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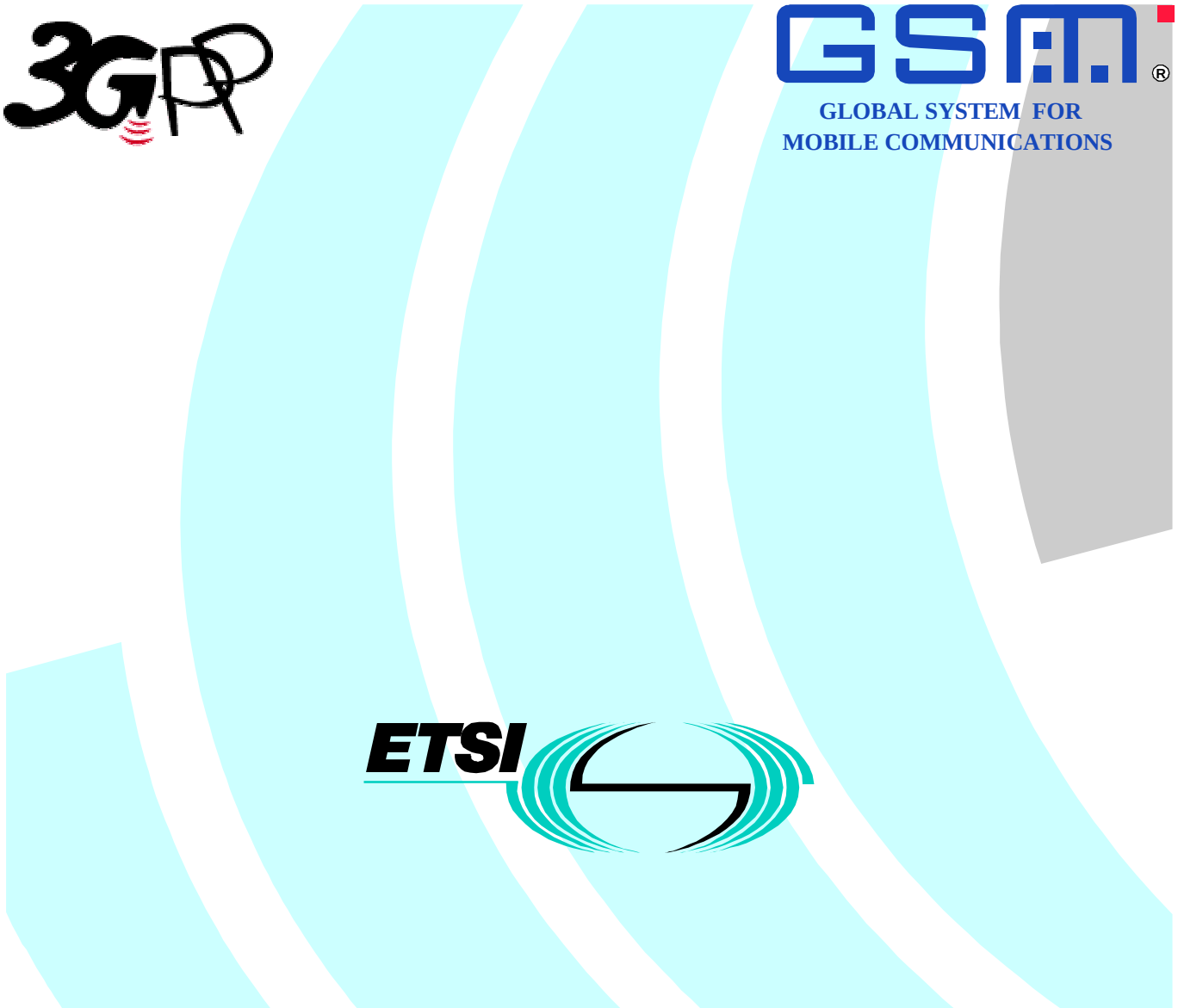
Technical Specification

**Digital cellular telecommunications system (Phase 2+) (GSM);
Universal Mobile Telecommunications System (UMTS);
Closed User Group (CUG) supplementary service - Stage 2
(3GPP TS 23.085 version 3.1.0 Release 1999)**



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Foreword

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Contents

Foreword

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

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0 Scope

The present document gives the stage 2 description of the closed user group supplementary service.

The community of interest supplementary service defined is:

- closed user group(CUG) (see clause 1).

0.1 References

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

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

[1] 3G TS 21.905: "3G Vocabulary".

[2] 3G TS 22.085: "Closed User Group (CUG) Supplementary Services; Stage 1".

0.2 Definitions

CUG terminology defined in GSM 02.85 is applicable to the present document. In addition, the following definitions apply.

CUG Authorisation Functions: Checks performed by the network to ensure that the integrity of a CUG related call is guarantied. CUG calls are rejected if they do not meet the criteria of these checks.

CUG call: CUG call, in signalling terms, is a call where CUG information is passed from the originating switching entity to the destination entity.

CUG Index: Code used to select a CUG for an outgoing call, or to indicate an incoming CUG call. Indices are passed between the user and the network and have significance only within the context of a users subscription.

CUG Interlock Code: Code which uniquely identifies a CUG within a network. The Interlock code is passed from the point of origin to the destination in a CUG call to identify the CUG which has been invoked.

CUG Related Call Barring: CUG related call barring is call barring applied to a CUG subscriber by the home network when roaming in a non-CUG network. The user is unable to remove CUG related call barring.

Explicit CUG Invocation: Explicit CUG invocation is where a calling user attempts to invoke a CUG by passing CUG information to the network in a call request.

Implicit CUG Invocation: Implicit CUG invocation is where the user invokes some default characteristic of a CUG without providing any CUG information in the call request.

Normal Call: Normal call in the context of this CUG TS is a call established from a CUG subscriber where no CUG information is passed from the originating switching entity to the destination entity.

Outgoing Access Indicator: Indication passed from the point of origin to the destination in a CUG call to indicate that the calling user has subscribed to the Outgoing Access inter-CUG accessibility subscription option.

0.3 Abbreviations

In addition to those listed below abbreviations used in the present document are listed in GSM 01.04.

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

BS	Basic Service
CI	CUG Index
CUG	Closed User Group
IA	Incoming Access
IC	Interlock Code
IC(pref)	Interlock code of the preferential CUG
IC+OA	Interlock Code and Outgoing Access indicator.
ICB	Incoming Calls Barred within the CUG
OA	Outgoing Access
OCB	Outgoing Calls Barred within the CUG
Pref CUG	Preferential CUG
SOA	Suppress OA
SPC	Suppress Preferential CUG

1 Closed user group (CUG)

The responsibilities of GSM network nodes with respect to CUG are described in the CUG handling clause. The Functions subclause 1.2.1 describes the CUG service logic and how CUG information is used. The flow of CUG information in various call cases is shown in the Information Flows subclause 1.2.2.

1.1 Handling of Closed User Group

A GSM PLMN supporting the CUG supplementary service must guarantee the integrity of any CUG which it handles. It is not however mandatory for a PLMN to support the CUG supplementary service.

A CUG is uniquely identified within a network by a CUG Interlock Code. The Interlock Code is transferred between terrestrial network entities to indicate a CUG call.

A user identifies a CUG by a CUG Index. A CUG Index is used to select or indicate the use of a specific CUG in relation to a call. The index is locally transferred between the mobile station and serving VLR and only has significance within the context of an individual subscription.

1.1.1 Mobile Originated (MO) CUG call handling

A CUG subscriber may invoke a CUG by providing the network with a CUG Index at call establishment. This is termed Explicit CUG invocation. Alternatively, if the subscription allows, some default characteristic of a CUG may be invoked automatically if no CUG information is provided. This is termed Implicit CUG invocation. The network may optionally indicate the use of an implicitly invoked CUG to the calling user.

A CUG subscriber may suppress certain CUG attributes by providing suppression indicators during call set-up. The provision of such suppression indicators results in explicit CUG invocation.

Any non-CUG related Call Barring supplementary service requirements shall be discharged before CUG authorisation occurs.

1.1.1.1 MO CUG call handling at the MSC

The MSC shall pass any user provided CUG information to the VLR at call establishment.

If an Interlock Code, or Interlock code with Outgoing Access indicator, is received from the VLR the MSC shall establish a CUG call with the destination network using this information. If a CUG Index is received from the VLR the MSC shall pass this to the calling MS.

If the CUG call authorisation is unsuccessful the MSC shall pass an indication to the mobile station.

1.1.1.2 MO CUG call handling at the VLR

Authorisation of a MO CUG call is performed by the serving VLR. Authorisation is determined by the information provided by the user, the subscription information stored in the VLR and the MO CUG call authorisation function, see Functions clause.

Successful authorisation may result in a normal MO call (call without CUG information transferred to the called party) or a MO CUG call (call with CUG information transferred to the called party).

When a CUG call is to be made the VLR passes CUG information to the MSC to be used in the call establishment. Note, the VLR may optionally pass a CUG Index to the MSC (to be passed to the calling user) to indicate that a CUG has been implicitly invoked. This parameter is not passed to the call destination.

In the case of a normal call, no CUG information is passed to the MSC and the call is established normally.

On authorisation failure the VLR shall reject the call providing a suitable indication to the serving MSC which is passed to the calling party.

1.1.2 Mobile Terminated (MT) CUG call handling

The terminating network is responsible for enforcing the integrity of a CUG related call. The terminating network must therefore ensure that the calling party attributes and the called party subscription meet CUG restrictions. The terminating network provides the called user with an indication of an incoming CUG call.

Non-CUG related Call Barring supplementary service requirements are discharged before CUG authorisations. Call forwarding requirements are discharged after CUG authorisations.

1.1.2.1 MT CUG handling at the GMSC

The GMSC shall pass any CUG information contained in an incoming call establishment message to the HLR in the routing enquiry.

The GMSC shall continue the call establishment using the CUG information received from the HLR rather than that which was initially received. Note, in rare circumstances the HLR may discard CUG parameters, see the Call Forwarding interaction.

If a CUG call fails the GMSC shall return an indication to the originating network.

1.1.2.2 MT CUG handling functions at the HLR

Authorisation of a MT CUG call is performed at the called parties HLR. Authorisation is determined by the information received in the call establishment signalling, the called party subscription information stored in the HLR, and the MT CUG call authorisation function, see Functions clause.

On successful authorisation, the HLR supplies the GMSC with CUG information for the continuation of the call establishment. On unsuccessful authorisations the HLR rejects the call supplying an indication of the reason for failure.

1.1.2.3 MT CUG handling functions at the MSC

The MSC shall pass any CUG related information received in incoming call establishment signalling to the VLR.

If the VLR returns CUG information to the serving MSC in response, the MSC shall pass the information to the called party in the call set-up signalling.

If the CUG call is rejected by the VLR (due to the call forwarding interaction) the MSC shall return an indication to the originating network.

1.1.2.4 MT CUG handling functions at the VLR

When the VLR receives an incoming call enquiry for a CUG subscriber, it shall attempt to provide a CUG call indication to the called party. The indication is sent depending on the attributes of the incoming call and the called parties subscription, as shown in table 1.1. The indication is achieved by sending the CUG Index, associated with the Interlock Code of the invoked CUG, to the called user.

Table 1.1: CUG Index provision at terminating VLR

Calling Party CUG Information	Interlock check	Called party subscription				
		CUG subscriber				Normal subscriber
		No IA		IA		
		No ICB	ICB	No ICB	ICB	
Interlock	Match	Index	-	Index	-	-
	No Match	-		-		
Interlock + Outgoing Access	Match	Index	-	Index	No Index	No Index
	No Match	-		No Index		
No CUG Info.	-	-		No Index		No Index

NOTE: "-" = Not Applicable, this check is not performed since such calls are rejected by the called parties HLR.

1.1.3 CUG subscriber roaming requirements

Normal CUG restrictions apply to CUG subscribers when roaming in CUG supporting GSM PLMNs. Extra restrictions (specified in GSM 02.85) are applied to CUG subscribers roaming in non-CUG GSM VPLMNs to preserve the integrity of CUG.

These restrictions are applied by the application of call barring programmes which are not under user control. Such restrictions only apply to a subscribers ability to make outgoing calls using CUG related basic services. Extra restrictions are not applicable in the MT call case since the requirements are met by the HLR MT CUG authorisation function and by CUG interworking restrictions.

When a CUG subscriber first roams into a network not supporting CUG, the HLR will pass to the VLR subscription data indicating that normal Outgoing Call Barring is active for each basic service which is affected by CUG and for which the user has no CUG Outgoing Access.

The HLR shall store the status of the CUG related barring separately from the previous user controlled status and CUG related barring shall take precedence over the user controlled status.

The user may still perform SS operations on the user controlled Outgoing Call Barring services. The status of the barring service as a result of these operations will be stored in the HLR in the normal way, however the HLR will ensure that the VLR in the non-CUG network continues to have the CUG related call barring programs active as described above.

When entering a CUG supporting network the CUG related barring activations shall be removed and the user controlled barring status restored.

1.1.4 CUG interworking requirements

1.1.4.1 Non-CUG GSM PLMNs

If a GSM switching entity receives a CUG Interlock code in a call establishment message but does not support the CUG service, it shall abort the call, reason for rejection: Incompatible Destination. However if an Interlock and Outgoing Access indicator are received the call shall continue to be established as a normal call with no CUG information.

1.1.4.2 Interworking to Non-CUG networks

If a GSM switching entity is unable to interwork with a destination switching entity for a CUG call , it shall abort the call, reason for rejection: Incompatible Destination. However if the call was a CUG call indicating outgoing access the GSM switching entity shall attempt to establish the call as a normal call (no CUG information).

1.1.5 Supplementary service interactions

1.1.5.1 Interaction with Call Forwarding

The interaction between CUG and Call Forwarding services is specified in GSM 02.85. The interaction is applied after the calling and called party CUG call has been successfully authorised, and Call Forwarding has been invoked. The interaction is the same for all types of call forwarding.

In the case of Call Forward Unconditional and Call Forwarding on Mobile Subscriber Not Reachable (invoked at HLR), the interaction is applied at the forwarding parties HLR.

In the case of CFB, CFNRy, CFNRc (invoked at the serving VLR) the interaction is applied at the forwarding parties serving VLR.

Table 1.2 indicates the requirements on the forwarding node when CUG and call forwarding interact. In each case the resultant information sent to the relevant MSC (either gateway or serving MSC) is given. This information should be used by the MSC for the forwarding or rejection. Note that the CUG information for the forwarding part of the call may be different from that initially used. The interlock code used for forwarding is always that of the calling party.

Table 1.2: CUG-Call Forwarding interaction

<table>
<tr><td rowspan="4">Forwarded Party CUG Infor-mation</td><td rowspan="4">Interlock check</td><td colspan="4">Forwarding party subscription for BS</td></tr>
<tr><td colspan="3">CUG subscriber</td><td rowspan="3">Normal subscriber</td></tr>
<tr><td colspan="2">No OA</td><td colspan="2">OA</td></tr>
<tr><td>No OCB</td><td>OCB</td><td>No OCB</td><td>OCB</td></tr>
<tr><td>Interlock</td><td>Match</td><td>IC</td><td>Reject</td><td>IC</td><td>Reject</td><td>-</td></tr>
<tr><td rowspan="2">Interlock +Outgoing Access</td><td>Match</td><td>IC</td><td>Reject</td><td>IC+OA</td><td>Normal</td><td rowspan="2">Interlock + Outgoing Access</td></tr>
<tr><td>No Match</td><td colspan="2">Reject</td><td colspan="2">Interlock+OA</td></tr>
<tr><td>No CUG Info.</td><td>-</td><td colspan="2">Reject</td><td colspan="2">Normal call</td><td>Normal call</td></tr>
</table>

NOTE: "-" = Not applicable.
Reason for rejection in all cases:
Called party supplementary service interaction violation.

1.1.5.2 Interaction with call waiting

There is no interaction with call waiting, however a CUG call indication shall be provided with the call waiting indication if the criteria for indicating a CUG call are met.

1.2 Functions and information flows

1.2.1 Functions

The following Mobile Additional Functions (MAF) have been identified for the CUG supplementary service:

MAF14

Mobile Originated CUG call authorisation.

The ability of a PLMN to determine whether a subscriber is authorised to attempt the establishment of a call request related to CUG. See figure 1.1.

Location: VLR.

The purpose of this function is to check the provisioning of CUG against the requested Basic Service, perform an Index to Interlock conversion where an Index is provided, check whether O/G calls are barred within the CUG, deal with preferential CUGs, OA and any CUG related suppression indicators.

The call request may contain either no CUG information or combinations of the following CUG parameters: CUG Index, Suppress Outgoing Access indicator, Suppress Preferential CUG indicator.

On successful authorisation the call is established with one of the following: no CUG information, CUG Interlock Code, CUG Interlock Code and Outgoing Access indicator. If a CUG is implicitly invoked the VLR may optionally provide the related CUG Index as an indication to the calling user.

On unsuccessful authorisation the call is rejected and a rejection reason given.

Table 1.3 specifies the VLRs response to CUG related call establishment requests.

Table 1.3: MO CUG Call Authorisation Function (VLR)

Calling user subscrip. for Basic Service	Information provided by calling user				
	No CUG Info.	CUG Index (CI) or CI+SPC	Suppress OA (SOA)	Suppress Pref CUG (SPC)	CI+SOA or CI+ SOA+SPC
CUG without Pref CUG. No OA	Reject note 1	Interlock note 2,3,4	Reject note 1	Reject note 1	Interlock note 2,3,4
CUG with Pref CUG. No OA	IC(pref)	Interlock note 2,3,4	IC(pref)	Reject note 1	Interlock note 2,3,4
CUG with OA and without Pref CUG	Normal call	IC+OA note 3,4,5	Reject note 1	Normal call	Interlock note 2,3,4
CUG with Pref CUG and with OA	IC(pref) +OA	IC+OA note 3,4,5	IC(pref)	Normal call	Interlock note 2,3,4
Normal subscriber	Normal call	Normal call	Normal call	Normal call	Normal call

NOTE 1: "Inconsistent access information - no CUG selected".

NOTE 2: If the intra-CUG restriction option "Outgoing calls barred within the CUG" is applicable for the requested CUG, the call shall be rejected, reason for rejection "Outgoing calls barred within the CUG".

NOTE 3: If an index is provided which is not recognised by the network the call is rejected, reason for rejection "Unknown CUG Index".

NOTE 4: If an index is provided which does not match with the interlock(s) of the requested basic service the call is rejected, reason for rejection "Inconsistent access information - Index incompatible with requested basic service".

NOTE 5: If a CUG is selected using a CUG Index but the intra-CUG restriction option "Outgoing calls barred within the CUG" is applicable, and the calling user subscription includes OA for the requested Basic Service the call shall be attempted as a normal call with no CUG information included in the call establishment signalling.

An SDL indicating when the authorisation function is invoked in the VLR is shown in figure 1.1. Inputs and outputs to the SDL apply to the serving MSC.

MAF15

Mobile Terminated CUG call authorisation.

The ability of a PLMN to compare received calling party information against a called party subscription for CUG integrity. See figure 1.2.

Location: HLR.

The purpose of this function is to identify a match between calling and called party CUG attributes for a given basic service, whilst enforcing intra-CUG communication restrictions. If no match is obtained the call is rejected.

The calling party CUG attributes may be either a CUG Interlock Code or a CUG Interlock Code and Outgoing Access indicator.

Table 1.4 indicates the HLRs response to incoming CUG calls, or incoming calls to CUG subscribers.

On successful authorisation the call establishment is continued using one of the following: no CUG information, CUG Interlock Code, Interlock Code and Outgoing Access indicator.

On unsuccessful authorisation the call is rejected and a rejection reason given.

Table 1.4: MT CUG Call Authorisation Function (HLR)

<table>
<tr><td rowspan="3">Calling Party CUG Infor-mation</td><td rowspan="3">Inter-lock check</td><td colspan="4">Called party subscription for Basic Service</td></tr>
<tr><td colspan="4">CUG subscriber</td><td rowspan="2">Normal subs.</td></tr>
<tr><td colspan="2">No IA</td><td colspan="2">IA</td></tr>
<tr><td>No ICB</td><td>ICB</td><td>No ICB</td><td>ICB</td><td></td></tr>
<tr><td rowspan="2">Interlock Code (IC)</td><td>Match</td><td>Interlock Code</td><td>Reject note 1</td><td>Interlock Code</td><td>Reject note 1</td><td>Reject</td></tr>
<tr><td>No Match</td><td colspan="2">Reject note 2</td><td colspan="2">Reject note 2</td><td>note 2</td></tr>
<tr><td rowspan="2">Interlock +Outgoing Access (IC+OA)</td><td>Match</td><td>IC+OA</td><td>Reject note 1</td><td>IC+OA</td><td>IC+OA</td><td rowspan="2">IC+OA</td></tr>
<tr><td>No Match</td><td colspan="2">Reject note 2</td><td colspan="2">IC+OA</td></tr>
<tr><td>No CUG Info.</td><td>-</td><td colspan="2">Reject note 3 and 4</td><td colspan="2">Normal call</td><td>Normal call</td></tr>
</table>

Notes on reasons for rejections:

NOTE 1: "Incoming calls barred within the CUG".

NOTE 2: "Interlock mismatch".

NOTE 3: "Requested basic service violates CUG constraints" A non-CUG call has invoked (via a particular basic service) a CUG which does not have an Incoming Access capability.

NOTE 4: See subclause 1.6.

An SDL indicating when the function is invoked in the HLR is shown in figure 1.2. Inputs and outputs to the SDL apply to the GMSC.

1.2.2 Information flows

The information flows for the CUG supplementary service are shown in figures 1.3 to 1.7.

List of figures:

- figure 1.3 Mobile Originated CUG calls;
- figure 1.4 Mobile Terminated CUG calls;

- figure 1.5 MT CUG call handling at the called party MSC/VLR;
- figure 1.6 Interworking with Non-ISDN/Non-GSM networks;
- figure 1.7 CUG interworking with Non-CUG GSM PLMN.

NOTE to figures 1.3 to 1.7:
"Conditional CUG Info" means that CUG information may or may not be present in the signalling message depending on the call case. These figures are intended to cover all call cases described in the CUG authorisation functions.

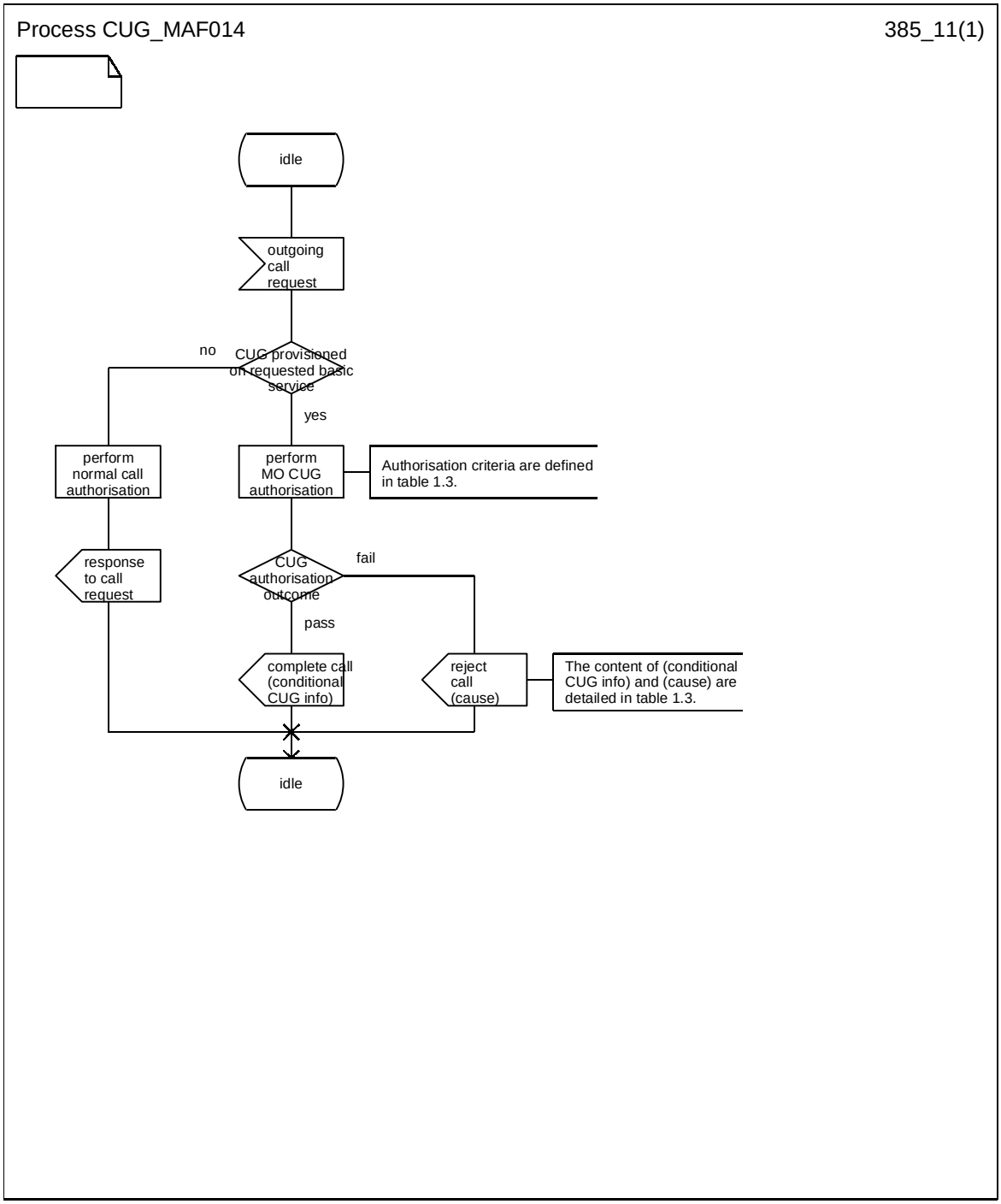


Figure 1.1: MAF014 Mobile Originated CUG call authorisation (VLR)

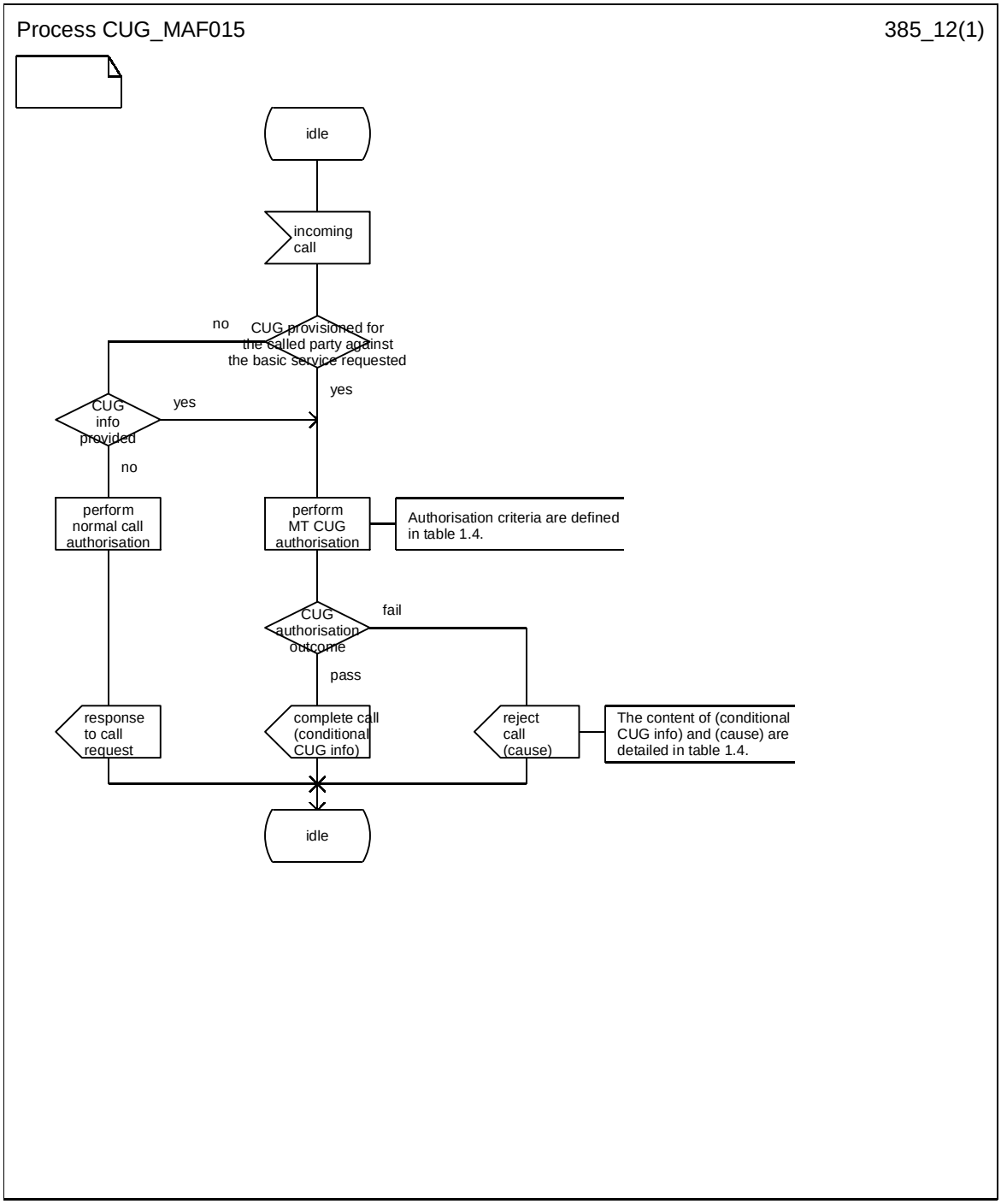
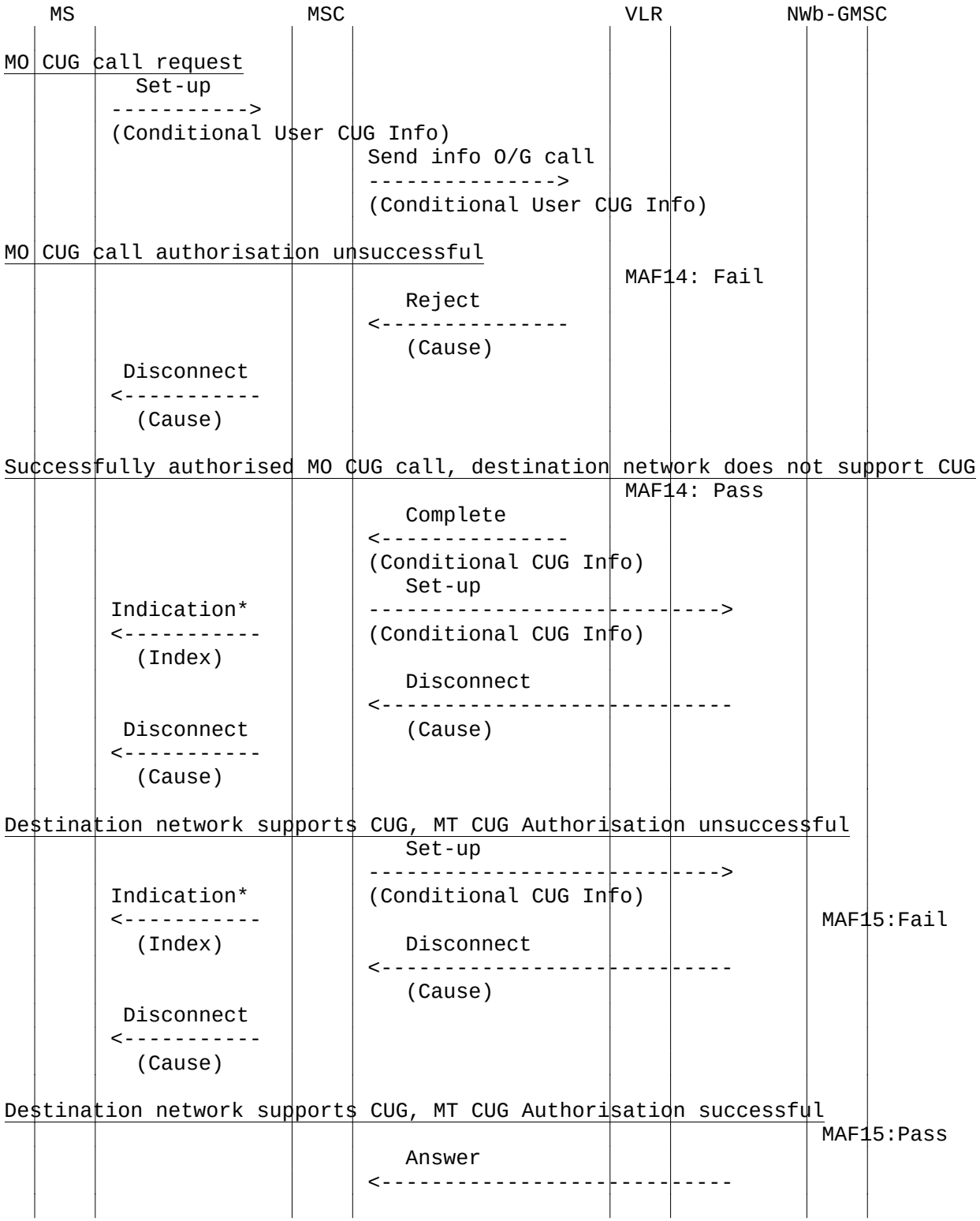
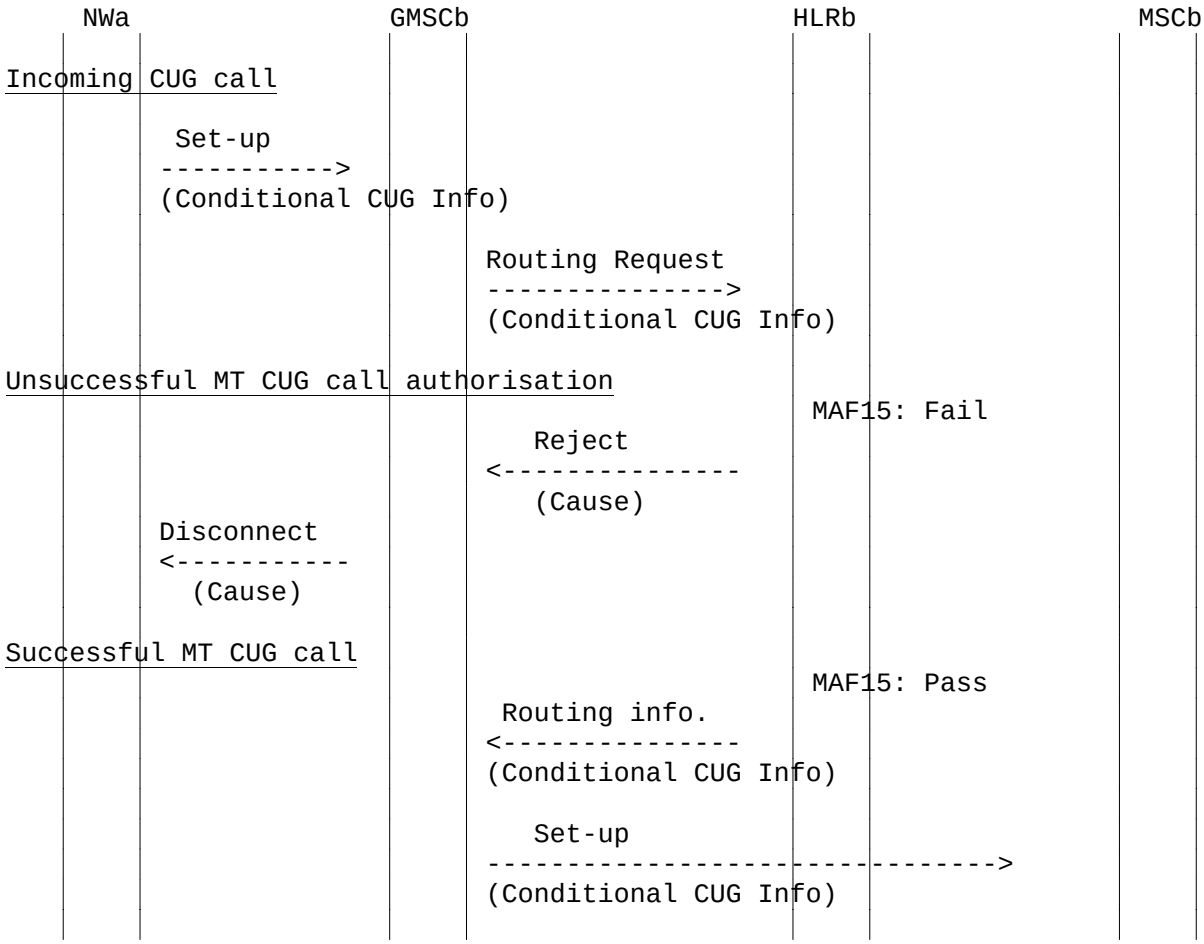


Figure 1.2: MAF015 Mobile Terminated CUG call authorisation (HLR)



NOTE: MAF14: MO CUG call Authorisation
MAF15: MT CUG call Authorisation
*: Optional message

Figure 1.3: Mobile Originated CUG calls



NOTE: MAF15: MT CUG call authorisation.

Figure 1.4: Mobile Terminated CUG calls

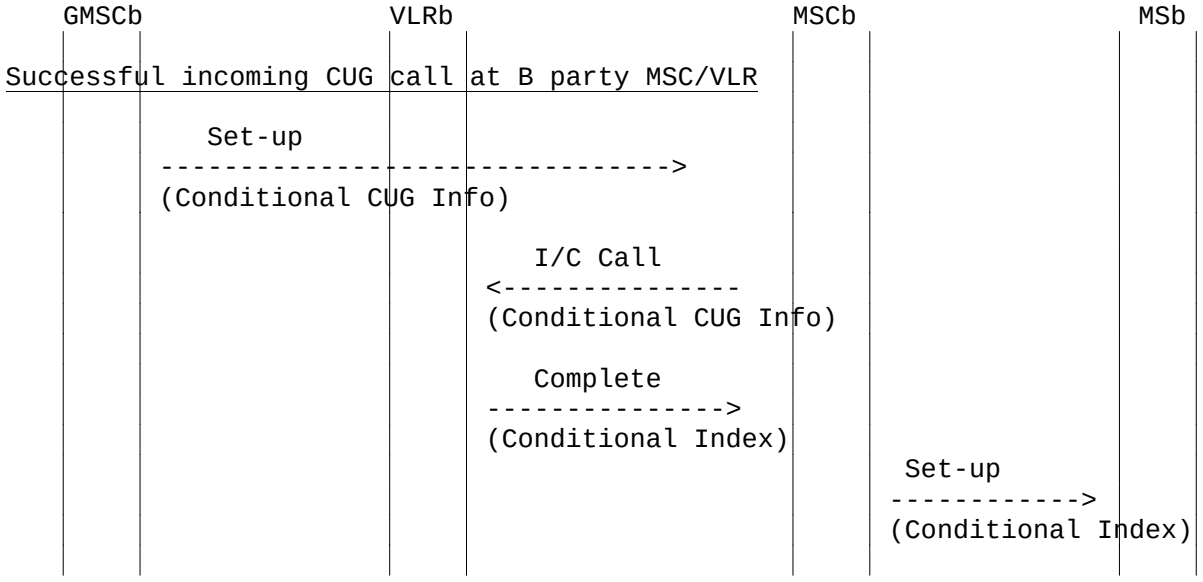
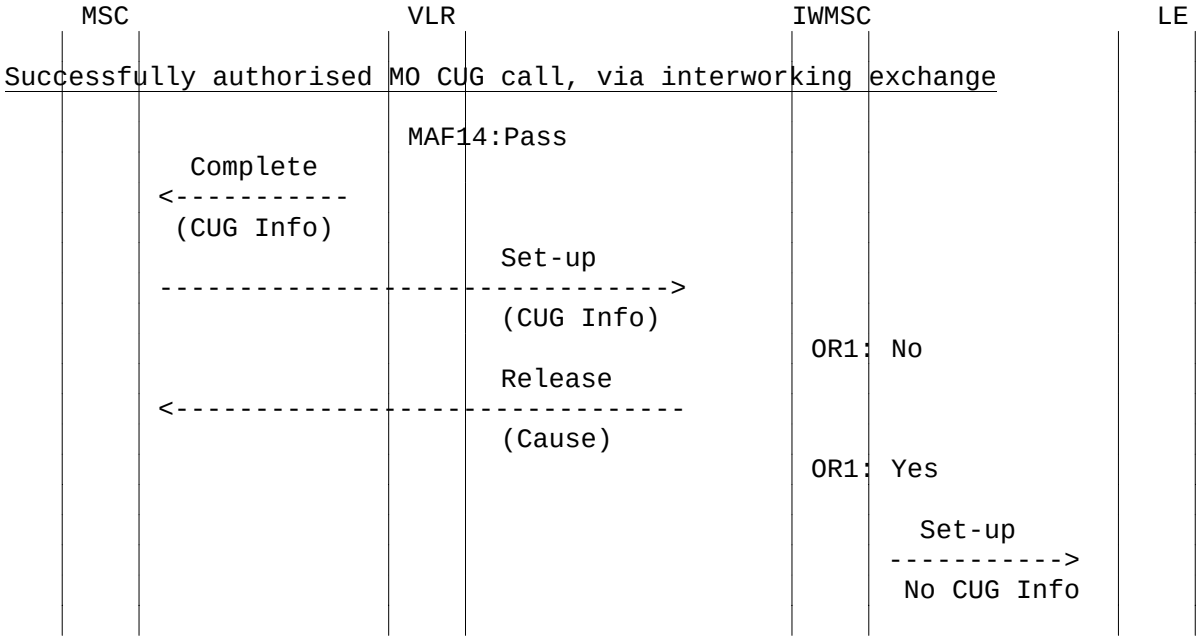
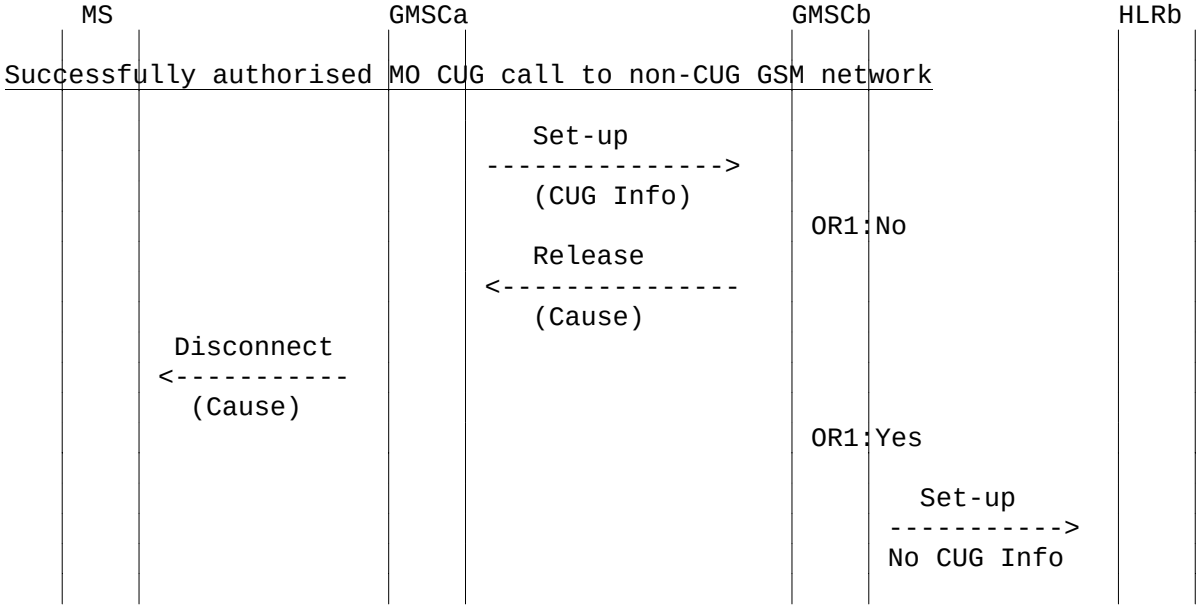


Figure 1.5: MT CUG call handling at called party MSC/VLR



NOTE: MAF14: MO CUG call Authorisation
OR1: CUG Info = IC+OA

Figure 1.6: Interworking with Non-ISDN/Non-GSM networks



NOTE: OR1: CUG Info = IC+OA

Figure 1.7: CUG Interworking with Non-CUG GSM PLMN

1.3 Information stored in the HLR

For the supplementary service Closed User Group the HLR shall store:

- per subscription (IMSI) a list of CUG Interlock codes up to a maximum specified in GSM 02.85.

Against each Interlock code the following parameters shall be stored:

- CUG Index;
- Intra-CUG restrictions;

  which may take one of the following values:

  - None;
  - Incoming calls barred within the CUG;
  - Outgoing calls barred within the CUG.
- Application to basic services;

  which may take one of the following types of value:

  - List of Basic Services Groups for which the CUG applies;
  - All basic services.

Against each Basic Service Group which is subject to CUG, the following shall be stored:

- Inter-CUG accessibility;

  which may take one of the following values:

  - None designated;
  - Outgoing Access;
  - Incoming Access;
  - Outgoing and Incoming Access.
- Preferential CUG;

  which may take one of the following types of value:

  - CUG Index;
  - None designated.

1.4 Information stored in the VLR

For the supplementary service Closed User Group the VLR shall store:

- per subscription (IMSI) a list of CUG Interlock codes up to a maximum specified in GSM 02.85.

Against each Interlock code the following parameters shall be stored:

- CUG Index;
- Intra-CUG restrictions;

  which may take one of the following values:

  - None;
  - Incoming calls barred within the CUG;
  - Outgoing calls barred within the CUG.
- Application to basic services;

  which may take one of the following types of value:

  - List of Basic Services Groups for which the CUG applies;
  - All basic services.

Against each Basic Service Group which is subject to CUG, the following shall be stored:

- Inter-CUG accessibility;

  which may take one of the following values:

  - None designated;
  - Outgoing Access;
  - Incoming Access;
  - Outgoing and Incoming Access.
- Preferential CUG;

  which may take one of the following types of value:

  - CUG Index;
  - None designated.

1.5 Handover

Handover will have no impact on the control procedures and operation of the service.

1.6 Cross phase compatibility

1.6.1 MSC, VLR only support phase 1

See subclause 1.1.3 "CUG subscriber roaming requirements".

1.6.2 GMSC only supports phase 1

When a routing request according to MAP phase 1 from GMSC (no CUG info) is received in the HLR and the called party does not have Incoming Access capability the HLR shall reject the routing request with the error "Call barred" instead the error "CUG-Reject".

NOTE: The error "CUG-Reject" is not available in the MAP phase 1 protocol.

Annex A (informative): Change history

Change history								
TSG CN#	**Spec**	**Old Ver**	**CR**	**Rev**	**Phase**	**Cat**	**New Ver**	**Subject/Comment**
Apr 1999	GSM 03.85	6.0.0			R97			Transferred to 3GPP CN1
CN#03	23.085				R99		3.0.0	Approved at CN#03
	23.085	3.0.0			R99		3.0.1	References updated from 2G to 3G
CN#09	23.085	3.0.1	001	1	R99	F	3.1.0	SDL refresh

History

Document history		
V3.0.0	January 2000	Publication
V3.1.0	October 2000	Publication