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Foreword

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1 Scope

The present document 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 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.
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[1] Void.

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

[2] 3GPP TS 42.068: "Voice Group Call Service (VGCS); Stage 1".

[3] 3GPP TS 43.022: "Functions related to Mobile Station (MS) in idle mode".

[4] 3GPP TS 23.067: "enhanced Multi-Level Precedence and Pre-emption service (eMLPP); Stage 2".

[5] 3GPP TS 44.018: "Mobile radio interface layer 3 specification; Radio Resource Control Protocol".

[6] 3GPP TS 45.008: "Radio subsystem link control".

[7] 3GPP TS 24.008: "Mobile radio interface Layer 3 specification; Core network protocols; Stage 3".

[8] ITU-T Recommendation E.164: "The international public telecommunication numbering plan".

[9] 3GPP TS 42.009(Rel-4): "Security aspects".

[10] 3GPP TS 43.020: "Security related network functions".

[11] 3GPP TS 44.068: "Group Call Control (GCC) protocol".

[12] 3GPP TS 22.083: "Call Waiting (CW) and Call Hold (HOLD) supplementary services; Stage 1".

[13] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".

[14] 3GPP TS 23.040: "Technical realization of the Short Message Service (SMS)".

[15] 3GPP TS 24.011: "Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface".

[16] 3GPP TS 28.062: "Inband Tandem Free Operation (TFO) of Speech Codecs; Service Description; Stage 3".

[17] 3GPP TS 23.236: "Intra-domain connection of Radio Access Network (RAN) nodes to multiple Core Network (CN) nodes".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TS 42.068 and the following apply:

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 (see also group call relay MSC). 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 Attributes (GCA): group call area, dispatcher identities, and the non-activity time which results in the release of the voice group call by the network

group call relay MSC: the 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

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

group call serving MSC: In a RANflex configuration the group call serving MSC of a location area is a group call anchor MSC or a group call relay MSC that controls the group call signalling for this location area. A location area within the pool area has a unique group call serving MSC. For a service subscriber located in this location area the visited MSC may be different from the location area's group call serving MSC.

In a RANflex configuration all location areas within a BSC service area are assigned to the same group call serving MSC.

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

group mode dedicated channel: In this mode, a mobile station participating in an ongoing voice group call is allocated at least two dedicated channels, only one of them being a SACCH

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)

originator-to-dispatcher information: information sent by the service subscriber originating a voice group call to the network during call setup for distribution to the dispatchers to be attached to the group call during call setup

RANflex configuration: A network configuration that allows a location area to be served by multiple MSCs in parallel. For details see 3GPP TS 23.236 [17]

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.

voice group call member: any group member or dispatcher participating in an on going voice group call

point-to-point short message: information that may be transferred between a mobile station and a Service Center

time-critical application-specific data: application-specific data which shall be transferred within the time limitation specified in 3GPP TS 42.068.

For the purposes of the present document, the following terms and definitions given in 3GPP TS 24.008 [7] apply.

dedicated mode
group receive mode
group transmit mode

3.2 Abbreviations

For the purpose of the present document, the abbreviations given in 3GPP TR 21.905 [1a] and the following apply:

AMR	Adaptive Multi-Rate
CC	Country Code
D-ATT	Downlink Attach
DA	Downlink Attach
DRX	Discontinuous reception
DTMF	Dual Tone Multi Frequency
EFR	Enhanced Full Rate
eMLPP	enhanced Multi-Level Precedence and Pre-emption
GCA	Group Call Attributes
GCR	Group Call Register
NCH	Notification Channel
NDC	National Destination Code
SN	Subscriber Number
UA	Uplink Attach
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/USIM. 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/USIM. 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.

If no NCH is defined in the cell, mobiles shall assume VGCS service is not available on that cell.

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. In a RANflex configuration a group call area can be restricted to a single pool area or can exceed one pool area.

A voice group call shall be initiated by a calling service subscriber by a related input function, e.g. via MMI, specifying the selected service and the group ID dialled or by a calling dispatcher by the MSISDN address (see subclause 9.2). As an option, the request of the calling service subscriber to set up a voice group call may specify information to be sent as originator-to-dispatcher information to the network; in this case the originator-to-dispatcher information is included in

the signalling for call setup from the mobile station to the network. It is the responsibility of the input function to ensure that the originator-to-dispatcher information has a correct format (in particular, an allowed length).

As a further option, the request of the calling subscriber may indicate one of the following talker priorities, listed in ascending order of talker priority:

- normal subscriber;
- privileged subscriber;
- emergency subscriber.

A mobile station supporting the use of talker priorities shall check with the SIM/USIM whether the subscriber is allowed to use the requested talker priority for the respective group ID before signalling the talker priority to the network.

On reception of a VGCS setup request with a talker priority different from "normal subscriber", the MSC shall check with the VLR whether the subscriber has a subscription to use this talker priority. If the subscriber is not allowed to use the requested talker priority, the MSC shall reduce the talker priority to a value the subscriber is allowed to use. In any case the talker priority used by the MSC shall be signalled back to the calling service subscriber in the Connect message.

If a VGCS setup request with talker priority "emergency subscriber" is received by the network and the subscription check is successful, the network shall set the emergency mode for this voice group call. The emergency mode may be reset during the voice group call (see subclause 4.2.2.1).

The MSC in which a voice group call is initiated obtains the group call attributes by requesting the Group Call Register (GCR, see clause 5). Without a RANflex configuration or in a RANflex configuration, if visited MSC and group call serving MSC are identical, the MSC performs a local GCR interrogation.

The local GCR interrogation after call initiation also determines whether the MSC shall act as anchor or as relay MSC. If the MSC is not the anchor MSC then the call will be "forwarded" from the relay to the respective anchor MSC (information also delivered by GCR) and further "call-establishment" is done by the anchor MSC as described in the following.

In a RANflex configuration the VMSC in which a voice group call is initiated may be different from the group call serving MSC of the voice group call initiating subscriber's location area. In this case the VMSC derives the identity of the group call serving MSC from the initiating subscriber's LAC and requests the group call anchor MSC address from the group call serving MSC's GCR by means of the SEND_GROUP_CALL_INFO MAP service. The call is then "forwarded" from the VMSC to the anchor MSC and further "call-establishment" is done by the anchor MSC as described in the following.

When a calling service subscriber or calling dispatcher 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 using notification response procedure. At the same time standard connections to dispatchers in the mobile network or in an external network shall be established. If originator-to-dispatcher information has been received in the signalling for call setup from the mobile station to the network and if the originating MSC supports processing of originator-to-dispatcher information, this information is transformed into user-to-user information and sent to the dispatchers as UUS1 when setting up the standard connections.

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.

During call establishment there are different options for the network to allocate a speech channel for the calling service subscriber:

In the first option, the calling service subscriber shall have its dedicated standard connection 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 service subscriber shall then go to the voice group call channel and the dedicated standard connection shall be released.

In the second option, the network shall allocate a dedicated signalling channel (e.g. SDCCH) to be used by the mobile station up to the time when the voice group call channel in the originating cell is established and the network decides that the mobile station shall join the voice group call channel.

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.

Destination 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/IMSIs. If the length of the group ID is less than 8 decimal digits , then the group call area ID is used 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.

The network may also send messages on appropriate voice group call channel 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.

Further the network may provide notification on the voice group call to service subscribers who have subscribed to the paged group ID and which are in dedicated mode. The process of broadcasting messages on NCHs 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.

If the emergency mode is set for a voice group call, the network shall include an emergency mode indication in the voice group call notification messages sent on the NCH, the group call channel FACCHs of all other ongoing voice group calls, voice broadcast calls, and the FACCHs associated with dedicated channels.

On receiving notification of a voice group call a group call member's mobile station shall adjust to the nominated channel to receive the voice group call 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 by use of the notification response procedure in order to respond to the notification. The network may then provide the mobile station with a channel description for the voice group call.

As a further mobile station option, the mobile station may read its paging subchannel in the current cell while in group receive mode or in group transmit mode in order to receive paging messages for mobile terminated calls.

4.2.1.2 Exceptional procedures

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

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 service 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 who uses the uplink of the voice group call channel can be commanded by the network to mute or unmute the downlink of the voice group channel when needed. The mobile station is commanded:

- to mute the downlink in order to avoid non intelligible echoes (in this case, the talking service subscriber can not hear dispatcher's voice); and
- to unmute the downlink in order to hear dispatcher's voice .

DTMF shall be used by dispatchers to trigger network signalling to mute and un-mute the downlink of a talking service subscriber as described in subclause 11.3.7.2.

If more than one service subscriber applies for 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' voice 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 a 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. If a network supports the use of talker priorities, it shall indicate the talker priority of the current talking service subscriber together with this uplink busy indication, and repeat the uplink busy indication periodically. 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.

The talker priorities specified in subclause 4.2.1.1 can be included by the mobile station in the uplink access message or priority uplink request message and used by the network to prioritize between different uplink requests or between an uplink request and the priority of the current talker. A mobile station shall not include a talker priority different from "normal subscriber" in the uplink access message and shall not send a priority uplink request message, if the network has indicated in the uplink busy message that talker priorities are not supported.

An uplink request with talker priority "normal subscriber" is signalled as an uplink request without talker priority.

If a subscriber requests for the uplink while the uplink is in use, a mobile station supporting the use of talker priorities shall signal the request to the network only if:

- the subscriber is allowed to use the requested talker priority for the respective group ID;
- the network supports the use of talker priorities. The mobile station shall assume that the network supports talker priorities, until the mobile station receives an uplink busy indication containing no talker priority information; and
- the requested talker priority is higher than the talker priority of the current talking service subscriber. The mobile station shall consider the talker priority of the current talking service subscriber to be "normal subscriber", until it receives an uplink busy indication indicating the actual talker priority.

If the BSS receives an uplink access message with a talker priority different from "normal subscriber", a BSS supporting the use of talker priorities shall delay the sending of the uplink request message to the MSC, until the MS identity, IMSI or TMSI, is received from the MS with the subsequent layer 3 message talker indication. The BSS shall then include in the uplink request message the layer 3 message, the requested talker priority, and the cell identity of the cell where the uplink access message was received.

If the BSS receives a layer 3 message priority uplink request, it shall include the MS identity received from the MS in the uplink request message. The BSS shall also include, in the uplink request message, the requested talker priority and the cell identity of the cell where the priority uplink request message was received.

The BSS shall send the uplink request message to the MSC only if the uplink is free or if the talker priority included in the uplink access is higher than the talker priority of the current talking service subscriber. If the layer 3 message is transmitted in the uplink request message, the BSS may omit the sending of the uplink request confirm message.

In a RANflex configuration, if the group call serving MSC receives an uplink request message it shall check by analysing the NRI of the requesting subscriber's TMSI whether it is the requesting subscriber's VMSC. If it is not, the group call serving MSC shall retrieve the IMSI and information about subscribed talker priorities from the VLR of the VMSC by means of the MAP service SEND_GROUP_CALL_INFO. During this MAP operation the VMSC shall check the subscription for the group ID.

In any configuration, if the MSC receives a talker request with a talker priority different from "normal subscriber" from the BSS, the MSC shall check whether the subscriber has a subscription to use this priority: