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## **Digital cellular telecommunications system (Phase 2+); Voice Group Call Service (VGCS) - Stage 2 (GSM 03.68)**

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## Foreword

This Global System for Mobile communications Technical Specification (GTS) has been produced by the Special Mobile Group (SMG) Technical Committee (TC) of the European Telecommunications Standards Institute (ETSI).

This specification defines the stage 2 description of the Voice Group Call Service (VGCS) within the digital cellular telecommunications system (Phase 2/Phase 2+).

GSM technical specifications are produced by TC-SMG to enable the GSM Phase 2+ specifications to become publicly available, prior to submission for the formal ETSI standards approval procedure to become European Telecommunications Standards (ETS). This ensures the earliest possible access to GSM Phase 2+ specifications for all Manufacturers, Network operators and implementors of the Global System for Mobile communications.

The contents of this GTS are subject to continuing work within TC-SMG and may change following formal TC-SMG approval. Should TC-SMG modify the contents of this GTS it will then be republished by ETSI with an identifying change of release date and an increase in version number as follows:

Version 5.x.y

where:

- y     the third digit is incremented when editorial only changes have been incorporated in the specification;
  
- x     the second digit is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

Reference is made within this GTS to GSM-TSs (note).

NOTE:     TC-SMG has produced documents which give the technical specifications for the implementation of the digital cellular telecommunications system. Historically, these documents have been identified as GSM Technical Specifications (GSM-TSs). These TSs may have subsequently become I-ETSs (Phase 1), or ETSS/ETSI Technical Reports (ETRs) (Phase 2). TC-SMG has also produced ETSI GSM TSs which give the technical specifications for the implementation of Phase 2+ enhancements of the digital cellular telecommunications system. These version 5.x.x GSM Technical Specifications may be referred to as GTSS.

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## 1 Scope

This Global System for Mobile communications Technical Specification (GTS) specifies the stage two description of the voice group call service (VGCS) which allows speech conversation of a predefined group of service subscribers in half duplex mode on the radio link taking into account multiple subscribers involved in the group call per cell.

## 2 Normative references

This specification incorporates by dated and undated references, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this specification only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- [1] GSM 01.04 (ETR 100): "European digital cellular telecommunications system (Phase 2); Abbreviations and acronyms".
- [2] GSM 02.68: "Digital cellular telecommunications system (Phase 2+); Voice Group Call Service (VGCS) - stage 1".
- [3] GSM 03.22 (ETS 300 535): "European digital cellular telecommunications system (Phase 2); Functions related to Mobile Station (MS) in idle mode".
- [4] GSM 03.67: "Digital cellular telecommunications system (Phase 2+); enhanced Multi-Level Precedence and Pre-emption service (eMLPP) - Stage 2".
- [5] GSM 04.08 (ETS 300 557): "European digital cellular telecommunications system (Phase 2); Mobile radio interface layer 3 specification".
- [6] GSM 05.08 (ETS 300 578): "European digital cellular telecommunications system (Phase 2); Radio subsystem link control".
- [7] GSM 08.08 (ETS 300 590): "European digital cellular telecommunications system (Phase 2); Mobile Switching Centre - Base Station System (MSC - BSS) interface Layer 3 specification".
- [8] CCITT Recommendation E.164: "Numbering plan for the ISDN era".

### 3 Definitions and abbreviations

#### 3.1 Definitions

Definitions used in this specification are also defined in GSM 02.68.

**voice group call channel:** Combined uplink/downlink to be allocated in a cell of the group call area for a particular voice group call. The uplink can be used by the presently talking service subscriber only. All mobile stations of the listening service subscribers in one cell shall listen to the common downlink.

**group members:** Service subscribers entitled to belong to a particular group classified by a certain group identification (group ID).

**voice group call member:** Any group member or dispatcher participating in an on going voice group call.

**group call attributes:** Group call area, dispatcher identities, acknowledgement destinations applying to a voice group call and the non-activity time which results in the release of the voice group call by the network.

**Group Call Register (GCR):** A functionality in the network containing the group call attributes.

**group call anchor MSC:** The MSC responsible for managing and maintaining a particular voice group call. The group call anchor MSC is determined as the one controlling the cells of the group call area. For voice group call services where the group call area exceeds one MSC area, the group call anchor MSC is predefined in the network.

**group call relay MSC:** MSC controlling cells of a group call area which are not under control of the group call anchor MSC for those voice group call services where the group call area exceeds one MSC area.

**notification:** Notifications are given on common control channels or dedicated channels in order to inform group members which are either in idle mode or in dedicated mode or participating in a voice group call or voice broadcast call on the existence of voice group calls.

**Notification Channel (NCH):** Common control channel on which the notifications are sent by the network (equivalent to a paging channel).

#### 3.2 Abbreviations

Abbreviations used in this specification are also listed in GSM 01.04 [1].

For the purpose of this specification the following abbreviations apply:

|       |   |
|-------|---|
| eMLPP | enhanced Multi-Level Precedence and Pre-emption |
| GCR:  | Group Call Register                             |
| NCH:  | Notification Channel                            |
| VBS:  | Voice Broadcast Service                         |
| VGCS: | Voice Group Call Service                        |



## **4 Main concepts**

### **4.1 Group definition**

Service subscribers can become group members on a PLMN wide basis to one or more groups pre-defined in the network by a corresponding group identification (group ID). The membership enables them to initiate or receive voice group calls associated with that group ID. Certain dispatchers connected to external networks also require the capability to initiate or receive voice group calls.

In addition to subscriber details in the HLR, it is necessary for the mobile station to be aware of its group membership by storing details on the SIM. This is required because it shall respond to notification messages which include only the group ID (i.e. no IMSI or TMSI details).

Having become a group member, each service subscriber can set to active state or deactive state the group ID or any one out of his several group IDs on the SIM. In active state the subscriber can initiate voice group calls to that group. When in deactive state the subscriber can not make voice group calls to the group and the mobile station ignores any notification for that group.

### **4.2 Group conversations**

#### **4.2.1 Group call initiation**

##### **4.2.1.1 Normal operation with successful outcome**

A group call area can be restricted to a single MSC area or can exceed one MSC area (implementation option).

A voice group call shall be initiated by a calling subscriber by a related MMI action for the service selection and the group ID dialled.

The MSC in which a voice group call is initiated obtains (by requesting the Group Call Register (GCR, see clause 5) the group call attributes.

When a calling subscriber initiates a voice group call, one voice group call channel shall be established in each cell of the group call area and notifications for that call shall be sent in each of these cells. As an alternative, voice group call channels may only be established in cells in reaction to responses received from mobile stations on the notifications. At the same time standard connections to dispatchers in the mobile network or in an external network shall be established.

A voice group call channel shall consist of a combined uplink/downlink. The uplink will be used exclusively by the presently talking service subscriber. All mobile stations of the listening service subscribers in one cell shall only listen to the same common downlink.

The calling subscriber shall have its dedicated standard uplink/downlink during call establishment and for the first period when he will be the talking service subscriber up to the time when the network decides that he shall join the voice group call channel. The mobile station of the calling subscriber shall then go to the voice group call channel and the dedicated standard uplink/downlink shall be released. From that moment on the calling subscriber shall be treated as all the other services subscribers.

Only one voice group call channel shall be established in each cell for any given voice group call, although there may be a number of simultaneous voice group calls within the same cell.

Service subscribers shall be notified on the voice group call in each cell. These voice group call notification messages shall be broadcast on the notification channel (NCH).

The notification messages use the group ID rather than individual TMSIs/IMSI. Additionally, a group call area identification shall be included in order to enable a resolution in the case of overlapping group call areas. A service subscriber's mobile station needs to be able to recognise notification messages for those group IDs subscribed to and presently activated.

As a network option, messages are also sent on appropriate voice group call channel SACCHs or FACCHs, in order to notify group call members who may participate in other voice group calls. In addition, also paging information messages for standard calls may be sent in order to inform group call members on actually paged point-to-point calls.

As a further network option, notification on the voice group call shall be provided to service subscribers which have subscribed to the paged group ID and which are in dedicated mode.

The ability to react on these notification and paging information messages which are provided into on-going calls shall be a mobile station option. It shall be indicated to the mobile stations by the network if the notification and paging information on the group call channel SACCH or FACCH is provided.

The process of broadcasting messages on NCHs and appropriate SACCHs or FACCHs is to be carried out throughout the call in order to provide the "late entry" facility whereby group members entering the area can join the call.

On receiving details of a voice group call a group call member's mobile station which is in idle mode shall adjust to the nominated channel if this channel was described in the notification message and receive the information on the downlink. Whilst receiving, the mobile station shall not transmit on the uplink SACCH. This group receive mode is different to the normal idle mode or dedicated mode. If no channel description was provided in the notification message, the mobile station shall establish a dedicated connection in order to respond to the notification. The network may then provide the mobile station with a channel description for the voice group call.

#### **4.2.1.2 Exceptional procedures**

Completion of links into congested cells where pre-emption did not occur is required.

If the cell in which the calling service subscriber is located will be reset, the voice group call shall be released as long as the calling service subscriber has a dedicated link. After this instance the voice group call shall be maintained.

On receiving details of a voice group call the user may choose to move to the notified call or the mobile station may automatically move to the notified call if the new call is of higher priority than the existing call and automatic acceptance applies for this priority level.

#### **4.2.2 On-going group calls**

##### **4.2.2.1 Normal operation with successful outcome**

Within each voice group call starting from the instant where the calling subscriber first becomes a listening service subscriber, one service subscriber has the access at any one time to the uplink of the voice group call channel and his speech is then broadcast on all voice group call channel downlinks accordingly. The mobile station of the talking service subscriber shall mute the downlink speech to avoid non intelligible echos.

If more than one service subscriber apply to the uplink, contention resolution shall be performed in the network. Contention resolution shall be performed in the group call anchor MSC.

Additionally, in order to speed up the uplink access procedure, the BSS may grant the uplink prior to contention resolution being performed by the group call anchor MSC. This would mean that more than one service subscriber may access to the uplink and the respective speech may be combined in the group call bridge and broadcast onto all voice group call downlink channels during a transitional period. The anchor MSC shall then select one of the talking subscribers and pre-empt the uplink use of the other talking subscribers.

Dispatchers involved shall be broadcast on the voice group call channel downlink at any time. Mobile dispatchers are provided with a standard link and thus with an dedicated permanent uplink different from the voice group call channel.

All non-dispatcher group call members are provided with an indication on the voice group call channel of whether the uplink is in use. When the uplink is not in use, any non-dispatcher group call member can request access to the uplink. Any speech from dispatchers is combined with any speech from a talking service subscriber.

In case of one talking service subscriber plus a parallel talking dispatcher, the talking service subscriber's mobile station shall receive an indication by means of signalling from the network so that it can unmute the downlink.

The release of the uplink is triggered by the user and indicated by the mobile station to the network. The network shall then indicate to the listening mobile stations that the uplink is free.

As an implementation option, information shall be broadcast on the voice group call SACCH concerning the voice group call channel details in neighbour cells. Mobile stations in group receive mode use a version of the standard idle mode procedures to "camp-on" to the group call channel in a new cell. If this information on the neighbouring cells is not provided at all or only provided for cells in the same BSC area, the mobile station may find the voice group call channel details of a new cell on the related NCH.

A network may decide not to establish voice group call channels in all cells. Instead, notifications containing no channel description may be provided. If a mobile station moves to such a cell, it must respond to the notification in order to receive the voice group call. The network may then establish a voice group call channel and inform the mobile station on the channel position.

A network may obtain knowledge on whether mobile stations are listening in a cell by sending an uplink access request on the voice group call channel downlink when no talking service subscriber is present. Mobile stations receiving such a request shall send uplink access bursts on the voice group call channel uplink with the establishment cause 'reply on uplink access request'. If no uplink access bursts are received by the network, the network may decide to release the voice group call channel in that cell and then provide notifications containing no channel description.

NOTE: Concerning security aspects, whilst authentication and membership checking of mobile call originators and of mobile uplink users can be carried out, it is not possible to authenticate service subscribers in group receive mode if they have not before established a dedicated connection to responded to a notification. No equivalent of a group "TMSI" is provided to protect the "identity" of established voice group calls.

#### **4.2.2.2 Exceptional procedures**

When a talking subscriber's mobile station loses contact with the network, the network must detect this loss and set the uplink free so that other mobile stations may access the uplink. The talking subscriber's mobile station which has lost the contact with the network shall return immediately to the group receive mode.

If a mobile station in group receive mode indicates a failure due to radio link time-out, the mobile station shall behave as specified in GSM 05.08 and go back to idle mode, possibly in another cell, as determined by the cell re-selection algorithm. If a notification is received for the same call, the mobile station shall try to reconnect.

#### **4.2.3 Leaving of a group call without termination**

A service subscriber can leave the voice group call at any point by "deselecting" it via an MMI function. Having deselected the voice group call the mobile station returns to idle mode and "ignores" any further notification messages related to that voice group call.

[Remark: If a service subscriber does not wish to participate in calls to a particular group ID for long periods of time, the group ID shall be switched to deactive state by the subscriber.]

The service subscriber shall have the capability to reselect the voice group call. The mobile station shall not ignore notification messages to that call any more.

The dispatcher shall be able to leave a voice group call without terminating it.

#### 4.2.4 Group call termination

A voice group call can only be terminated by the calling subscriber or by an entitled dispatcher due to no activity timer expiry (see subclause 8.1.3).

The calling subscriber can terminate the call only if the calling subscriber has access to the uplink. He shall remain the calling subscriber during the length of the particular voice group call even if he leaves the call and then returns to it later.

The dispatcher can terminate the call by a network defined user operation (e.g. via DTMF).

#### 4.2.5 Acknowledgements

The acknowledgement is an application option.

For voice group calls which are identified by an acknowledgement flag in the notification message mobile stations which have acknowledgement facilities are informed that they have to return an acknowledgement message with a predefined content in a predefined manner.

The flag is set on basis of the GCR data.

The acknowledgement shall be sent using an appropriate data service, to a predefined address or with a predefined short code stored on the SIM card. The network may apply geographical routing to a predefined acknowledgement service centre.

#### 4.2.6 Transactions between the mobile station and the network

Mobile stations which are in group receive mode shall not perform any transactions with the network while adjusted to the voice group call channel. They shall leave the group receive mode and act in a standard way to perform any transaction if necessary and return to the voice group call afterwards.

Mobile stations which have access to the voice group call channel uplink shall not perform any transactions for supplementary services and SMS. [Other features such as DTMF are under discussion.]

## 5 General architecture

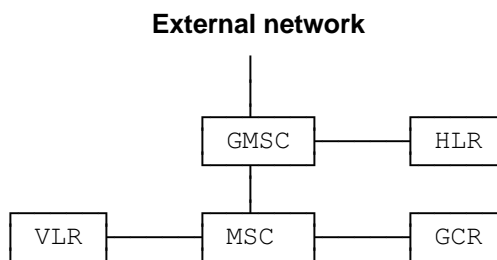
### 5.1 Group Call Register (GCR)

The general architecture of GSM is maintained. In addition, a network function is required which is used for registration of the group call attributes, the Group Call Register (GCR).

The GCR function is mainly a database function, holding information about voice group calls.

NOTE 1: The GCR implementation is not specified. It may be realized e.g. as a new network node, in a PABX directly attached to an MSC, inside an MSC or as an HLR. The interface between the GCR function and other functions is not specified in the GSM technical specifications. As a consequence, the functional split between MSC and GCR as developed in this document is only indicative, and other functional splits can be implemented.

The GCR data for a specific voice group call is set at the creation of the group call attributes, and can be subsequently modified. No support for these functions is specified in the GSM technical specifications.



**Figure 1: Functional architecture with a Group Call Register**

The signalling between the entities shown in figure 1, for the two cases of service subscriber and dispatcher originated calls, shall be as defined in the following.

**Service subscriber originated:** The MSC containing the cell within which this voice group call is initiated shall perform subscription checking against VLR records. It shall then consult its GCR to determine the group call attributes related to its MSC area and whether it is the group call anchor MSC for that voice group call. If it is not, the GCR shall provide with the group call attributes the routing information identifying the group call anchor MSC to the originating MSC. The originating MSC shall then route the voice group call to the anchor MSC. If the originating MSC is the group call anchor MSC, along with the group call attributes, the GCR shall provide information on all group call relay MSCs to be involved.

The group call anchor MSC shall set up links to all group call relay MSCs. Each MSC involved in a voice group call obtains its proper group call attributes from the GCR related to the MSC.

The IMSI of the calling service subscriber must be provided to and stored in the anchor MSC in order to allow the originator to clear the group call later on.

**Dispatcher originated:** In the case of dispatchers calling from an external network, the call request, in the form of an ISDN number, shall be received at a GMSC. The number shall be passed to the appropriate HLR, which shall pass the corresponding MSRN back to the GMSC referring to the group call anchor MSC for the call. Alternatively, the call request can be directly routed to the group call anchor MSC by the GMSC based on the called identity without requesting an HLR. The group call anchor MSC shall interrogate the GCR and obtain the group call attributes. If an identical voice group call is currently in progress, the dispatcher shall be connected to this call and no new call shall be initiated. When interrogating the GCR, the identity of the dispatcher is compared with the list of dispatchers to which a dedicated link is to be established. If the dispatcher is not in the list, or an identity is not provided, the network shall reject the call.

NOTE 2: Optionally dispatchers may also be user of the GSM network in which the VGCS service is provided or may directly be connected to a PABX containing the GCR. Dispatcher which are registered for a certain voice group call and which have also a subscription for VGCS with the same group ID as the voice group call for which they are dispatcher shall deactivate this group ID when they are located in the corresponding group call area in order to avoid conflicts between paging for the dispatcher and notifications for the group ID.

## 5.2 Voice group call responsibility

The MSC responsible for the voice group call is the one nominated within the GCR or the one to which the call is routed from the GMSC in the case of a dispatcher originated call. This MSC is termed the group call anchor MSC.

If the group call area extends beyond one MSC area then any MSCs controlling cells in the area outside of the group call anchor MSC are referred to as group call relay MSCs.

## 6 Compatibility issues

VGCS can not be used with standard phase 1 or phase 2 mobile stations. A dedicated mobile station with VGCS capability is required.

A mobile station with VGCS capability shall also provide the complete functionality in order to allow the use of phase 2 services.

Standard phase 1 and phase 2 mobile stations in a network shall not be impacted by the presence of VGCS services in that network due to VGCS signalling, also if the mobile station is operated with a SIM of a VGCS service subscriber.

## 7 Transmission

### 7.1 Transmission architecture

A conference bridge is required to connect the transmission paths of the nominated cells. The bridge is to be located within the group call anchor MSC. The group call anchor MSC is responsible for setting up all connections, both to the nominated cells (voice group call channels) in the group call anchor MSC and in any related group call relay MSC, and to the dispatchers. There shall be one link for every cell within the group call relay MSC which is involved in the voice group call, i.e. there shall be no secondary bridges in BSCs or group call relay MSCs.

NOTE 1: The conference bridge shall not mute the uplink speech.

NOTE 2: As GSM phase2+ evolves, distribution functions may be realised in the BSC or in the group call relay MSC which allow a more efficient use of the network resources.

VAD is required on each of the dispatcher connections into the conference bridge. If any activity is detected, the downlink muting flag on the SACCH shall be lifted if the uplink is currently busy, and uplink busy indications shall be provided if the uplink was free.

### 7.2 Radio channels

In each cell of the group call area one voice group call channel may be established consisting of a downlink received by all service subscriber's mobile stations and an uplink which shall be used by the talking subscriber's mobile station only.

The calling subscriber's mobile station shall use a dedicated standard uplink/downlink which is connected to the conference bridge up to the instant where the network decides that the mobile station shall join the voice group call channel and the dedicated connection is released.

The network may decide to switch a talking subscriber's mobile station from the voice group call channel to a dedicated standard uplink/downlink at any time. This dedicated connection shall then be maintained up to the instance where the network decides that the mobile station shall join the voice group call channel again and the dedicated connection is released.

A listening subscriber's mobile station which responds to a notification because no description of the voice group call channel was provided in the notification may be assigned a dedicated standard uplink/downlink which is connected to the conference bridge up to the instant where the network decides that the mobile station shall join the voice group call channel and the dedicated connection is released.

Voice group call channels shall be standard full rate or half rate speech channels. A specific voice group call can have cells in the group call area where the voice group call channels are either only half rate speech or only full rate speech or there are cells with half rate speech and cells with full rate speech. Those implementations are optional for the network operator.

Mobile station using the uplink are in group transmit mode. Signalling for this RR mode is specified in GSM 04.08. Mobile stations not using the uplink and not in dedicated mode shall ignore any signalling concerned only with uplink usage.

Full standard duplex channels shall be provided to all dispatchers listed in the GCR. These may be provided either via GSM, or via an external network. The links to the dispatchers are connected to the conference bridge.

The mobile station of the talking service subscriber will transmit on the uplink related to the downlink of the voice group call channel. The downlink of this channel which is also received by the mobile station using the uplink will typically echo the uplink unless one or more dispatchers are talking simultaneously. The mobile station of the talking service subscriber shall mute the downlink speech unless more than one speaker is talking. In this case, an indication shall be provided to the mobile station, and the mobile station shall no longer mute the downlink. When the downlink is not muted it is acceptable for the talking subscriber to hear an echo, and possibly other distortions which may occur, as the intention is to alert the talking subscriber to the fact that someone else is talking, rather than allow them to hear the message from the dispatcher. If no dispatcher is talking anymore and the talking service subscriber still has access to the uplink, an indication shall be provided to the mobile station, and the mobile station shall mute the downlink again.

### **7.3 Data confidentiality**

Data confidentiality on the radio can be provided as a network option.

If data confidentiality is provided, both the uplink and the downlink of the voice group call channels in each cell of the group call area shall be ciphered using the same group key.

The group key is related to the group ID. For each group ID, there is a number of group keys stored on the SIM which are identified by a group key number. The group key number identifying the group key to be used for a particular voice group call is provided with the notification to the mobile stations. Mobile stations which have a dedicated connection shall be informed of the group key number before they join the voice group call channel.

The distribution of the group keys to the related SIMs shall be done off-line.

NOTE: The distribution of group keys shall be done by the service provider when editing the SIM. Distribution of group keys via the air interface may be possible with future features as the SIM-toolkit. Those distribution schemes are for further study.

Details on data confidentiality for voice group calls are provided in GSM 02.09 and GSM 03.20.

## 8 Information storage

### 8.1 Information stored in the GCR

#### 8.1.1 Information used for routing of service subscriber originated voice group calls

The GCR shall hold for a related MSC area for each group ID and cell from which voice group calls can be established by service subscribers the group call reference to be used for a voice group call to be established and an indication whether the originating MSC is the group call anchor MSC.

If the originating MSC is the group call anchor MSC, the GCR shall provide the group call attributes related to that group call reference as defined in subclause 8.1.2 to the originating MSC and the originating MSC shall establish the voice group call.

If the originating MSC is not the anchor MSC, the GCR shall provide the group call reference plus the routing information identifying the anchor MSC to the originating MSC and the originating MSC shall route the voice group call to the anchor MSC.

NOTE: In case the GCR function is distributed over different physical entities, each may hold only the information needed to treat requests coming from the MSCs connected to the physical GCR entity.

#### 8.1.2 Group call attributes

Each MSC involved in a voice group call requests its proper group call attributes from its related GCR. For any group call reference the GCR shall provide the corresponding group call attributes to the requesting MSC. These lists shall be programmed by the service provider at registration of the network specific service configuration.

The contents of each list related to requests of the group call anchor MSC is as follows:

- a list of cells inside the MSC area of the group call anchor MSC into which the call is to be sent (part of the group call area), see subclause 8.1.2.1;
- a list of group call relay MSCs into which the call is to be sent;
- information on the cipher algorithm and the group key to be used for this voice group call;
- information on the codecs allowed for this voice group call;
- a list of identities of dispatchers to which a dedicated link is to be established, see subclause 8.1.2.2;
- a list of identities of dispatchers which are allowed to initiate the voice group call, see subclause 8.1.2.2;
- a list of identities of dispatchers which are allowed to terminate the voice group call, see subclause 8.1.2.2;
- the length of time over which no activity is detected before the voice group call is automatically terminated, see subclause 8.1.2.3;
- the default priority level related to the voice group call if eMLPP applies, see subclause 8.1.2.4;
- a status flag indicating if a voice group call with the related group call reference is on-going, see subclause 11.3.1.1.1;
- a flag indicating if acknowledgements are required for this voice group call.



The contents of each list related to requests of a group call relay MSC is as follows:

- A list of cells inside the MSC area of the requesting MSC into which the call is to be sent (part of the group call area), see subclause 8.1.2.1;

#### **8.1.2.1 Group call area**

The group call area is defined as a list of cells inside the network. The cells shall be defined by their cell identification consisting of the Location Area Code and the Cell Identity as defined in GSM 08.08 and are therefore uniquely identified in the network.

In the case the group call area extends over several MSCs, only the cells belonging to the requesting MSC are included in the group call attributes.

#### **8.1.2.2 Dispatcher identities**

Dispatcher identities shall be ISDN numbers or MSISDN numbers with the structure according to CCITT Recommendation E.164. They shall correspond both to the number to be used to establish a call toward the dispatcher and the number provided as calling line identification when the call is originated by a dispatcher.

The list of dispatcher identities is used by the anchor MSC to establish dedicated communication paths to each dispatcher and connect them to the conference bridge of the call.

The list of dispatcher identities which are allowed to initiate voice group calls is used by the anchor MSC for verification for a voice group call establishment by a dispatcher.

The list of dispatcher identities which are allowed to terminate voice group calls is used by the anchor MSC for verification for a voice group call release by a dispatcher.

#### **8.1.2.3 No activity time**

A timer in the MSC used to release the voice group call because of no activity can be set to a fixed value or can be set to a value defined for each voice group call.

The value of the timer in the MSC shall be started each time an uplink release has been indicated to the MSC and no voice activity is detected for a dispatcher line. It shall be reset each time an uplink access is indicated to the MSC or voice activity is detected for a dispatcher line.

When a variable timer is provided, there shall be sufficient timers such that one can be associated with each on-going group call. The corresponding time shall be stored in the GCR.

The length of the timer is not specified in the GSM technical specifications.

#### **8.1.2.4 Priorities**

If the eMLPP supplementary service is applied to a voice group call, the priority level shall be stored in the GCR. For further details see GSM 03.67.

## **8.2 Information managed per subscriber**

### **8.2.1 Stored in the HLR**

The following additional information shall be stored in the HLR:

- the subscription option for voice group calls which can be made in the HPLMN only or also in case of roaming;
- a list of all the group IDs a service subscriber is entitled to use.

The group IDs are defined in subclause 9.1.

A service subscriber shall not be provided with more than 50 group IDs.

### **8.2.2 Stored in the VLR**

The list of all the group IDs a service subscriber is entitled to use shall be brought forward to a VLR at the same time as other subscriber information is copied, and VLR entries shall be modified when corresponding HLR records are changed.

### **8.2.3 Stored in the SIM**

The information detailed in subclause 8.2.1 also needs to be stored on the SIM. The service subscriber shall be able to deactivate or reactivate a group ID by MMI interaction so that the mobile station does ignore notification messages to this group ID.

For each group ID where data confidentiality may be applied, the SIM needs to store the cipher algorithm to be used and the possible group keys.

## **8.3 Information used for routing of dispatcher originated voice group calls**

Routing of dispatcher originated calls shall be performed on the MSISDN number received at a GMSC in the Initial\_Address\_Message.

The GMSC may use one of the two alternative information to route the call request to the corresponding group call anchor MSC:

- The routing information may be provided by an HLR as for normal mobile terminated calls. The called party MSISDN number shall be passed to the appropriate HLR which shall pass the corresponding MSRN back to the GMSC referring to the group call anchor MSC for the call. The related IMSI shall include the group call reference as defined in subclause 9.2.

NOTE: Alternatively, the MSRN may be predefined in the HLR and in the group call anchor MSC with a fixed relation to a group call reference.

- The routing information may be provided in the routing table of the GMSC which directly routes the call request to the group call anchor MSC without requesting an HLR. In this case, the group call reference shall be included in the called MSISDN number as defined in subclause 9.2d.

## 9 Identities

### 9.1 Elementary identities for group calls

#### a) Group ID

The group ID shall be a binary number with a maximum value depending on the composition of the group call reference defined under c).

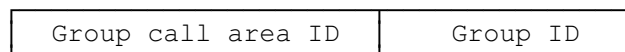
VGCS shall also be provided in case of roaming. If this applies, certain group IDs shall be defined as supra-PLMN group IDs which have to be co-ordinated between the network operators and which shall be known in the networks and in the SIM.

#### b) Group call area ID

The group call area ID shall be a binary number uniquely assigned to a group call area in one network and with a maximum value depending on the composition of the group call reference defined under c).

#### c) Group call reference

Each voice group call in one network is uniquely identified by its group call reference. The group call reference is composed of the group ID and the group call area ID. In the case where the routing of dispatcher originated calls is performed without the HLR (see subclause 8.3), the group call reference shall have a maximum length of 8 digits. The composition of the group call area ID and the group ID can be specific for each network operator.



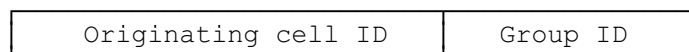
### 9.2 Use of identities in the network

For each voice group call the identifications as defined in the following shall be used within the network for the related purpose mentioned.

For voice group call services which are to operate in more than one PLMN, group identities have to be co-ordinated between the network operators involved.

#### a) Identities used for GCR requests for service subscriber originated voice group calls

In case of a service subscriber originated call, the identity of the call used by the MSC in which the call is originated to interrogate the GCR shall consist of the originating serving cell identity as defined in GSM 08.08 and the group ID as defined in subclause 9.1.



A service subscriber initiating a voice group call has to call the wanted group ID. The MSC in which the call is originated shall accumulate from the BSS the called group ID and the originating cell ID.

If the group call area exceeds one MSC area, the identity used to interrogate the GCR by an MSC in which the call was not originated shall consist of the group call reference as defined in subclause 9.1.

#### b) Identities used for GCR requests for dispatcher originated voice group calls

In case of dispatcher originated call the identity used by the MSC to interrogate the GCR shall consist of the group call reference as defined in subclause 9.1.

#### c) Identities used for notifications

Identities used for notification messages shall consist of the group call reference as defined in subclause 9.1.

**d) Identities used by dispatchers for voice group call establishment**

For dispatcher originated calls an MSISDN is dialled. The CC and NDC are used as normal for routing purposes. The numbering scheme is according to CCITT Recommendation E.164. The SN is used to indicate

- the request of a group call by use of a prefix. The length of the prefix shall be 1 to 2 digits [tbc];
- the wanted group call reference as defined in subclause 9.1 if the routing is performed by the GMSC without requesting an HLR.

|    |     |        |                      |
|----|-----|--------|----------------------|
| CC | NDC | Prefix | Group call reference |
|----|-----|--------|----------------------|

If the routing is performed by requesting an HLR, the MSISDN shall be translated within the HLR to an IMSI where the MCC and MNC are set as for normal GSM calls and the MSIN contains the prefix plus the group call reference.

|     |     |        |                      |
|-----|-----|--------|----------------------|
| MCC | MNC | Prefix | Group call reference |
|-----|-----|--------|----------------------|

**e) Identities used for VLR requests for service subscriber originated group calls**

The group ID shall be used on the B-Interface for VLR requests.

**10 Operation and maintenance aspects**

NOTE: A list and short description of the operation and maintenance aspects will be given. This includes the options and parameters which can be set by the operator.

- handling of timers
- registration aspects etc.

**11 Function and information flows**

**11.1 Group management**

The group call attributes, as given in subclause 8.1 shall be entered and modified by the service provider. A list providing information on necessary Operation and Maintenance actions is given in clause 10.

**11.2 Group membership management**

Once the membership is established, the individual membership of the group can be placed in an active or deactive state on the SIM by the user. If a subscriber has a group ID in an active state, the subscriber is able to establish voice group calls corresponding to that group ID.

In a deactive state the mobile station prevents the service subscriber from establishing calls using the group ID and the corresponding notifications need to be "ignored" by the mobile station.

The active state and deactive state entries may be password protected as an implementation option.

Group IDs are listed in the subscription data within the network and on the SIM. The SIM must be returned to the network operator or service provider for updating if the subscription is to be changed.

NOTE: Updating of subscription data over the air interface is not considered. However, this shall not preclude future applications if corresponding mechanisms may be implemented.

Users can interrogate their mobile stations to determine to which groups they are members and which subscriptions are currently in an active state.

### **11.3 Call management**

#### **11.3.1 Call establishment**

A voice group call can be established by either a service subscriber or by a dispatcher.

##### **11.3.1.1 Service subscriber call establishment**

###### **11.3.1.1.1 Initial stage**

In the initial stages (between the MS and the MSC), service subscriber originated voice group call establishment shall proceed as for a standard call. The initial signalling from the originator informs the network that a voice group call is required and details the group ID. No information relative to the group call area is given by the caller.

The network shall perform a number of checks in order to determine how to handle the call:

- Check of the ability of the subscriber to establish the call;
- Check whether the call can be initiated from the cell;
- Check of the existence of an on-going call of the same group call reference.

The MSC shall check the VLR records for the ability of the subscriber to start the call. If the service subscriber has no subscription for the voice group call service with the indicated group ID, the call shall be released. In addition, the VLR shall return barring and identity presentation restriction checks to the MSC.

The MSC shall then request information from the GCR by giving the group ID and the originating cell ID as defined in subclause 9.2. The GCR first derives the group call area ID from the group ID and the originating cell ID. If no group call area ID is related to the group ID and originating cell ID, the call shall be released. If a group call area ID is related to the group ID and originating cell ID, the GCR shall transfer the corresponding group call attributes to the MSC. From that moment until the MSC indicates the contrary, the call shall be considered as on-going by the GCR.

If the MSC is not the group call anchor MSC for the voice group call as indicated in the GCR, then the voice group call request shall be passed to the group call anchor MSC.

It is possible that two service subscribers or a service subscriber and a dispatcher or two dispatchers may attempt to establish a call using the same group ID and corresponding to the same group call area ID. If the two voice group calls are established with the same group ID but for different group call areas then separate voice group calls shall be established. If the group call areas overlap, it is up to receiving mobile station to determine which call to participate in. If more than one call is made to identical group ID and group call area, the network shall reject all but one of the call attempts.

A service subscriber which is entitled by his subscription to establish voice group calls while roaming shall only be able to use supra-PLMN group IDs as defined in subclause 9.1 in case of roaming. In case of roaming, the mobile station shall only react on notifications for supra-PLMN group IDs.

If the GCR receives a new interrogation related to a group call reference where the call is indicated as on-going in the GCR, the GCR shall provide the on-going status together with the group call reference back to the MSC. The MSC shall then release the call with cause user busy in case of a service subscriber originated call request. The mobile station of the service subscriber shall then look for notifications of the

respective group ID on the NCH and join the voice group call. In case of a dispatcher originated voice group call request, the MSC shall join the dispatcher to the conference bridge of the voice group call.

Because of the possibility of overlapping group call areas, each call requires a unique reference, assigned by the GCR related to the MSC in which the call was originated. The group call reference shall be composed of the group ID and a group call area ID (see clause 9).

Authentication of the calling subscriber can be performed by the network as for normal calls.

#### **11.3.1.1.2 Establishment of the transmission means**

A voice group call channel shall be established in all the cells throughout the identified group call area using physical channels selected by the BSCs as appropriate. The downlink channels shall be established without any return signalling from mobile stations. Whilst the downlink channel is being established, the MSC shall form a conference bridge containing the appropriate channels on all BTSs in the group call area. The MSC is responsible for adding dispatchers to the conference bridge.

Alternatively, the network may establish voice group call channels in a cell on demand, i.e. if mobile stations respond to the notifications as defined in subclause 4.2.2.1.

In parallel, a dedicated suitable channel is allocated to the caller if not already the case. Once this is done, and at least one downlink channel is established, the MSC shall signal to the calling subscriber that this has occurred so that he knows when to start speaking.

The mobile station shall indicate connection to the subscriber. If channels could not be established in particular cells because of congestion, channels are allocated to these cells as soon as possible.

#### **11.3.1.1.3 Release of the dedicated transmission means of the calling service subscriber**

The calling subscriber shall be given a dedicated connection up to the time where the network requests him to join the voice group call channel. If the calling subscriber is not talking, the network requests him to join the voice group call channel as a listener by use of a channel release procedure. Otherwise, the network shall request him to join the voice group call channel as a talker by either a channel assignment procedure or a handover procedure or a channel mode modify procedure.

For the time when the voice group call is established until the calling subscriber becomes a listening service subscriber for the first time, the "uplink busy" flag is set (see subclause 11.3.8). Mobile stations shall be programmed such that if they originate the call, they indicate to the user that it is required that an indication of the desire to speak should be made if he wants to speak. If this is not done within a certain time, the mobile station sends an UPLINK\_REL message to the network and the uplink shall become free.

#### **11.3.1.1.4 Release of the dedicated transmission means of mobile stations responding to a notification**

Mobile stations which respond to a notification for which no description of the voice group call channel was given in the notification message may be given a dedicated connection up to the time where the network requests the mobile station to join the voice group call channel. If the service subscriber is not talking, the network requests him to join the voice group call channel as a listener by use of a channel release procedure. Otherwise, the network shall request him to join the voice group call channel as a talker by either a channel assignment procedure or a handover procedure or a channel mode modify procedure.

#### **11.3.1.1.5 Transfer of a talking service subscriber to a dedicated connection**

The network may decide to switch a talking subscriber's mobile station from the voice group call channel to a dedicated standard uplink/downlink at any time. This dedicated connection shall then be maintained up to the instance where the network decides that the mobile station shall join the voice group call channel again.

At this instance, if the service subscriber is not talking, the network requests him to join the voice group call channel as a listener by use of a channel release procedure. Otherwise, the network shall request him to

join the voice group call channel as a talker by either a channel assignment procedure or a handover procedure or a channel mode modify procedure.

### 11.3.1.2 Dispatcher call establishment

In the case of dispatchers originated calls the call request, in the form of an MSISDN number, shall be received at a GMSC. Such a call can be treated by the GMSC as a normal mobile terminated call. In this case, the GMSC shall interrogate an HLR, determined on the basis of the MSISDN number, The HLR in turn may either interrogate the appropriate MSC/VLR to obtain an MSRN, or may supply an MSRN predefined in the HLR and related to the respective group call reference in the MSC/VLR. If the HLR interrogates the MSC/VLR for the MSRN, the HLR shall provide this MSC/VLR with the related IMSI including the group call reference as defined in clause 9.

Alternatively, the call request can be forwarded directly to the related group call anchor MSC on basis of the GMSC's internal routing table. In this case, the group call reference shall already be included in the requested MSISDN number as defined in clause 9.

When interrogated by the group call anchor MSC, the GCR shall check if the calling line identity is within the list of dispatcher identities allowed to establish the voice group call. If not the case, the call shall be rejected.

After reception of the call request, the group call anchor MSC checks whether an on-going call of the same group call reference exists, in which case the group call anchor MSC shall add the dispatcher to the call.

At the point at which notification messages are sent to mobile stations, a tone is relayed to the dispatcher to inform the dispatcher that the message can commence.

### 11.3.1.3 Notification procedures

Different notification procedures shall be applied in relation to the mode of the mobile station as presented in table 1 and defined in the following sections.

**Table 1: Overview on different information messages for new or on-going calls**

| call type:                                 | new group call                     | on-going group call                   | new ptp call                        |
|--|------------------------------------|---------------------------------------|-------------------------------------|
| <b>MS states:</b>                          |                                    |                                       |                                     |
| Idle mode                                  | Initial Notific. NCH (section a)   | Subsequent Notific. NCH (section a)   | (standard paging)                   |
| group receive mode and group transmit mode | Initial Notific. FACCH (section b) | Subsequent Notific. SACCH (section b) | Paging info SACCH/FACCH (section d) |
| dedicated mode                             | Initial Notific. FACCH (section c) | Subsequent Notific. SACCH (section c) | (standard Call Waiting)             |

#### a) Notification for mobile stations in idle mode

Once the voice group call channel has been established in a cell or the network is waiting to receive notification responses to establish a voice group call channel, notifications shall be broadcast on the NCH in that cell.

The position of the NCH is derived from the system information of the BCCH.

The notification messages shall include the group call reference and possibly the description of the voice group call channel, the call priority if eMLPP is applied, an indication whether acknowledgements are required for this call and the group cipher key number.

A notification message can contain no, one or more notifications.

The notification process needs to continue throughout the duration of the group call, in order to permit the "late entry" of other mobile stations. Mobile stations moving into the group call area which are in idle mode shall be directed to the voice group call channel by the notification messages, possibly by means of the notification response procedure.

The scheduling of the notification messages in a cell shall be managed by the BSS. Information can be added in the messages to limit the required reception of NCH messages. The following constraints shall be met:

- Initial notifications (i.e. the first for a given group call) shall have priority over subsequent notifications (i.e. the messages for an on-going group call) and must be sent as soon as possible;
- After the initial notification, two other notifications for the call shall be sent to limit the probability of the notification not being received due to bad propagation.

NOTE: In addition initial notification messages for calls with or above an operator defined priority level can be sent on all possible paging or access grant channels to reduce the delay for those mobile stations which are not using DRX.

- Afterwards, an on-going group call in the cell shall be periodically notified on the NCH.

Since the information for the establishment of a voice group call is sent onto the NCH rather than on the PCH as for normal point-to-point calls, the mobile station must listen to the PCH as well as to the NCH. A "reduced NCH monitoring" mechanism can be used to save power in the mobile station when listening to the NCH.

A mobile station able to receive voice group calls either, depending on the implementation:

- can use the "reduced NCH monitoring" mechanism. When entering a cell, the mobile station shall listen to the NCH to get the notifications of the voice group calls on-going in the cell. Afterwards, the mobile station needs to listen to the NCH only if it is informed on the availability of a notification for a new voice group call. This shall be based on the NCH status information provided, as indicated in GSM 04.08. In situations where conflicts due to other idle mode tasks occur, the mobile station shall fulfil those idle mode tasks with priority in multiframes which do not correspond to the own paging subgroup;
- do not apply the "reduced NCH monitoring" mechanism and read all possible paging or access grant channels.

#### **b) Notifications into on-going voice broadcast and group calls**

Notifications into on-going voice broadcast and group calls may be provided as an implementation option.

In addition to sending initial notification messages on the NCH for the voice group call, the BSS can provide initial notification into on-going voice broadcast and group calls informing mobile stations partaking in these calls of new voice group calls that are being set-up in the cell.

In order to do this the BSS sends initial notification messages on FACCH to all on-going voice broadcast and group calls in the cell. The initial notification message on FACCH shall contain the group call reference, the priority level if eMLPP applies and possibly the TCH description which allows the mobile station to connect directly to the new call without reading the NCH.

To provide a late entry facility, the BSS can provide subsequent notifications on the SACCH into on-going voice broadcast or group calls informing late arrivals of the existence of the calls. The subsequent notification message on SACCH shall contain the group ID and the priority. The mobile station can decide, using this data, that there is a call of a higher priority and then look to the NCH in order to connect to the call.



The subsequent notification on SACCH needs to continue throughout the duration of the voice group call allowing a late entry of mobile stations that missed the initial notification.

As an option the BSS may reduce the number of initial or subsequent notifications sent by using the priority field if the service is provisioned.

**c) Notification into on-going point-to-point calls**

Notification into on-going point-to-point calls shall be provided as an implementation option.

In addition to establishing the links for the voice group call, the BSS can provide initial and subsequent notification onto on-going point-to-point calls informing mobile stations partaking in point-to-point calls of new and on-going voice group calls.

The BSS shall only perform this procedure for those mobile stations whose classmark indicates that the voice group call service is provisioned. The mobile station shall set the classmark if the mobile station supports voice group calls and the SIM has a subscription to voice group calls and at least one group ID is in active state on the SIM.

In order to perform initial notification the BSS shall send an initial notification message on the FACCH to the MS. The initial notification message shall contain the group call reference, the priority level if eMLPP applies and possibly the channel description which allows the mobile station to connect directly to the new call without reading the NCH.

To provide a late entry facility, the BSS can provide subsequent notification on SACCH indication on-going voice group calls. The subsequent notification message on SACCH shall contain the group ID and possibly the priority. The mobile station can decide, using these data, whether there is a call of a higher priority and then look to the NCH in order to connect to the call.

The subsequent notification shall continue throughout the duration of the voice group call allowing late entry of mobile stations. That is mobile stations that either ignored the initial notification or have subsequently moved into the group call area.

As an option the BSS may reduce the number of the initial or subsequent notifications sent by using the priority field if the service is provisioned.

**d) Paging into on-going voice group calls**

Paging into on-going voice group calls shall be provided as an implementation option.

In addition to establishing the links for the voice group call, the network can provide paging information into on-going voice group calls informing mobile stations partaking in a voice group call of new incoming point-to-point calls.

For this, the MSC shall initiate paging sending the BSS an indication as to whether the paged mobile station has a subscription to voice group calls. The BSS detecting that paging is to be initiated for a mobile station which has a subscription for voice group calls shall send a SACCH/FACCH paging information message on the voice group call channels in the cells in which the paging is required.

Two different paging information mechanisms may be applied as a network option as defined in the following:

1) Paging of mobile subscriber identity

The BSS shall provide paging messages for new calls with the related mobile subscriber identity on the SACCH/FACCH of the voice group call channel downlink.

2) Information on the availability of new paging messages on the PCH

The paging information message shall contain an indication of the paging group to which the mobile station is being paged. A BSS shall ensure that the paging is repeated on the PCH in order to allow enough time for the mobile stations involved in voice group calls to go to the PCH and read the paging message.

Those mobile stations which receive a paging information on the SACCH/FACCH which match their paging group shall look to their PCH paging subgroup (derived from the BCCH data) in order to search for the paging message.

In the event of a reorganisation of the PCH the BSS shall inform the mobile stations via the SACCH/FACCH that paging reorganisation has occurred. A mobile station receiving this indication shall decode the BCCH in order to obtain the new paging configuration.

As an option the BSS may reduce the number of paging information sent by using the priority field if the service is provisioned.

#### **11.3.1.4 Destination subscribers**

Mobile stations of destination subscribers which are in idle mode shall listen to notification messages on the NCH and move to the voice group call channel or respond to the notification.

Mobile stations which are busy shall either pre-empt the current call (if eMLPP is applied and the new call is of a sufficient priority), or shall provide the service subscriber with an indication similar to call waiting, when applicable.

#### **11.3.1.5 Called dispatchers**

Dispatchers are connected into the voice group call as a standard point-to-point call.

#### **11.3.2 Call release**

The voice group call can be terminated by the calling subscriber clearing it down, or by any dispatcher nominated in the GCR allowed to terminate the call.

The calling subscriber will need to gain the uplink before he can issue a termination request. If this occurs a call release message shall be sent on the FACCH of all cells in the group call area and then all resources are freed.

The MSC has to store the identity of the calling subscriber and to check it against the identity of the service subscriber which sends the voice group call disconnect message.

A time-out mechanism is required, such that if the MSC does not detect any downlink activity (i.e. either uplink or dispatcher activity) for a pre-set time, the call is terminated by the network. For this a timer shall be provided with a length as defined in the group call attributes in the GCR or, as an implementation option, with a fixed length.

#### **11.3.3 Leaving of a dispatcher**

A dispatcher can disconnect from the call at any time without terminating the call. In order to terminate the call a dispatcher who is entitled to do this must use explicit signalling (e.g. DTMF).

NOTE: This signalling is currently not specified in the GSM technical specifications and left for operator specific solutions.

#### **11.3.4 Leaving and returning to a voice group call**

A service subscriber shall automatically disconnect from the call when leaving the group call area.

A service subscriber shall be able to disconnect from the voice group call by a deselection/reselection process.

A mobile station shall leave the voice group call by no longer listening to the voice group call downlink and returning to idle mode. A voice group call is returned to by listening to the periodic notification messages for that call, and reacting on them appropriately.

### **11.3.5 Cell change**

#### **11.3.5.1 Listening subscriber**

In all cases change of cell shall be initiated and performed by the service subscriber's mobile station. In order for the service subscribers changing from one cell to another within the group call area to know which channel to listen to in adjacent cells, the channels used in each surrounding cell within the same BSC area, and if applicable, optionally in other BSC areas, are periodically broadcast on the downlink SACCH of the voice group call as a network option. In this case, mobile stations entering a new cell shall perform cell change according to the algorithm C2, see GSM 05.08 and GSM 03.22.

Mobile stations which want to enter a cell for which they have received no channel information need to listen in addition to the BCCH to the NCH to determine which channel they shall retune to so that they can continue with the voice group call if available in that cell.

Mobile stations entering a new location area shall perform location updating as normal.

#### **11.3.5.2 Talking subscriber**

Standard mobile station assisted handover shall be used for the cell change of the talking service subscriber.

#### **11.3.5.3 Dispatcher**

Dispatchers which are mobile subscribers shall change the cell by standard handover procedures.

### **11.3.6 New calls**

Any service subscriber originated new voice group calls which have identical group ID and group call area to on-going voice group calls shall be rejected by the network with cause busy. The mobile station shall then read the notifications for the corresponding group ID on the NCH.

For any dispatcher originated new voice group calls which are identical to on-going voice group calls as described above the network shall include the dispatcher in the on-going call.

Otherwise, new calls are treated as detailed in subclause 11.3.8. In the case of congestion, voice group calls are treated according to their priority with each BSC treating each downlink depending on the situation in each cell to which the call is sent. Therefore, it is possible that a voice group call might be established only in a subset of the required cells.

In the case where there are no conference bridges free, and pre-emption is not performed, then the call request shall be rejected.

In the case of group members involved in group or point-to-point calls who have been informed of a new voice group call, the mobile station shall make a decision as to which to monitor as if both the on-going call and new call were point-to-point calls, and follow the procedure defined in GSM 03.67.

### **11.3.7 Uplink transmission management**

The downlink FACCH channel shall be used to indicate whether the uplink is in use.

If a request to talk is made by the user and the uplink has been free the mobile station shall start to transmit UPLINK\_ACCESS messages as defined in the GSM 04.08.

If an VGCS\_UPLINK\_GRANT message is received by the mobile station with a different request reference than that of the access made by the mobile station, the mobile station shall not signal for a further 1s. If in

this time the uplink becomes busy, the mobile station shall indicate to the user that the access has been denied.

The user shall be provided with a short indication immediately after the reception of the VGCS\_UPLINK\_GRANT which indicates that he can speak. Contention caused by simultaneous access messages on the uplink of the voice group call channel shall be resolved as for standard random access procedures. If the uplink access is rejected a further indication shall be provided to the user to inform him that his access attempt was not successful.

The network then shall send an UPLINK\_BUSY message on the FACCH of the voice group call channel downlink in all cells involved in the group call.

The network shall forward the CLI of the calling subscriber to the dispatchers at call establishment.

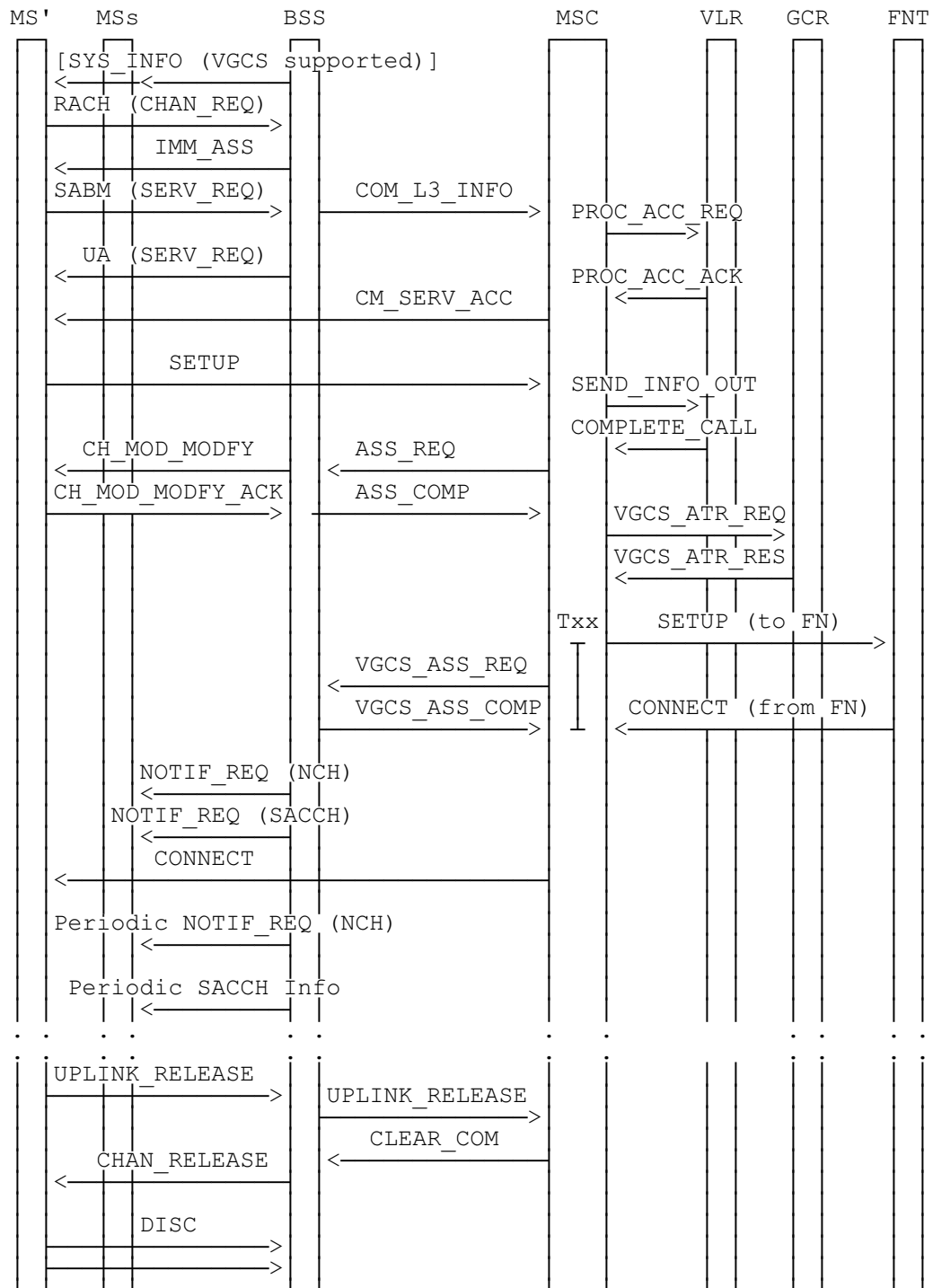
Signalling messages for call establishment and termination on the voice group call channel shall then only apply for the mobile station currently using the uplink. All other mobile stations shall not respond to this downlink signalling. Once the request to talk is over, this shall be indicated to the network by the mobile station, an UPLINK\_FREE message is broadcast on all FACCHs in the group call area.

### 11.3.8 Overview of signalling

In this overview, the messages required to implement the specified concept are identified, and brief details are given of each message.

A diagrammatic representation of the voice group call message structure proposed and actions required is given in figures 2 to 5.

NOTE: For VGCS implementations where the group call area exceeds an MSC area, the MSC in figures 2 to 4 is the anchor MSC except for the VLR requests in figure 2..



NOTE: MS' = calling subscriber mobile station;  
 MSs = destination subscriber mobile stations;  
 FNT = fixed network user terminal

**Figure 2: Signalling information required for establishing voice group calls by a service subscriber**

**SYS\_INFO (VGCS supported):** Message used to indicate if the VGCS establishment is supported in the cell and if voice group call channels and the corresponding notification is supported in the cell.

**Initial RACH CHAN\_REQ:** Standard message.

**IMM\_ASS:** Standard message send on the PCH.

**SERV\_REQ (voice group call):** Modified form of the current call request message L3-MM CM SERVICE REQUEST sent on the allocated channel. Teleservice Voice group call is indicated.

**UA (SERV\_REQ):** This message is used to acknowledge the layer 2 link and provide contention resolution of the service request.

**COM\_L3\_INFO:** The MSC is provided with initial information about the voice group call.

NOTE 1: Messages flows for authentication and ciphering are not represented although performed as normal.

**PROC\_ACC\_REQ:** The MAP\_PROCESS\_ACC\_REQ message is sent to the VLR to check the requested VGCS teleservice against the subscription data.

**PROC\_ACC\_ACK:** The MAP\_PROCESS\_ACC\_ACK message acknowledges the requested service.

**CM\_SERV\_ACC:** The service request is acknowledged. Acknowledgement of the service request can also be performed by invocation of ciphering mode setting.

**SETUP:** The MSC is provided with details about the voice group call.

NOTE 2: Alternatively, an IMMEDIATE\_SETUP may have been send as the initial message including all details of the voice group call. In this case no SETUP message must be sent.

**SEND\_INFO\_OUT:** The requested group ID is transferred to the VLR in the MAP\_SEND\_INFO\_FOR\_OUTGOING\_CALL message.

**COMPLETE\_CALL:** The VLR returns the MAP\_COMPLETE\_CALL message confirming the use of the requested group ID.

**ASSIGNMENT\_REQUEST:** Standard message.

**CHAN\_MOD\_MODIFY:** Standard message to modify the channel mode in case of very early assignment.

**CHAN\_MOD\_MODIFY\_ACK:** Standard message to acknowledge the modification of the channel mode.

**ASSIGNMENT\_COMPLETE:** Standard message.

NOTE 3: Alternatively, early assignment or OACSU procedures might be applied with the corresponding assignment messages not presented in this figure.

**VGCS\_ATR\_REQ:** The group call attributes are requested from the GCR.

**VGCS\_ATR\_RES:** The requested information is returned from the GCR.

**VGCS\_ASSIGNMENT\_REQ:** This message is sent from the MSC to all affected BSCs, [one dedicated message for every requested channel in a cell,] including the group call reference, the channel type and possibly the call priority and details on the ciphering.

NOTE 4: As an operator option the voice group call channels, the links to them and optionally also the links to dispatchers can already be established and permanently reserved in order to speed up the call set-up for emergency voice group calls.

**VGCS\_ASSIGNMENT COMPLETE:** Acknowledgement message from the affected BSC in answer to the assignment requests. If the assignment is not successful, a VGCS\_ASSIGNMENT\_FAILURE message shall be sent instead.

**SETUP to fixed network users:** Based on the information determined about the users of external networks to be involved in the call, the MSC shall initiate calls to these users in the normal manner, depending on their mode of connection into the MSC, and shall connect them into the conference bridge. Alternatively normal calls to GSM subscribers may be established for dispatchers being GSM subscribers which is not presented in the diagram.

**Txx:** Timer implemented in the MSC which is started with the incoming VGCS SETUP message and stops with the outgoing paging message. If the timer expires before the MSC receives all of the expected CHAN\_REQ\_ACK from the BSCs and the CONNECT messages from the external networks, the VGCS shall be established by the MSC to all available parts of the group call area.

**NOTIF\_REQ (NCH):** Messages for notification which contain the group call reference, the priority of the call if eMLPP is applied, the acknowledgement flag and possibly the channel description of the voice group call channel to which the mobile stations shall listen and the number of the group key used for ciphering.

**NOTIF\_REQ (SACCH):** Message for notification sent on the SACCH or FACCH to the mobile stations currently involved in other calls. The notification on the SACCH shall include only the group call reference, the acknowledgement flag and the priority level. The notification on the FACCH may include also the channel description and the group ciphering key numbers.

**Periodic NOTIF\_REQ (NCH):** The notifications are sent periodically so that mobile stations moving into the area can join the voice group call.

**Periodic SACCH Info:** Periodic messages sent on the downlink of the SACCH or on the FACCH informing mobile stations of:

- optional details of surrounding cells which may include the channel description of the BCCH and the voice group call channel in each surrounding cell of the group call area or of the group call area inside the same BSC area and other information used for cell reselection;
- whether the group call uplink is free;
- notifications or paging information messages on other calls in the cell.

**CONNECT:** Information to the mobile station of the calling subscriber that the VGCS is established with the related group call reference as the connected number.

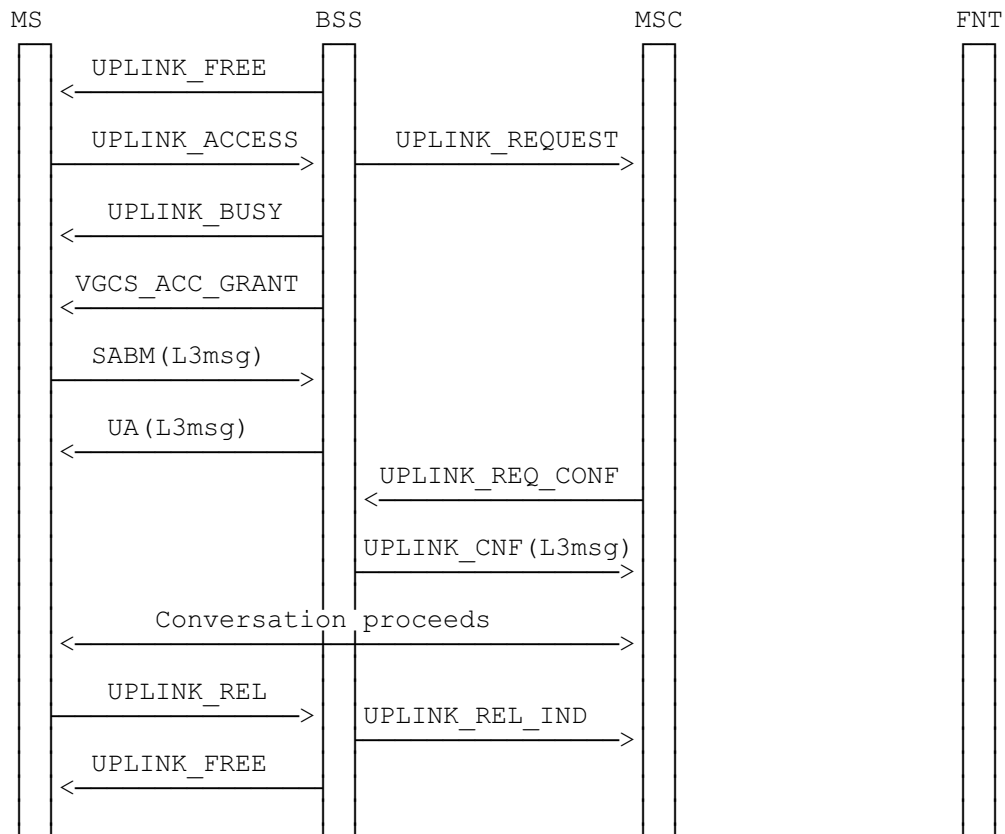
**UPLINK\_RELEASE:** When the calling service subscriber wants to become a listening service subscriber for the first time, a message indicating release of the uplink is required to be sent from the MS to the BSS in order to set the uplink free.

**CLEAR\_COM:** The MSC requests the BSC to clear the dedicated channel of the calling service subscriber. The CLEAR\_COM shall contain the group call reference.

**CHAN\_RELEASE:** The BSS sends a channel release message to the calling service subscriber's mobile station including the channel description of the voice group call channel to which the mobile station shall tune to.

NOTE 5: Alternatively, if no UPLINK\_RELEASE has been sent to the network by the mobile station, the network may transfer the mobile station to the voice group call channel by the channel mode modify procedure or by an assignment procedure or by a handover procedure.

**DISC:** Two layer 2 disconnect messages shall be sent by the mobile station to the network.



**Figure 3: Signalling information required for the voice group call uplink access (normal case, without contention resolution)**

**UPLINK\_FREE:** This connectionless RR message is repeatedly sent by the BSS on the main signalling link (FACCH) to inform all mobile stations of the voice group call members that the uplink is free.

**UPLINK\_ACCESS:** This is sent on the uplink of the voice group call channel using random access procedures. The UPLINK\_ACCESS message is similar to a channel request but sent on the group call channel uplink. The establishment cause for subsequent talker uplink request as defined in GSM 04.08 shall be used for this purpose. The mobile station may send repeated UPLINK\_ACCESS messages (see GSM 04.08).

**UPLINK\_REQUEST:** The request for the uplink is indicated to the MSC. Only one request per BSC shall be forwarded.

**UPLINK\_BUSY:** This connectionless RR message is sent on the downlink FACCH to inform all mobile stations that the uplink is now busy.

**VGCS\_UPLINK\_GRANT:** The reply to the uplink request sent on the voice group channel downlink containing information for synchronisation of the mobile station to the network and uplink access contention resolution. The VGCS\_UPLINK\_GRANT message shall therefore include a request reference (reflecting the UPLINK\_ACCESS) and the physical info required for transmission on the voice group call channel uplink. On receipt of a VGCS\_UPLINK\_GRANT, the related mobile station can start to send speech directly.

**SABM(L3msg):** The layer 2 link is set up and layer 3 information on classmark and mobile station identity included.

**UA(L3msg):** The layer 2 link is acknowledged and the layer 3 information reflected for contention resolution.



**UPLINK\_REQUEST\_CONFIRM:** The MSC acknowledges the uplink to one BSC. If uplink requests have been made by more than one BSC, all remaining uplink requests shall be rejected by an UPLINK\_REJ which is not presented in figure 3. On reception of an UPLINK\_REJ the BSS shall send an UPLINK\_REL to the related mobile station, followed by an UPLINK\_BUSY to indicate to the mobile stations that the uplink is in use. The MSC shall send to other BSCs which did not send an uplink request an UPLINK\_SEIZED message which is not presented in figure 3. On reception of an UPLINK\_SEIZED the BSS shall send an UPLINK\_BUSY to indicate to the mobile stations that the uplink is in use.

**UPLINK\_CNF:** The BSS confirms the uplink use to the MSC together with the mobile station identity.

**Conversation proceeds:** Once the mobile station has control of the uplink, it shall be able to communicate directly. The two-way nature of the conference bridge will ensure that they are already connected to all appropriate downlink channels.

**UPLINK\_REL:** When the service subscriber who has access to the uplink wants to release the channel, then a message indicating release of the uplink is required to be sent from the MS to the BSS on the FACCH.

**UPLINK\_RELEASE\_INDICATION:** The BSS informs the MSC on the uplink release.

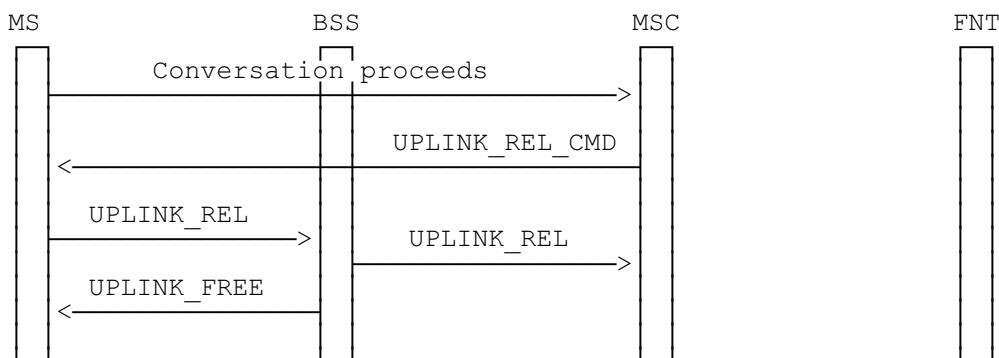


Figure 4: Signalling information required for the voice group call uplink release requested by the network

**UPLINK\_REL\_CMD:** When the network wants to release the uplink for any reason then a message requesting release of the uplink is required to be sent from the network to the mobile station on the FACCH.

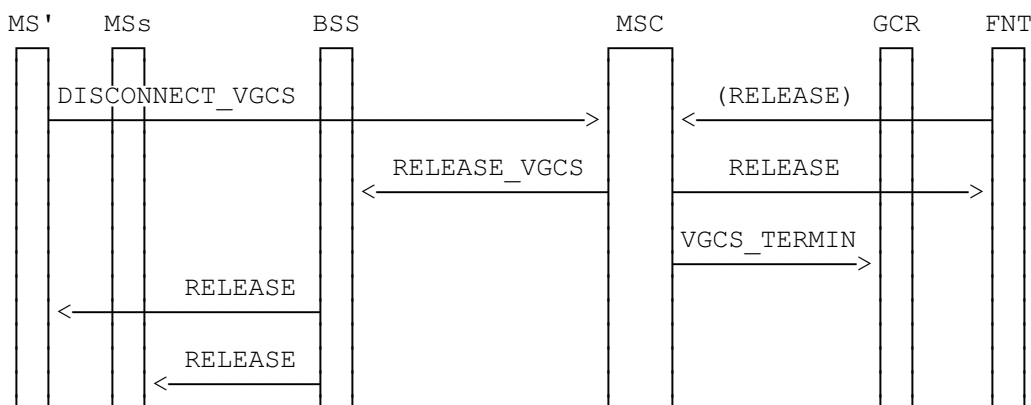


Figure 5: Signalling required to disconnect the group call

**DISCONNECT\_VGCS:** An authorised mobile station can send a DISCONNECT message to clear down the entire voice group call. To do this, the mobile station must have access to the uplink. The network has to check the IMSI to verify the calling subscriber. If the IMSI of the mobile station which has uplink access is presently not known to the network, the network shall send an identity request to the mobile station. Alternatively an authorised dispatcher can terminate the voice group call in which case a RELEASE message is received from the external network.

**RELEASE\_VGCS:** This message is sent from the MSC to all related cells to disconnect calls from the conference bridge and stop all periodic notifications for the voice group call to be released.

**VGCS\_TERMIN:** The MSC informs the GCR that the voice group call with the related group call reference is terminated.

**RELEASE:** RELEASE messages are sent on all downlink FACCH to the service subscribers. The RELEASE messages shall be repeated for a predefined period in order to provide a high probability that the listening mobile stations receive the message.

In addition, RELEASE messages are sent to all related dispatchers.

## History

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|--|---------------|--|
| Date   | Version       | Remarks  |
|  |               | No phase 1 version   |
| January 1995   | version 4.0.0 | TS approved by SMG#13  |
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