating VMS:
- 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.

Wait_For_Clear

Hold request

Hold supported?

Yes

Process_Hold_Request

Wait_For_Clear

No

Hold reject

Retrieve request

Hold supported?

Yes

Process_Retrieve_Request

Wait_For_Clear

No

Retrieve reject

See 3G TS 23.083

Figure 8j: Procedure OG_Call_Setup_MSC (sheet 10)
Procedure OG_Call_Setup_MSC

*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)
Procedure Obtain.IMSI_MSC

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

Provide IMSI ack

Result:= Pass

Result:= Aborted

Send IMSI negative response

Release transaction

Abort

Release transaction

Figure 9: Procedure Obtain.IMSI_MSC
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

Procedure Authenticate_MSC

wait_for_auth_response

authenticate

authenticate_ack

authenticate_negative_response

release_transaction

abort

release_transaction

result: aborted

authentication accepted

authentication rejected

authentication rejected

result: pass

Figure 10: Procedure Authenticate_MSC
Procedure Obtain_IMEI_MSC

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

Provide IMEI ack

Result:= Pass

Abort

Result:= Aborted

Send IMEI negative response

Release transaction

Release transaction

Figure 11: Procedure Obtain_IMEI_MSC
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.

**Procedure Check_IMEI_MSC**

1. **IMEI available?**
   - Yes: Send IMEI
   - No: Wait For IMEI

2. **CM service abort**
   - Release transaction
   - Send IMEI negative response
   - Check IMEI
     - To EIR
     - Check IMEI ack
     - From EIR
   - Result:= Aborted

3. **Abort**
   - Release transaction
   - Check IMEI negative response
   - Check IMEI ack
   - Check IMEI ack
   - Result:= Aborted

4. **Result:= Pass**

**Figure 12: Procedure Check_IMEI_MSC**
Procedure Establish-Originating_TCH_If_Required

- Procedure in the originating VMSC
- 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

Figure 13: Procedure Establish-Originating_TCH_If_Required
Procedure Set_CLI_Presentation_Indicator_MSC

Signals to/from the right are to/from the process CLI_MAF004

Initiate handling of CLI

Wait For CLI_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

Figure 15: Procedure Send_Alerting_If_Required
Procedure Set_COLP_Info_MSC

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

Initiate handling of COLP

Wait_For_COLP_Info

Release transaction

Continue call handling

Release

From BSS

To/from the MSC

To determine the COLP information to be sent to the MS

Release transaction From BSS

Continue call handling

Release

From destination

exchange

Figure 16: Procedure Set_COLP_Info_MSC
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Figure 17: Procedure Handle_AoC_MO_MSC
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.**

**Figure 18: Procedure Send_Access_Connect_If_Required**
Procedure TCH_Check

Is call speech?

Yes

Speech TCH required

Wait_For_TCH_Result

Non speech TCH required

No

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

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: 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 3: 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, 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].
Figure 7.1.2.1: Process OCH_VLR
Procedure Process_Access_Request_VLR

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

1. IMEI stored?
   - No
   - Obtain IMEI_VLR
   - Obtain PUESBNE supported?
   - Yes
   - Result = Pass?
   - Yes
   - Send UESBI-Iu to Access Network
   - No
   - Result = Aborted

2. Identity known?
   - No
   - Result = Aborted

3. Identity = IMEI?
   - No
   - Result = Fail?
   - No
   - Authenticate VLR
   - Yes
   - Result = Pass?
   - Yes
   - IMSI detached = False
   - Yes
   - Set negative response: System Failure
   - No
   - Set negative response: Unidentified Subscriber
   - Result = Aborted

Figure 7.1.2.2a: Procedure Process_Access_Request_VLR (sheet 1)
Procedure Process_Access_Request_VLR

1

False

Location info confirmed in HLR

Update_Location_VLR

No

Mobile Not Reachable Flag set?

Yes

Subscriber_Present_VLR

Data confirmed by HLR

False

True

Set negative response: Unidentified Subscriber

Roaming allowed in current LA?

No

Yes

Tracing required?

No

Start_Tracing_VLR

Yes

Ciphering required?

No

Yes

Figure 7.1.2.2b: Procedure Process_Access_Request_VLR (sheet 2)
Procedure Process_Access_Request_VLR

Signals to the left are to the MSC.

1. Start security procedures
   - Identity:= IMSI

2. Check IMEI_VLR
   - Result:= Pass?
     - Yes
     - No
       - IMEI check required?
         - Yes
         - IMEI_MSC
       - No
         - IMEI_MSC

3. TMSI reallocation required?
   - Yes
     - CCBS_Report_MS_Acct
     - Set negative response: Illegal Equipment
     - Result:= Aborted
   - No

4. Forward New TMSI
5. Freeze existing TMSI

Wait_For_TMSI_Ack

---

Figure 7.1.2.2c: Procedure Process_Access_Request_VLR (sheet 3)
Procedure Process_Access_Request_VLR

Signals from the MS are from the MSC.

2

Result= Aborted?

Yes

Result= Aborted

No

Result= Procedure Error?

Yes

Set negative response: System Failure

No

Result= Unknown Subscriber?

Yes

Set negative response: Unidentified Subscriber

No

Result= Unidentified Subscriber?

Yes

Set negative response: Illegal Subscriber

2

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

Yes

No

Yes

No

Yes

No

Result= Aborted

Result= Procedure Error

Result= Unknown Subscriber

Result= Unidentified Subscriber

Yes

No

Yes

No

Yes

No

Result= Pass

Yes

No

Figure 7.1.2.2d: Procedure Process_Access_Request_VLR (sheet 4)
Procedure Process_Access_Request_VLR

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Figure 7.1.2.2e: Procedure Process_Access_Request_VLR (sheet 5)
Figure 7.1.2.3a: Procedure OG_Call_Subscription_Check_VLR (sheet 1)
Procedure OG_Call_Subscription_Check_VLR

1

CAMEL_OCH_VLR

Result= Fail?

Yes

Check_OG_Barring

Yes

Call barred?

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)

No

Yes

Identity = IMSI?

No

Identification allowed?

Yes

Obtain IMSI_VLR

Result = Pass?

No

No

Yes

Result = Aborted

IMSI known?

Yes

Result = Fail

No

Result = Pass

Figure 7.1.2.4: Procedure Obtain_Identity_VLR
Figure 7.1.2.5: Procedure Obtain_IMSI_VLR
Procedure Authenticate_VLR

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

Procedure Authenticate_VLR

Yes

No

Authentication sets available?

Obtain Authentication Sets_VLR

Result=

Pass?

Yes

No

Authenticate

Result=

Aborted?

Yes

No

Authenticate

Wait For Authenticate Result

Result=

Aborted

Result=

Procedure Error

Yes

No

Authentication accepted

Result=

Pass

Received SRES= expected SRES?

Yes

No

More authentication sets needed?

Yes

No

Fetch Authentication Sets_VLR

Authentication accepted

Result=

Pass

More authentication sets needed?

No

Yes

Fetch Authentication Sets_VLR

Authentication failure report

Abort

Authentication failure report

Abort

No

Yes

Result=

Aborted

Figure 7.1.2.6a: Procedure Authenticate_VLR (sheet 1)
Procedure Authenticate_VLR

1. Identity=IMSI?
   Yes
   - Authentication accepted
   Result:= IMSI
   - Authentication rejected
   Result:= Aborted

   No
   - Rely with IMSI?
     Yes
     - Authentication accepted
     Result:= IMSI
     - Authentication rejected
     Result:= Aborted

     No
     - Obtain IMSI_VLR
       - IMSI known?
         Yes
         - IMSI matches TMSI?
           Yes
           - Authentication accepted
           Result:= IMSI
           - Authentication rejected
           Result:= Aborted

           No
           - Authentication failure report

         No
         - Authentication accepted
         Result:= IMSI
         - Authentication rejected
         Result:= Aborted

Signals to the left are to the MSC.

Figure 7.1.2.6b: Procedure Authenticate_VLR (sheet 2)
Procedure Obtain_Authentication_Sets_VLR

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

Send Authentication Info

Wait_For_Authentication_Sets

Send Authentication Info ack

Empty result?

Authentication sets available in VLR?

Yes

Yes

Yes

Yes

Result:= Pass

Result:= Procedure Error

Result:= Unknown Subscriber

No

No

No

No

No

Yes

No

Result:= Unknown Subscriber

Figure 7.1.2.7a: Procedure Obtain_Authentication_Sets_VLR (sheet 1)
Procedure Obtain\_Authentication\_Sets\_VLR

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

Authentication sets available?

Yes

No

Yes, Reuse old sets?

Yes

No

Result:= Pass

Result:= Aborted

Result:= Aborted

Result:= Aborted

Result:= Aborted

Result:= Aborted

Result:= Aborted

Result:= Aborted

Result:= Aborted

Result:= Aborted

Figure 7.1.2.7b: Procedure Obtain\_Authentication\_Sets\_VLR (sheet 2)
Procedure Start_Tracing_VLR

ST_TR_V1(1)

Signals to the left are to the MSC.

Tracing active?

Yes

Trace Subscriber Activity

No

Figure 7.1.2.8: Procedure Start_Tracing_VLR
Procedure Check_IMEI_VLR

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

1. Check IMEI
2. Wait For Check_IMEI Result
   - Abort
   - Check IMEI negative response
     - Result: Aborted
   - Check IMEI ack
     - Service granted?
       - No
         - Result: Fail
       - Yes
         - Result: Pass

Figure 7.1.2.9: Procedure Check_IMEI_VLR
Signals to/from the left are to/from the MSC

Procedure Obtain_IMEI_VLR

Figure 7.1.2.10: Procedure Obtain_IMEI_VLR
Process Fetch_Authentication_Sets_VLR

Figure 7.1.2.11: Process Fetch_Authentication_Sets_VLR
Procedure Check_BAOC

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

Operator determined BAOC imposed?

Yes

Result:= Call barred (ODB)

Initiate handling of BAOC

Wait_For_BAOC_Response

No

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

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

Procedure OG_CUG_Check

Figure 7.1.2.13: Procedure OG_CUG_Check
Procedure Get_LI_Subscription_Info_MO_VLR

Initial handling of CLIR

Wait_For_CLIR_Info

Abort from MSC

Continue call handling

Abort from MSC

Continue call handling

From MSC

To process CLIR_MAF003

From process CLIR_MAF003

To process COLP_MAF005

From process COLP_MAF005

Figure 7.1.2.14: Procedure Get_LI_Subscription_Info_MO_VLR
Figure 7.1.2.15: Procedure Get_AoC_Subscription_Info_VLR
Procedure Check_OG_Barring

Procedure to check call request against SS barring and ODB categories

Result: Call barred (ODB)

Figure 7.1.2.16a: Procedure Check_OG_Barring (sheet 1)
Procedure Check_OG_Barring

1

No

Yes

Operator determined BOIC s_HC & BOIZC imposed?

2

Yes

No

Destination address ZC = Local ZC?

2

Yes

No

Destination address CC = Local CC?

2

No

Yes

Destination address CC = HPLMN CC?

Result: Call barred (ODB)
Procedure Check_OG_Barring

1. Call barred?
   - Yes: Initiate handling of BOIC
     - Wait_for_BOIC_Response
     - From MSC: Abort
     - From process MAF018: Continue call handling
   - No: Call barred?
     - Yes: Look for MAF018
     - No: Call allowed

Result:= Call barred (SS barring)
Result:= Call allowed

Figure 7.1.2.16c: Procedure Check_OG_Barring (sheet 3)
Process Update_Location_VLR

*Process in the VLR
*To update the location
*Information in the HLR

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

<table>
<thead>
<tr>
<th>SRI negative response</th>
<th>ISUP release cause number</th>
<th>ISUP release cause name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent subscriber</td>
<td>20</td>
<td>Subscriber absent</td>
</tr>
<tr>
<td>Bearer service not provisioned</td>
<td>57</td>
<td>Bearer capability not authorized</td>
</tr>
<tr>
<td>Call barred (ODB)</td>
<td>21</td>
<td>Call rejected</td>
</tr>
<tr>
<td>Call barred (SS barring)</td>
<td>21</td>
<td>Call rejected</td>
</tr>
<tr>
<td>CUG reject (Called party SS interaction violation)</td>
<td>21</td>
<td>Call rejected</td>
</tr>
<tr>
<td>CUG reject (Incoming calls barred within CUG)</td>
<td>55</td>
<td>Incoming calls barred within CUG</td>
</tr>
<tr>
<td>CUG reject (Subscriber not member of CUG)</td>
<td>87</td>
<td>User not member of CUG</td>
</tr>
<tr>
<td>CUG reject (Requested basic service violates CUG constraints)</td>
<td>87</td>
<td>User not member of CUG</td>
</tr>
<tr>
<td>Data missing</td>
<td>111</td>
<td>Protocol error, unspecified</td>
</tr>
<tr>
<td>Facility not supported</td>
<td>69</td>
<td>Requested facility not implemented</td>
</tr>
<tr>
<td>Forwarding violation</td>
<td>21</td>
<td>Call rejected</td>
</tr>
<tr>
<td>Number changed</td>
<td>22</td>
<td>Number changed</td>
</tr>
<tr>
<td>System failure</td>
<td>111</td>
<td>Protocol error, unspecified</td>
</tr>
<tr>
<td>Teleservice not provisioned</td>
<td>57</td>
<td>Bearer capability not authorized</td>
</tr>
<tr>
<td>Unexpected data value</td>
<td>111</td>
<td>Protocol error, unspecified</td>
</tr>
<tr>
<td>Unknown subscriber</td>
<td>1</td>
<td>Unallocated (unassigned) number</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>Misrouted call to a ported number (note)</td>
</tr>
</tbody>
</table>

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 routing 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 Routieing 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 CAMEL phase 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 1: global flag "Clear MT Roaming Retry IE" is initialized to No at the start of MT_GMSC procedure.

Sheet 1: if Mobile Terminating Roaming Retry is supported, and if no Resume Call Handling message for roaming retry has been received, the GMSC shall include the GMSC address, the call reference number and the MT Roaming Retry Supported IE in the SRI message.

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 3: sending of "Release Resources" is an implementation option. If support of "Release Resources" by the VMSC is not indicated in Send Routing Info ack, "Release Resources" shall not be sent.

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

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_Check_MNP_Indicators 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: 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 GMSC does not support CAMEL phase 4 or later, 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 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 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

Figure 36a: Process MT_GMSC (sheet 1)
Figure 36b: Process MT_GMSC (sheet 2)
Process MT_GMSC

Wait For ACM

Address Complete

Send ACM, f_Required

CAMEL_MT_GMSC, START

CAMEL_MT_GMSC, ALERTING

Answer

Result?

Pass

Wait For Answer

Answer

Result?

Pass

Set destination address parameter

Send Answer, f_Required

Send Network Connect, f_Required

Release

Result?

Fail

1

Idle

Result?

Pass

Set destination address parameter

Send Network Connect, f_Required

Figure 36c: Process MT_GMSC (sheet 3)
Figure 36d: Process MT_GMSC (sheet 4)
Process MT_GMSC

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

Refer to TS 23.079 for message contents.

Figure 36e: Process MT_GMSC (sheet 5)
Figure 36f: Process MT_GMSC (sheet 6)
Process MT_GMSC

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
- Wait_For_ACM
- Wait_For_Forward_ACM
- Wait_For_Answer
- Wait_For_Forward_Answer
- Release cause:
  - No answer from user?
  - Release cause=
  - For_Release

CAMEL_MT_GMSC_DisCo3
CAMEL_MT_GMSC_DisCo6
CAMEL_MT_GMSC_DisC0
CAMEL_MT_GMSC_DisC4
CCBS_Set_Diagnostic_For_Release
CCBS_MT_GMSC_Check_CCBS_Possible

Figure 36g: Process MT_GMSC (sheet 7)
Figure 36h: Process MT_GMSC (sheet 8)
Process MT_GMSC

CAMEL phase 4 or later control relationship exists?

Yes

Leg1_status := Active

No

See TS 23.078

CAMEL_MT_LEG1_GMSC

See TS 23.078

CAMEL_MT_GMSC_LEG2

Wait For Clear

Idle

Figure 36i: Process MT_GMSC (sheet 9)
Procedure Obtain_Routing_Address

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

- See TS 23.066
  - MOBILE_NUMBER_PORTABILITY_IN_TQoD

- See TS 23.093
  - CCBS_MT_MSC_Check
  - CCBS_Call

- See TS 23.081
  - CLI_MT_GMSC

Result
- Number ported? = Number

- Routeing address := routeing number

- MT Roaming
  - Pre-paging supported?
    - Yes
      - Set Pre-paging supported
    - No
  - MT Roaming
    - Retry supported?
      - Yes
        - Clear MT Roaming Retry IE
          - true
          - set MT Roaming Retry Supported IE
          - To HLR
          - Send Routing Info
          - Wait_for_Routing_Info
      - No

- Routeing address := Routing number

Procedure Obtain_Routing_Address
FPAR IN Input address, Reference address, Own PLMN
IN/OUT Routing address, Destination address, OR, Result

Figure 37a: Procedure Obtain_Routing_Address (sheet 1)
Procedure Obtain_Routeing_Address

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

1. Release
   - Result: Call Released
   - Wait_for_Routeing_Info

2. Send Routing Info negative response
   - Call Released?
     - Yes: Result = Aborted
     - No: Result = See TS 23.172 SCUDIF_negative_SRI_response_handling

3. Result
   - Pass
   - Fail
     - OR_Handle_SRI_Negative_Response (Own PLMN): See TS 23.079

4. Result
   - Yes
     - Result = Pass
     - No
       - Routeing address := routeing number
         - Result = Fail

5. Result
   - No
     - Error: Unknown subscriber?
       - Yes
         - Result = See TS 23.066 MOBILE_NUMBER_PORTABILITY_IN_QoHR
         - No: Result = Number ported?
           - Yes: Routeing number
           - No: Result = Fail

Figure 37b: Procedure Obtain_Routeing_Address (sheet 2)
Procedure Obtain_Routeing_Address

1. **Wait for Routing Info**

2. **SCUDIF_Check_Service_Compatibility**
   - **Result = Aborted**
   - **Result = Leg1_only**

3. **SCUDIF_Check_Service_Availability**
   - **Result = Aborted**
   - **Result = MSRN**
   - **Result = second_SRI**

4. **Send Routing Info**

5. **Network Signal Info**
   - **Result**
     - **Network Signal Info**
       - **Result**: less preferred service

6. **Call Released?**
   - **Yes**
     - **Result = Aborted**
   - **No**
     - **Release Resources**

7. **Send MSRN ack**

8. **From HLR**

Figure 37c: Procedure Obtain_Routeing_Address (sheet 3)
Procedure Obtain_Routeing_Address

1. SCUDIF_Check_Service_Compatibility
   - See TS 23.172

2. CCBS_MT_GMSC_Check_CCBS_Indicators
   - See TS 23.093

3. Store Forwarding Interrogation
   - Required Indicator

   - MSRN contains a Routing number?

   - Yes
     - MNP_MT_GMSC_Check_MNP_Indicator
       - See TS 23.066

     - Result = Fail?
       - Yes
         - Result = Fail
       - No
         - Result = Routing_address := MSRN

       - Result = Pass

     - Routeing address := MSRN

   - No
     - Result := Routeing number

   - Destination address := VMSC address

Figure 37d: Procedure Obtain_Routeing_Address (sheet 4)
Procedure Obtain_Routeing_Address

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

Figure 37e: Procedure Obtain_Routeing_Address (sheet 5)
Procedure Obtain_Routing_Address

1. OR:=OR
2. Activate_CF_Process
3. Result?
   - Release
   - Pass

   Release
   - Result:=Aborted

   Result:=Aborted

   Route_permitted
     - Route:=Reference_Address
     - Route SHALL be passed to the MC
   - Route:=Reference_Address
     - OR:=False
     - Result:=Pass
   - Route:=Reference_Address
     - OR:=True
     - Result:=Forward
     - OR:=True
     - Result:=Forward

   OR:=False
   - Result:=Pass

See TS 23.093
Route_Permitted
See TS 23.079
Route_Permitted
CAMEL_MT_GMSC_DISC3
See TS 23.078
CAMEL_MT_GMSC_DISC4
See TS 23.078

Figure 37f: Procedure Obtain_Routing_Address (sheet 6)
Procedure to send an Address Complete Message to the preceding exchange if one is required for this call.

Figure 38: Procedure Send_ACM_If_Required
Procedure Send_Answer_If_Required

Signals to the left are to the originating exchange.

Figure 39: Procedure Send_Answer_If_Required
Procedure Send_Network_Connect_If_Required

Signals to the left are to the originating exchange

Figure 40: Procedure Send_Network_Connect_If_Required
Procedure Handle_COLP_Forwarding Interaction_MSC

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

- To initiate the process which handles call forwarding

Perform call forwarding (BDR, FTN)

Wait For CF_Response

- 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

- Result:= Fail

- CF cancelled

- Result:= Fail

- Perform call forwarding ack

- Result:= Pass

- Perform call forwarding negative response

- Result:= Fail

- Int_Release_Call from gsmSSF

- CF cancelled

- Result:= Release

Figure 42: Procedure Activate_CF_Process
Figure 43a: Process MT_CF_MSC (sheet 1)
Figure 43b: Process MT_CF_MSC (sheet 2)
Figure 43c: Process MT_CF_MSC (sheet 3)
Process MT_CF_MSC

1. CAMEL_OCH_MSC1
   - Result?
   - Yes: Perform Call Forwarding positive response
   - No: Idle

2. CAMEL_CF_Dialled_Services
   - Result?
   - Yes: Perform Call Forwarding positive response
   - No: Idle

3. Release call resources

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

Figure 43d: Process MT_CF_MSC (sheet 4)
Process MT_CF_MSC

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

Figure 43e: Process MT_CF_MSC (sheet 5)
Process MT_CF_MSC

CAMEL phase 4 or later control relationship exists?

Yes

CAMEL_MT_CF_LEG2_MSC

Leg1_status := Active

Wait_For_Clear

No

See TS 23.078

CAMEL_MT_CF_LEG1_MSC(Leg1_status)

Idle

See TS 23.078

Figure 43f: Process MT_CF_MSC (sheet 6)
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 Routing 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 Routing; it is specified in 3GPP TS 23.079 [13]. If the HLR does not support Optimal Routing, 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 Routing Info negative response message. This negative response parameter is global data, accessible by the process SRI_HLR.

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 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.

Sheet 2: the test "Suppress CCBS Handling?" 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.

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 Routing. It is specified in 3GPP TS 23.079 [13]. If the HLR does not support Optimal Routing, 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 Routing 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 Routing. If the HLR does not support Optimal Routing, 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 ?".

Sheet 7: A HLR implementing the Mobile Terminating Roaming Retry feature (see sub-clause 5.2.1) shall delay the sending of the PRN message till completion of any on-going Location Update procedure.

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 test "Suppress CUG Handling?" 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 in the HLR to handle a request for routing information

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

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

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

Figure 44b: Process SRI_HLR (sheet 2)
Figure 44c: Process SRI_HLR (sheet 3)
Process SRI_HLR

SRI_HLR4(7)

Figure 44d: Process SRI_HLR (sheet 4)
Process SRI_HLR

Wait for MSRN

Provide Roaming Number ack

Wait for MSRN

Provide Roaming 
Number negative response

SCUDIF Check
Second Service 
after PRN

Result= Continue?

Send Roaming Info ack

Idle

Figure 44e: Process SRI_HLR (sheet 5)
Process in the HLR to handle a request for routing information

SRI_HLR(7)

Figure 44f: Process SRI_HLR (sheet 6)
Process in the HLR to handle a request for routing information

Figure 44g: Process SRI_HLR (sheet 7)
Procedure Check_Parameters

```
Procedure to check the parameters of a received message
```

```
Chk_Par1(1)
```

- All required parameters present?
  - Yes: Result:= Pass
  - No: All parameter values acceptable?
    - Yes: Result:= Pass
    - No: Set negative response: Unexpected data value

- Set negative response: Data missing

```
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

**127**

See TS 29.007

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**Figure 46: Procedure Subscription_Check_HLR**
Procedure First_Forwarding_HLR

Procedure in the HLR before interrogation of the VLR

Handle_CFU

Result= Fail?

No

Yes

Result= Forward?

No

Yes

MS not reachable?

Handle_CFNR

Result= Fail?

No

Yes

Result= Forward?

No

Set negative response: Forwarding violation

Yes

Set negative response: Absent subscriber

Result:= Forward

Result:= Continue

Result:= Forward

Result:= Fail

Figure 47: Procedure First_Forwarding_HLR
Procedure PRN_Error_HLR

Procedure in the HLR

*for a roaming number request*

---

Procedure PRN_Error_HLR

**PRN_E_H1(1)**

1. CBS_Report
   - PRN_Failure
     - See TS 23.093

2. Negative response=OR not allowed??
   - No
   - Yes
     - Set negative response:
       - OR not allowed

3. Negative response=Facility not supported?
   - No
   - Yes
     - Negative response=Absent subscriber?
       - No
         - Negative response=No roaming number?
           - Yes
             - Handle_CFNRc
               - Result?
                 - Fail
                   - Set negative response: Forwarding
                     - Result: Forward
                       - Super_Charged_SRI_Error_HLR
                         - Yes
                           - Result: Purged?
                             - No
                             - Set negative response: Absent subscriber
                               - Handle_CFNRc
                                 - Result?
                                   - Fail
                                     - Set negative response: System failure
                                       - Result:= Fail
             - Forwarding violation
               - Result:= Fail
           - Forwarding violation
             - Result:= Fail
         - Set negative response: System failure
           - Result:= Fail
   - No
     - Negative response=Absent subscriber?
       - Yes
         - Handle_CFNRc
           - Result?
             - Fail
               - Set negative response: Forwarding
                 - Result: Forward
                   - Super_Charged_SRI_Error_HLR
                     - Yes
                       - Result: Purged?
                         - No
                         - Set negative response: Absent subscriber
                           - Handle_CFNRc
                             - Result?
                               - Fail
                                 - Set negative response: System failure
                                   - Result:= Fail
             - Forwarding violation
               - Result:= Fail
     - No
       - Negative response=No roaming number?
         - Yes
           - Handle_CFNRc
             - Result?
               - Fail
                 - Set negative response: Forwarding
                   - Result: Forward
                     - Super_Charged_SRI_Error_HLR
                       - Yes
                         - Result: Purged?
                           - No
                           - Set negative response: Absent subscriber
                             - Handle_CFNRc
                               - Result?
                                 - Fail
                                   - Set negative response: System failure
                                     - Result:= Fail
             - Forwarding violation
               - Result:= Fail
         - No
           - Set negative response: Facility not supported
             - Result:= Fail
---

Figure 48: Procedure PRN_Error_HLR
Procedure to carry out CUG authorisation check for a forwarded call

1. CUG info provided in routing information request
   - Yes
   - No

   - Perform Forwarding CUG authorisation
     - As defined in TS 23.085
     - CUG authorised
       - Pass
       - Call allowed
     - Fail
       - Result:= Call barred

   - Result:= Call allowed

   - Update CUG info
     - As defined in TS 23.085

2. CUG provisioned for forwarding subscriber against requested basic service
   - Yes
   - No

Figure 49: Procedure Forward_CUG_Check

Figure 50: Void
Procedure to check call request against SS barring and ODB categories.

Procedure Check_IC_Barring

Result: Call barred (ODB)

Operator determined BAIC imposed?

Operator determined BIC-Roam imposed?

Operator determined BIC-RoamHZ imposed?

MS registered in HPLMN zone?

Figure 51a: Procedure Check_IC_Barring (sheet 1)
Procedure Check_IC_Barring

1

Initiate handling of BAIC

Wait For BAIC Response

Continue call handling

Yes

Call barred?

No

Initiate handling of BIC-Roam

Wait For BIC-Roam Response

Continue call handling

Yes

Call barred?

No

Result:= Call barred (SS barring)

Result:= Call allowed

Figure 51b: Procedure Check_IC_Barring (sheet 2)
Proced ure IC_CUG_Check

IC_CUG1(1)

Signals to/from the right are to/from the process CUG_MAP016

Procedure to carry out CUG authorisation check for an incoming (MT) call

HLR supports CUG?

Yes

Incoming call

HLR supports CUG?

No

Yes

Incoming call

HLR supports CUG?

No

Yes

Outgoing Access present?

No

Response to call request

Complete call (conditional CUG info)

Reject call (cause)

Wait For CUG_Response

Result:= Call allowed

Result:= Call barred (cause)

Result:= Call allowed

Figure 52: Procedure IC_CUG_Check
Procedure Handle_CFU

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

Figure 53: Procedure Handle_CFU
Procedure Handle_CFNRe

Signals to/from the right are to/from the process MAP010.

CAMEL_CHECK_SII2_CDTI See TS 23.078

Result = Pass?

Yes

initiate handling of CFNRc

No

Wait For
CFNRc_Result

continue call handling

Error?

Yes

Mobile subscriber not reachable?

No

Result = Fail

Yes

Result = Forward

No

Result = Not reachable
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 2, sheet 4: A VLR not supporting the flag "Subscriber data dormant" shall behave as if this flag is set to false.

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 4: "Location cancelled" cause is set when VMSC receives Cancel Location while paging.

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".
Process PRN_VLR

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

Idle

Provide Roaming Number

Check Parameters

Result: Pass?

Yes

No

OR indicator present?

Yes

No

OR supported?

Yes

No

Convert PLMN BC to basic service

IF PLMN BC was included in the Provide Roaming Number

Service supported by VLR?

Yes

No

Pre-paging supported in VLR?

Yes

No

IMSI known in VLR?

Yes

No

Check_Reason_In_Serving_Network_Entity

Result: Purged?

Yes

No

Set negative response:

Facility not supported

Set negative response:

OR not allowed

Provide Roaming Number negative response

See TS 23.116

IMSI known in VLR?

Yes

No

Pre-paging allowed?

Yes

No

Check_Reason_In_Serving_Network_Entity

Result: Purged?

Yes

No

Idle

Figure 55a: Process PRN_VLR (sheet 1)
Process PRN_VLR

Signals to the left are to the HLR.

1. Set negative response: Purged MS

2. Subscriber data dormant
   - True
   - False

   IMSI detached
   - True
   - False

   Roaming in LA allowed?
   - Yes
   - No

   MSRN available?
   - Yes
   - No

   MSC per VLR
   - True
   - False

   Set negative response: No roaming
   - Absent
   - Subscriber

9. Received MSC number? Stored MSC number?
   - Confirmed by radio contact

Allocate MSRN

CAMEL SET_SOA

Store compatibility info

Store Alerting Pattern (if received)

CLI_PRN_VLR

CCBS_Handle_PRN

Provide Roaming Number ack

MT Roaming Retry Supported
   - Yes
   - No

Idle
Figure 55b: Process PRN_VLR (sheet 2)

Process PRN_VLR

- Process in the VLR to handle a request for a roaming number
- Signals to the left are to the HLR.

1. **MSRN available**
   - Yes: Allocate MSRN
   - No: Set negative response, No roaming number

2. **CAMEL_SET_SOA**
   - See TS 23.078

3. **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

4. **Allocate LMSI**

5. **Store compatibility info**
   - PLMN BC, ISDN BC, ISDN LLC & ISDN HLC (as available)
   - Store Alerting Pattern (if received)

6. **CLI_PRN_VLR**
   - See TS 23.081
   - More authentication sets needed?
     - Yes: Provide Roaming Number ack
     - No: Fetch, Authentication, Sets_VLR

7. **CCBS_Handle_PRN**
   - See TS 23.093

8. **Idle**

Figure 55c: Process PRN_VLR (sheet 3)
Process in the VLR to handle a request for a roaming number

Signals to the right are to the MSC.

 Subscriber data dormant

 True

 IMSI detached?

 Yes

 No

 Roaming in LA allowed?

 Yes

 No

 Location area ID known?

 True

 Data confirmed by HLR?

 Yes

 No

 More authentication sets needed?

 Yes

 No

 Fetch_Authentication_Sets_VLR

 Restore_Subscriber_Data_VLR

 Search_For_MS_VLR

 Result=Pass?

 Yes

 No

 Absent subscriber?

 Yes

 No

 Location cancelled?

 Yes

 No

 Set negative response: Purged MS

 Set response: Absent subscriber

 Wait_For_Access_Request

 Set negative response: Purged MS

 Paging via SGSN possible?

 Yes

 No

 Set Paging via SGSN possible

 Page MS

 Page type=circuit-switched call

 Figure 54d: Process PRN_VLR (sheet 4)
Figure 54e: Process PRN_VLR (sheet 5)
Signals to the left are to the HLR; signals to/fom the right are to/from the MSC unless shown otherwise.

**Process PRN_VLR**

1. Process Access Request

   - Wait For Access Request
   - Yes
     - MSC per VLR
       - MSCRN available?
         - Yes
           - Use received MSC number for MSRN
           - Allocate MSRN
             - CAMEL_SET_SOA
               - See TS 23.076
             - Store compatibility info
             - Store Alerting Pattern (if received)
             - CLI_PRN_VLR
               - See TS 23.061
             - CCBS Handle PRN
               - See TS 23.093
             - Provide Roaming Number ack
               - 8
           - Set negative response: No roaming number
             - Set negative response: Absent subscriber
               - 1
         - No
           - Confirmed by radio contact
           - Use stored MSC number for MSRN
             - Allocate MSRN
               - CAMEL_SET_SOA
                 - See TS 23.076
               - Store compatibility info
               - Store Alerting Pattern (if received)
               - CLI_PRN_VLR
                 - See TS 23.061
               - CCBS Handle PRN
                 - See TS 23.093
               - Provide Roaming Number ack
                 - 8
           - Set negative response: System failure
   - No
     - Page MS negative response
       - Busy subscriber?
         - Yes
           - Absent subscriber?
             - Yes
               - Busy subscriber?
                 - No
                   - Absent?
                     - Yes
                       - Set negative response: No roaming number
                         - Set negative response: Absent subscriber
                           - 1
                     - No
                       - False
                         - >1
                           - Yes
                             - Resolved MSC number=Stored MSC number?
                               - Yes
                                 - Confirmed by radio contact
                                 - Use received MSC number for MSRN
                                 - Allocate MSRN
                                   - CAMEL_SET_SOA
                                     - See TS 23.076
                                   - Store compatibility info
                                   - Store Alerting Pattern (if received)
                                   - CLI_PRN_VLR
                                     - See TS 23.061
                                   - CCBS Handle PRN
                                     - See TS 23.093
                                   - Provide Roaming Number ack
                                     - 8
                                 - Set negative response: System failure
                               - No
                                 - Confirmed by radio contact
                                 - Use stored MSC number for MSRN
                                   - Allocate MSRN
                                     - CAMEL_SET_SOA
                                       - See TS 23.076
                                     - Store compatibility info
                                     - Store Alerting Pattern (if received)
                                     - CLI_PRN_VLR
                                       - See TS 23.061
                                     - CCBS Handle PRN
                                       - See TS 23.093
                                     - Provide Roaming Number ack
                                       - 8
                                 - Set negative response: No roaming number
                               - System failure
                           - >1
                             - No
                               - Confirmed by radio contact
                               - Use stored MSC number for MSRN
                                 - Allocate MSRN
                                   - CAMEL_SET_SOA
                                     - See TS 23.076
                                   - Store compatibility info
                                   - Store Alerting Pattern (if received)
                                   - CLI_PRN_VLR
                                     - See TS 23.061
                                   - CCBS Handle PRN
                                     - See TS 23.093
                                   - Provide Roaming Number ack
                                     - 8
                                 - Set negative response: System failure
                           - >1
                             - No
                               - Confirmed by radio contact
                               - Use stored MSC number for MSRN
                                 - Allocate MSRN
                                   - CAMEL_SET_SOA
                                     - See TS 23.076
                                   - Store compatibility info
                                   - Store Alerting Pattern (if received)
                                   - CLI_PRN_VLR
                                     - See TS 23.061
                                   - CCBS Handle PRN
                                     - See TS 23.093
                                   - Provide Roaming Number ack
                                     - 8
                                 - Set negative response: No roaming number
                               - System failure
                           - >1
                             - No
                               - Confirmed by radio contact
                               - Use stored MSC number for MSRN
                                 - Allocate MSRN
                                   - CAMEL_SET_SOA
                                     - See TS 23.076
                                   - Store compatibility info
                                   - Store Alerting Pattern (if received)
                                   - CLI_PRN_VLR
                                     - See TS 23.061
                                   - CCBS Handle PRN
                                     - See TS 23.093
                                   - Provide Roaming Number ack
                                     - 8
                                 - Set negative response: No roaming number
                               - System failure
                           - >1
                             - No
                               - Confirmed by radio contact
                               - Use stored MSC number for MSRN
                                 - Allocate MSRN
                                   - CAMEL_SET_SOA
                                     - See TS 23.076
                                   - Store compatibility info
                                   - Store Alerting Pattern (if received)
                                   - CLI_PRN_VLR
                                     - See TS 23.061
                                   - CCBS Handle PRN
                                     - See TS 23.093
                                   - Provide Roaming Number ack
                                     - 8
                                 - Set negative response: No roaming number
                               - System failure
                           - >1
                             - No
                               - Confirmed by radio contact
                               - Use stored MSC number for MSRN
                                 - Allocate MSRN
                                   - CAMEL_SET_SOA
                                     - See TS 23.076
                                   - Store compatibility info
                                   - Store Alerting Pattern (if received)
                                   - CLI_PRN_VLR
                                     - See TS 23.061
                                   - CCBS Handle PRN
                                     - See TS 23.093
                                   - Provide Roaming Number ack
                                     - 8
                                 - Set negative response: No roaming number
                               - System failure
                           - >1
                             - No
                               - Confirmed by radio contact
                               - Use stored MSC number for MSRN
                                 - Allocate MSRN
                                   - CAMEL_SET_SOA
                                     - See TS 23.076
                                   - Store compatibility info
                                   - Store Alerting Pattern (if received)
                                   - CLI_PRN_VLR
                                     - See TS 23.061
                                   - CCBS Handle PRN
                                     - See TS 23.093
                                   - Provide Roaming Number ack
                                     - 8
                                 - Set negative response: No roaming number
                               - System failure
   - >1
     - Yes
       - Confirmed by radio contact
       - Use received MSC number for MSRN
         - Allocate MSRN
           - CAMEL_SET_SOA
             - See TS 23.076
           - Store compatibility info
           - Store Alerting Pattern (if received)
           - CLI_PRN_VLR
             - See TS 23.061
           - CCBS Handle PRN
             - See TS 23.093
           - Provide Roaming Number ack
             - 8
         - Set negative response: No roaming number
     - No
       - Confirmed by radio contact
       - Use stored MSC number for MSRN
         - Allocate MSRN
           - CAMEL_SET_SOA
             - See TS 23.076
           - Store compatibility info
           - Store Alerting Pattern (if received)
           - CLI_PRN_VLR
             - See TS 23.061
           - CCBS Handle PRN
             - See TS 23.093
           - Provide Roaming Number ack
             - 8
         - Set negative response: No roaming number
   - MSCRN available?
     - Yes
       - MSC per VLR
         - MSCRN available?
           - Yes
             - Use received MSC number for MSRN
             - Allocate MSRN
               - CAMEL_SET_SOA
                 - See TS 23.076
               - Store compatibility info
               - Store Alerting Pattern (if received)
               - CLI_PRN_VLR
                 - See TS 23.061
               - CCBS Handle PRN
                 - See TS 23.093
               - Provide Roaming Number ack
                 - 8
             - Set negative response: No roaming number
           - No
             - Confirmed by radio contact
             - Use stored MSC number for MSRN
               - Allocate MSRN
                 - CAMEL_SET_SOA
                   - See TS 23.076
                 - Store compatibility info
                 - Store Alerting Pattern (if received)
                 - CLI_PRN_VLR
                   - See TS 23.061
                 - CCBS Handle PRN
                   - See TS 23.093
                 - Provide Roaming Number ack
                   - 8
               - Set negative response: No roaming number
         - No
           - Confirmed by radio contact
           - Use stored MSC number for MSRN
             - Allocate MSRN
               - CAMEL_SET_SOA
                 - See TS 23.076
               - Store compatibility info
               - Store Alerting Pattern (if received)
               - CLI_PRN_VLR
                 - See TS 23.061
               - CCBS Handle PRN
                 - See TS 23.093
               - Provide Roaming Number ack
                 - 8
             - Set negative response: No roaming number
     - No
       - Confirmed by radio contact
       - Use stored MSC number for MSRN
         - Allocate MSRN
           - CAMEL_SET_SOA
             - See TS 23.076
           - Store compatibility info
           - Store Alerting Pattern (if received)
           - CLI_PRN_VLR
             - See TS 23.061
           - CCBS Handle PRN
             - See TS 23.093
           - Provide Roaming Number ack
             - 8
         - Set negative response: No roaming number
   - MSCRN available?
     - No
       - Confirmed by radio contact
       - Use stored MSC number for MSRN
         - Allocate MSRN
           - CAMEL_SET_SOA
             - See TS 23.076
           - Store compatibility info
           - Store Alerting Pattern (if received)
           - CLI_PRN_VLR
             - See TS 23.061
           - CCBS Handle PRN
             - See TS 23.093
           - Provide Roaming Number ack
             - 8
         - Set negative response: No roaming number
   - Wait For Access Request

Figure 54f: Process PRN_VLR (sheet 6)
Process PRN_VLR

Signals to the left are to the HLR.

1. **MSRN available?**
   - Yes: MSC per VLR
   - No: Set negative response: No roaming number

2. MSC per VLR
   - Yes: Received MSC number. Stored MSC number?
   - No: Confirmed by radio contact

3. Use received MSC number for MSRN
   - Yes: Allocate MSRN
   - No: Use stored MSC number for MSRN

4. Store compatibility info:
   - PLMN BC, ISDN BC, ISDN LLC & ISDN HLC (as available)
   - Store Alerting Pattern (if received)

5. CLI_PRN_VLR
   - See TS 23.081

6. CCBS_Handle_PRN
   - See TS 23.093

7. Provide Roaming Number ack
   - PAR pending.:False; PAR successful.:False; Fatal PAR error.:False

8. Idle

Figure 54g: Process PRN_VLR (sheet 7)
Signals to/from the left are to/from the process ICH_VLR; signals to/from the right are to/from the MSC.
Process Restore_Subscriber_Data_VLR

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

Restore Data

Wait_For_Data

Restore Data ack

Update Subscriber Data

Update HLR number

Update MS Not Reachable indicator

Data confirmed by HLR=True

Restore Data negative response

Figure 56: Process Restore_Subscriber_Data_VLR
Process PSI_VLR

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

Idle

Provide Subscriber Info

Check Parameters

Results Pass?

No

Yes

IMSI known in VLR?

No

Yes

Subscriber state requested?

No

Yes

IMSI detached?

No

Yes

Roaming in LA allowed?

No

Yes

Set subscriber state requested

Subscriber state = determined not reachable

Wait For MSC Response

Obtain Subscriber Info

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Figure 57a: Process PSI_VLR (sheet 1)
Process PSI_VLR

Wait_For_MSC_Response

Obtain Subscriber Infoack

Subscriber state received?

Set subscriber state

Active retrieval required?

Active_Info_Retrieval_VLR

Retrieve_Location_Info_VLR

Provide Subscriber Infoack

Idle

Figure 57b: Process PSI_VLR (sheet 2)
Procedure Retrieve_Location_Info_VLR

Retrieve location info from SGSN?

Yes

Send MS information

Location info := Stored location info

Wait For SGSN Response

No

Send MS Information negative response

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

1. Set information required
2. Paging via SGSN possible?
   - No
   - Yes, Set paging via SGSN possible
3. Location area ID known?
   - No
   - Yes
   - Search for MS
     - Page type= Active information retrieval
       - Wait For Search Result
   - Page MS
     - Page type= Active information retrieval
       - Wait For Page Result

Figure 59a: Procedure Active_Info_Retrieval_VLR
Procedure Active_Info_Retrieval_VLR

Wait_For_Search_Result

Search for MS ack

Roaming in LA allowed?

Yes

Location info received?

No

No

Location info = Stored location info

Location info = Received location info

Location info received?

Yes

Location info = Stored location info

Location info = Received location info

Page MS

Wait_For_Search_Result

Page MS via SGSN

Yes

Location info received?

No

Location info = Stored location info

Location info = Received location info

Page MS

Wait_For_Search_Result

Page MS via SGSN

Yes

Page MS

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".

ETS
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 Prepaging_MS_MSC
Procedure Prepaging_Search_For_MS_MSC

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

Paging via SGSN possible?

Yes

Page MS via SGSN

In specified location area

No

MS busy?

Yes

Set negative response: Busy Subscriber

No

Page

Set access connection status

Start Page response timer

Wait For_Page_Response

Result:= Pass

Result:= Fail

Cancel Location

Page MS negative response

Result:= Fail

Page MS connection established

Page response timer expired

Result:= Fail

CM Service Request

For circuit-switched call

To process OCH_MSC

Page MS

Set access connection status

Set negative response: Location Cancelled

Page MS negative response

Result:= Fail

Result:= Pass

Result:= Fail

Result:= Fail

Set negative response: Absent Subscriber

Set negative response: Busy Subscriber (NDUB)

Page MS negative response

Page MS negative response

Page MS negative response

Figure 61: Procedure Prepaging_Page_MS_MSC
Figure 62: Procedure Prepaging_Search_For_MS_MSC
Process OSI_MSC

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

Figure 63: Process OSI_MSC
Process AIR_MSC

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

Figure 64: Process AIR_MSC
Procedure Active_Info_Retrieval_Page_MSC

1. Location area ID known?
   - Yes
   - No

2. MS connection exists?
   - Yes
   - No

3. Paging via GGSN possible?
   - Yes
   - No

4. Location info requested?
   - Yes
   - No

5. Location Reporting Control
   - Yes
   - No

6. Location info requested?
   - Yes
   - No

7. Location Reporting Control
   - Yes
   - No

8. Location info received?
   - Yes
   - No

9. Set negative response: Absent subscriber

10. MS connection established
    - Yes
    - No

11. CM Service Request
    - Yes
    - No

12. Retrieve IMEI If Required
    - Yes
    - No

13. Release transaction

14. Page MS negative response

15. Page MS back

16. Set negative response: Unknown LAI

Figure 65: Procedure Active_Info_Retrieval_Page_MSC
Figure 66: Procedure Active_Info_Retrieval_Search_MSC
Procedure Retrieve_IMEI_If_Required

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

IMEI requested?

Yes

Send IMEI

Wait For IMEI

To supervising process, if required

IMEI Received IMEI

Release transaction

Release transaction

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 task "Release Resources" refers to any resources that may have been allocated for the call due to Pre-Paging.

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, 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].

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

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

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 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 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 is specific 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_ForwardingInteraction_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 1: If the MSC supports the option to delay Mobile Terminating CM request during a location update procedure (see 3GPP TS 24.008 [13] section 4.5.1.3.1 Mobile Terminating CM Activity):

If location update procedure is ongoing for the MS,

If the "follow-on" indicator is received and MSC supports "follow-on" feature, the Page_MS_MSC procedure should return FAIL after sending Page MS negative response (cause Busy Subscriber) to VLR.

Otherwise, the MSC should delay the launching of Page_MS_MSC procedure until the location update procedure ends.

- If the result of location update is successful and location update is not through Gs interface, then Page_MS_MSC procedure returns with PASS.

- If the result of location update is successful and location update is through Gs interface, then Page_MS_MSC continues from the beginning of the procedure.

- If the result of location update is not successful, then the procedure should return FAIL after sending Page MS negative response (cause Absent Subscriber) to VLR.

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.

Sheet 4: A MSC not implementing the MT Roaming Retry feature may not immediately stop paging upon receipt of a Cancel Location message.

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 1: If the MSC supports the option to delay the Mobile Terminating CM request during a location update procedure (see 3GPP TS 24.008 [13] section 4.5.1.3.1 Mobile Terminating CM Activity):

If location update procedure is ongoing for the MS, and if the "follow-on" indicator is received and the MSC supports the "follow-on" feature, the Search_MS_MSC procedure should return FAIL after sending Search MS negative response (cause Busy Subscriber) to VLR.

Otherwise, the MSC should delay the launching of Search_MS_MSC procedure until location update procedure ends.
- If the result of location update is successful and location update is not through Gs interface, then the Search_MS_MSC procedure returns with PASS.

- If the result of location update is successful and location update is through Gs interface, then the procedure continues from the beginning of the Page_MS_MSC procedure.

- If the result of the location update is not successful, then the procedure should return FAIL after sending the Search MS negative response (cause Absent Subscriber) to VLR.

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.

Sheet 4: A MSC not implementing the MT Roaming Retry feature may not immediately stop paging upon receipt of a Cancel Location message.

### 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: 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 procedure Handling_CD_MSC is specific to Call Deflection; it is specified in 3GPP TS 23.072 [11].

Sheet 5, 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 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 procedures UUS_MSC_Check_UUS1_UUI is specific to UUS; it is specified in 3GPP TS 23.087 [20].

Sheet 8, 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 Set_CLIP_Info_MSC 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

1. Release Resources
2. Release MSRN
3. Idle
4. Send Info For Incoming Call
5. Wait For Page Request
6. Continue CAMEL Handling
7. CAMEL ICH_MSC INIT

**Leg1_status** => Set-up

**CAMEL ICH LEG1 MSC (Leg1 Status)**

**Idile**

**Leg1 only**

**Reconnect**

**MSRN**

**Aborted**

**Fail**

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

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

To handle an incoming (MT) call:

1. Send Info For Incoming Call negative response
2. Complete Call
3. Process ICH_MSC

ICH_MSC3(17)

Wait_For_MT_Call_ Result

Complete Call_In_MSC

See TS 23.072

See TS 23.083

Wait_For_MT_Call_ Result

See TS 23.093

Store CW Treatment indicator for this call if received in SII2

Call answered := True

Result:= Pass?

Result:= Pass?

Result:= Pass?

Send Info For MT Reconnected Call

Release transaction

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

Figure 67c: Process ICH_MSC (sheet 3)
CAMEL phase 4 or later control relationship exists? 

Yes 

Leg1_status := Active 

CAMEL_ICH_LEG1_MSC (Leg1_Status) 

See TS 23.078 

CAMEL_ICH_LEG2_MSC 

See TS 23.078 

Wait_For_Clear 

No 

Idle 

Figure 67d: Process ICH_MSC (sheet 4)
Process ICH_MSC

1. Wait_For_MT_Call_ Result
   - Call is to be forwarded

2. MT_Roaming
   - Yes
     - MT_Roaming Retry supported
     - Yes
       - Handle_RLCF_VMSC
     - No
       - MT_Roaming Retry Indicator received
         - Yes
           - CAMEL_Check_RLCF_VMSC
         - No
           - ORLCF_VMSC See TS 23.079

3. Release
   - ORLCF See TS 23.079
   - Code
     - Accepted
       - Forwarding Failed
       - CD_Failure See TS 23.072
     - Code Failure
       - CAMEL_MT_GMSC_DISC See TS 23.078

4. Release call resources

5. Idle

Figure 67e: Process ICH_MSC (sheet 5)
Figure 67f: Process ICH_MSC (sheet 6)
Figure 67g: Process ICH_MSC (sheet 7)
Figure 67h: Process ICH_MSC (sheet 8)
Process ICH_MSC

7

CAMEL phase 4 or later control relationship exists?

Yes

Leg1_status := Active

See TS 23.078

CAMEL_ICH_LEG1_MSC (Leg1_Status)

Wait_For_Clear

No

See TS 23.078

CAMEL_ICH_LEG2_CF_MSC

Idle

Figure 67i: Process ICH_MSC (sheet 9)
Figure 67j: Process ICH_MSC (sheet 10)
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 ask

Call answered

False

Tokens

Wait For Reconnected Call Result

Send Info For MT Reconnected Call ask

Call answered

False

Tokens

Handle ORLGF_VMSC

Results Accepted?

No

Yes

Results Forwarding Failed?

Yes

CD_Failure

See TS 23.072

CD_Success

See TS 23.072

Release call resources

Idle

Release

CMRL,M MSC,MT_GMSC_DISC6

See TS 23.078

CCBS_Check_Last_Call

See TS 23.093

Figure 67k: Process ICH_MSC (sheet 11)
Process ICH_MSC

Wait For MT_Call

Result

Release

CAI-EL_MT_GMSC_DISC6

See TS 23.078

Release transaction

CAI-EL_MT_GMSC_DISC4

See TS 25.078

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

Yes

Release

No

Wait For Reconnected_Call_Result

CCBS_Check_Last_Call

Add to VLR

Send Info For MT Reconnected Call

Abort

Release call resources

Idle

Release transaction

Release

See TS 23.093

CAMEL_MT_GMSC_DISC4

CAMEL_MT_GMSC_DISC6

See TS 23.078

Result= Reconnect?

No

Yes

Release

Send Info For MT Reconnected Call

Wait For Reconnected_Call_Result

Figure 67l: Process ICH_MSC (sheet 12)
Figure 67m: Process ICH_MSC (sheet 13)
Figure 67n: Process ICH_MSC (sheet 14)
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 67o: Process ICH_MSC (sheet 15)
Process ICH_MSC

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

Wait For Clear

Hold request

Hold supported?

Yes

Hold reject

Process Hold Request

See 3G TS 23.080

No

Retrieve reject

Process Retrieve Request

See 3G TS 23.083

No

Yes

Retrieve request

Process Retrieve Request

See 3G TS 23.083

Wait For Clear

Figure 67p: Process ICH_MSC (sheet 16)
Signals from the left are from the BSS; signals to the right are to the Subs_FSM process.

Figure 67q: Process ICH_MSC (sheet 17)
Procedure Page_MS_MSC

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

1. Location area ID known?
   - No
   - Call still exists?
     - No
     - MS connection exists?
       - No
       - Signals to/from the left are to/from the BSS; signals to/from the right are to/from the VLR unless marked otherwise
     - Yes
     - Set negative response: Unknown LAI
   - Yes
   - Call still exists?
     - No
     - MS connection exists?
       - No
       - SMS or SS page?
         - Yes
         - System Failure
       - No
       - Clear received: False
     - Yes
     - Paging via SGSN possible?
       - No
       - In specified location area
         - Page
         - Page MS via SGSN
         - Request call status
           - To Subs_FSM
           - Set call status
             - Result: Pass
         - Start Page response timer
           - Wait For Page Response
           - Wait For Call Status
             - Result: Fail
       - Yes
         - Page MS

Result:=

Figure 68a: Procedure Page_MS_MSC (sheet 1)
Procedure Page_MS_MSC

Wait_For_Call_Status

Call status

Check_MT_Multicall_MSC

Result=Offered?

Yes

No

Result=More calls possible?

Yes

No

Result=not provisioned?

Yes

No

Call in setup?

Yes

No

Call waiting?

Yes

No

Set access connection status

Result=Pass

Page MS negative response

Result=Fail

More calls possible

Set negative response: Busy subscriber

No

Yes

Page MS negative response

Set negative response: Busy subscriber (NDUB)

No

Yes

Set negative response: Busy subscriber

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

Figure 68b: Procedure Page_MS_MSC (sheet 2)
Procedure Page_MS_MSC

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

For circuit-switched call

Wait For Page Response

Figure 68c: Procedure Page_MS_MSC (sheet 3)
Procedure Page_MS_MSC

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

Wait_For_Page_Response

Cancel Location

Clear received:

Set negative response: Location Cancelled

Release transaction

Page MS negative response

Result:= Fail

Result:= Aborted

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

Figure 68c: Procedure Page_MS_MSC (sheet 4)
Procedure Search_For_MS_MSC

1. Call still exists?
   - Yes
   2. MS connection exists?
      - Yes
         3. Clear received := False
            4. Paging via SGSN possible?
               - No
                  5. Start Page response timer
                     6. Wait For_ Search_Response
                     7. Result := Pass
               - Yes
                  8. Search for MS via SGSN
                     9. Request call status
                        10. To Subs_FSM
                           11. Set access connection status
                              12. Search For MS negative response
                                 13. Result := Fail
         - No
            14. SMS or SS page?
               - Yes
                  15. Request call status
                     16. To Subs_FSM
                           17. Set access connection status
                              18. Search For MS negative response
                                 19. Result := Fail
               - No
                  20. Set negative response: System Failure

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

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

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.

Focus on procedure Subs_FSM.

Wait_For_Call_Status

Call status: From process Subs_FSM

Check_MT_Multica1_MSC

Result=Offered?

Yes

Result=More calls possible?

No

Result=More calls possible?

Yes

Result=More calls possible?

No

Result=not provisioned?

Yes

Call in setup?

Yes

Call waiting?

No

Set access connection status

Result:=Pass

Search For MS negative response

Result:=Fail

Set negative response: Busy Subscriber

More calls possible

Set negative response: Busy Subscriber (NDUB)

No

Figure 69b: Procedure Search_For_MS_MSC (sheet 2)
Figure 69c: Procedure Search_For_MS_MSC (sheet 3)
Figure 69d: Procedure Search_For_MS_MSC (sheet 4)
Procedure Complete_Call_In_MSC

Set_CLIP_Info_MSC

Derive required PLMN BC

See TS 29.007

Setup

See TS 29.007

UUS_ICH_UUS1_Implicit_Active

See TS 23.087

CCBS_Report_Not_Idle

See TS 23.093

Wait_For_Setup_Response

Setup failure

Set negative response: Absent Subscriber

Complete Call negative response

Result:= Fail

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

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

1. Wait For Setup Response
2. Call Confirmed
3. Multicall supported in MSC?
   - Yes: Establish Terminating TCH Required
   - No: Multicall supported

   Multicall supported

   Yes: Establish Terminating TCH Required
   - Result = Fail?
     - Yes: CAMEL_MT_GMSC_DISC4
       - See TS 23.078
     - No: CAMEL_MT_GMSC_DISC6
       - See TS 23.078

   Yes: Result = Aborted
     - Yes: CAMEL_MT_GMSC_DISC6
       - See TS 23.078
     - No: CCBS_ICCH_MSC_Report_FAILURE
       - See TS 23.093

   Yes: Result = Rejected?
     - Yes: Complete Call negative response
     - No: Set negative response: Radio congestion

   No: Result = Aborted
     - Yes: Result = Reconnect?
       - No: Complete Call negative response
       - Yes: Result = Fail

   No: Result = Reconnect?
     - No: Complete Call negative response

4. Wait For Alerting

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

Wait_ForAlerting

Alerting

UUS_ICH, Check_Support

Results=Pass?

No

DCBS_ICH_MSC_Report_Success

Results=Pass?

No

NRCT provided?

Yes

Start No Reply Call Timer

CAMEL_Start_TMFy

Send ACM If Required

UTU2Cnt:=0

CAMEL_MT_MSC_ALERTING

Result=Pass?

No

Wait_forAnswer

Yes

Release

To GMSC

Result=Aborted

Result=Reconnect

Result=Aborted

Result=Aborted

Result=Aborted

Result=Aborted

Result=Aborted

Result=Aborted

Result=Aborted

Result=Aborted

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Result=Aborted

Result=Reconnect

Result=Abored
Figure 70d: Procedure Complete_Call_In_MSC (sheet 4)
Figure 70e: Procedure Complete_Call_In_MSC (sheet 5)
Figure 70f: Procedure Complete_Call_In_MSC (sheet 6)
Figure 70g: Procedure Complete_Call_In_MSC (sheet 7)
Procedure Complete_Call_In_MSC

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

1. Wait_for_Answer
2. Signals to/from the left are to/from the BSS; signals to/from the right are to/from the VLR unless marked otherwise
3. No Reply Call Timer expired
4. CAMEL TNRy expired
5. UUS_ICH_Check_Forwarding
6. See TS 23.087
7. Result=Pass?
8. Yes
9. Set negative response: No subscriber reply
10. Complete Call negative response
11. Release transaction
12. Result=Fail
13. Release transaction

Figure 70h: Procedure Complete_Call_In_MSC (sheet 8)
Procedure Complete_Call_In_MSC

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

Release transaction

BS_ICH_MSC_Report_Failure

Wait_For_Setup_Response, Wait_For_Alerting

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

User busy?

No

Set negative response: Busy subscriber (UDUB)

Complete Call negative response

Result:= Fail

Yes

CBBS_ICH_MSC_Report_Failure

See TS 23.093

UUS_MSC_Check_UUS1_UUI

See TS 23.087

Result:= Aborted

Release To GMSC

CCBS_ICH_MSC_Report_Failure

See TS 23.093

UUS_MSC_Check_UUS1_UUI

See TS 23.087

Abort

Release transaction

From GMSC

CAMEL_MT_GMSC_DISC6

See TS 23.078

Figure 70: Procedure Complete_Call_In_MSC (sheet 9)
Procedure Complete_Call_In_MSC

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 70j: Procedure Complete_Call_In_MSC (sheet 10)**
Figure 70k: Procedure Complete_Call_In_MSC (sheet 11)
Procedure Set_CLIP_Info_MSC

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 in the terminating VMSC:

- Establish Traffic Channel (TCH) if one has not been established for this call.

Signals:
- From the left (left side): to/from the BSS.
- From the right (right side): to/from the GMSC.

Figure 73: Procedure Establish_Terminating_TCH_If_Required
Procedure Handle_AoC_MT_MSC

AOCMT_M1(1)

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

Figure 74: Procedure Handle_AoC_MT_MSC
Procedure Set_COL_Presentation_Indicator_MSC

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 or the MS is marked as "Subscriber data dormant" (e.g. due to super-charger), 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: If the MSRN is not allocated, "GMSC supports MT Roaming Retry" takes "No" exit.

Sheet 1: If no IMSI record is found, the "Subscriber data dormant" check takes the "False" exit.

Sheet 1: A VLR not supporting the flag "Subscriber data dormant" shall behave as if the flag is set to false.

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_LA_Subscription_Info_MT_VLR is specific to CLIP and COLR. If the VLR supports neither CLIP nor COLR, the procedure call is omitted.

Sheet 3: 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

Process in VLRB to handle a request for information for an incoming (MT) call

Idle

Release MSRN

Send Info For Incoming Call

MSRN known?

Yes

CAMEL_ICH_VLR(8)

See TS 23.078

MT Roaming Retry supported?

No

Yes

GMSC supports MT Roaming Retry

Set MT Roaming Retry Indicator

Send Info For Incoming Call Ack

Idle

No

Subscriber data dormant?

False

Set negative response: Unallocated Roaming Number

Set negative response: System Failure

Send Info For Incoming Call negative response

Idle

True

CCBS_ICH_VLR_Report_Failure

See TS 23.093

No Roaming in LA allowed?

False

IMSI detached?

Yes

CCBS_ICH_VLR_Report_Not_Reachable

See TS 23.093

No

Subscriber data dormant?

CCBS_ICH_VLR_Report_Failure

See TS 23.093

Set negative response: Unallocated Roaming Number

False

Set negative response: System Failure

Send Info For Incoming Call negative response

Idle

True

Data confirmed by HLR

Derive required basic service

Subscribers data dormant?

False

Send Info For Incoming Call negative response

Idle

True

Send Info For Incoming Call

Figure 76a: Process ICH_VLR (sheet 1)
Figure 76b: Process ICH_VLR (sheet 2)
Process ICH_VLR

1. Wait For Access Request
2. Page MS negative response
3. Busy subscriber?
4. NDUB?
5. Get AoC Subscription Info_VLR
6. Release
7. Forward
8. Get LI Subscription Info_MT_VLR
9. CW available?
10. Get CW Subscription Info_VLR
11. Multicall supported in VLR?
12. GMSC supports MT Roaming
13. Location Cancelled?

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

Figure 76c: Process ICH_VLR (sheet 3)
Figure 76d: Process ICH_VLR (sheet 4)
Figure 76e: Process ICH_VLR (sheet 5)
Process ICH_VLR

- Handle a request for information for an incoming (MT) call.

**Signals to/from the left are to/from the VMS:**

1. **CAMEL_CHECK**
   - _SII2_CDTI_ See TS 23.078
   - Result = Pass?
     - Yes
   - No

2. **Set NRCT**
   - Yes

3. **CLL_ICH_VLR, Add_CLI**
   - See TS 23.081
   - Process Call Waiting

4. **Wait_For_PCW_result**
   - Busy subscriber?
     - Yes
   - No

5. **CD_Authorization**
   - Result = Aborted?
     - Yes
     - No
   - Result = Fail?
     - Yes
     - No

6. **Set negative response: Impossible call completion**
   - No

7. **Send Info For Incoming Call negative response**
   - Yes

8. **Idle**

9. **NDUB?**
   - Yes
   - No

**Figure 76f: Process ICH_VLR (sheet 6)**
Figure 76g: Process ICH_VLR (sheet 7)
Process ICH_VLR

ICH_VLR8(8)

Signals to the left are to the VMSC.

Process in VLR to handle a request for information for an incoming (MT) call.

Forward_CUG_Check

Result: Call allowed?

Yes

Set result: Forward

Set forwarding information

CAMEL_O_CSI_CHECK_VLR

See TS 23.078

CAMEL_D_CSI_CHECK_VLR

See TS 23.078

Send Info For Incoming Call ack

Idle

Set negative response: CUG reject

Send Info For Incoming Call negative response

Idle

Figure 76h: Process ICH_VLR (sheet 8)

Figure 77: Void
Procedure Search_For_MS_VLR

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

Paging via SGSN possible?

Set paging via SGSN possible

Search For MS

Page type=

Wait_For_Search_Result

Search For MS ack

Search For MS negative

Result:= Pass

Result:= Fail

Result:= Aborted

Search for MS via SGSN

To SGSN

Page MS

Wait_For_Search_Result

Update Location Area ID

Result:= Pass

Result:= Fail

Result:= Aborted

Figure 78: Procedure Search_For_MS_VLR
Procedure Get_CW_Subscription_Info_VLR

Signals to/from the right are to/from the process MAF013

Procedure Get_CW_Subscription_Info_VLR

- Procedure in the VLR to retrieve subscription information for the Call Waiting service

- Initiating 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

To retrieve subscription information for the CLIP & COLR line identification services for an MT call

**Figure 80: Procedure Get_LI_Subscription_Info_MT_VLR**
Signals to/from the right are to/from the process MAF008

Figure 81: Procedure Handle_CFB
Procedure Handle_CFNRy

Signals to/from the right are to/from the process MAF009

Initiate handling of CFNRy

Wait For CFNRy_Result

Continue call handling

Error?

Yes

Normal call?

No

Result:= Fail

Yes

Result:= Forward

No

Result:= No reply
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 procedure 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 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.
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.

**Figure 83b: Process Subs_FSM (sheet 2)**
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 TCH_MSC.

**Figure 83c: Process Subs_FSM (sheet 3)**
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.

Figure 83d: Process Subs_FSM (sheet 4)
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

Signals to/from the left are to/from either process OCH_MSC or process ICH_MSC unless marked otherwise.

Figure 83f: Process Subs_FSM (sheet 6)
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.

Figure 83g: Process Subs_FSM (sheet 7)
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.

Process Subs_FSM

Call_Held_Call_Active

MPTY request

ECT request

MPTY supported?

Yes

No

Handle_MPTY

MPTY reject

ECT reject

Handle_ECT_Active

Result

Call_Held_Call_Active

Result

Call_Held_Call_Active

End

End_Active

End_Held

Fail

Idle

Data_Call_Active

Call_Active

Call_Held_Call_Active

Idle

Call_Held_Call_Active

Pass

Figure 83h: Process Subs_FSM (sheet 8)
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 83i: Process Subs_FSM (sheet 9)
Figure 83j: Process Subs_FSM (sheet 10)
Process in the serving MSC to control the call states on a per subscriber basis.

**Process Subs_FSM**

- Call setup failed
- Call established
- Call cleared

Signals to/from the left are to/from either process OCH_MSC or process ICH_MSC.

**Call_Held**
- Call_Held
- Call_Active
- Setup_Pending

**OG_Call**
- OG_Call_Alerting

**Speech call?**
- Yes
- No

**Non_Speech call ongoing?**
- Yes
- No

**Non_Speech Calls**
- Active
- Null

**Speech_Call**
- Null
- Active

**Check_Ongoing_Calls**
- Yes
- No

**Data_Call**
- Active
- Setup_Pending

**Figure 83k: Process Subs_FSM (sheet 11)**
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.

Figure 84l: Process Subs_FSM (sheet 12)
Process in the serving MSC to control the call states on a per-subscriber basis.

**Process Subs_FSM**

- **SFSM13(18)**
  - Signals to/from the left are to/from either process OCH_MSC or process ICH_MSC.

- **States**:
  - Call established
  - Call setup failed
  - Hold request
  - Retrieve request
  - Retrieve reject
  - Call_Held_Call, Active_Data_Call, Setup_Pending
  - Non_Speech_CallCnt := Non_Speech_CallCnt + 1
  - Non_Speech_Calls := Active
  - Update Non_Speech_Calls Status
  - Result
  - Active_Clr
  - Call_Held_Call, Active_Data_Call, Setup_Pending
  - Call_Held_Call, Active_Data_Call, Setup_Pending
  - Call_Held_Call, Active_Data_Call, Setup_Pending
  - Call_Held_Call, Active_Data_Call, Setup_Pending

**Figure 84m: Process Subs_FSM (sheet 13)**
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.

Figure 84n: Process Subs_FSM (sheet 14)
Process in the serving MSC to control the call states on a per-subscriber basis.

**Figure 84o: Process Subs_FSM (sheet 14)**
Process Subs_FSM

Signals to/from the left are to/from either process OCH_MSC or process ICH_MSC

Figure 84p: Process Subs_FSM (sheet 14)
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"

Figure 84q: Process Subs_FSM (sheet 14)
Process Subs_FSM

Signals to/from the left are to/from either process OCH_MSC or process ICH_MSC

- MPTY request
- MPTY reject

Except for the following state:
"Call Held Call Active"

Figure 84r: Process Subs_FSM (sheet 14)
Macrodefi nition Check_Ongoing_Calls

---

Macro to check if there are any speech or non-speech calls remaining (and also update the Non_Speech_Calls status variable).

```c
COC1(1)
```

```
Non_Speech_Call_Cnt

0

Non_Speech_Calls:=Null

Speech_Call_Cnt

>=1

No_Calls_Ongoing

Calls_Ongoing
```

Figure 85: Macro Check_Ongoing_Calls
Macro definition Update_Non_Speech_Calls_Status

Update_Non_Speech_Calls_Status

Macro to update the Non_Speech_Calls variable depending on whether there are any non-speech calls ongoing or not.

Yes
Non-speech call ongoing?
No

Non_Speech_Calls := Active
Non_Speech_Calls := Null

Figure 86: Macro Update_Non_Speech_Calls_Status
Macro definition Increment_Call_Counter

```
Inc_Call_Cnt1(1)
```

Figure 87: Macro Increment_Call_Counter
Macro definition Decrement_Call_Counter

Inc_Call_Cnt1(1)

---------

speech call?

No

Speech

Yes

Non_Speech_Call_Cnt := Non_Speech_Call_Cnt - 1

Speech_Call_Cnt := Speech_Call_Cnt - 1

Figure 88: Macro Decrement_Call_Counter
7.5  TO call

7.5.1  Functional requirements of inter-connecting MSC

7.5.1.1  Process TO_MSC

Sheet 1: the procedure CAMEL_TOC_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 "Pass" exit of the test "Result=?". The procedure call formal parameter “First” or “NotFirst” indicates whether the procedure was called earlier in the same call.

Sheet 1, sheet 4: the procedure CAMEL_TOC_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 trunk triggering, processing continues from the "Pass" exit of the test "Result?". The procedure call formal parameter “First” or “NotFirst” indicates whether the procedure was called earlier in the same call.

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, sheet 2, 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 1, sheet 4: the procedure CAMEL_OCH_MSC_DISC3 is specific to CAMEL phase 1; it is specified in 3GPP TS 23.078 [12].

Sheet 1, sheet 2, sheet 4: 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 7: 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 1, sheet 2: The variable “Return_Place” indicates at which detection point the additional digit collection is.

Sheet 1, sheet 2: The “inter-digit timer” is a MSC internal timer to wait for additional dialling from the incoming side. At the expiry of the timer, the MSC/gsmSSF may report digits to the gsmSCF (if the event detection point is armed). This timer is used for the SDL modelling purposes only and it may not present the actual implementations.

Sheet 2: “Number_of_Digits” is the Collected_Info specific reporting criterion. The gsmSCF specifies the criterion. The process CS_gsmSSF sends the parameter to the TO_MSC process.

Sheet 2: “ST digit” is the ISUP value for a digit indicating that the Called Party Number is complete.

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

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

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_OCH_MSC2 is specified in 3GPP TS 23.078 [12].
Sheet 6: 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 6: 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 6: the processing in the branch beginning with the Int_O_Release input will occur only if the MSC supports CAMEL.

Sheet 6: after the process TO_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.

Sheet 7: the process CAMEL_MT_CF_LEG2_MSC is specific to CAMEL phase 4 or later; it is specified in 3GPP TS 23.078 [12].
Process TO_MSC

*To handle trunk originated call.*

Signals to/from the left are to/from the originating switch; signals to/from the right are to/from the destination exchange or MT_GMSC or ICH_MSC process depending on the called number.

---

**Figure 7.5.1a: Process TO_MSC (sheet 1)**
Process TO_MSC

Signals to/from the left are to/from the originating switch; signals to/from the right are to/from the destination exchange or MT_GMSC or ICH_MSC process depending on the called number.

Digits are waited based on timer for modelling purposes. Once timer expires, new digits are reported to gsmSCF. There may be vendor specific differences in this issue.

Figure 7.5.1b: Process TO_MSC (sheet 2)
Process TO_MSC

- Process in the MSC to handle trunk originated call.
- Signals to/from the left are to/from the originating switch; signals to/from the right are to/from the destination exchange or MT_GMSC or ICH_MSC process depending on the called number.

- Wait_For_ACM
- Connect
- SAM
- UUS_MSC_Clear_UUS
- CAMEL_Store_Destination_Address (False, False)
- CAMEL_CF_MSC_ALERTING
- Result?
  - Pass
  - Address Complete
  - Wait_For_Answer
  - Answer
  - Result?
    - Pass
    - Address Complete
    - Wait_For_Answer
    - Answer
    - Result?
      - Pass
      - Address Complete
      - Wait_For_Answer
      - Answer
      - Result?
        - Pass
        - Address Complete
        - Wait_For_Answer
        - Answer
        - Result?
          - Pass
          - Address Complete
          - Wait_For_Answer
          - Answer
          - Result?
            - Pass
            - Address Complete
            - Wait_For_Answer
            - Answer
            - Result?
              - Pass
              - Address Complete
              - Wait_For_Answer
              - Answer
              - Result?
                - Pass
                - Address Complete
                - Wait_For_Answer
                - Answer
                - Result?
                  - Pass
                  - Address Complete
                  - Wait_For_Answer
                  - Answer
                  - Result?
                    - Pass
                    - Address Complete
                    - Wait_For_Answer
                    - Answer
                    - Result?
                      - Pass
                      - Address Complete
                      - Wait_For_Answer
                      - Answer
                      - Result?
                        - Pass
                        - Address Complete
                        - Wait_For_Answer
                        - Answer
                        - Result?
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                                                                                           - Pass
                                                                                           - Address Complete
                                                                                           - Wait_For_Answer
                                                                                           - Answer
                                                                                           - Result?
Process TO_MSC

Signals to/from the left are to/from the originating switch; signals to/from the right are to/from the destination exchange or MT_GMSC or ICH_MSC process depending on the called number.

Figure 7.5.1d: Process TO_MSC (sheet 4)
Process TO_MSC

Wait_For_Answer

TNRy expired

Signals to/from the left are to/from the originating switch; signals to/from the right are to/from the destination exchange or MT_GMSC or ICH_MSC process depending on the called number.

Internal

3

Release

TOMSC5(7)

See TS 23.078

Release

Result?

Fail

Reconnect

Release call resources

See TS 23.078

Idle

Result?

No

Release

Yes

Reconnect

Pass

Abort

Result?

Fail

Release

Dialled_Services

(First)

See TS 23.078

CAMEL_OCH_MSC1

CAMEL_TOC

Release

No

Yes

Idle

Figure 7.5.1e: Process TO_MSC (sheet 5)
Signals to/from the left are to/from the originating switch; signals to/from the right are to/from the destination exchange or MT_GMSC or ICH_MSC process depending on the called party.

Figure 7.5.1f: Process TO_MSC (sheet 6)
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;
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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abort reason</td>
<td>M</td>
<td>Indicates the reason for the procedure being aborted.</td>
</tr>
</tbody>
</table>

#### 8.1.2 Authenticate

The following information elements are required for authentication of a UMTS UE:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAND(I)</td>
<td>M</td>
<td>Random number challenge to be sent to the MS (3GPP TS 33.102 [32])</td>
</tr>
<tr>
<td>AUTN(I)</td>
<td>M</td>
<td>Authentication token to be sent to the MS (3GPP TS 33.102 [32])</td>
</tr>
</tbody>
</table>
The following information elements are required for authentication of a GSM MS:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAND</td>
<td>M</td>
<td>Random number challenge to be sent to the MS (3GPP TS 43.020 [1])</td>
</tr>
<tr>
<td>CKSN</td>
<td>M</td>
<td>Cipher key sequence number to be sent to the MS (3GPP TS 43.020 [1])</td>
</tr>
</tbody>
</table>

8.1.3 Authenticate ack

The following information element is required for authentication of a UMTS UE:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RES(I)</td>
<td>M</td>
<td>Result returned by the MS (3GPP TS 33.102 [32])</td>
</tr>
</tbody>
</table>

The following information element is required for authentication of a GSM MS:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRES</td>
<td>M</td>
<td>Signature result returned by the MS (3GPP TS 43.020 [1])</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment status</td>
<td>M</td>
<td>Indicates whether the ME is black-listed, grey-listed or white-listed</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSISDN</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>IMEI</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Category</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>PLMN bearer capability</td>
<td>C</td>
<td>Shall be present for an MT call according to the rules defined in 3GPP TS 29.007 [30].</td>
</tr>
<tr>
<td>ISDN bearer capability</td>
<td>C</td>
<td>Shall be present for an MT call if it was received in the Provide Roaming Number; otherwise shall be absent.</td>
</tr>
<tr>
<td>ISDN low layer compatibility</td>
<td>C</td>
<td>Shall be present for an MT call if it was received in the Provide Roaming Number; otherwise shall be absent.</td>
</tr>
<tr>
<td>ISDN high layer compatibility</td>
<td>C</td>
<td>Shall be present for an MT call if it was received in the Provide Roaming Number; otherwise shall be absent.</td>
</tr>
<tr>
<td>CLIP provision</td>
<td>C</td>
<td>Indicates that CLIP is provisioned. Shall be present for an MT call if CLIP is provisioned; otherwise shall be absent.</td>
</tr>
<tr>
<td>CLIR override provision</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>CLIR provision</td>
<td>C</td>
<td>Indicates that CLIR is provisioned. Shall be present for an MO call if CLIR is provisioned; otherwise shall be absent.</td>
</tr>
<tr>
<td>CLIR mode</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>COLP provision</td>
<td>C</td>
<td>Indicates that COLP is provisioned. Shall be present for an MO call if COLP is provisioned; otherwise shall be absent.</td>
</tr>
<tr>
<td>COLR override provision</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>COLR provision</td>
<td>C</td>
<td>Indicates that COLR is provisioned. Shall be present for an MT call if COLR is provisioned; otherwise shall be absent.</td>
</tr>
<tr>
<td>No Reply Condition Timer</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>CUG index</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>CUG interlock</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>CUG outgoing access</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Advice of Charge provision</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Alerting Pattern</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Information element name</td>
<td>Required</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>NAEA preferred Carrier Id</td>
<td>O</td>
<td>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.</td>
</tr>
</tbody>
</table>

### 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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMSI</td>
<td>M</td>
<td>TMSI to be sent to the MS.</td>
</tr>
</tbody>
</table>

### 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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSI</td>
<td>M</td>
<td>IMSI of the MS for which information is required.</td>
</tr>
<tr>
<td>Subscriber state requested</td>
<td>C</td>
<td>Indicates that the VLR requires state information for the MS. Shall be present if state information is required; otherwise shall be absent.</td>
</tr>
</tbody>
</table>

### 8.1.16 Obtain Subscriber Info ack

The following information elements are required:
8.1.17 Page MS

The following information elements are required:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subscriber state</td>
<td>C</td>
<td>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.</td>
</tr>
</tbody>
</table>

8.1.18 Page MS ack

The following information elements are required:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location area ID</td>
<td>M</td>
<td>Location area in which the MS responded to the page.</td>
</tr>
<tr>
<td>Serving cell ID</td>
<td>M</td>
<td>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.</td>
</tr>
<tr>
<td>Service area ID</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>MS classmark</td>
<td>M</td>
<td>MS classmark 2 as defined in 3GPP TS 24.008 [26].</td>
</tr>
<tr>
<td>IMEI (with software version)</td>
<td>C</td>
<td>IMEI 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.</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSI</td>
<td>M</td>
<td>IMSI of the MS to be paged.</td>
</tr>
<tr>
<td>eMLPP priority</td>
<td>O</td>
<td>Circuit-switched paging priority.</td>
</tr>
<tr>
<td>TMSI</td>
<td>O</td>
<td>TMSI to be broadcast to identify the MS.</td>
</tr>
<tr>
<td>Channel type</td>
<td>O</td>
<td>Type of channel required for the call.</td>
</tr>
</tbody>
</table>

8.1.21 Process Access Request

The following information elements are required:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM service type</td>
<td>M</td>
<td>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.</td>
</tr>
<tr>
<td>Access connection status</td>
<td>M</td>
<td>Indicates whether or not the connection to the MS is ciphered and whether or not it is authenticated.</td>
</tr>
<tr>
<td>Current location area ID</td>
<td>M</td>
<td>Identity of the location area from which the access request was received.</td>
</tr>
<tr>
<td>Service area ID</td>
<td>C</td>
<td>Identity of the service area (for UMTS access) in use by the served subscriber. Shall be present for UMTS access; otherwise shall be absent.</td>
</tr>
<tr>
<td>Serving cell ID</td>
<td>C</td>
<td>Identity of the cell (for GSM access) in use by the served subscriber. Shall be present for GSM access; otherwise shall be absent.</td>
</tr>
<tr>
<td>IMSI</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>TMSI</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>IMEI</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>CKSN</td>
<td>C</td>
<td>Cipher key sequence number of the MS requesting the access. Shall be present if TMSI is present; otherwise shall be absent.</td>
</tr>
</tbody>
</table>

8.1.22 Process Access Request ack

The following information elements are required:
### 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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSISDN</td>
<td>M</td>
<td>MSISDN of the MS for which the Process Call Waiting is sent.</td>
</tr>
<tr>
<td>PLMN bearer capability</td>
<td>C</td>
<td>Shall be present according to the rules defined in 3GPP TS 29.007 [30].</td>
</tr>
<tr>
<td>ISDN bearer capability</td>
<td>C</td>
<td>Shall be present if it was received in the Provide Roaming Number for the waiting call; otherwise shall be absent.</td>
</tr>
<tr>
<td>ISDN low layer compatibility</td>
<td>C</td>
<td>Shall be present if it was received in the Provide Roaming Number for the waiting call; otherwise shall be absent.</td>
</tr>
<tr>
<td>ISDN high layer compatibility</td>
<td>C</td>
<td>Shall be present if it was received in the Provide Roaming Number for the waiting call; otherwise shall be absent.</td>
</tr>
<tr>
<td>CLIP provision</td>
<td>C</td>
<td>Indicates that CLIP is provisioned. Shall be present if CLIP is provisioned; otherwise shall be absent.</td>
</tr>
<tr>
<td>CLIR override provision</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>COLR provision</td>
<td>C</td>
<td>Indicates that COLR is provisioned. Shall be present if COLR is provisioned; otherwise shall be absent.</td>
</tr>
<tr>
<td>No Reply Condition Timer</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>CUG index</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Advice of Charge provision</td>
<td>C</td>
<td>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.</td>
</tr>
</tbody>
</table>

### 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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMEI</td>
<td>M</td>
<td>IMEISV (as defined in 3GPP TS 23.003 [5]) of the ME involved in the access request.</td>
</tr>
</tbody>
</table>

8.1.29  Provide IMSI

This message contains no information elements.

8.1.30  Provide IMSI ack

The following information element is required:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSI</td>
<td>M</td>
<td>IMSI of the MS involved in the access request.</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSRN</td>
<td>M</td>
<td>Mobile Station Roaming Number received in the IAM.</td>
</tr>
<tr>
<td>Bearer service</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Teleservice</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Dialled number</td>
<td>C</td>
<td>Number dialled by the calling subscriber. Shall be present if it was received in the IAM; otherwise shall be absent.</td>
</tr>
<tr>
<td>Number of forwarding</td>
<td>C</td>
<td>Number of times the incoming call has already been forwarded. Shall be present if it was received in the IAM; otherwise shall be absent.</td>
</tr>
<tr>
<td>CUG interlock</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>CUG outgoing access</td>
<td>C</td>
<td>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.</td>
</tr>
</tbody>
</table>
8.1.37  Send Info For Incoming Call ack

The following information elements are required:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSI</td>
<td>M</td>
<td>IMSI of the B subscriber.</td>
</tr>
<tr>
<td>Forwarded-to number</td>
<td>C</td>
<td>E.164 number of the C subscriber. Shall be present if the call is to be forwarded other than for MT roaming retry reason.</td>
</tr>
<tr>
<td>Forwarding reason</td>
<td>C</td>
<td>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). Shall be present if the call is to be forwarded other than for MT roaming retry reason.</td>
</tr>
<tr>
<td>Notification to calling party</td>
<td>C</td>
<td>Indication of whether the calling party is to be notified that the call has been forwarded. Shall be present if the call is to be forwarded other than for MT roaming retry reason.</td>
</tr>
<tr>
<td>Notification to forwarding party</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Forwarded-to subaddress</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Redirecting presentation</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>MSISDN</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>CUG interlock</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>CUG outgoing access</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>NAEA preferred Carrier Id</td>
<td>O</td>
<td>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.</td>
</tr>
<tr>
<td>MT Roaming Retry Indicator</td>
<td>C</td>
<td>Indication that the call is forwarded for MT roaming retry. All other forwarding parameters are not relevant if this IE is present.</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Called number</td>
<td>M</td>
<td>E.164 number of the call destination.</td>
</tr>
<tr>
<td>Bearer service</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Teleservice</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>CUG index</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Suppress preferential CUG</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Suppress CUG outgoing access</td>
<td>C</td>
<td>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.</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMEI (with software version)</td>
<td>C</td>
<td>IMEI/SV as defined in 3GPP TS 23.003 [5].</td>
</tr>
</tbody>
</table>

8.1.41  Start security procedures

The following information elements are required for a UMTS connection:
The following information elements are required for a GSM connection:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CK</td>
<td>M</td>
<td>Ciphering key to be used to cipher communication over the radio link (see 3GPP TS 33.102 [32]).</td>
</tr>
<tr>
<td>IK</td>
<td>M</td>
<td>Integrity key to be used to verify the integrity of messages transferred over the radio link (see 3GPP TS 33.102 [32]).</td>
</tr>
</tbody>
</table>

8.1.42 Trace subscriber activity

The following information elements are required:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace reference</td>
<td>M</td>
<td>Reference number to be included with tracing reports which the VMSC sends to the OMC</td>
</tr>
<tr>
<td>Trace type</td>
<td>M</td>
<td>For the definition of this IE, see 3GPP TS 52.008 [3]</td>
</tr>
</tbody>
</table>

8.1.43 Use existing TMSI

This message contains no information elements.

8.1.44 Release MSRN

The following information elements are required:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSRN</td>
<td>M</td>
<td>Mobile Station Roaming Number received with the message RELEASE RESOURCES.</td>
</tr>
</tbody>
</table>

8.2 Messages on the C interface (MSC-HLR)

8.2.1 Send Routeing Info

The following information elements are required:
<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSISDN</td>
<td>M</td>
<td>MSISDN of the B subscriber (see 3GPP TS 23.003 [5]).</td>
</tr>
<tr>
<td>Alerting Pattern</td>
<td>C</td>
<td>Shall be present if received in a Connect operation from the gsmSCF; otherwise shall be absent.</td>
</tr>
<tr>
<td>CUG interlock</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>CUG outgoing access</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Number of forwarding</td>
<td>C</td>
<td>Number of times the incoming call has already been forwarded. Shall be present if it was received in the IAM; otherwise shall be absent.</td>
</tr>
<tr>
<td>ISDN BC</td>
<td>C</td>
<td>ISDN bearer capability. Shall be present if the GMSC received it in the IAM, otherwise shall be absent.</td>
</tr>
<tr>
<td>ISDN LLC</td>
<td>C</td>
<td>ISDN lower layer compatibility. Shall be present if the GMSC received it in the IAM, otherwise shall be absent.</td>
</tr>
<tr>
<td>ISDN HLC</td>
<td>C</td>
<td>ISDN higher layer compatibility. Shall be present if the GMSC received it in the IAM, otherwise shall be absent.</td>
</tr>
<tr>
<td>Pre-paging supported</td>
<td>C</td>
<td>Shall be present if the GMSC supports pre-paging, otherwise shall be absent.</td>
</tr>
</tbody>
</table>
### 8.2.2 Send Routing Info ack

The following information elements are required:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSI</td>
<td>M</td>
<td>IMSI of the B subscriber (see 3GPP TS 23.003 [5]).</td>
</tr>
<tr>
<td>Roaming number</td>
<td>C</td>
<td>E.164 number required to route the call to VMSCB (see 3GPP TS 23.003 [5]). Should 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.</td>
</tr>
<tr>
<td>Forwarded-to number</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Forwarded-to subaddress</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Notification to calling party</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Forwarding reason</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Redirecting presentation</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>MSISDN</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>CUG interlock</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>CUG outgoing access</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>NAEA preferred Carrier Id</td>
<td>O</td>
<td>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.</td>
</tr>
</tbody>
</table>

### 8.2.3 Send Routing 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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSI</td>
<td>M</td>
<td>IMSI of the B subscriber (see 3GPP TS 23.003 [5]).</td>
</tr>
<tr>
<td>MSC number</td>
<td>M</td>
<td>E.164 number which identifies VMSCB (see 3GPP TS 23.003 [5]).</td>
</tr>
</tbody>
</table>
| 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/facsimile group 3 calls this information element shall contain one PLMN bearer capability, as specified in 3GPP TS 29.007 [30]. 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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roaming number</td>
<td>M</td>
<td>E.164 number required to route the call to VMSCB (see 3GPP TS 23.003 [5]).</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSI</td>
<td>M</td>
<td>IMSI of the subscriber for whom information is requested (see 3GPP TS 23.003 [5]).</td>
</tr>
<tr>
<td>LMSI</td>
<td>C</td>
<td>Local Mobile Subscriber Identity. Shall be present if the LMSI was sent to the HLR at location updating.</td>
</tr>
<tr>
<td>Requested information</td>
<td>M</td>
<td>Indicates which of the following information the HLR requires: location information; subscriber state; IMEI (with software version); MS classmark.</td>
</tr>
<tr>
<td>Active location retrieval requested</td>
<td>C</td>
<td>Indicates that the HLR requires active location retrieval. Shall be absent if the requested information does not indicate that the HLR requires location information.</td>
</tr>
</tbody>
</table>

8.3.5 Provide Subscriber Info ack

The following information elements are required:
### 8.3.5.1 Location information

The compound information element Location information consists of the following subordinate information elements:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location number</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Service area ID</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Cell ID</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Geographical information</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Geodetic information</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>VLR number</td>
<td>O</td>
<td>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.</td>
</tr>
<tr>
<td>Age of location information</td>
<td>C</td>
<td>Measured in minutes. Shall be present if available in the MSC/VLR; otherwise shall be absent.</td>
</tr>
<tr>
<td>Current Location Retrieved</td>
<td>C</td>
<td>Shall be present when location information was obtained after a successful paging procedure for Active Location Retrieval.</td>
</tr>
</tbody>
</table>

### 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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSI</td>
<td>M</td>
<td>IMSI of the subscriber for whom data are to be restored (see 3GPP TS 23.003 [5]).</td>
</tr>
<tr>
<td>LMSI</td>
<td>O</td>
<td>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.</td>
</tr>
</tbody>
</table>

8.3.8 Restore Data ack

The following information elements are required:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HLR number</td>
<td>M</td>
<td>E.164 number which identifies the HLR (see 3GPP TS 23.003 [5]).</td>
</tr>
<tr>
<td>MS not reachable flag</td>
<td>C</td>
<td>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.</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMEI</td>
<td>M</td>
<td>IMEI of the ME whose status is to be checked (see 3GPP TS 23.003 [5]).</td>
</tr>
</tbody>
</table>

8.4.2 Check IMEI ack

The following information element is required:
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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forwarded-to number</td>
<td>M</td>
<td>E.164 number of the C subscriber.</td>
</tr>
<tr>
<td>OR call</td>
<td>M</td>
<td>Indicates whether the call which is to be forwarded was subject to basic OR as specified in 3GPP TS 23.079 [13]</td>
</tr>
</tbody>
</table>

8.5.3 Perform Call Forwarding ack

The following information element is required:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forwarded-to number</td>
<td>M</td>
<td>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.</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSI</td>
<td>M</td>
<td>IMSI of the MS to be paged.</td>
</tr>
<tr>
<td>eMLPP priority</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>TMSI</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Location area identity</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Channel type</td>
<td>C</td>
<td>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.</td>
</tr>
</tbody>
</table>

8.7.2 Send MS information

The following information elements are required:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSI</td>
<td>M</td>
<td>IMSI of the MS for which information is required.</td>
</tr>
<tr>
<td>Information requested</td>
<td>M</td>
<td>Information required for the specified MS.</td>
</tr>
</tbody>
</table>

8.7.3 Send MS information ack

The following information elements are required:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSI</td>
<td>M</td>
<td>IMSI of the MS for which information is required.</td>
</tr>
<tr>
<td>Service area ID</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Cell ID</td>
<td>C</td>
<td>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.</td>
</tr>
<tr>
<td>Location information age</td>
<td>M (note)</td>
<td>Time in minutes since the MS last established a radio transaction</td>
</tr>
</tbody>
</table>

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.

8.8 Messages on the E interface (GMSC-VMSC)

8.8.1 Release Resources

The following information elements are required:

<table>
<thead>
<tr>
<th>Information element name</th>
<th>Required</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSRN</td>
<td>M</td>
<td>Mobile Station Roaming Number.</td>
</tr>
</tbody>
</table>
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 setup procedure 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.
Procedure in the MSC to handle an incoming IAM and trigger the correct application process.

Called party address in MSRN range for this MSC?

Yes

Incoming IAM was routed with routing number for MNP?

No

Recover reported number from IAM

Yes

HLR address derivable?

No

To process ICH_MSC

Yes

To destination determined by routing tables

To process MT_GMSC

To process
Annex B (informative):
Change history

<table>
<thead>
<tr>
<th>TSG CN#</th>
<th>Spec</th>
<th>CR</th>
<th>Phase</th>
<th>Version</th>
<th>New Version</th>
<th>Subject/Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr 1999</td>
<td>GSM 03.18</td>
<td></td>
<td></td>
<td>7.0.0</td>
<td></td>
<td>Transferred to 3GPP CN1</td>
</tr>
<tr>
<td>CN#03</td>
<td>23.018</td>
<td></td>
<td></td>
<td>3.0.0</td>
<td>3.1.0</td>
<td>Approved at CN#03</td>
</tr>
<tr>
<td>CN#04</td>
<td>23.018</td>
<td>001</td>
<td>3.0.0</td>
<td>3.1.0</td>
<td>3.2.0</td>
<td>Notification of Call Forwarding to the gsmSCF</td>
</tr>
<tr>
<td>CN#05</td>
<td>23.018</td>
<td>002r4</td>
<td>3.1.0</td>
<td>3.2.0</td>
<td></td>
<td>Addition of the description for Pre-Paging</td>
</tr>
<tr>
<td>CN#05</td>
<td>23.018</td>
<td>006</td>
<td>3.1.0</td>
<td>3.2.0</td>
<td></td>
<td>Removal of TDP criteria from Resume Call Handling</td>
</tr>
<tr>
<td>CN#05</td>
<td>23.018</td>
<td>007r1</td>
<td>3.1.0</td>
<td>3.2.0</td>
<td></td>
<td>GMS CAMEL phases in Provide Roaming Number</td>
</tr>
<tr>
<td>CN#05</td>
<td>23.018</td>
<td>023</td>
<td>3.1.0</td>
<td>3.2.0</td>
<td></td>
<td>Separation of success &amp; failure cases for OR of late call forwarding</td>
</tr>
<tr>
<td>CN#05</td>
<td>23.018</td>
<td>024</td>
<td>3.1.0</td>
<td>3.2.0</td>
<td></td>
<td>Notification of Call Forwarding to the gsmSCF before activating call forwarding process</td>
</tr>
<tr>
<td>CN#06</td>
<td>23.018</td>
<td>004r2</td>
<td>3.2.0</td>
<td>3.3.0</td>
<td></td>
<td>Introduction of the Super-Charger Concept in TS 23.018</td>
</tr>
<tr>
<td>CN#06</td>
<td>23.018</td>
<td>027r3</td>
<td>3.2.0</td>
<td>3.3.0</td>
<td></td>
<td>Introduction of CAMEL Phase 3</td>
</tr>
<tr>
<td>CN#07</td>
<td>23.018</td>
<td>025r7</td>
<td>3.3.0</td>
<td>3.4.0</td>
<td></td>
<td>Addition of the description for Multicall</td>
</tr>
<tr>
<td>CN#07</td>
<td>23.018</td>
<td>026r2</td>
<td>3.3.0</td>
<td>3.4.0</td>
<td></td>
<td>Alternative solution for ALR</td>
</tr>
<tr>
<td>CN#07</td>
<td>23.018</td>
<td>030</td>
<td>3.3.0</td>
<td>3.4.0</td>
<td></td>
<td>Correction of the SDL diagrams for Pre-paging</td>
</tr>
<tr>
<td>CN#07</td>
<td>23.018</td>
<td>032r1</td>
<td>3.3.0</td>
<td>3.4.0</td>
<td></td>
<td>Inclusion of D-CSI check in HLR/VLR</td>
</tr>
<tr>
<td>CN#07</td>
<td>23.018</td>
<td>033</td>
<td>3.3.0</td>
<td>3.4.0</td>
<td></td>
<td>Initialization of Backward Call indicator</td>
</tr>
<tr>
<td>CN#07</td>
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