3GPP TR 29.882 V8.0.1 (2008-12)

Technical Report

3rd Generation Partnership Project;
Technical Specification Group Core Network and Terminals;
Customized Alerting Tones (CAT) in the 3GPP CS domain;
(Release 8)

Keywords
CAT

3GPP

Postal address

3GPP support office address
650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet
http://www.3gpp.org

Contents

Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

1   Scope

The present document provides a study into providing a Customized Alerting Tones in the 3GPP CS domain. The document covers the functional description, network architecture and protocol definition to support CAT in the 3GPP CS domain for speech and multimedia calls.

2   References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

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

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

[2]   3GPP TS 22.182: "Customized Alerting Tone (CAT) requirements; Stage 1".

[3]   3GPP TS 23.205: "Bearer independent circuit-switched core network; Stage 2".

[4]   ITU-T Recommendation H.324 Amendment 1: "New Annex K "Media Oriented Negotiation Acceleration Procedure" and associated changes to Annex".

[5]   3GPP TR 26.911: "Terminal Implementor's Guide"

[6]   3GPP TS 22.078: "Customized Applications for Mobile network Enhanced Logic (CAMEL); Service Description; Stage 1".

[7]   ITU-T Recommendation H.324 (09/2005): "Terminal for low bit-rate communication"

[8]   ITU-T Recommendation H.245 (05/2006) : "Control protocol for multimedia communication"

[9]   3GPP TS 23.014: "Support of Dual Tone Multi-Frequency (DTMF) signalling"

[10]   3GPP TS 23.231: "SIP-I based Circuit Switched Core Network ; Stage 2"

[11]   3GPP TS 29.002: "Mobile Application Part (MAP) specification"

3   Definitions, symbols and abbreviations

3.1   Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and 3GPP TS 22.182 [2] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1] and 3GPP TS 22.182 [2].

Customized Alerting Tone: same definition as in 3GPP TS 22.182 [2], limited to audio and video.

CAT capable (resp. non CAT capable) UE: UE supporting (resp. not supporting) the CAT signalling enhancements and functionalities specified in this specification.

3.2 Symbols

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

A party	Calling party
B party	Called party
CAT-A	CAT of the calling party A
CAT-B	CAT of the called party B
GMSC-X	GMSC of the called party X
MSC-A	Originating MSC of the calling party A
MSC-B	Terminating MSC of the called party B

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and 3GPP TS 22.182 [2] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1] and 3GPP TS 22.182 [2].

4 Overview of CAT service requirements in the 3GPP CS domain

4.1 Overview of CAT service requirements

CAT service requirements are specified in 3GPP TS 22.182 [2].

The basic CAT functionalities applicable to the 3GPP CS domain are :

- CAT service is an operator specific service by which an operator enables the subscriber to customize the alerting tone which is played to the calling party. CAT service should not negatively affect the conversation between calling and called parties, e.g. no voice/video clipping, no longer call setup time.

- The service user shall be able to subscribe the CAT service, activate the CAT service, update the settings, e.g. to change his active CAT.

- The CAT subscriber should be able to configure the CAT service. The CAT service should be able to select the appropriate CAT according to the rules. The CAT subscriber profile is based on the following parameters:

    1. CAT content descriptor - Pointing to the right content or combination of contents (e.g. personal prompt plus chosen music track).

    2. CAT timing descriptor - Time of day, day of week, specific date and intervals based on each of those parameters.

    3. User (called/calling party) descriptor - user ID (or group ID of users), user presence, user location, CAT user charging mode

    The CAT service shall be able to select the appropriate CAT according to the CAT user profile.

    NOTE 1: As location information may be restricted in some instances , the default user location may be a generic "unknown".

    NOTE 2: Presence information for a CS user is limited to attached or detached

- It should be possible to inform the user about status and changes in his CAT service, e.g. close expiry date for the CAT service or a particular CAT content.

    NOTE: In the CS domain, this information may be provided by existing means such as SMS and web access.

- The called party shall be able to pre-configure the CAT service. The preconfigured service is played upon receipt of an incoming call notification. This may be based upon the calling party identity.

- The calling party shall be able to experience the CAT set by the called CAT service subscriber.

- In CS, the calling party shall be able to experience the CAT set by the calling CAT service subscriber when in the HPLMN. When roaming this function may not be available.

- If the calling party is in the CS domain, when the called party answers the call the CAT shall stop.

- The CAT shall override the default alerting tone towards the calling party.

- The operator should have the capability to store multiple CATs per CAT service subscriber.

- The operator shall be able to charge for the CAT service.

- It shall be possible for a CAT subscriber to subscribe to a CAT that is provided by a third party content provider.

- The calling user shall have the possibility to copy the CAT of a called user as his own CAT while the CAT is being played. The pre-requisites are that the called user has enabled CAT sharing, if applicable, for that instance of CAT and that both users are subscribers to the same HPLMN and the calling user is within the HPLMN.

    NOTE 1: A CAT might also be copied offline via e.g. web interface but that functionality does not require standardisation.

    NOTE 2: The expression "to copy the CAT" does not necessarily mean that the CAT is actually copied. It may also mean that a purchase request is being sent to the CAT service provider.

- When the CAT is playing, the calling party shall be able to stop it, subject to service provider policy, and then he shall experience the default alerting tone for the duration of the call establishment. The pre-requisites are that both called and calling user are subscribers to the same HPLMN and the calling user is within the HPLMN.

    NOTE 3: The default alerting tone may be a CAT selected by the operator in the event of e.g. CAT STOP.

- The calling party should be able to reject the CAT service based on rules e.g. time, the identity of the called party.

- The calling party's operator shall be able to configure which CAT should have priority, the one set by the called or calling CAT service subscriber. By default, if no preference is set, the CAT set by the calling party has priority.

4.2 Analysis of CAT service requirements

1) The following requirements do not impact CSCN protocols and do therefore not require any specific work in the scope of this report.

   1.1 CAT charging : CAT charging is handled separately by the CAT server ; no specific charging evolutions are expected from (G)MSC servers.

   1.2 The provisioning of the CAT "content" is handled outside of the CS signalling domain.

   1.3 TS 22.182, sub-clause 4.1 : " It should be possible to inform the user about status and changes in his CAT service, e.g. close expiry date for the CAT service or a particular CAT content".
   In the CS domain, this information is assumed to be provided by existing means such as SMS and web access

2) The following comments were agreed regarding service requirements specified in 3GPP TS 22.182 [2]:

   2.1 For calls involving both the IMS and CS domains (i.e. CS originated calls towards IMS and vice-versa), the service requirement more precisely depends on whether the calling or the called party is located in the CS domain or in IMS. The CS domain is the domain that will constrain the service ultimately. Besides, the CAT server will normally not be aware of the calling party's location (in IMS or CSCN).

   2.2 TS 22.182, sub-clause 4.1 : " When the CAT is playing, the calling party shall be able to stop it, then he shall experience the default alerting tone for the duration of the call establishment"

   The following comments were expressed on SA1 proposal to use DTMFs to signal the CAT server to stop an on-going CAT and play a default CAT :

- from a service perspective, it was questioned how the calling parties would get the knowledge that DTMF may be used to stop the CAT or which specific DTMFs to send to stop the CAT ? Though the subscribers of the operator providing CAT services can be educated to learn how to stop the CAT played by the HPLMN, it is unclear how calling parties that would belong to other PLMNs or other networks/countries would get that knowledge.

- Transmission of DTMFs during the alerting phase would require that the bearer from the calling party to the CAT server is two-way through-connected during the alerting phase (in networks where DTMFs are sent inband). Though signalling extensions are defined in ISUP v3 to allow this, this can not be guaranteed in ISUP v2 networks. So whether the service can be provided will depend on the networks crossed by the call.

- Calls originating from PBXs may be prevented from transmitting DTMF prior to answer.

How to render the service needs therefore further technical investigations in CT4.

2.3 CAT is not a new standardized supplementary service, i.e. the CAT service is not activated, configured, deactivated from the UE like the traditional supplementary service e.g. calling line presentation.

2.4 The scope of the CAT copy service is limited between subscribers of the same PLMN.

In particular, no new interfaces e.g. between PLMNs or between CAT servers needs to be defined to allow exchange of CAT information.

With regard to the statement "The calling user may have the possibility to copy the CAT of a called user as his own CAT provided the called user has enabled CAT sharing for that instance of CAT", it is agreed that configuration of CAT sharing from called party is implemented at the CAT Content service level, e.g. within the web domain, i.e. it has no impact on the existing CSCN protocols/ procedures.

Since DTMF is proposed as the solution to carry the CAT copy request, this TR does only need to specify the requirements allowing the sending of DTMF from the calling UE to the CAT Server. It is out of the scope of the TR to specify the CAT copy procedure itself.

2.5 CT4 assumes that presence information in the CS domain ('user detached') may be used to send a specific CAT to the calling party when the called party is not reachable, e.g. prior to forwarding the call. No other service requirements are expected with regards to the 'user detached' or 'user attached' presence information.

2.6. The service requirement "The calling party should be able to reject the CAT service based on rules e.g. time, the identity of the called party." may be supported by requiring the calling subscriber to configure CAT-A service and give priority to CAT-A over CAT-B whenever CAT-B is not desired. Taking into account rules e.g. time or identity of the called party would then require that the network supports CAT priority as per calling party's preference.

5 Architectural aspects

5.1 Architectural requirements

5.2 Reference model

5.2.1 Logical network architecture

An overview of the logical network architecture to provide CAT in the 3GPP CS domain is given in Fig.5.2.1.1.
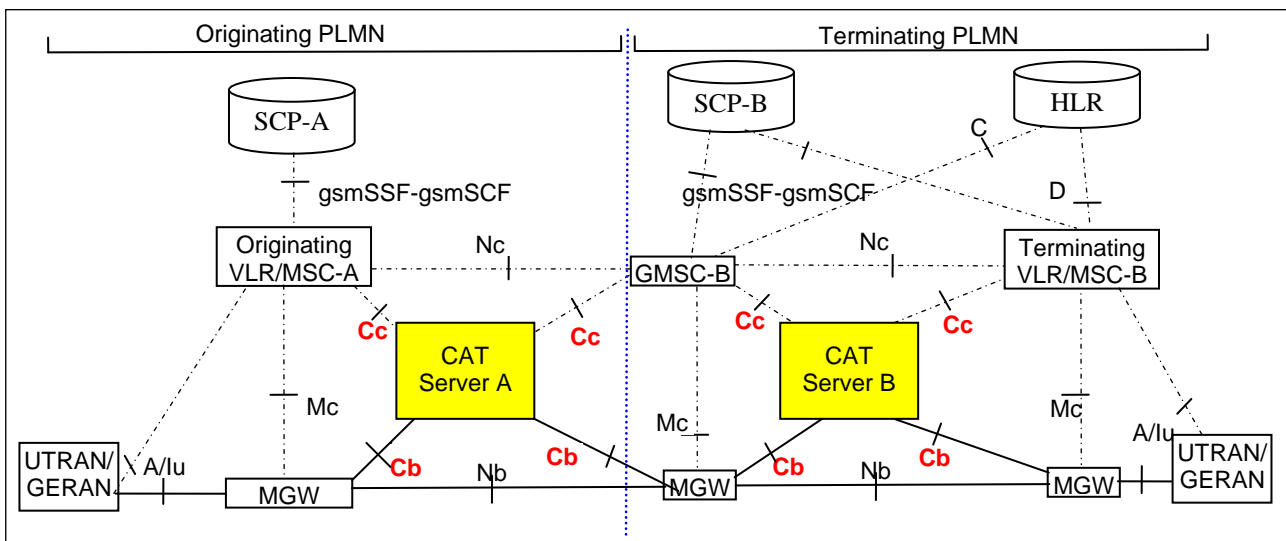
Figure 5.2.1.1: Logical network architecture for CAT in the 3GPP CS domain

NOTE: Cc and Cb are new reference points for the control and bearer planes between the CAT Server and respectively the (G)MSC Server and the MGW.

The interface between the CAT Server A and the GMSC-B/MGW of the terminating PLMN only applies to the CAT server switch architecture, see sub-clause 5.2.2.

5.2.1.1 (G)MSC Server switch architecture

In this approach, for called party configured CAT service the (G)MSC server controls the establishment, switch and release of the legs associated to the calling party, called party and CAT media. If the called party configured CAT service is triggered, the GMSC establishes a leg towards the CAT Server B which selects the appropriate audio or video CAT and delivers the associated media. The ring back tone is played during the alerting phase till the called party picks up the call. At this point in time, the GMSC Server through-connects the calling and called parties and releases the leg towards the CAT server B. For multimedia calls, a new end to end H.245 call is then set up between the calling and the called parties.

For calling party configured CAT service, it is similar to the called party configured CAT described above with the exceptions:
  - The originating VMSC server and CAT server A instead of the GMSC server and CAT server B respectively.

This is illustrated on the following figures for called party configured CAT service.
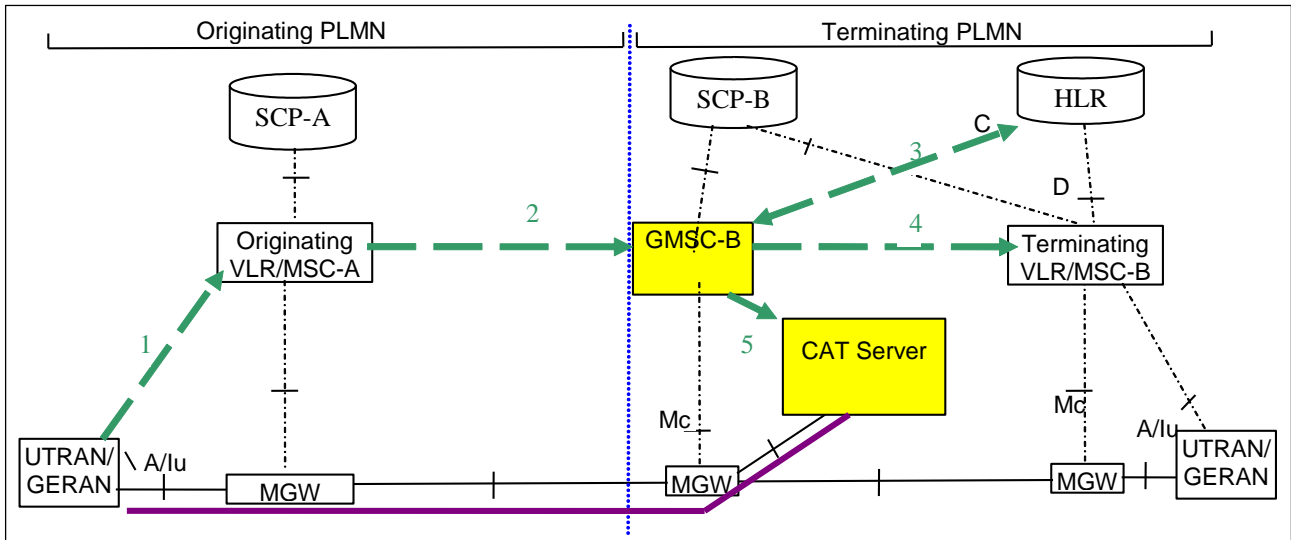
Figure 5.2.1.1.1: (G)MSC Server switch architecture –called party configured CAT during alerting phase
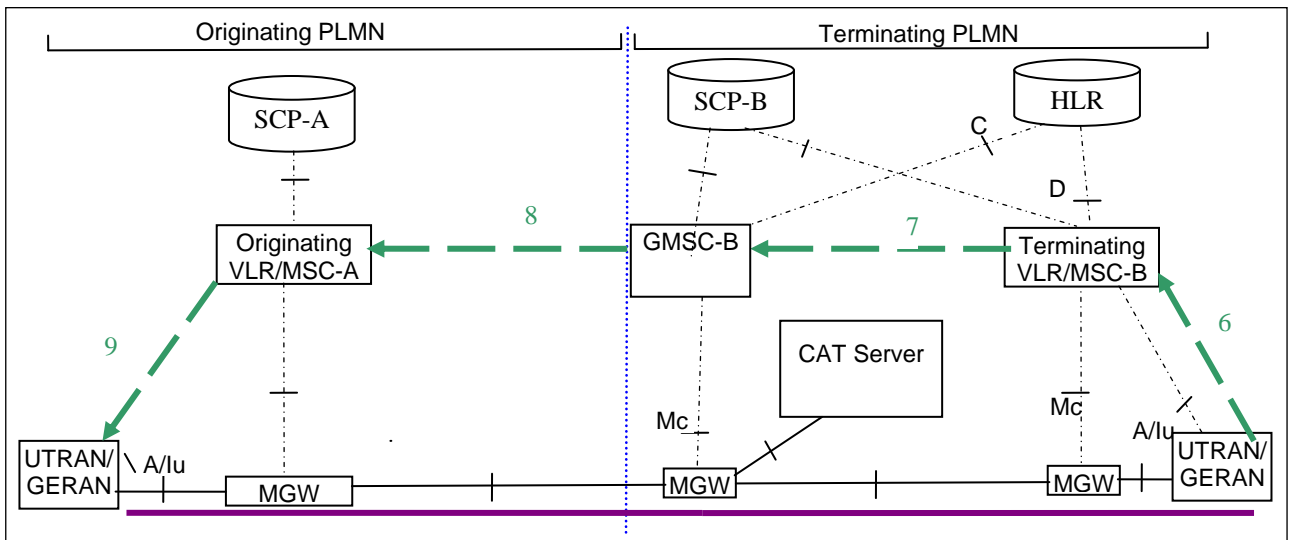
Figure 5.2.1.1.2: (G)MSC Server switch architecture – Called party picks up the call

Call flows are further detailed in sub-clause 7.1.

5.2.1.2   CAT Server switch architecture

In this approach, the CAT server controls the switch of the bearer for CAT media delivery and for conversation.

For called party configured CAT service, the GMSC establishes the call towards the CAT Server B if the called party configured CAT service is triggered and the CAT server B establishes the call to the terminating VMSC server. During the alerting phase till the called party picks up the call, the CAT server B selects the appropriate audio or video CAT and delivers the associated media to the calling party. After the called party picks up the call, the CAT Server B both-way through-connects the bearer to the calling and called parties for conversation in a voice call. In a multimedia call, the CAT server B continues to delivery the multimedia CAT media to the calling party till the complete of the H.245 call setup towards the called party after the called party picks up the call to improve the calling party's experience. This is illustrated figure 5.2.1.2.1 and 5.2.1.2.2.

For calling party configured CAT service, it is similar to the called party configured CAT described above with the modification:

- The originating VMSC server and CAT server A instead of the GMSC server and CAT server B respectively.
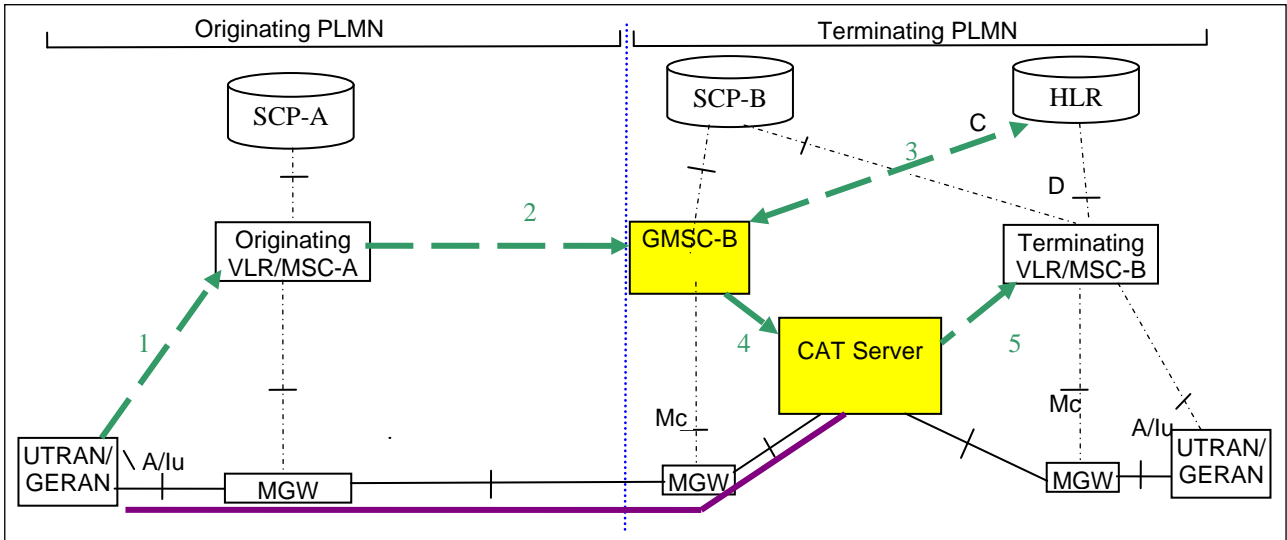
Figure 5.2.1.2.1: CAT Server switch architecture – called party configured CAT playing phase
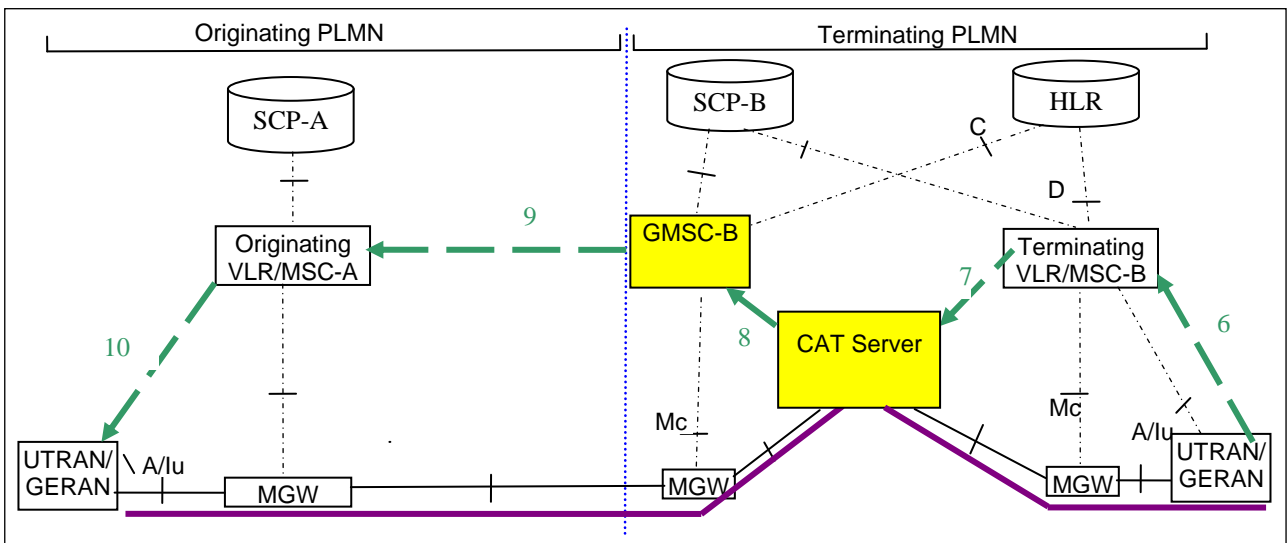
Figure 5.2.1.2.2: CAT Server switch architecture – conversation phase

5.2.1.3 (G)MSC Server bridge architecture

Same as defined for the (G)MSC Server switch architecture as specified in sub-clause 5.2.1.1 with the modification below.

For multimedia calls, the (G)MSC server or the originating VMSC server bridges two H.245 calls, one between the calling party and the (G)MSC/MGW or the originating VMSC/MGW, and another between the (G)MSC/MGW or the originating VMSC/MGW and the called party. The multimedia CAT may be continue to be delivered to the calling party during the second H.245 call setup towards the called party after the called party picks up the call to improve the calling party's experience.

5.2.1.4 CAT Server switch architecture with routing back to GMSC Server

In this approach, the CAT server controls the switch of the bearer for CAT media delivery and for conversation.

For called party configured CAT service, the GMSC establishes the call towards the CAT Server B if the called party configured CAT service is triggered and the CAT server B routes the call back to the GMSC Server. The second HLR inquiry in GMSC Server provides the roaming number and the call will be routed to the terminating VMSC server. During the alerting phase till the called party picks up the call, the CAT server B selects the appropriate audio or video CAT and delivers the associated media to the calling party. After the called party picks up the call a second H.245 session is established between the CAT Server and the called subscriber. The CAT Server B bridges the 2 multimedia sessions. This is illustrated figure 5.2.1.4.1 and 5.2.1.4.2.

For calling party configured CAT service, it is similar to the called party configured CAT described above with the exceptions:

- The originating VMSC server and CAT server A instead of the GMSC server and CAT server B respectively.

This is illustrated on the following figures for called party configured CAT service.
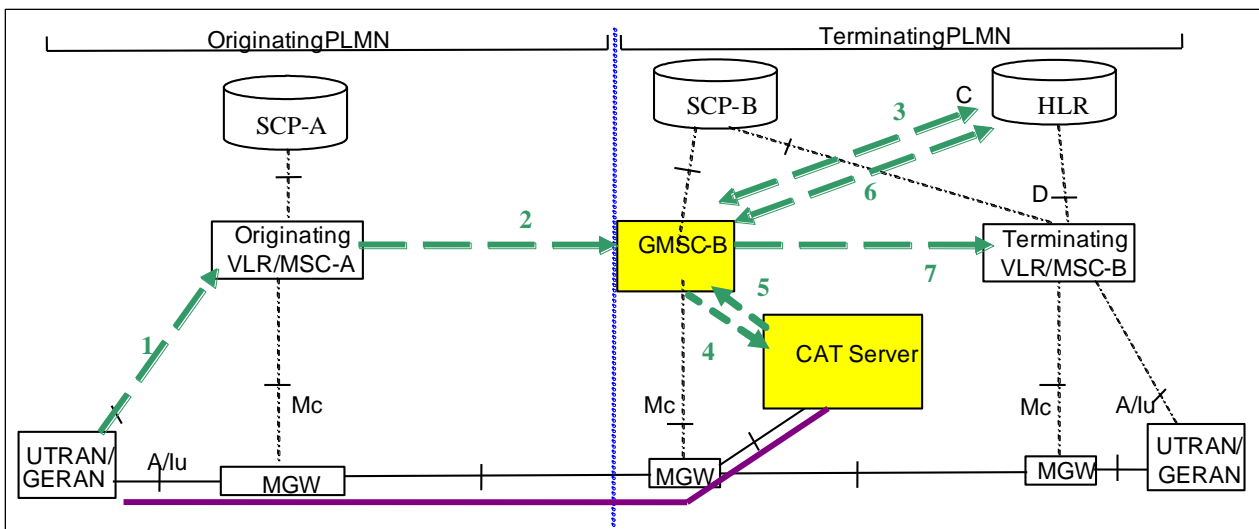
Figure 5.2.1.4.1: CAT Server switch architecture with routing back to GMSC – CAT playing phase
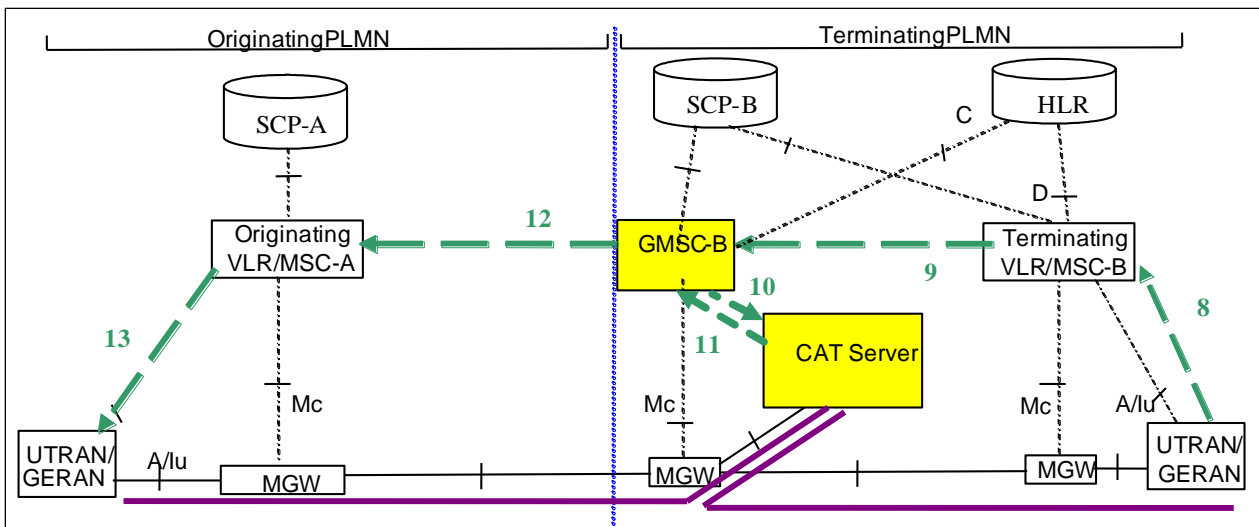
Figure 5.2.1.4.2: CAT Server switch architecture with routing back to GMSC – conversation phase

5.2.1.5 (G)MSC Server switch architecture use based on UE capabilities

In this approach, the (G)MSC server controls the switch of the bearer for CAT media delivery and for conversation. For multimedia CAT the CAT server stays in conversation phase in the call path or is released depending on UE capabilities (H.245 session reset support or indication if UE is CAT capable in Setup message).

UEs which support the session reset capability can re-negotiate the H.245 after a session reset. The information if an UE supports session reset is available in the CAT server during the first H.245 negotiation. The CAT server provides this information to the GMSC Server (f.e. with an additional connection) as illustrated in figure 5.2.1.5.1.

Also UEs which are CAT capable and provide this information in the Setup message to the Originating MSC Server can re-negotiate the H.245. For providing CAT capable information in the Setup message a spare bit of the Classmark 2 field can be used. The (G)MSC server can retrieve the Classmark 2 with the help of the ATI/PSI MAP operations as illustrated in figure 5.2.1.5.2.

In the case that UE A does not support session reset or is not CAT capable the CAT server needs to stay in the connection path during the whole video call. In the case that the UE-A supports the session reset or is CAT capable the connection path to the CAT server can be released after the CAT phase. This is illustrated figure 5.2.1.5.3 and 5.2.1.5.4.
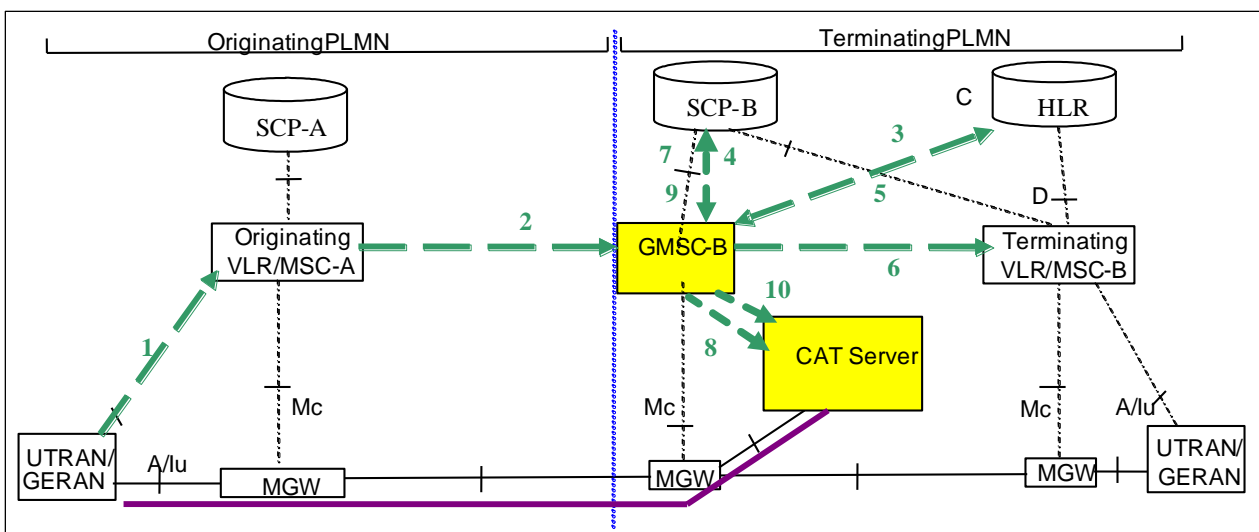
Figure 5.2.1.5.1: (G)MSC Server switch architecture based on UE capabilities – CAT playing phase - UE session reset capability indicated by CAT-Server
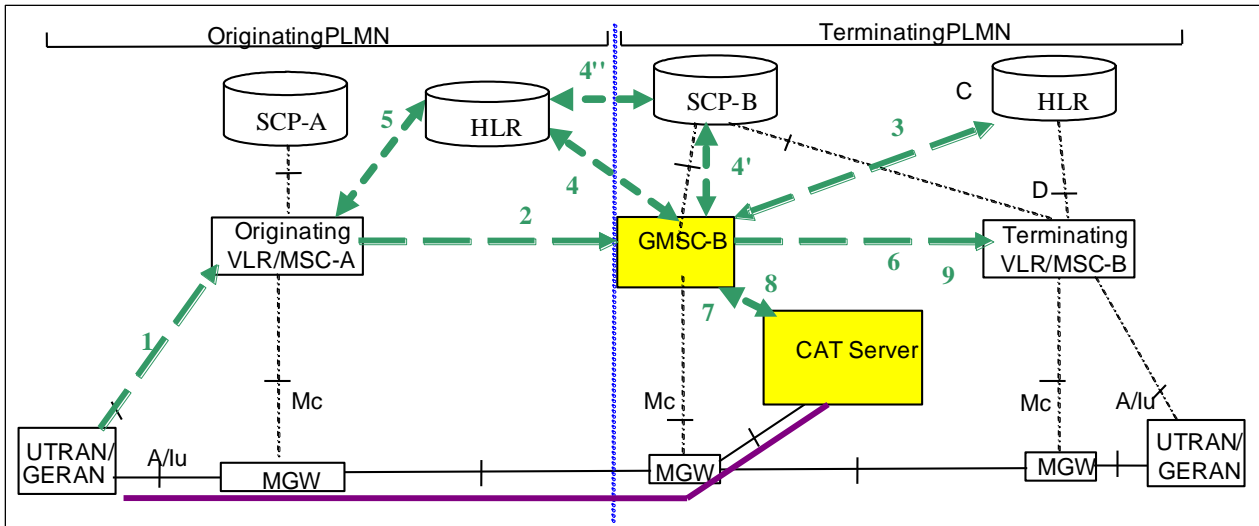
Figure 5.2.1.5.2: (G)MSC Server switch architecture based on UE capabilities – CAT playing phase - UE CAT capability retrieved with ATI/PSI
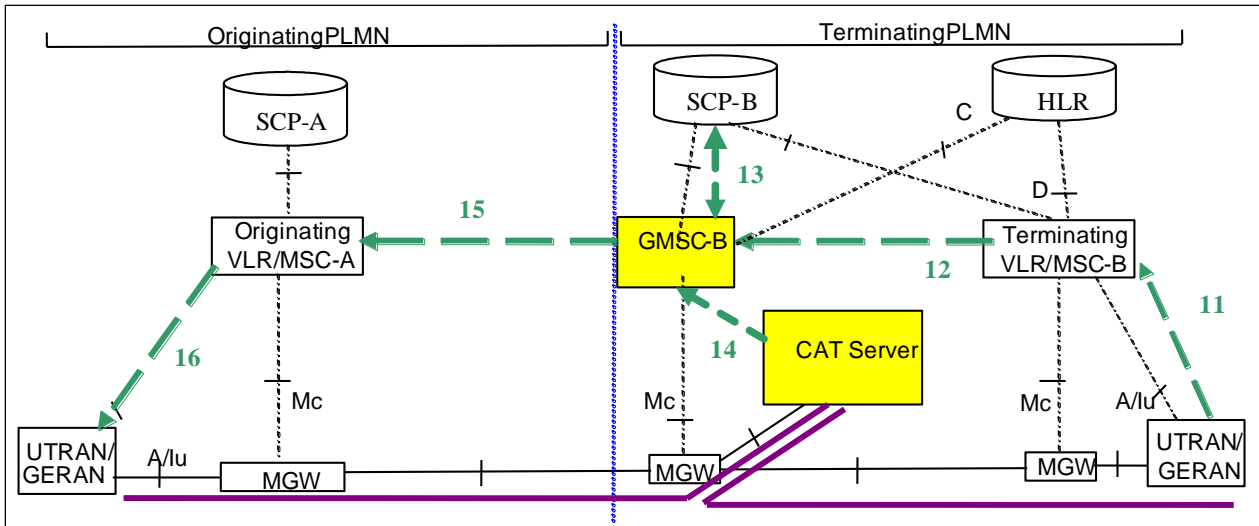
Figure 5.2.1.5.3: (G)MSC Server switch architecture based on UE capabilities – conversation phase if no session reset support or UE non CAT capable
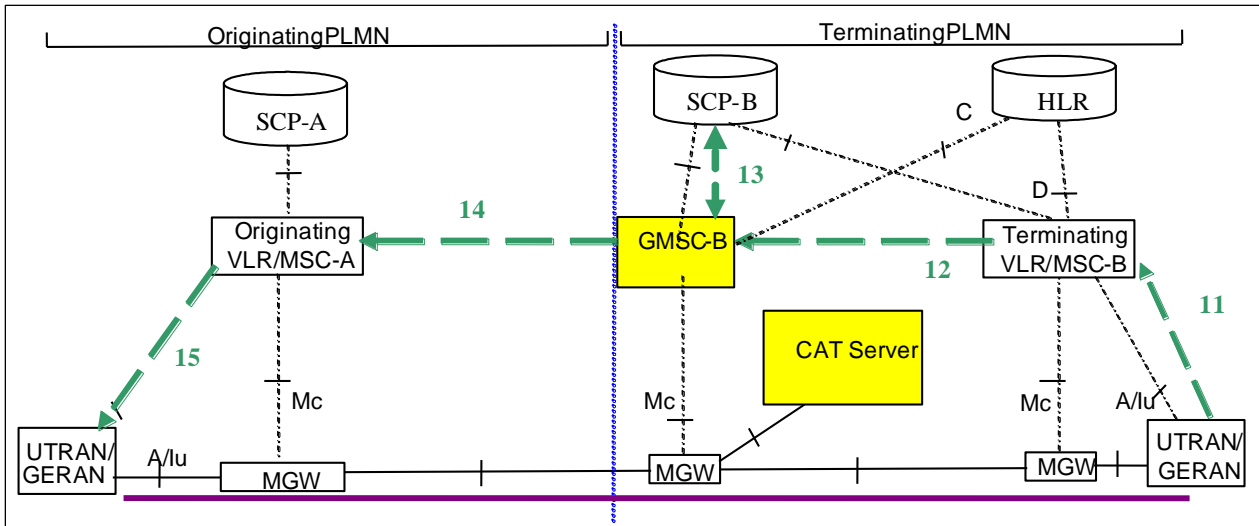
Figure 5.2.1.5.4: (G)MSC Server switch architecture based on UE capabilities – conversation phase if session reset support or UE CAT capable

5.2.1.6   Terminating MSC Server switch architecture

In this approach, for called party configured CAT service the terminating MSC server controls the establishment, switch and release of the legs associated to the calling party, called party and CAT media. If the called party configured CAT service is triggered, the terminating MSC establishes a leg towards the CAT Server B which selects the appropriate audio or video CAT and delivers the associated media. The CAT media is played during the alerting phase till the called party picks up the call. After the call is answered, the terminating MSC Server through-connects the calling and called parties and releases the leg towards the CAT server B. For multimedia calls, a new end to end H.245 call is then set up between the calling and the called parties.

This is illustrated on the following figures for called party configured CAT service.
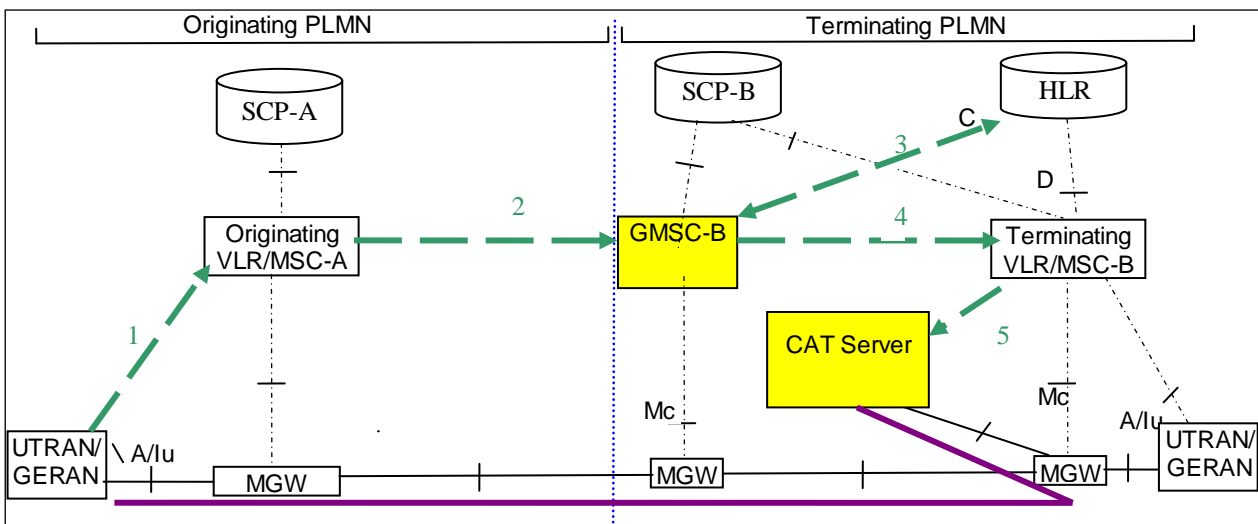
Figure 5.2.1.6.1: Terminating MSC Server switch architecture when called party configured CAT is playing during the alerting phase
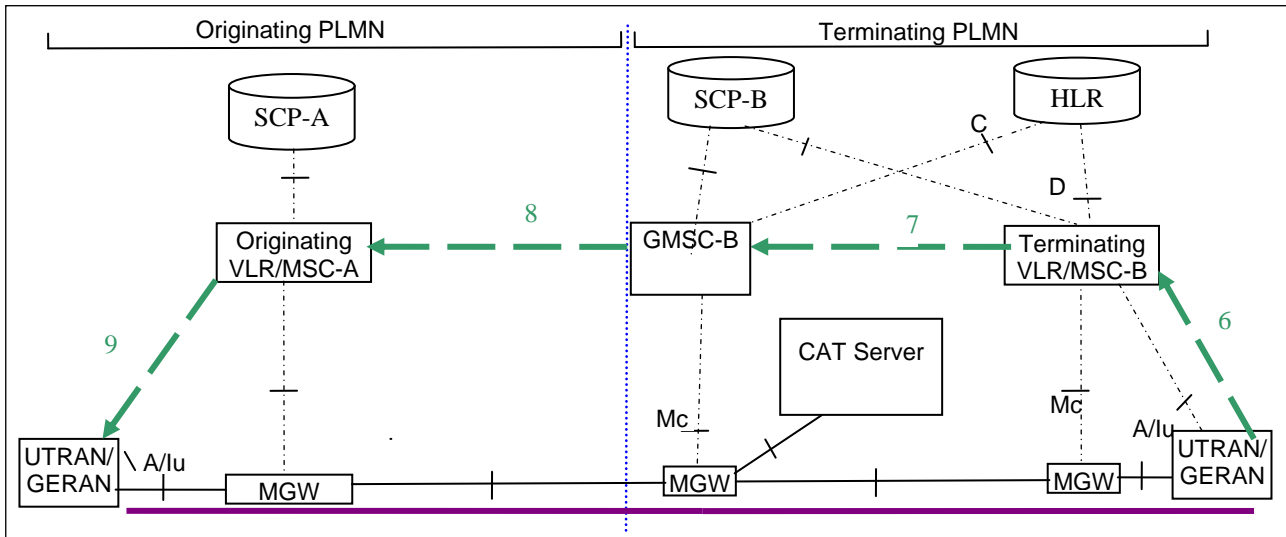
Figure 5.2.1.6.2: Terminating MSC Server switch architecture after the called party answered the call

Call flows are further detained in sub-clause 7.5.

5.3 Functional Entities

The following entities are involved in the delivery of CAT services.

Originating MSC:

> This is the MSC from which the calling party originates the call. It may be located within the subscriber's HPLMN or a VPLMN.

> It initiates an outgoing call to the CAT server to provide CAT-A if applicable (e.g. if the calling party has subscribed the CAT-A service).

> In the (G)MSC Server switch and bridge architectures, it also routes the on-going call towards the called party, and controls the through-connection, switch and release of the legs associated to the calling party, called party and CAT media (if applicable).

GMSC:

> It interrogates the HLR for routing information in order to route a mobile terminating call to the terminating MSC where the called party is roaming. It is located within the subscriber's HPLMN.

> If the GMSC is the node in charge of setting the connection towards the CAT server:

> - it initiates an outgoing call to the CAT server to provide CAT-B if applicable, e.g. if the called party has subscribed to customized ring back tones, or e.g. to send a customized call forwarding tone;

> - In the (G)MSC Server switch and bridge architectures, it also routes the call towards the terminating MSC, and controls the through-connection, switch and release of the legs associated to the calling party, called party and CAT media (if applicable).

> If the terminating MSC is the node in charge of setting the connection towards the CAT server:

> - it routes the call towards the terminating MSC.

Terminating MSC:

> This is the MSC from which the called party receives the terminating call. It may be located within the subscriber's HPLMN or a VPLMN.

> If the GMSC is the node in charge of setting the connection towards the CAT server:

- it establishes the call towards the called party.

If the terminating MSC is the node in charge of setting the connection towards the CAT server:

- it initiates an outgoing call to the CAT server to provide CAT-B if applicable, e.g. if the called party has subscribed to customized ring back tones or e.g. to send a customized call waiting tone;

- it establishes the call towards the called party and controls the through-connection, switch and release of the legs associated to the calling party, called party and CAT media.

NOTE: Different approaches are studied with either the GMSC or the terminating MSC being in charge of setting the connection towards the CAT server. Only one approach should be retained ultimately.

HLR:

It stores on per subscriber basis subscription information to provide CAT-A and CAT-B.

CAT server:

It stores the CAT subscriber's profile as specified in section 4.1.

It stores the CAT audio/multimedia media/file locally for playing CAT media to the calling party.

It selects the appropriate audio or multimedia CAT to be experienced by the calling party according to the information collected for the ongoing call, the CAT subscriber's rules selection and/or operator's policy.

It delivers the media of the selected audio or multimedia customized alerting tone while the CAT is playing.

In the CAT Server switch architecture, it also routes the on-going call towards the called party, and controls the through-connection, switch and release of the legs associated to the calling party, called party and CAT media.

CAT server A provides the calling party with CAT-A. It is located in the calling subscriber's PLMN.

CAT server B provides the calling party with CAT-B. It is located in the called subscriber's PLMN.

The Originating MSC, GMSC and Terminating MSC may or may not be co-located on the same node.

SCP:

In the (G)MSC Server switch architecture use based on UE capabilities and use of CAMEL-based triggering methods (e.g. T-CSI/O-CSI) the SCP controls the CAT service.

Depending on the UE-capabilities the SCP orders the GMSC server (CAT-B) or originating MSC (CAT-A) to connect the CAT-server in the call path during the whole multimedia call or only during the CAT-phase.

5.4 Interfaces

5.4.1 Cc Interface

Cc interface is for the control of the CAT service between the CAT Server and the (G)MSC Server. Any suitable protocol used on the Nc interface in the Bearer Independent Core Network may be used for the purpose.

Editor's note: The recommendation on the Cc interface protocol may be further studied.

5.4.1.1 BICC based Cc interface

The same procedures for the BICC based Nc interface may be used for the control of the CAT service between the CAT Server and the (G)MSC Server.

Editor's note: The procedures for the BICC based Cc interface different from the BICC based Nc interface shall be highlighted in the description of the CAT call flows and the interactions with other features.

5.4.1.2 SIP-I based Cc interface

The same procedures for the SIP-I based Nc interface may be used for the control of the CAT service between the CAT Server and the (G)MSC Server.

Editor's note: The procedures for the BICC based Cc interface different from the BICC based Nc interface shall be highlighted in the description of the CAT call flows and the interactions with other features.

5.4.1.3 ISUP based Cc interface

The same procedures for the ISUP based Nc interface may be used for the control of the CAT service between the CAT Server and the (G)MSC Server.

Editor's note: The procedures for the ISUP based Cc interface different from the ISUP based Nc interface shall be highlighted in the description of the CAT call flows and the interactions with other features.

5.4.2 Cb Interface

Cb interface is for the control of the CAT service between the CAT Server and the MGW. The same profiles for the BICC and SIP-I based Nb interface should be used for BICC and SIP-I based Cc interface respectively.

6 CAT service provisioning, activation & deactivation, configuration

6.1 CAT copy/ stop methods

6.1.1 Principles

DTMF is proposed as the method to convey the CAT copy request and CAT stop request from the calling UE to the CAT Server. Consequently it is out of the scope of the TR to specify CAT copy and CAT stop procedures.

DTMF is transmitted from the calling UE to the CAT Server as specified in sub-clause 8.2.6. In CAT architectures where the CAT Server does not remain in the path during the conversation phase, the DTMF can only be transmitted to the CAT Server during the alerting phase.

An end to end both-way through-connection will necessarily exist when a multimedia CAT is played to the calling party. It is therefore always possible to transfer the DTMF from the calling UE to the CAT Server to request copying or stopping a multimedia CAT.

An end to end both-way through-connection is not required to play an audio CAT to the calling party. To allow transferring DTMF to request copying or stopping an audio CAT, a both-way through-connection is required for the GMSC and any intermediary nodes when DTMF is transmitted inband in both sides. A both-way through connection is not required when DTMF is transported out of band in either side of (G)MSC and any intermediary nodes.

6.1.2 CAT copy

The CAT copy can be supported when the calling and called parties have subscribed to CAT services and subscribed to the same PLMN since no interface is standardized to copy CAT between CAT Servers.

When DTMF is transported inband, the request to copy an audio CAT can be conveyed to the CAT Server only if an end to end both-way through-connection exists between the calling party and the CAT Server. See the corresponding discussion in sub-clause 10.1.1.2.

Upon receipt of a DTMF denoting a CAT copy request, the CAT server normally copies the called party's CAT being played to the calling party subscriber, after optionally performing authorization checks as required by local policy.

6.1.3 CAT stop

The CAT stop can be supported when the calling party is receiving a CAT. The calling party may be a CAT subscriber or not. The calling and called party may belong to the same or different PLMNs. However the calling party needs to know which DTMF to press to request stopping the CAT of the called party, which may restrict the service to subscribers belonging to the same PLMN.

When DTMF is transported inband, the request to stop an audio CAT can be conveyed to the CAT Server only if an end to end both-way through-connection exists between the calling party and the CAT Server. See the corresponding discussion in sub-clause 10.1.1.2.

Upon receiving the DTMF denoting a CAT stop request, the CAT server normally stop playing it and play instead the default alerting tone.

6.2 CAT-A / CAT-B priority handling

6.2.1 Introduction

In call scenarios where both the calling and called parties subscribed and activated respectively CAT-A and CAT-B services, the CAT experienced by the calling party may be prioritized as follows :

- the calling party's operator has configured which CAT should have the priority , as per 3GPP TS 22.182 requirement [2];

- the calling party has configured which CAT he prefers to experience, potentially on a per called party basis (requirement not currently in 3GPP TS 22.182 [2] but requested to be investigated by 3GPP SA1).

NOTE: Assuming that the originating MSC triggers CAT-A service only if the calling party is in its HPLMN, the calling party's operator is the operator of the MSC to which the calling party is currently connected.

Both approaches are investigated further down.

6.2.2 CAT priority configured by the calling party's operator

When the originating MSC and GMSC are co-located, e.g. the calling and called parties are two subscribers pertaining to the same PLMN and served by the same HPLMN MSC, a single MSC Server is engaged in the call. If the calling and the called party subscribed respectively CAT-A or CAT-B service, this MSC Server can decide which CAT prevails as per local operator policy and request the CAT Server to play the corresponding CAT.

Editor's note: how the MSC indicates to the CAT Server whether to play CAT-A or CAT-B is ffs.

When the originating MSC is not co-located with the GMSC of the called party, e.g. the calling party is calling a called party of a foreign PLMN, the following issues arise :

- the GMSC does not know whether the originating MSC wishes to insert a CAT-A (if CAT-A should prevail over CAT-B); it may consequently uselessly require the CAT Server B to generate a CAT-B.

- the originating MSC can not know, for a speech call, whether the GMSC inserted or not a CAT-B. Indeed the "in-band information" OBCI indication reported in the ACM or CPG message does not allow to differentiate whether a normal ring back tone has been inserted by the terminating MSC, or whether the GMSC has inserted a CAT-B; this prevents the originating MSC to give preference to CAT-B over CAT-A. The originating MSC could know, for a multimedia call, whether the GMSC inserted or not a CAT-B by checking the "in-band information" OBCI indicator.

In other words, with the current signalling protocols used in 3GPP CSCN, only the following services are possible:

- CAT-A prioritized over CAT-B for speech or multimedia calls (CAT-B is played useslessly) ;

- CAT-B priorititized for multimedia call.

The following signalling extensions could be envisaged to remove the aforementioned limitations:

- In IAM message : a new 'inhibit CAT in-band information' could be sent, as an option, when the originating MSC intends to insert a CAT in-band information locally (i.e. when CAT-A has always priority over CAT-B as per local configuration). This would indicate to the downstream node that it does not need to insert a CAT itself.

- In ACM/CPG message : a 'CAT in-band information' could be sent when the GMSC inserts a CAT inband information locally to inform the upstream node that a CAT has been inserted.

When CAT-A would be prioritized over CAT-B :

- the originating MSC would send an IAM with the 'inhibit CAT in-band information' set;

- a GMSC receiving this information could refrain from inserting CAT-B;

- the originating MSC would insert CAT-A locally;

- if CAT-A can not be played for any reason, the calling party would experience the default ring back tone received from the terminating MSC for a speech call. For a multimedia call, the originating MSC would send a normal ALERTING message to the calling UE, which would then optionally play a default alerting indication (as if there were no CAT at all).

When CAT-B would be prioritized over CAT-A :

- the originating MSC would send an IAM without the 'inhibit CAT in-band information' ;

- a GMSC receiving this information would insert CAT-B locally and would return the 'CAT in-band information' in the ACM or CPG message;

- the originating MSC would transit the CAT-B towards the calling party, if announced in the ACM or CPG message, otherwise would insert CAT-A locally.

NOTE: The originating MSC would not receive any explicit indication from legacy GMSC implementations on whether a CAT-B was inserted or not. Prioritization of audio CAT-B over CAT-A will not be possible with those legacy implementations.

Editor's note: the encoding of those extensions is ffs.

6.2.3 CAT priority as per calling party's preference

One possible approach could rely on the following principles :

- The calling party's preference needs to be stored in the CAT Server, globally or on a per called party basis.

- The originating MSC could send an IAM message to CAT Server to request the playing of CAT-A. If the calling party configured a preference to CAT-B for the call, the CAT server could release the call with a specific reason. The originating MSC would then through-connect the calling party to the GMSC (or CAT-B leg for co-located originating MSC/GMSC). Otherwise the CAT server would accept sending CAT-A by returning an ACM message.

However, if the calling party prioritizes CAT-B for the call, no CAT would be played to the calling party if the CAT-B could not be played, e.g. called party has no CAT-B service subscription or CAT is not supported by the called party's PLMN. To avoid those service restrictions, the originating MSC would have to let the called party 's GMSC insert CAT-B, and if CAT-B is really received, it would indicate to the CAT-A Server to check the calling party's preference as above.

Editor's note: how the MSC would indicate this to the CAT Server is ffs.

NOTE: In this scenario, a CAT-B could be played by the CAT Server B though the calling party could experience his own CAT-A. The same applies if the CAT priority is configured by the calling party's operator, and CAT-A is prioritized over CAT-B, and the originating MSC does not send the new optional 'inhibit CAT in-band information'. In those cases, the charging mode 'Fee per CAT usage' would charge the B party for a CAT-B that would not be received by the calling party.

Another possible approach could consist in handling some specific subscriber marks (e.g. OSSS codes) in the HLR, that would be downloaded to the originating MSC during the MAP Update Location procedure and that would allow to indicate whether the subscriber has subscribed to CAT-A, which CAT the subscriber as a calling party prioritizes (CAT-A or CAT-B) and whether he would accept to receive or not CAT-B. The originating MSC would take those marks into account upon the subsequent establishment of mobile originated calls by the subscriber. The same CAT prioritization would apply for all calls originated by the subscriber, without taking into account any other parameters (e.g. called party number, time of the day…).

7 CAT call flows

7.1 Alternative 1 – (G)MSC Server switch architecture

7.1.1 Triggering methods

One or several marks, e.g. specific OSSS code(s) or routing information (e.g. routing code – new subscription information)., are configured in the HLR on a per subscriber's record to indicate support of audio or/and multimedia CAT-A and CAT-B services.

The originating VMSC triggers CAT-A service if the calling party has subscribed and activated the CAT-A service and is in its HPLMN. It retrieves the subscription data of the subscriber during the location update procedure.

 NOTE: Support of CAT-A service for roaming subscribers would require CAT to be standardized as a new supplementary service, which is not envisaged.

The GMSC triggers CAT-B service upon arrival of an incoming call to a CAT subscriber having subscribed and activated the CAT-B service. The GMSC server retrieves the subscription data of the subscriber during the HLR interrogation.

7.1.2 Trigger points in the call

The originating MSC server shall trigger the calling party configured CAT service if the calling party has subscribed and activated the CAT service.

The GMSC server shall trigger the called party configured CAT service if the called party has subscribed and activated the CAT service.

The originating MSC (for CAT-A) and GMSC (for CAT-B) decides to play CAT during the alerting phase by establishing a connection to the CAT Server upon receipt from the succeeding node of an ACM message with the Called Party Status in the Backward Call Indicators set to 'Subscriber free' or upon receipt of a CPG message with the Event Information set to Alerting, if this is the first "Subscriber free or Alerting" indication received for the call and neither the "Call Diversion Information" IE nor the Generic Notification Indicator IE set to 'Call diverting' nor the ANSI Notification Indicator set to 'Call is forwarded/deflected' has been received.

 NOTE: The SS notification may be optional depending on the vendor's implementation. The first "Subscriber free or Alerting" indication may be received from the forwarded-to switch but the receiver does not know."

If the GMSC and the terminating MSC are co-located, the Alerting message from called party will be the trigger to connect the CAT server.

 Editor's note: Interactions between CAT-A and CAT-B services are not considered yet either.

7.1.3 Nominal call flows

7.1.3.1 Speech call

7.1.3.1.1 Ring back tone provided by CAT server B

It is assumed in this sub-clause that the calling party has either not subscribed or not activated CAT service, or that it has activated CAT service but with CAT settings indicating preferences to CAT-B service.

To play an audio CAT during a speech call, GMSC-B through-connects the speech bearer from the the calling party A to the CAT server B when the called party B is free, which is transparent to the A party. When the B party answers the call, GMSC-B through-connects the calling and called parties.
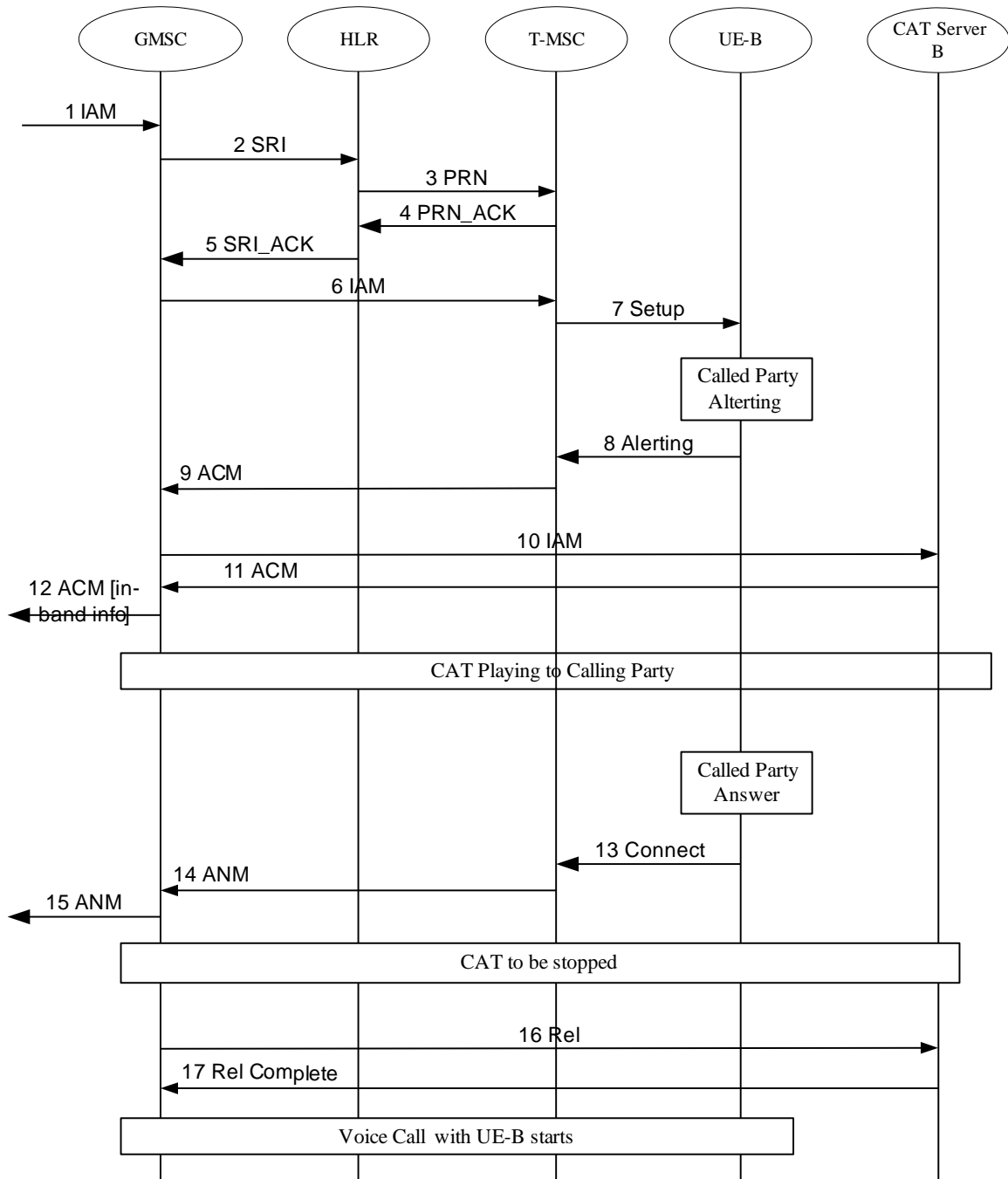
Figure 7.1.3.1.1.1: Audio Ring back tone provided by CAT server B

1 to 4 As per normal mobile terminating (speech) call scenario.

5 SRI ACK includes a specific mark (e.g. OSSS code) to indicate that the called party supports audio CAT-B during ringing phase.

6 to 9 As per normal mobile terminating (speech) call scenario.

10 As instructed by the subscriber mark (e.g. OSSS code) received in the SRI-ACK message (5), the GMSC establishes a call towards the CAT server B with the called party number including UE-B's MSISDN. The CAT server's address is decided on local policy or UE-B's MSISDN.

Editor's Note: The exact means to convey the called party number to the CAT server is ffs. E.g. the called party number could contain RBT steering (routeing) digits followed by the UE-B's MSISDN.

11 Upon receipt of the ACM message from the CAT server, the GMSC through-connect the originating call with the call established towards the CAT server. The audio CAT is played to the calling UE.

12 The GMSC sends an ACM message towards the originating MSC indicating that in-band information is available.

NOTE: Steps 12 can be performed in parallel with step 10 to avoid delaying call handling.

13 Upon receipt of the ANM message from the terminating MSC (once UE answers the call), the GMSC releases the connection with the CAT server and through-connects the originating call with the called party.

NOTE: If the Originating MSC is co-located with the GMSC, the message 1 is SETUP, message 10 is ALERTING, message 15 is CONNECT.

NOTE: A very short clipping might occur till the GMSC through-connects the calling and called parties.

Editor's Note: The originating MSC needs to know whether a CAT-B is played or not to determine whether a CAT-A may be played or not. It is ffs how this can be signalled.

7.1.3.2 Multimedia call

It is assumed in that sub-clause that the calling party has either not subscribed or not activated CAT service, or that it has activated CAT service but with CAT settings indicating preferences to CAT-B service. It is also assumed that the CAT server support H.324m.

To play the video CAT, two successive H.245 negotiations are performed :

- a first one between the calling party's UE and the CAT server during the alerting phase ; the end to end bearer connection between the calling party's UE and the CAT server shall be two-way through-connected to allow the H.245 negotiation ;

- a second one between the calling and the called parties's UE when the called party picks up the call. I.e. when the called party answers, the calling party's UE shall be instructed to release the H.245 call with the CAT server and to setup the 2nd H.245 connection with the called party's UE.

Video CATs can only be delivered to handsets supporting the corresponding capabilities (not supported by pre-Rel8 handsets).

It should be further investigated during the normative specification work to define a forward indicator to indicate support for MuMe CAT in the Ue/MSC-A.

Additionally a specific indication in the backward direction should be considered to clearly identify to the originating MSC that a Multimedia CAT is required as an alternative to the option to provide inband information indicator in the Optional backward call indicators IE.

Both the above proposals would require enhancements to ISUP – either as new ISUP parameters (with associated compatibility information) or via the APM mechanism; preferably a 3G specific APM – the specific solution is FFS.
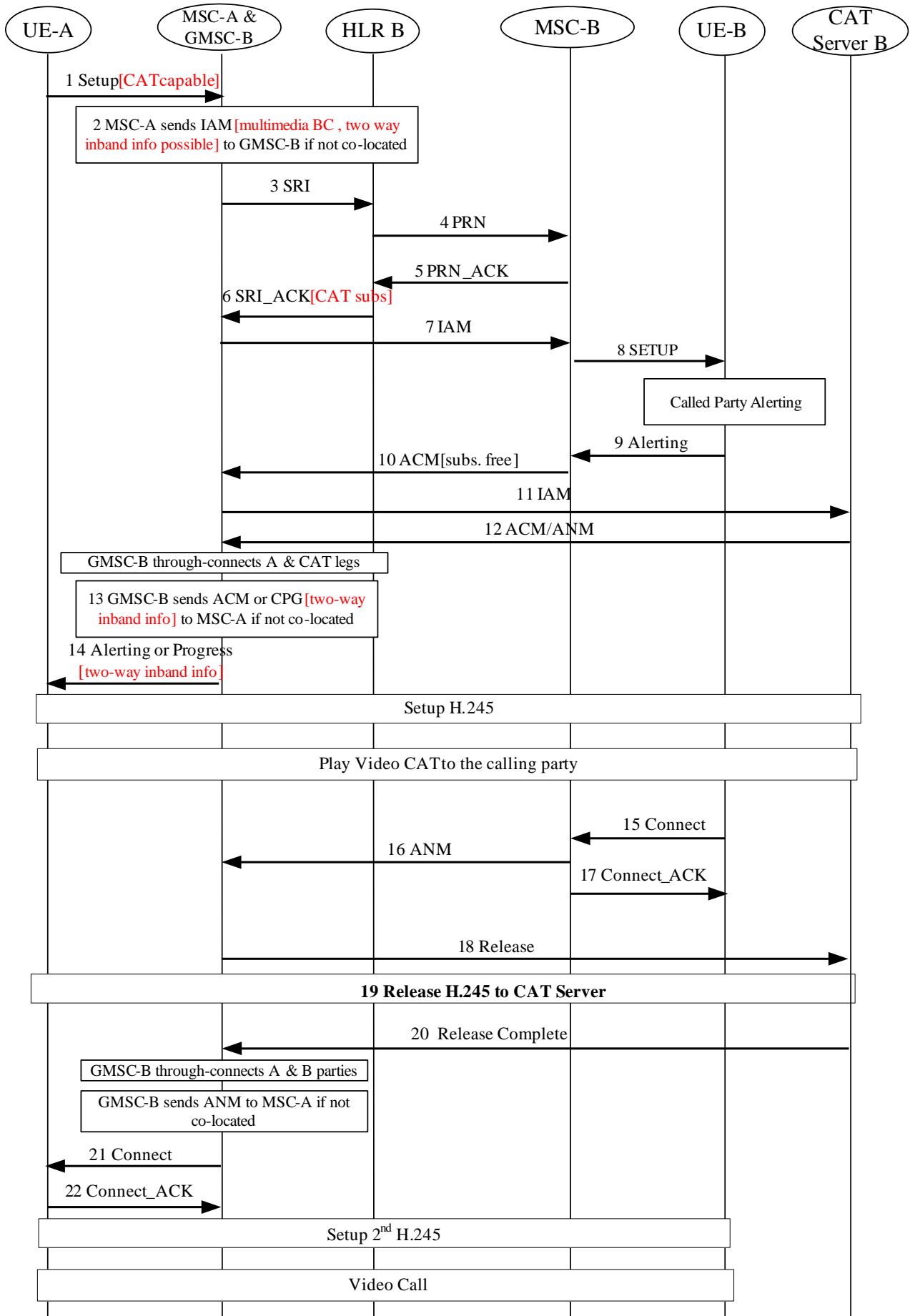
Figure 7.1.3.2.1.1: Video Ring back tone provided by CAT server B

1 to 6   As per normal mobile originating/terminating (multimedia) call scenario, with the following additions :

- the UE indicates in the SETUP message if it supports the capability to setup an early multimedia CAT call prior to the multimedia call towards the end party signals

- MSC-A sends to GMSC-B an IAM message with a multimedia bearer capability.

- SRI ACK includes a mark to indicate that the called party is a CAT subscriber.

7 to 10 As per normal mobile terminating (multimedia) call scenario.

11   If the called subscriber is a CAT subscriber, and if a multimedia call can be setup between the calling and called parties, the GMSC establishes a UDI call towards the CAT server B with the called party number set as UE-B's MSISDN. The CAT server's address is decided on local policy or UE-B's MSISDN.

NOTE 1:   In the above figure the GMSC does not get in the IAM message an indication on whether the calling party UE supports video CAT or not. It will establish a bearer towards the multimedia CAT server for all incoming multimedia calls towards called parties with CAT service, irrespective of the early CAT capability or not of the calling party (i.e. this leads to useless reservation of resources in the CAT Server when the calling UE is not CAT capable). A signalling solution should be investigated as indicated above to avoid this.
Without an explicit indication, it can not be guaranteed that all legacy intermediate nodes will both-way through-connect the bearer during the alerting phase. Calling parties supporting early video CAT would start an H.245 negotiation that would fail if the two-way through-connection is not achieved.
In both cases, the CAT Server will never receive a H.245 call setup request.

NOTE 2:   It should be ensured then that GMSCs never through-connects the calling and called parties during the alerting phase to make sure that a normal video call does not take place without being charged, or that CDRs are generated during the alerting phase.

13   In this figure GMSC-B (if not co-located with the originating MSC) sends an ACM or CPG message to MSC-A with the *In-band information indicator* of the Optional backward call indicators IE set to "in-band information or an appropriate pattern is now available" to inform the originating MSC that a video CAT is available. This is one option although in the normative phase of this work a specific signaling solution should be considered as indicated above. In addition, for ANSI networks only, the the *User-Network Interaction indicator* of the Optional backward call indicators IE set to '*user network interaction occurs, cut through in both directions'* is also returned by the CAT Server and relayed by the GMSC to request intermediate nodes to both way through the bearer during the alerting phase.,). MSC-A sends an ALERTING or PROGRESS message instructing UE-A to start a H.245 negotiation with the CAT server to play the video CAT.

NOTE 3:   In ITU ISUP v3 networks, the GMSC may send as an option the ITU ISUP/BICC *UID Action Indicator* set to '*through-connect in both directions'* to ensure the setting of *User-Network Interaction indicator* in ANSI networks for a call spanning over ANSI and ITU networks.

NOTE 4:   A change is required to allow the UE attaching the user connection for a multimedia call during the alerting phase since not allowed by the current TS 24.008 : "the progress indicator IE indicated user attachment and a speech mode traffic channel is appropriate for the call the mobile station shall in addition: attach the user connection for speech as soon as an appropriate channel in speech mode is available".

16 to 22   Upon receipt of the ANM message from the MSC-B (once UE answers the call), GMSC-B releases the connection with the CAT server, waits for the Release Complete message from the CAT server, and if not co-located with MSC-A, sends an ANM message which notifies originating MSC that the called party answers the video call. MSC-A sends a CONNECT message to UE-A. UE-A's releases the H245 connection with the CAT server and establishes a new H245 connection towards UE-B.

Editor's note : The influence to the UE-B and CAT server B need to be investigated with CT1, when GMSC-B through-connects A & B parties before receiving Release complete from CAT server B.

Editor's note : How the CATcapable and " inband info" flags are encoded on the MSC-UE interface is for further study. The" inband info" could be encoded as a new value of the call progress indicator.

Editor's note: The figure needs to be updated to split MSC-A and GMSC-B entities, and to represent the MGW bearer connection for each node.

NOTE: The second H.245 call is established in sequence after the release of the first H.245 call. This may introduce a period during which no video call is received by the calling party. This duration would however be very short (typically under 1 second) if MONA procedures are supported.

7.1.4   Abnormal call flows

7.1.5   Fallback call flows

7.1.5.1   CAT server failure / CAT server refuses to deliver a CAT

The call establishment shall proceed normally and the calling party shall experience the traditional alerting indication instead of the CAT if the (G)MSC Server does not succeed in establishing the connection to the CAT Server because e.g. the links to the CAT Server are all busy, or the CLIR or COLR service takes precedence over the CAT service, or the CAT Service is de-activated by the CAT subscriber, or any further reasons.

Similarly, the call establishment shall also proceed normally and the calling party should also experience the traditional alerting indication if the (G)MSC succeeds in establishing the connection to the CAT Server but the H.245 negotiation subsequently fails with the calling party. The originating UE should play locally an alerting indication to the subscriber if the H.245 session fails during the alerting phase (new handset requirement).

7.1.5.2   Multimedia call not possible towards called party

If a multimedia CAT can not be delivered to the calling party e.g. because the called party does not support BS30 or because it is not under radio coverage authorizing a multimedia call, an audio CAT may be played instead if possible, e.g. if the calling party initiates a SCUDIF call with both speech and multimedia supported. Otherwise the call is rejected with a specific cause, a new speech call may then be re-established by the UE where an audio CAT may be played as per the calling party's subscription.

7.1.5.3   Handover during video CAT

SCUDIF procedures may be initiated if the calling party experiencing a video CAT is handed over to a radio coverage not supporting multimedia session, if applicable. During reconfiguration of a multimedia to a speech call, any on-going video CAT shall be stopped and be replaced by the default alerting tone.

Editor's Note: Whether an audio CAT may be played in that condition is ffs. This would require, among others, that the (G)MSC Server retrieves the audio and multimedia CAT marks during the HLR interrogation, independently of the bearer capability sent to the HLR.

7.2   Alternative 2 – CAT Server switch architecture

7.2.1   Triggering methods

Same triggering methods specified in sub-section 7.1.1 for the (G)MSC Server switch architecture can be used for the CAT Server switch architecture.

7.2.2   Trigger points in the call

Same triggering points specified in sub-section 7.1.2 for the (G)MSC Server switch architecture is used for the CAT Server switch architecture with the following modifications:

- The CAT server plays CAT to the calling party locally with no establishing a connection to the CAT server;

- The CAT server does not play CAT to the calling party locally instead of "no connection to CAT server";

7.2.3 Nominal call flows

7.2.3.1 Speech call

It is assumed in that sub-clause that the calling party has either not subscribed or not activated CAT service, or that it has activated CAT service but with CAT settings indicating preferences to CAT-B service.

To play an audio CAT during a speech call, GMSC-B both-way through-connects the speech bearer from the calling party A to the CAT server B when the called party B is free, which is transparent to the A party. When the B party answers the call, CAT Server B through-connects the calling and called parties.
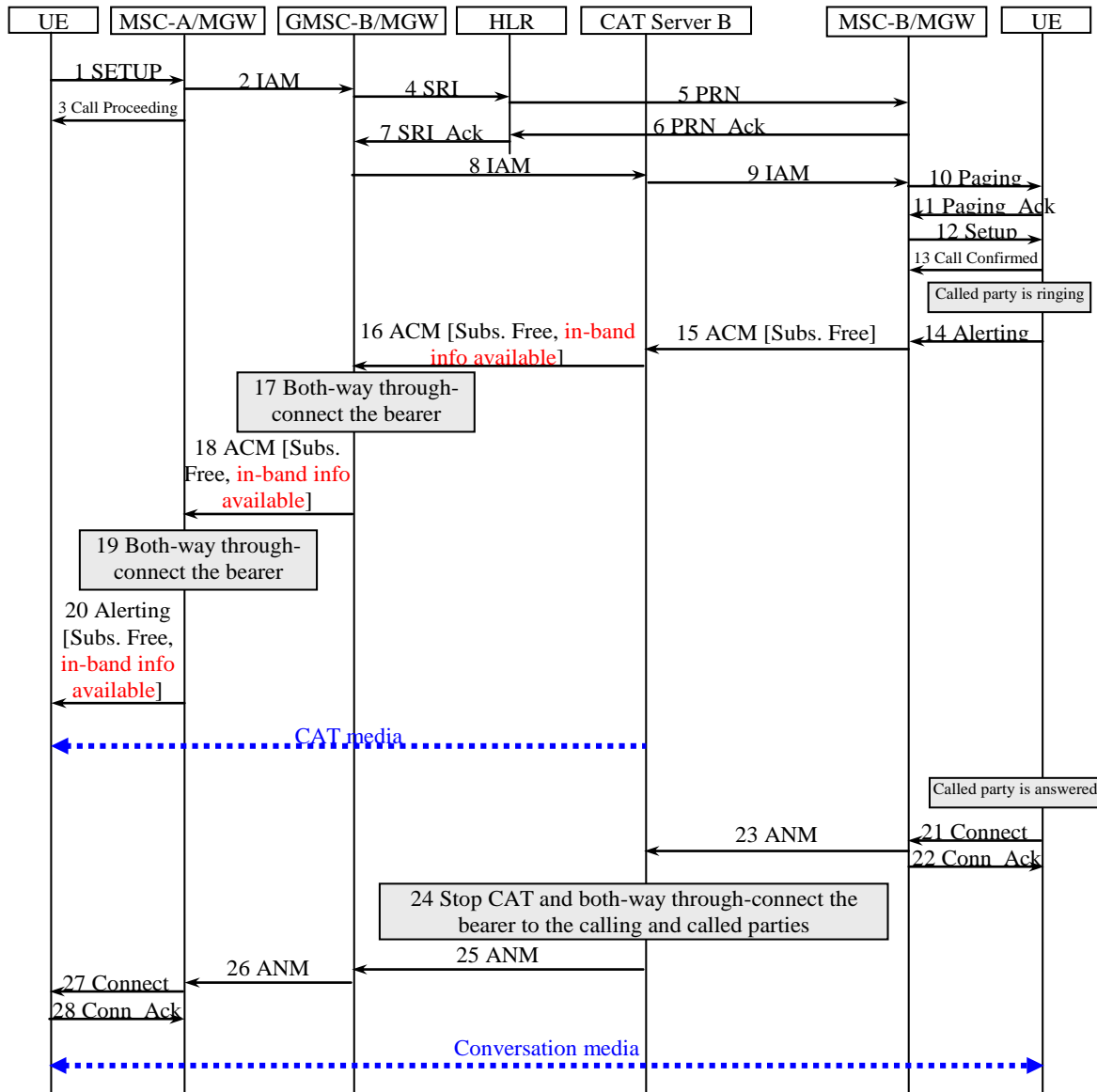
Figure 7.2.3.1.1: Audio CAT provided by CAT server B

1 to 7 As per normal mobile originating/terminating speech call, with the following additions:

- SRI ACK includes a mark to indicate that the called party is a CAT subscriber.

8 MSC-B route the call to CAT Server B.

9 CAT Server B route the call to MSC-B.

10-14 As per normal mobile terminating (speech) call.

15 Upon receipt of the ACM message from the MSC-B, the CAT Server B plays audio CAT to the calling UE and shielding the alerting tone from the succeeding node.

16 CAT server send ACM message to the preceding node, GMSC-B as normal call, with the following additions:

- In the ACM message, In-band information indicator of the Optional backward call indicators information element is set to "in-band information or an appropriate pattern is now available".

17 GMSC-B process the ACM as normal call with the following additions:

- Both-way through-connect the bearer to the succeeding node with the preceding node to enable DTMF transmission if in-band DTMF transmission mechanism is used in both sides.

NOTE: Both-way through-connect the bearer to the preceding node and the CAT server is for enabling the DTMF transmission if in-band DTMF transmission mechanism is used in both sides. If out-of-band DTMF transmission is used on either to the preceding node or to the succeeding, through-connect the bearer from the succeeding node to the preceding node is used.

18 GMSC-B send ACM message to the preceding node, MSC-A as normal call, with the following additions:

- In the ACM message, In-band information indicator of the Optional backward call indicators information element is set to "in-band information or an appropriate pattern is now available".

19 MSC-A process the ACM as normal call.

20 MSC-A send Alerting to the UE-A as normal call with the following additions:

- "In-band information or appropriate pattern now available" flag of the Progress indicator information element is set to indicate in-band info is available.

21-22 As per normal mobile terminating (speech call).

23-24 Upon receipt of the ANM message from the MSC-B, CAT server B stops CAT and both-way through-connect the bearer to the calling and called parties.

25-28 As per normal mobile terminating (speech call).

7.2.3.2 Multimedia call

It is assumed in that sub-clause that the calling party has either not subscribed or not activated CAT service, or that it has activated CAT service but with CAT settings indicating preferences to CAT-B service. It is also assumed that the CAT server support H.324m.

To play the video CAT, two successive H.245 negotiations are performed:

- A first one between the calling party's UE and the CAT server during the alerting phase; the end to end bearer connection between the calling party and the CAT server shall be two-way through-connected to allow the H.245 negotiation;

- A second one between the CAT server and the called party when the called party answers the calls.

Video CATs can only be delivered to handsets supporting the corresponding capabilities (not supported by pre-Rel8 handsets).
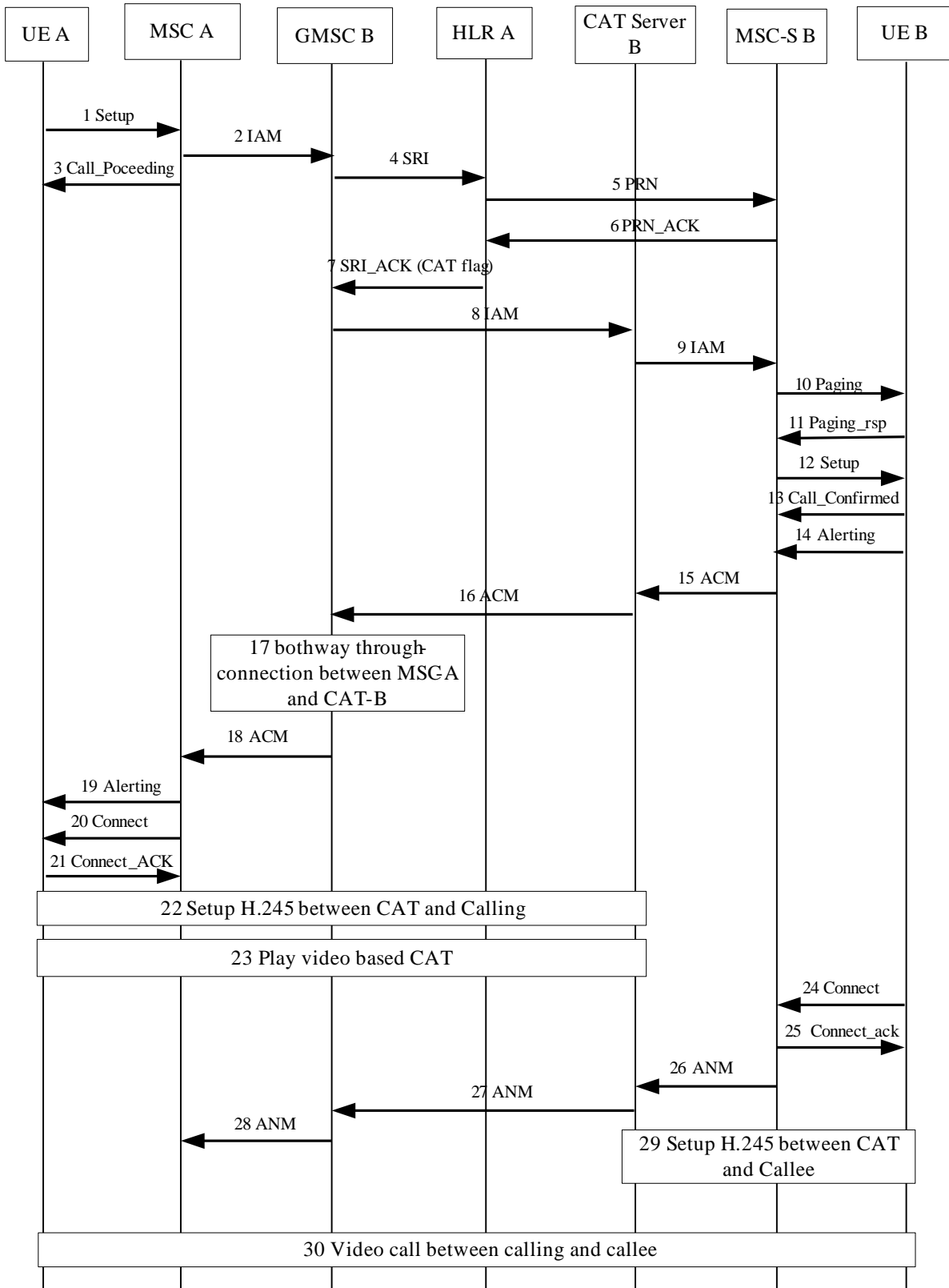
Figure 7.2.3.2.1: Video CAT provided by CAT server B

1 to 7   As per normal mobile originating/terminating multimedia call, with the following additions:

- SRI ACK includes a mark to indicate that the called party is a CAT subscriber.

8   GMSC-B route the call to CAT Server B if the called party has subscribed and activated CAT service with the following additions:

- the called number IE is set to the called party MSISDN with additional prefix.

- the Generic Number IE is set to the MSRN with specific 'Number Qualifier Indicator'.

9   CAT Server B route the call to MSC-B.

10-15 As per normal mobile terminating (multimedia) call.

16   CAT server send ACM message to the preceding node, GMSC-B as normal call, with the following additions:

- In the ACM message, In-band information indicator of the Optional backward call indicators information element is set to "in-band information or an appropriate pattern is now available".

17   GMSC-B process the ACM as normal call with the following additions:

- Both-way through-connect the bearer to the succeeding node with the preceding node to enable the H.245 negotiation and DTMF transmission.

18   GMSC-B send ACM message to the preceding node MSC-A, with the following additions:

- In the ACM message, *In-band information indicator* of the Optional backward call indicators information element is set to "*in-ban*d information or an appropriate pattern is now available".

19   MSC-A process the ACM as normal call and send Alerting to the UE-A as normal call, with the following additions:

- both-way through-connect the bearer to the succeeding node with the preceding node to enable the H.245 negotiation.

20-21 MSC-A send Connect message to UE-A and receive the Connect-Ack from UE-A.

NOTE: The Connect message to CAT capable UE-A could be sent after MSC-A receiving the ANM message, see the description in subclause 10.1.1, as another alternative, which will require the Alerting message to UE-A with additional information to indicate that "in-band multimedia info is available". How the "in-band multimedia info is available" flags are encoded on the MSC-UE interface is FFS

22-23 For multimedia call, the UE-A and the CAT server will start the in-band H.245 negotiation to establish the multimedia bearer through the fully connected bearer. After the completion of the H.245 negotiation, the UE-A will receive multimedia customized alerting tone media and play it to the calling subscriber.

24-28 As per normal mobile terminating (multimedia call). When MSC-A receive the ANM message, and will not send the Connect message to UE-A.

29   CAT server B starts the in-band H.245 negotiation with the UE-B.

30   After the completion of the H.245 negotiation with the UE-B, CAT server B stops CAT and bridge the media between the bearer to the calling and called parties.

7.2.4   Abnormal call flows

7.2.5   Fallback call flows

7.3   Alternative 3 – CAT Server switch architecture with routing back to GMSC Server

7.3.1   Triggering methods

One or several marks, (e.g. T-CSI/O-CSI) triggering the CAT service in SCP are configured in the HLR on a per subscriber basis to indicate support of audio or/and multimedia CAT-A and CAT-B services.

The originating VMSC triggers CAT-A service in the SCP if the calling party has subscribed and activated the CAT-A service and is in its HPLMN. It retrieves the subscription data of the subscriber during the location update procedure.

The GMSC triggers CAT-B service in the SCP upon arrival of an incoming call to a CAT subscriber having subscribed and activated the CAT-B service. The GMSC server retrieves the subscription data of the subscriber during the HLR interrogation.

Instead of SCP triggering also the methods described in chapter 7.1.1 for the (G)MSC Server switch architecture can be used.

7.3.2 Trigger points in the call

The originating VMSC server shall trigger the calling party configured CAT service and route the call to the CAT server if the originating party has subscribed and activated the CAT service.

The GMSC server shall trigger the called party configured CAT service and route the call to the CAT server if the called party has subscribed and activated the CAT service. The CAT server routes the call back to the GMSC Server.

The CAT server checks the content of the incoming ACM and CPG from the succeeding node and decides to do or do not play CAT locally during alerting phase as defined in chapter 7.1.2.

7.3.3 Nominal call flows

7.3.3.1 Speech call

The speech call is handled as in chapter 7.1.3.1 with the following exceptions:

A 2 phase HLR inquiry is executed. In the first phase GMSC receives a mark (f.e. T-CSI with service key) indicating CAT subscriber but without roaming number. In the second HLR inquiry (with T-CSI suppressed) GMSC receives the roaming number.

SCP may be used only for triggering or GMSC could store the MSRN received in the SRI and uses it when the call is routed back from the CAT Server to the GMSC Server.

7.3.3.2 Multimedia call

NOTE: The triggering H.245 negotiation to the CAT Server with the Connect message in the alerting phase (analysed in chapter 10.1.1 Triggering of the H.245 call setup towards the CAT Server) assumes that bothway through connection is put in place during the alerting phase.

CAT phase
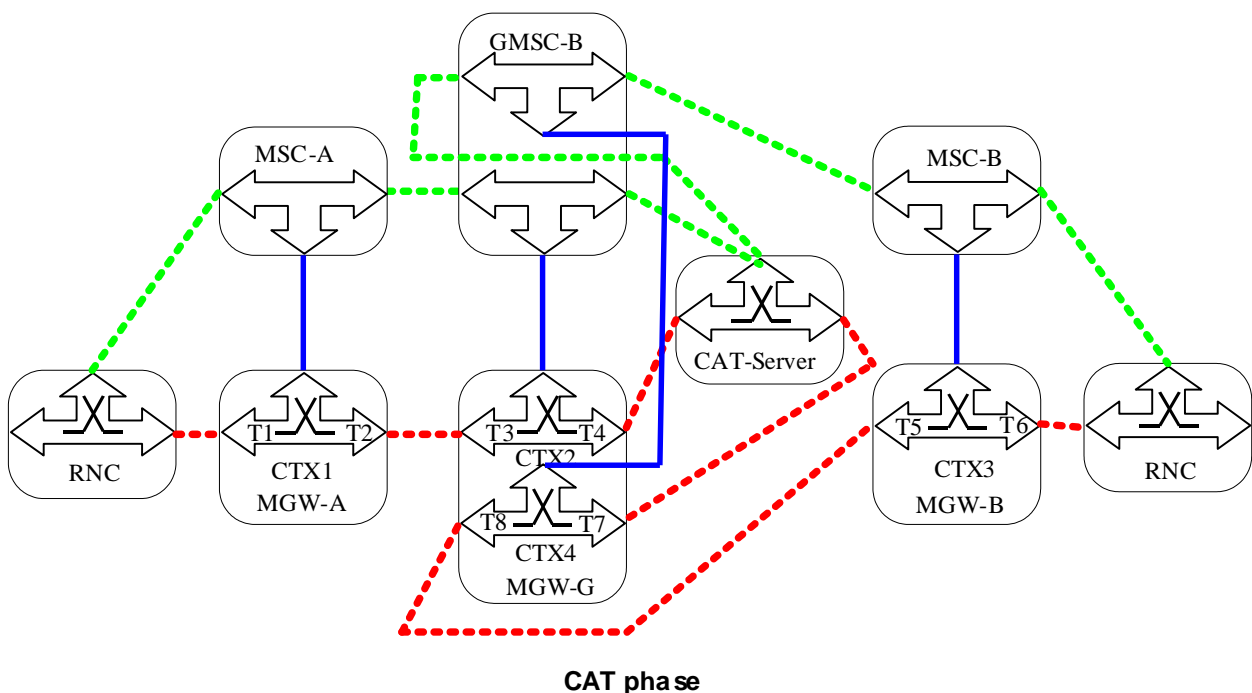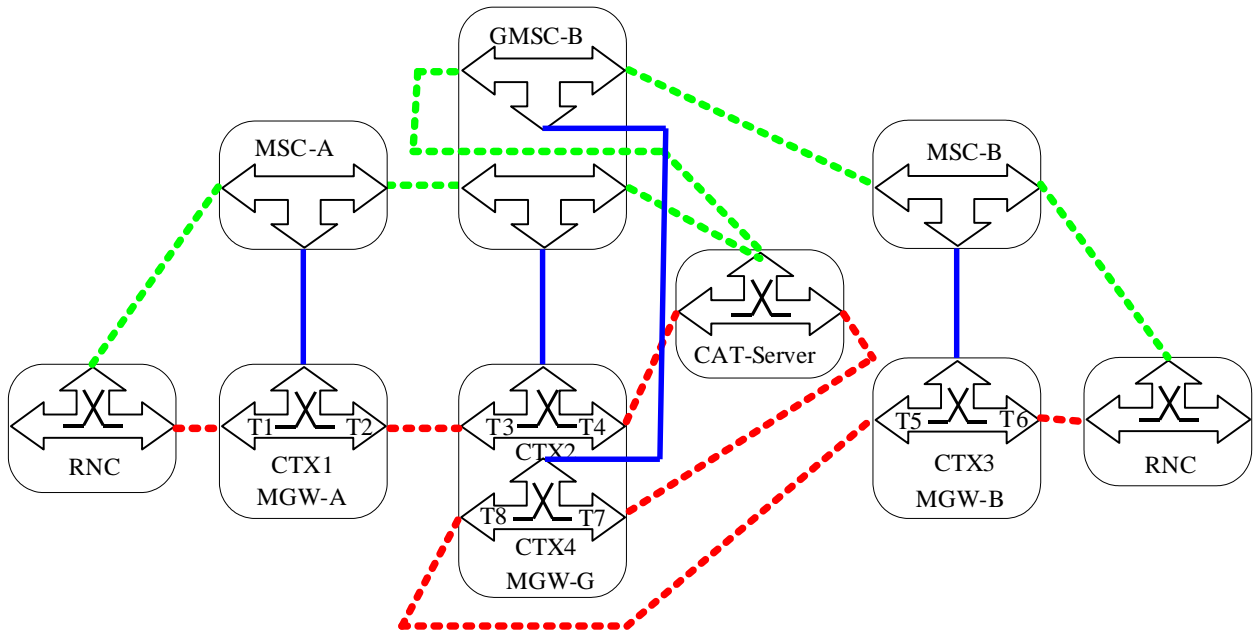
Video call phase

Figure 7.3.3.2.1 CAT-B server switch architecture with routing back to GMSC Server (network model)

UE-A MSC-A MGW-A GMSC-B MGW-g HLR B CAT Server B MSC-B MGW-B UE-B

1 Setup

1a Setup (CAT capable)

2 IAM[BC]

3 ADD.req $($)

7 SRI

4 ADD.rep C1(T1)

8 SRI_ACK[T-CSI (CAT subs)]

5 ADD.req C1($)

9 ADD.req $($)

6 ADD.rep C1(T2)

10 ADD.rep C2(T3)

11 ADD.req C2($)

12 ADD.rep C2(T4)

13 IAM [A-number, MSISDN B]

14 IAM [A-number, MSISDN B]

15 SRI [supress T-CSI]

16 PRN

17 PRN_ACK

18 SRI_ACK[MSRN]

19 ADD.req $($)

20 ADD.rep C4(T7)

21 ADD.req C4($)

22 ADD.rep C4(T8)

23 IAM [A-number, MSRN]

24 SETUP

25 ADD.req $($)

26 ADD.rep C3(T5)

27 ADD.req C3(T6)

28 ADD.rep C3(T6)

Called PartyAlerting

29 Alerting

30 ACM[subs. free]

31 ACM[subs. free]

32 ACM[OBCi]

33 ACM/CPG[OBCi]

34 MOD.req C1(T1)

35 MOD.rep C1(T1)

36 Connect

36a Alerting (two-way-inband info)

37 Connect_ACK

38 Setup H.245

39 Play Video CAT to the calling party

40 Connect

41 MOD.req C3(T6)

42 MOD.rep C3(T6)

43 Connect_ACK

44 ANM

45 ANM

46 Setup 2nd H.245

47 Remove Video CAT to the calling party; bridge UE-A - UE-B

48 Video Call

49 ANM

50 ANM

50a Connect

50b Connect_ACK

Figure 7.3.3.2.2 CAT-B server switch architecture with routing back to GMSC Server

1 to 6   As per normal mobile originating call scenario as defined in the clause 6.1 of 3GPP TS 23.205.

1a.   For CAT capable UEs the Setup message includes a mark that the UE is CAT capable.

7 to 12 As per normal mobile terminating (multimedia) call scenario in GMSC, with the following additions:
- SRI ACK includes a mark (in this example T-CSI with service key) to indicate that the called party is a CAT subscriber. The GMSC Server activates the internal CAT service logic.

NOTE: T-CSI is included to show that the roaming number is suppressed in the SRI ACK.

13   The GMSC Server establishes a call to the CAT-Server with the called subscribers MSISDN. The CAT Server address is decided on local policy or on UE-B's MSISDN.

14   The CAT server establishes a call to the GMSC.

15 to 18   The GMSC Server inquires HLR (T-CSI is suppressed) for roaming number.

19 to 23   The GMSC Server establishes a call to the MSC-B Server.

24 to 30   As per normal mobile terminating call scenario as defined in the clause 6.2 of 3GPP TS 23.205.

31   The GMSC Server sends the address complete message with subscriber free indication to the CAT Server

32 to 33   GMSC Server receives ACM/CPG with inband info available in the optional Backward Call Indicator from the CAT Server and sends it to the MSC-A Server.

34 to 37   In MSC-A Server the call will be bothway through connected and a Connect to the UE-A will be sent if the call is a multimedia call and the ACM&CPG included inband info available information in the Optional Backward Call Indicator.

36a   For CAT capable UEs instead of a Connect message an Alert message with a mark (two-way inband info) that triggers CAT capable UEs to start H.245 negotiation. UE does not send in this case message 37 (Connect_Ack).

38 to 39   H.245 is setup between UE-A and the CAT-Server. The CAT Server plays the Video CAT to UE-A.

40 to 44   As per normal mobile terminating call scenario as defined in the clause 6.2 of 3GPP TS 23.205 after the called party answers.

45 to 48   The GMSC Server sends the Answer message to the CAT Server. The CAT server sets up a H.245 connection towards UE-B, removes the video CAT to the calling party and bridges between UE-A and UE-B in the CAT Server.

49   The CAT server sends the Answer message to the GMSC Server.

50   MSC-A Server receives the answer message from GMSC Server and starts the charging.

50a to 50b For CAT capable UEs MSC-A Server sends a Connect message in this phase for triggering a H.245 session reset and a new H.245 negotiation with the CAT server.

Editor's note: If the CAT Server can promote the H.245 Session reset to UE-B and through connects the path is ffs.

7.3.4   Abnormal call flows

7.3.5   Fallback call flows

7.3.5.1   CAT server failure / CAT server refuses to deliver a CAT

Same handling in sub-section 7.1.5.1 for the (G)MSC Server switch architecture can be used for the CAT Server switch architecture with routing back to the GMSC Server.

7.3.5.2 Multimedia call not possible towards called party

Same handling in sub-section 7.1.5.2 for the (G)MSC Server switch architecture can be used for the CAT Server switch architecture with routing back to the GMSC Server.

7.3.5.3 Handover during video CAT

Same handling in sub-section 7.1.5.3 for the (G)MSC Server switch architecture can be used for the CAT Server switch architecture with routing back to the GMSC Server.

7.4 Alternative 4 – (G)MSC Server switch architecture use based on UE capabilities

7.4.1 Triggering methods

One or several marks, (e.g. T-CSI/O-CSI) triggering the CAT service in SCP are configured in the HLR on a per subscriber basis to indicate support of audio or/and multimedia CAT-A and CAT-B services.

The originating VMSC triggers CAT-A service in the SCP if the calling party has subscribed and activated the CAT-A service and is in its HPLMN. It retrieves the subscription data of the subscriber during the location update procedure.

The GMSC triggers CAT-B service in the SCP upon arrival of an incoming call to a CAT subscriber having subscribed and activated the CAT-B service. The GMSC server retrieves the subscription data of the subscriber during the HLR interrogation.

Editor's Note: It is FFS if the restriction of CAT-A service to its HPLMN can be removed.

7.4.2 Trigger points in the call

The originating VMSC server shall trigger the calling party configured CAT service. The SCP orders the VMSC Server to connect the call to the CAT server if the originating party has subscribed and activated the CAT service.

The GMSC server shall trigger the called party configured CAT service. The SCP orders the GMSC Server to connect the call to the CAT server if the called party has subscribed and activated the CAT service.

The originating MSC (for CAT-A) and GMSC (for CAT-B) reports to the SCP the receipt of an ACM message with the Called Party Status in the Backward Call Indicators set to 'Subscriber free' or upon receipt of a CPG message with the Event Information set to Alerting. The SCP orders the originating MSC (for CAT-A) or the GMSC (for CAT-B) to establish a connection to the CAT Server.

The originating MSC (for CAT-A) and GMSC (for CAT-B) reports to the SCP if a received CPG message includes the Event Information set to Call Forwarding , a "Call Diversion Information" IE, a Generic Notification Indicator IE set to ' Call diverting' or an ANSI Notification Indicator set to 'Call is forwarded/deflected'. The SCP is aware of existing connections between the originating MSC /GMSC and a CAT Server and the UE's session reset capability. If the UE supports session reset the SCP requests the GMSC Server to release the connection to the CAT-Server.

7.4.3 Nominal call flows

7.4.3.1 Speech call

For a speech call the UE capabilities like session reset support have no influence. So a speech call can be handled as described in chapter 7.1.3.1 except that SCP triggering is used.

7.4.3.2 Multimedia call

7.4.3.2.1 UE session reset capability indicated by CAT-server

The following solution maynot require changes on the UE-MSC interface by taking advantage of the H.324 annex J session reset capability. UE which support the session reset capability can re - negotiate the H.245 after a session reset.

NOTE: Concern is raised that this requires that the UE accepts that the physical connection will be broken which is not in accordance with H.324 Clause 7.7.1 and therefore would require indication that the CAT session reset capability is supported by the Ue, if this solution were accepted this issue needs to be further investigated.

The information if an UE supports session reset is available in the CAT server during the first H.245 negotiation. For providing this information also to the GMSC Server a CAMEL 4 solution which uses the Call Party handling is described. An additional connection (connection 2 in the example call flow below) to the CAT Server is used. On this connection the CAT server indicates if the calling UE supports session reset or not. In the case that UE A does not support session reset the CAT server needs to stay in the connection path during the whole video call. The CAT server indicates this by not releasing the additional connection. In the case that the UE-A supports the session reset the connection path to the CAT server can be released after the CAT phase. The CAT Server indicates this by sending a REL message on the additional connection. For indicating the different connections to the CAT Server different prefixes to the B-MSISDN are used.

Instead of CAMEL 4 procedures also an MSC Server internal SCP solution could be used.

NOTE: This solution (triggering H.245 negotiation to the CAT Server with the Connect message in the alerting phase) assumes that bothway through connection is put in place during the alerting phase which may not be guarantied in some existing switch implementations. Would this through connection not be realized, the H.245 negotiation with the CAT server would fail which would also fail the call.

Editor's note: TS 22.078 specifies that CPH procedures only apply to speech telephony. TS 22.078 needs to be expanded to cover also multimedia calls

CAT phase

Video call phase
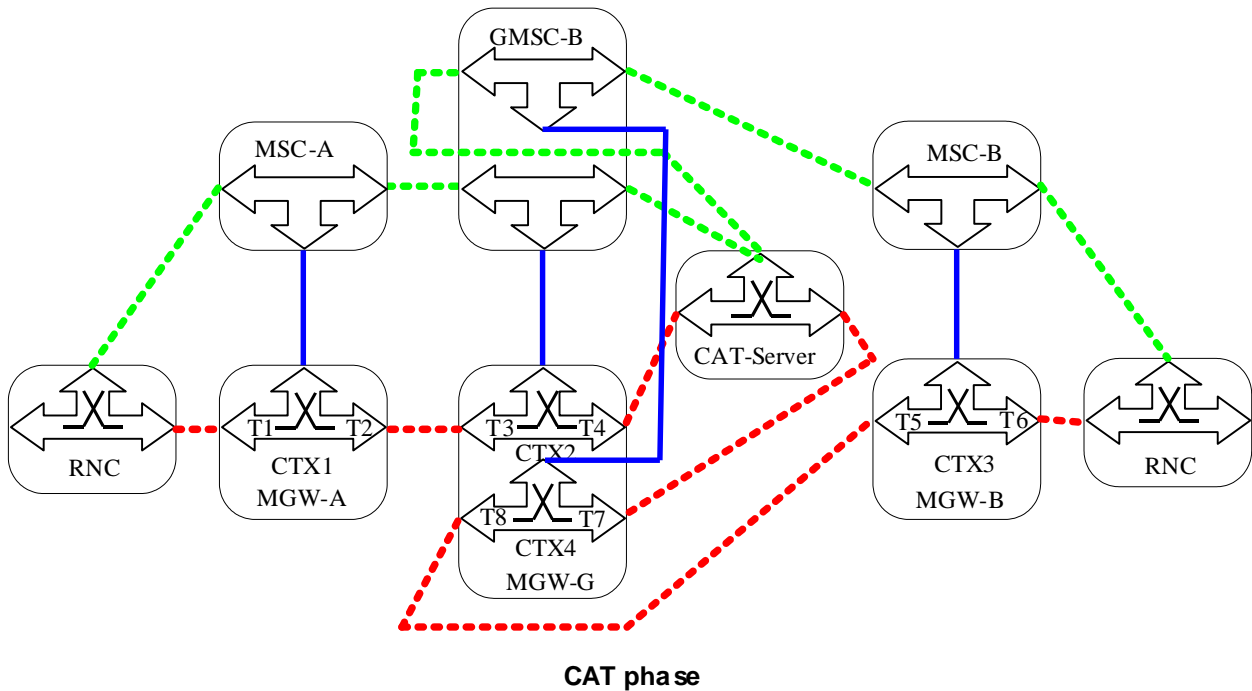
Figure 7.4.3.2.1.1 (G)MSC Server switch architecture use based on UE capabilities (UE no session reset support) (network model)

```
  UE-A   MSC-A  MGW-A    GMSC-B  MGW-g   HLR B    CAT     MSC-B   MGW-B    UE-B
                                                 Server B

    1 Setup

         2 IAM[BC]

      3 ADD.req $($)        7 ADD.req $(T3)

      4 ADD.rep C1(T1)      8 ADD.rep C2(T3)

      5 ADD.req C1($)          9 SRI[BC]

      6 ADD.rep C1(T2)   10 SRI_ACK[T-CSI, (CAT subs)]

                                           SCP

                      11 IDP[T-CSI,BC]

          12 ICA[suppress T-CSI, CS2, leg 3,MSISDN_B, A-number], RRBCSM, DiscLeg(leg 2),CWA(leg 3)

                                          HLR B

          13 SRI  [suppress T-CSI,BC]       14 PRN

            16 SRI_ACK[MSRN]                15 PRN_ACK

          17 ADD.req $(T8)        SCP

          18 ADD.rep C4(T8)

          19 IAM [A-number, MSRN,BC]

                                                           20 SETUP

                                                     21 ADD.req $($)

                                                     22 ADD.rep C3(T5)

                                                     23 ADD.req C3($)

                                                     24 ADD.rep C3(T6)

                                                   Called Party Alerting

                    26 ACM[subs. free]                     25 Alerting

          27 ERB[Alert]

          28 ETC[CS1,CAT Server Address,A-number,OCD,SII 2]

          29 ADD.req C2(T4)

          30 ADD.rep C2(T4)

          31 IAM [A-number, prefix_1+MSISDN B ] ;connection 1

            32 ACM [OBCi] ; connection 1

      33 ACM/CPG[OBCi]

          34 ETC[CS2, CAT Server Address,A-number,OCD]; leg 4

          35 AC[SFRConnection=CS2]; CWA(leg 4)

          36 ADD.req C4(T7)

          37 ADD.rep C4(T7)

          38 IAM [A-number, prefix_2+MSISDN B ,A-number,OCD];connection 2

          39 ACM ;connection 2

          40 ANM ;connection 2

      41 MOD.req C1(T1)

      42 MOD.rep C1(T1)

   43 Connect

   44 Connect_ACK
```

Figure 7.4.3.2.1.2 (G)MSC Server switch architecture use based on UE capabilities (UE no session reset support) part 1
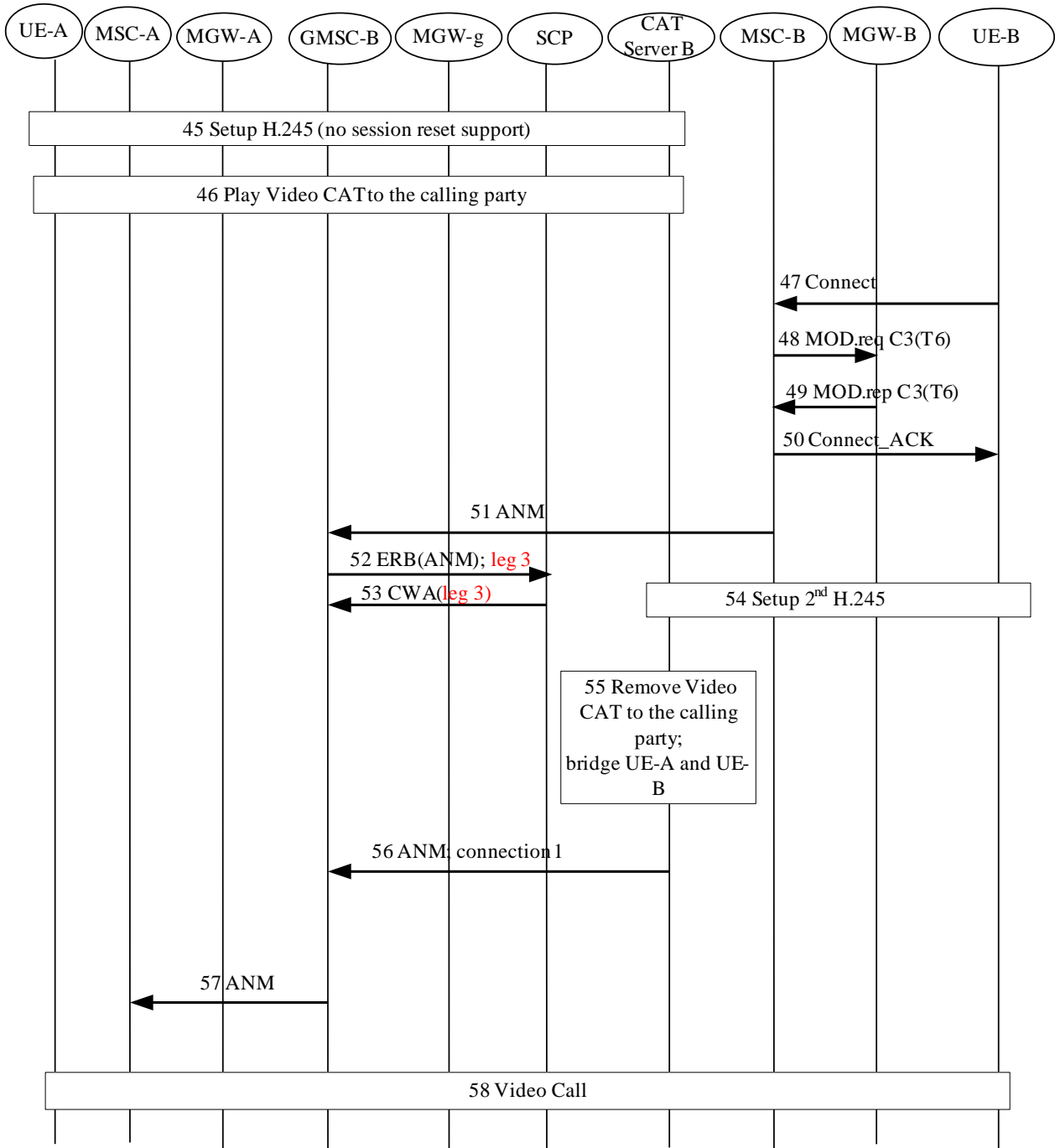
Figure 7.4.3.2.1.3 (G)MSC Server switch architecture use based on UE capabilities (UE no session reset support) part 2

1 to 6 As per normal mobile originating call scenario as defined in the clause 6.1 of 3GPP TS 23.205.

7 to 10 The GMSC Server reserves the incoming side termination and interrogates the HLR. GMSC Server receives the T-CSI which includes information about the CAT subscription of the called subscriber.

11 Initial DP is sent to the SCP.

12 to 19 The SCP initiates the call to the B-subscriber with an Initiate Call Attempt procedure. T-CSI triggering is suppressed. New Call Segment is set to 2 and leg to be created is set to 3.

20 to 26 As per normal mobile terminating call scenario as defined in the clause 6.2 of 3GPP TS 23.205,

27 to 32   Alerting is reported to the SCP and the SCP establishes a temporary connection (connection 1) to the CAT Server. A specific prefix (Prefix 1) with the B-MSISDN is used. Service Interaction Indicators Two.BothWayThroughConnection parameter is set True.

33   GMSC Server sends ACM/CPG with inband info available in the optional Backward Call Indicator to the MSC-A Server.

34 to 40   The SCP requests the (G)MSC server to establish a second connection (leg 4 for call segment 2) to the CAT server with an Establish Temporary Connection procedure.

This connection will be used for informing the GMSC server if the calling subscriber supports H.245 renegotiation (support of the H.245 session reset). A different prefix (prefix 2) with the B-MSISDN is used.

For the reporting of the session reset capability to the SCP an Apply Charging operation is used.

41 to 44   In MSC-A Server the call will be bothway through connected and a Connect to the UE/A will be sent if the call is a multimedia call and the ACM&CPG included inband info available information in the Optional Backward Call Indicator.

45   H.245 is setup between UE-A and the CAT-Server. In the capability exchange is indicated that the UE does not support the SessionResetCapability, defined in H.324 Annex J.

Because UE-A does not support "H.324 session reset" the CAT Server needs to stay in the connection after the call is answered.

46   The CAT Server plays the Video CAT to UE-A.

47 to 51   As per normal mobile terminating call scenario as defined in the clause 6.2 of 3GPP TS 23.205 after the called party answers.

52 to 53   GMSC Server reports the Answer message to the SCP. SCP sends only Continue with Arguments for leg 3, because SCP knows that UE-A does not support SessionResetCapability (ACR has not been received).

54 to 55   When the UE-B has answered the call, H.245 session is started between the CAT server and the UE-B. The CAT server disconnects the Video CAT and bridges between UE-A and UE-B in the CAT Server.

56 CAT-Server sends Answer message for connection 1 to GMSC.

57 MSC-A Server receives the answer message and starts the charging.

CAT phase

Video call phase

Figure 7.4.3.2.1.4 (G)MSC Server switch architecture use based on UE capabilities (UE session reset support) (network model)

UE-A　MSC-A　MGW-A　GMSC-B　MGW-g　HLR B　CAT Server B　MSC-B　MGW-B　UE-B

1 Setup

2 IAM[BC]

3 ADD.req $($)

7 ADD.req $(T3)

4 ADD.rep C1(T1)

8 ADD.rep C2(T3)

5 ADD.req C1($)

9 SRI[BC]

6 ADD.rep C1(T2)

10 SRI_ACK[T-CSI, (CAT subs)]

SCP

11 IDP[T-CSI,BC]

12 ICA[suppress T-CSI, CS2, leg 3,MSISDN_B, A-number], RRBCSM, DiscLeg(leg 2),CWA(leg 3)

HLR B

13 SRI [suppress T-CSI,BC]

14 PRN

15 PRN_ACK

16 SRI_ACK[MSRN]

17 ADD.req $(T8)

SCP

18 ADD.rep C4(T8)

19 IAM [A-number, MSRN,BC]

20 SETUP

21 ADD.req $($)

22 ADD.rep C3(T5)

23 ADD.req C3($)

24 ADD.rep C3(T6)

Called Party Alerting

26 ACM[subs. free]

25 Alerting

27 ERB[Alert]

28 ETC[CS1,CAT Server Address,A-number,OCD,SII 2]

29 ADD.req C2(T4)

30 ADD.rep C2(T4)

31 IAM [A-number, prefix_1+MSISDN B] ;connection 1

32 ACM [OBCi] ; connection 1

33 ACM/CPG[OBCi]

34 ETC[CS2, CAT Server Address,A-number,OCD]; leg 4

35 AC[SFRConnection=CS2]; CWA(leg 4)

36 ADD.req C4(T7)

37 ADD.rep C4(T7)

38 IAM [A-number, prefix_2+MSISDN B ,A-number,OCD];connection 2

39 ACM ;connection 2

40 ANM ;connection 2

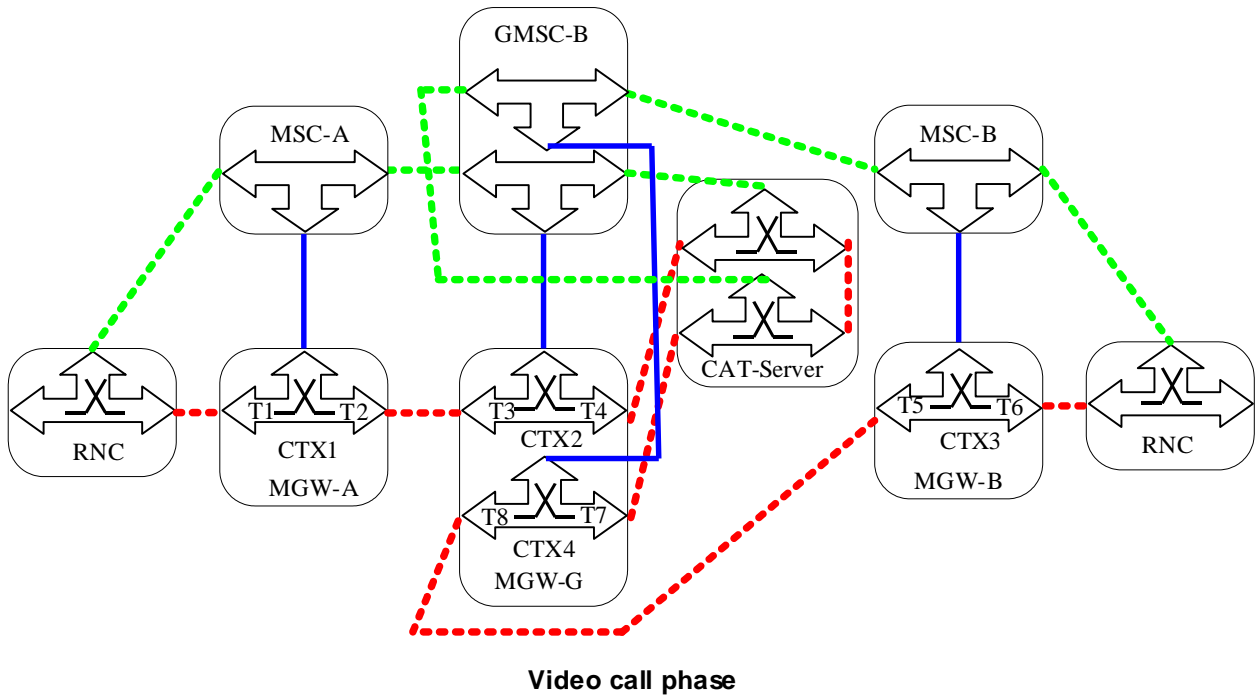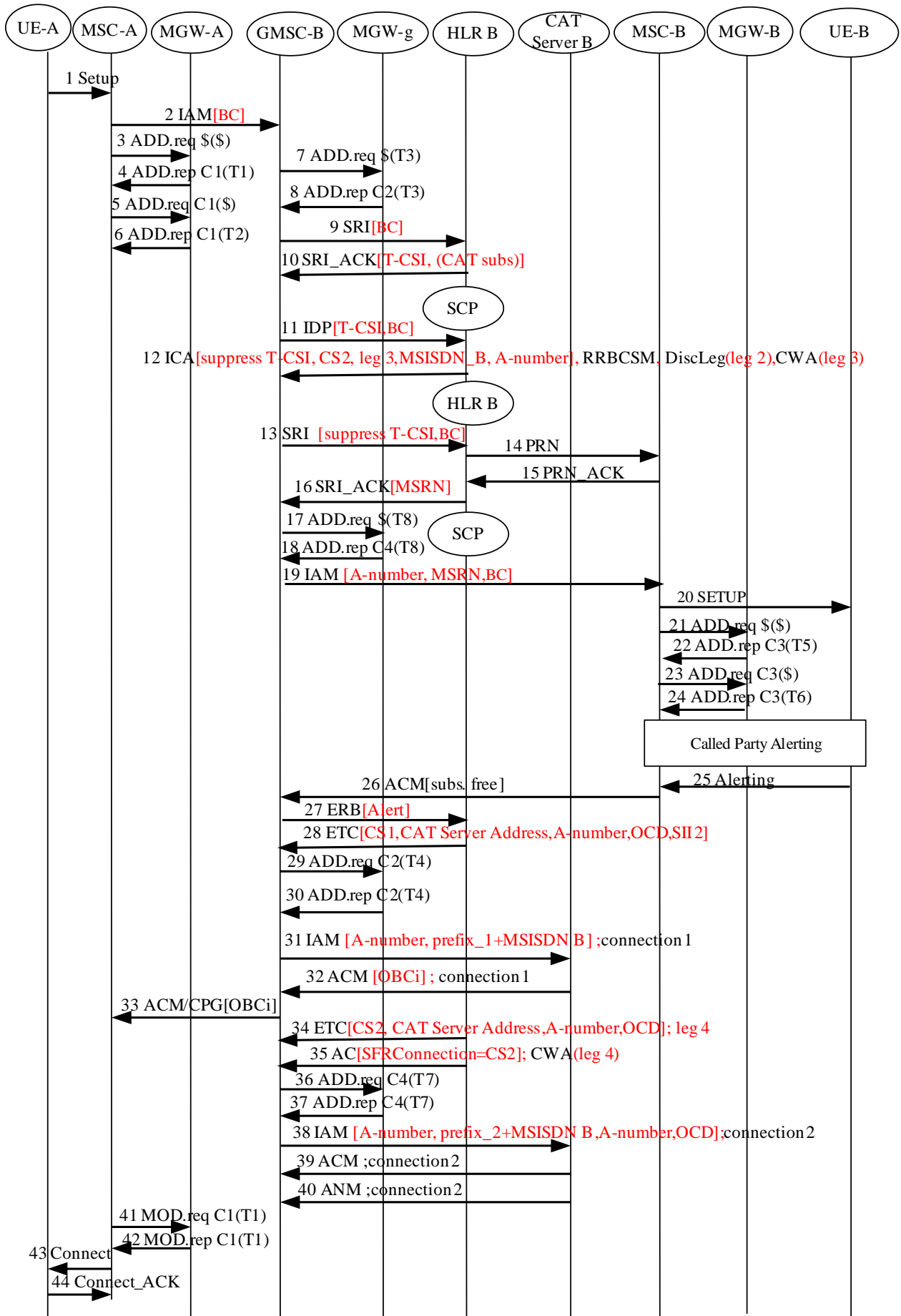41 MOD.req C1(T1)

42 MOD.rep C1(T1)

43 Connect

44 Connect_ACK

Figure 7.4.3.2.1.5 (G)MSC Server switch architecture use based on UE capabilities (UE session reset support) part 1

Figure 7.4.3.2.1.6 (G)MSC Server switch architecture use based on UE capabilities (UE session reset support) part 2

1 to 6 As per normal mobile originating call scenario as defined in the clause 6.1 of 3GPP TS 23.205.

7 to 10 The GMSC Server reserves the incoming side termination and interrogates the HLR. GMSC Server receives the T-CSI which includes information about the CAT subscription of the called subscriber.

11   Initial DP is sent to the SCP

12 to 19   The SCP initiates the call to the B-subscriber with an Initiate Call Attempt procedure. T-CSI triggering is suppressed. New Call Segment is set to 2 and leg to be created is set to 3.

20 to 26   As per normal mobile terminating call scenario as defined in the clause 6.2 of 3GPP TS 23.205,

27 to 32   Alerting is reported to the SCP and the SCP establishes a temporary connection (connection 1) to the CAT Server. A specific prefix (Prefix 1) with the B-MSISDN is used. Service Interaction Indicators Two.BothWayThroughConnection parameter is set True.

33   GMSC Server sends ACM/CPG with inband info available in the optional Backward Call Indicator to the MSC-A Server.

34 to 40   The SCP requests the (G)MSC server to establish a second connection (leg 4 for call segment 2) to the CAT server with an Establish Temporary Connection procedure.

This connection will be used for informing the GMSC server if the calling subscriber supports H.245 renegotiation (support of the H.245 session reset). A different prefix (prefix 2) with the B-MSISDN is used.

For the reporting of the session reset capability to the SCP an Apply Charging operation is used.

41 to 44   In MSC-A Server the call will be bothway through connected and a Connect to the UE-A will be sent if the call is a multimedia call and the ACM&CPG included inband info available information in the Optional Backward Call Indicator.

45   H.245 is setup between UE-A and the CAT-Server. In the capability exchange is indicated that the UE does support the SessionResetCapability, defined in H.324 Annex J.

46 to 47   Because UE-A supports "H.324 session reset" the CAT Server connection can be released after the call is answered. CAT-Server indicates this to the GMSC Server by sending a Release message for connection 2 to GMSC. GMSC Server sends Apply Charging Report for Call Segment 2 to the SCP. With this message SCP knows that the temporary connection (leg 4) of call segment 2 to the CAT server has been released and that UE-A supports session reset.

48 The CAT Server plays the Video CAT to UE-A.

49 to 51   GMSC Server releases termination of connection 2 towards CAT Server and sends a release complete to the CAT Server.

52 to 56   As per normal mobile terminating call scenario as defined in the clause 6.2 of 3GPP TS 23.205 after the called party answers.

57 The GMSC Server reports the Answer message to the SCP with an event report BCSM operation

58 to 59   SCP has already the information that UE-A supports session reset so it initiates a Disconnect Forward Connection with Argument operation for removing also the first connection to the CAT Server. GMSC Server initiates the release towards the CAT Server.

60 The CAT Server removes the Video CAT and sends a H.324 session reset to UE-A.

61 to 63   After the CAT Server has acknowledged the release, GMSC Server releases the termination towards the CAT Server in the MGW-g.

64 to 67   The SCP initiates a Move Leg operation for through connecting the terminations towards MSC-A Server and MSC-B Server.

68 MSC-A Server receives the answer message and starts the charging.

69 to 70   UE-A establishes a new H.245 connection towards UE-B.

7.4.3.2.2   Use of CAT capable indication in SETUP message (SS code solution)

A spare bit of the Classmark 2 field is used for signalling that an UE is CAT capable in the SETUP message from UE-A to MSC-A Server. Classmark 2 field can be interrogated by the HLR with a MAP Provide Subscriber Information (PSI)

from the MSC-A Server. This interrogation is initiated by the GMSC-Server with the Any Time Interrogation (ATI) MAP operation.

NOTE: ATI from GMSC-Server to HLR is not defined yet so 3GPP TS 29.002 [11] chapter 8.11.1 needs to be updated.
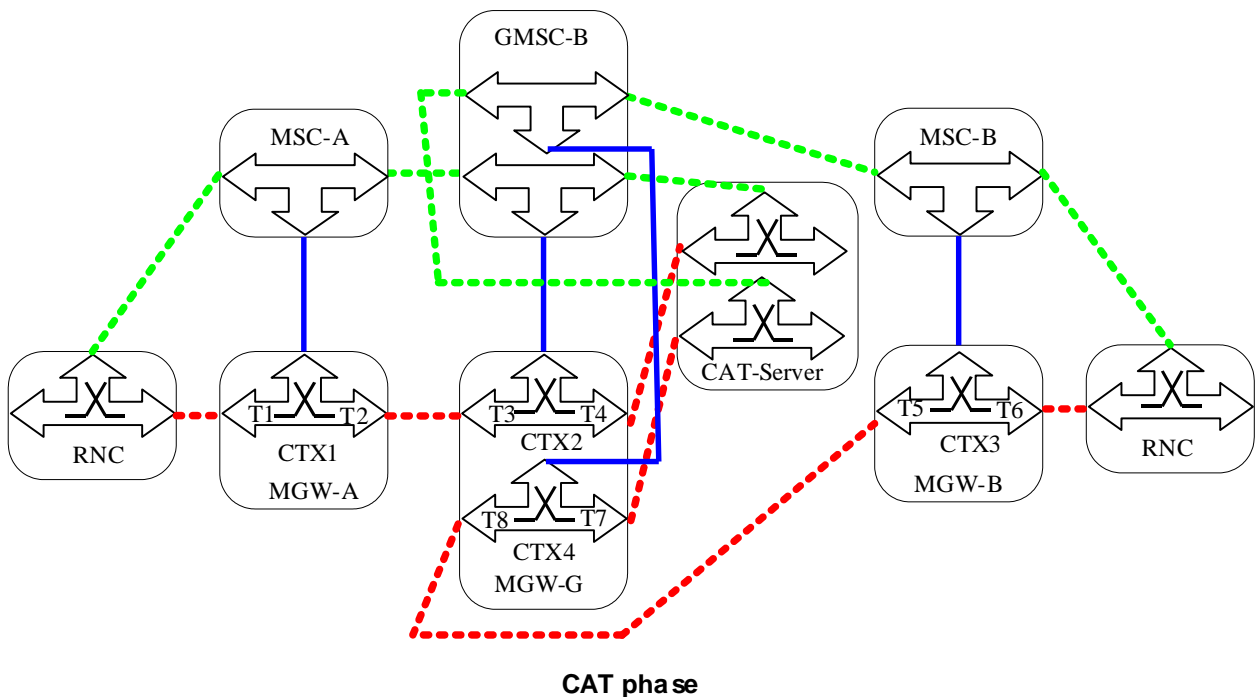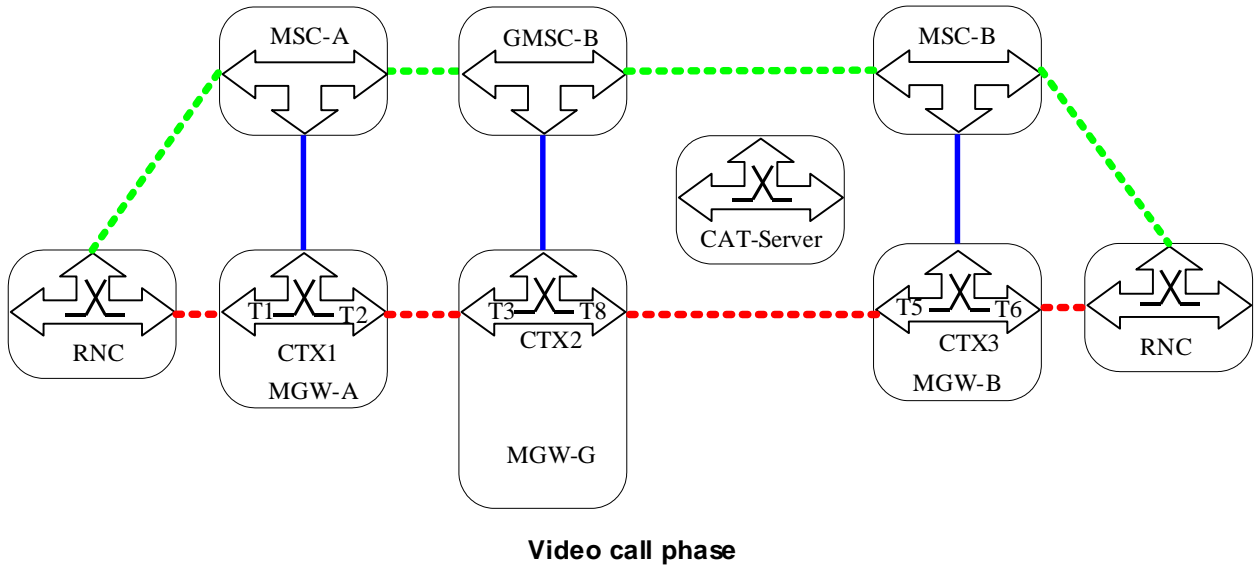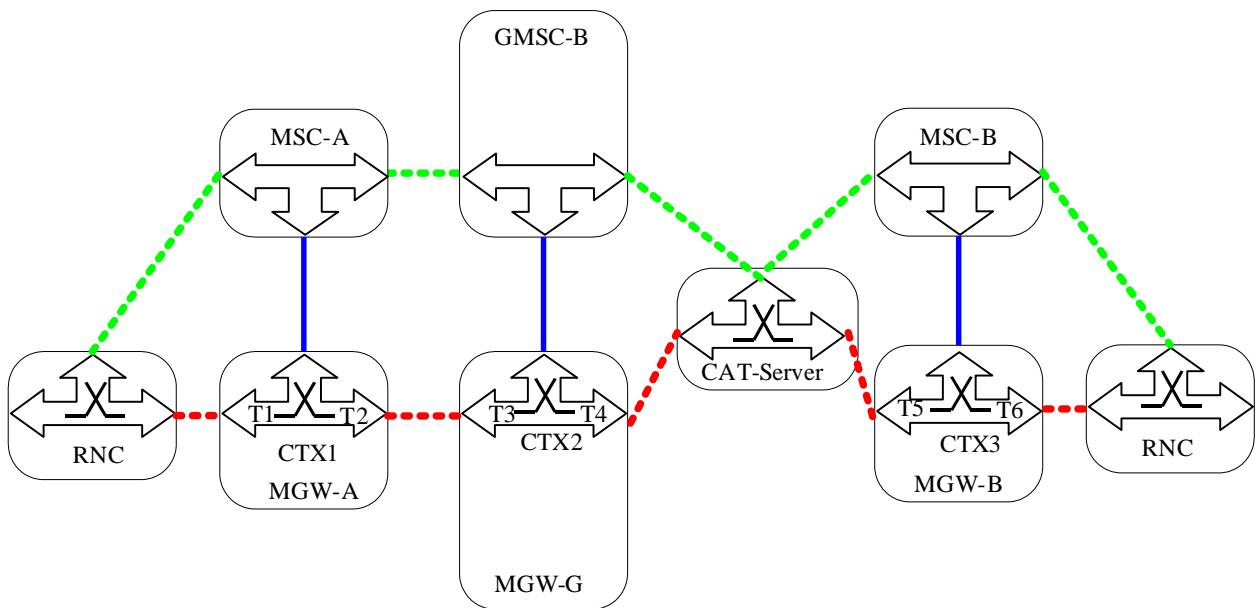
CAT phase
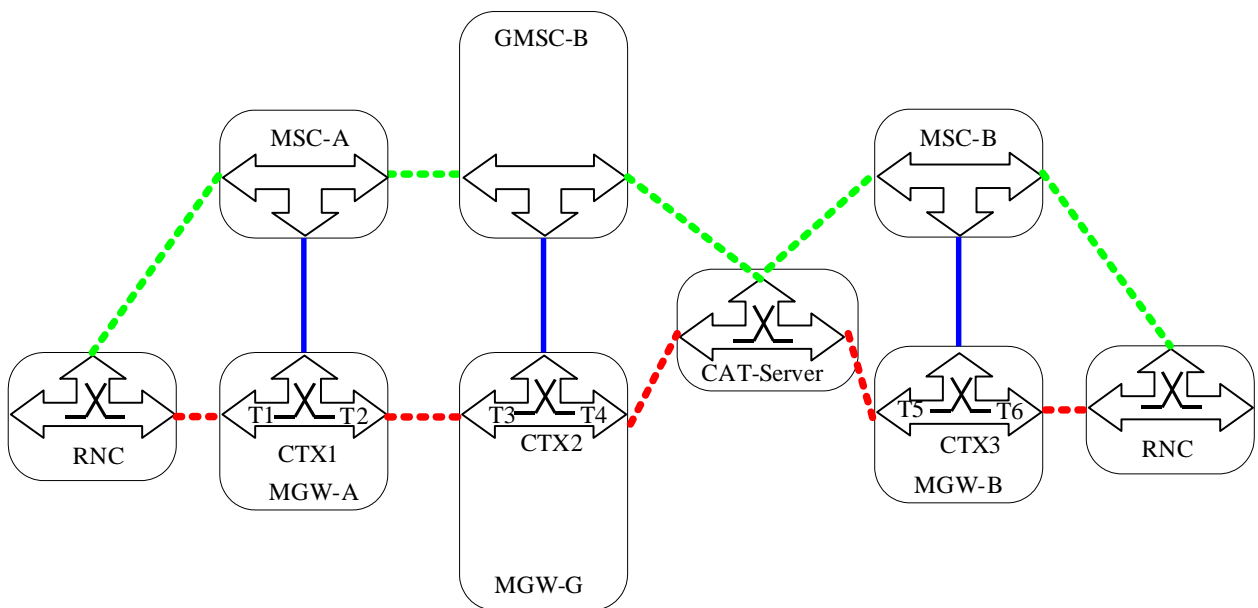
Video call phase

Figure 7.4.3.2.2.1 (G)MSC Server switch architecture use based on UE capabilities (non CAT capable UE) (network model)
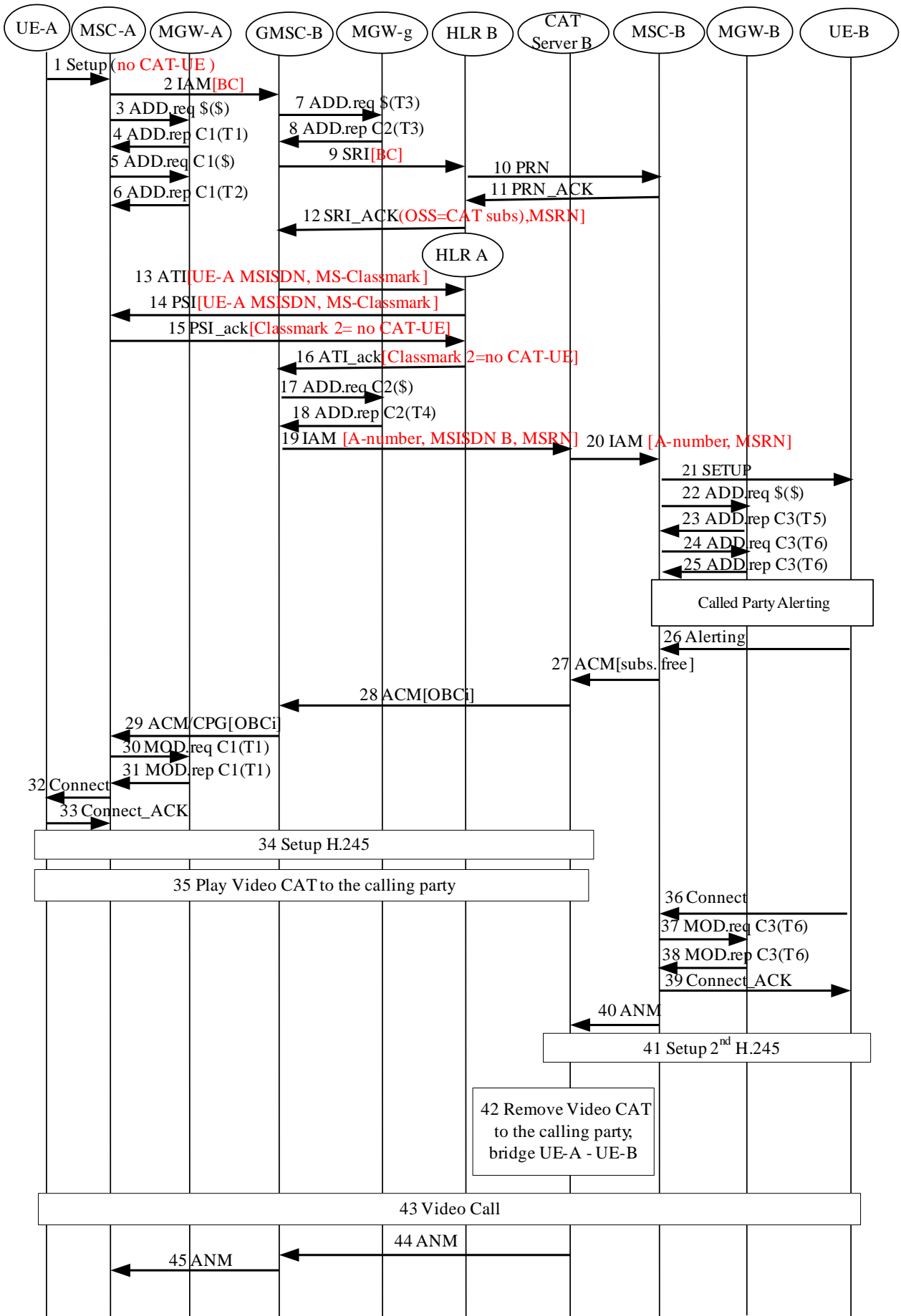
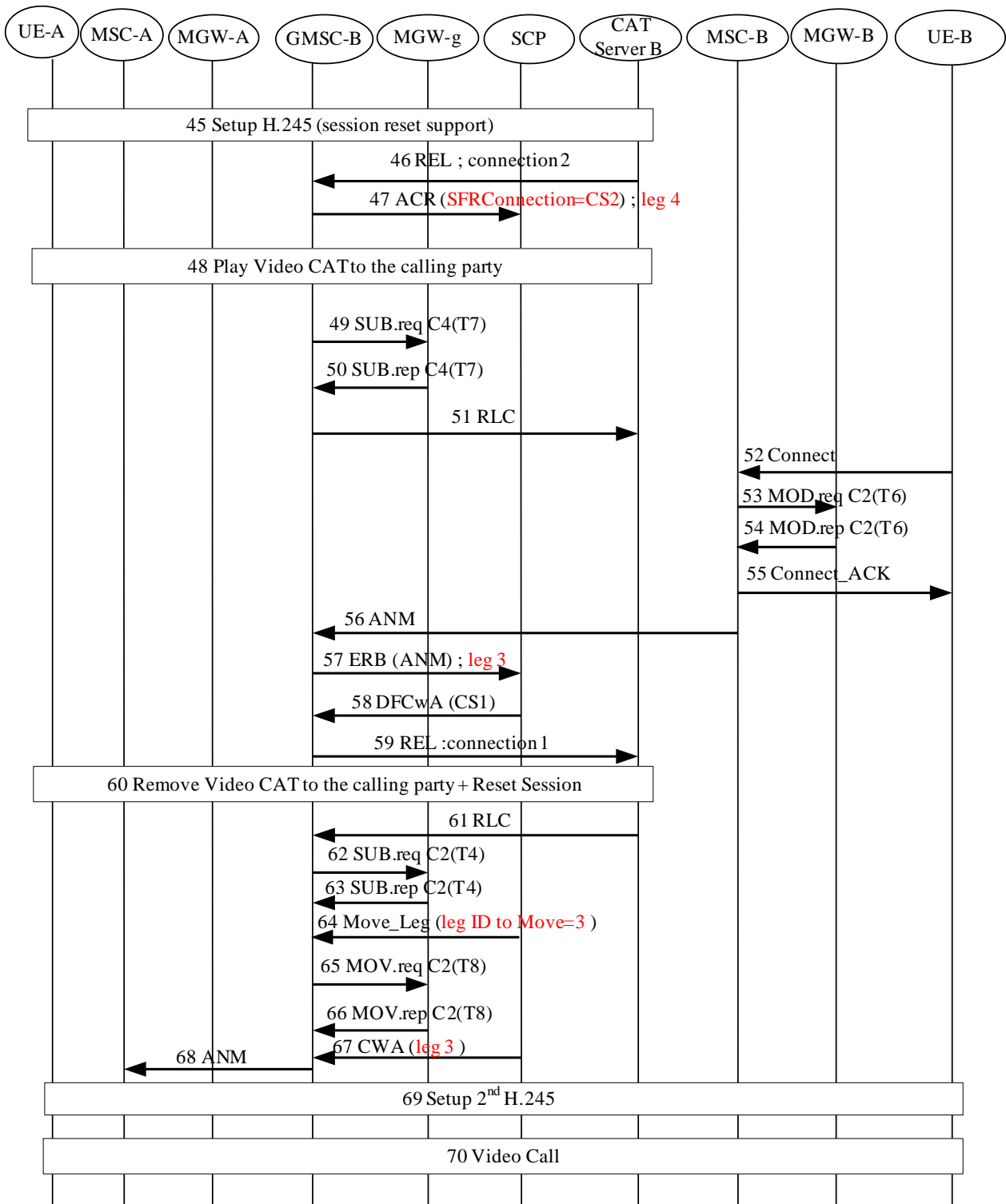**Figure 7.4.3.2.2.2 (G)MSC Server switch architecture use based on UE capabilities (non CAT capable UE)**

1 to 6 As per normal mobile originating call scenario as defined in the clause 6.1 of 3GPP TS 23.205. In the Setup message is no information that UE is CAT capable.

7 to 12 The GMSC Server reserves the incoming side termination and interrogates the HLR. GMSC Server receives an OSS which includes information about the CAT subscription of the called subscriber and the MSRN of the called subscriber.

13 GMSC initiates ATI (AnyTime Interrogation) operation to the calling subscriber's HLR for examining if UE-A is CAT capable.

14-15 HLR requests the Classmark 2 of UE-A from the originating MSC Server with the PSI (Provide Subscriber Information) operation.

16 GMSC Server receives the ATI-ack and notices that UE-A is non-CAT capable. GMSC Server initiates a call-setup in which the CAT-Server stays in the call path (as described in CAT-B server switch architecture).

17 to 20 The GMSC Server sets up a call to the CAT-Server which establishes a call to the MSC-B Server.

21 to 26 As per normal mobile terminating call scenario as defined in the clause 6.2 of 3GPP TS 23.205.

27 The MSC-B Server sends the address complete message with subscriber free indication to the CAT Server.

28 to 29 The GMSC Server receives ACM/CPG with inband info available in the optional Backward Call Indicator from the CAT Server and sends it to the MSC-A Server.

30 to 33 In MSC-A Server the call will be bothway through connected and a Connect to the UE-A will be sent if the call is a multimedia call and the ACM&CPG included inband info available information in the Optional Backward Call Indicator.

34 to 35 H.245 is setup between UE-A and the CAT-Server. The CAT Server plays the Video CAT to UE-A.

36 to 40 As per normal mobile terminating call scenario as defined in the clause 6.2 of 3GPP TS 23.205 after the called party answers.

41 to 43 The CAT Server sets up a H.245 connection towards UE-B, removes the video CAT to the calling party and bridges between UE-A and UE-B in the CAT Server.

44 The CAT server sends the Answer message to the GMSC Server.

45 MSC-A Server receives the answer message from GMSC Server and starts the charging.

CAT phase

Video call phase
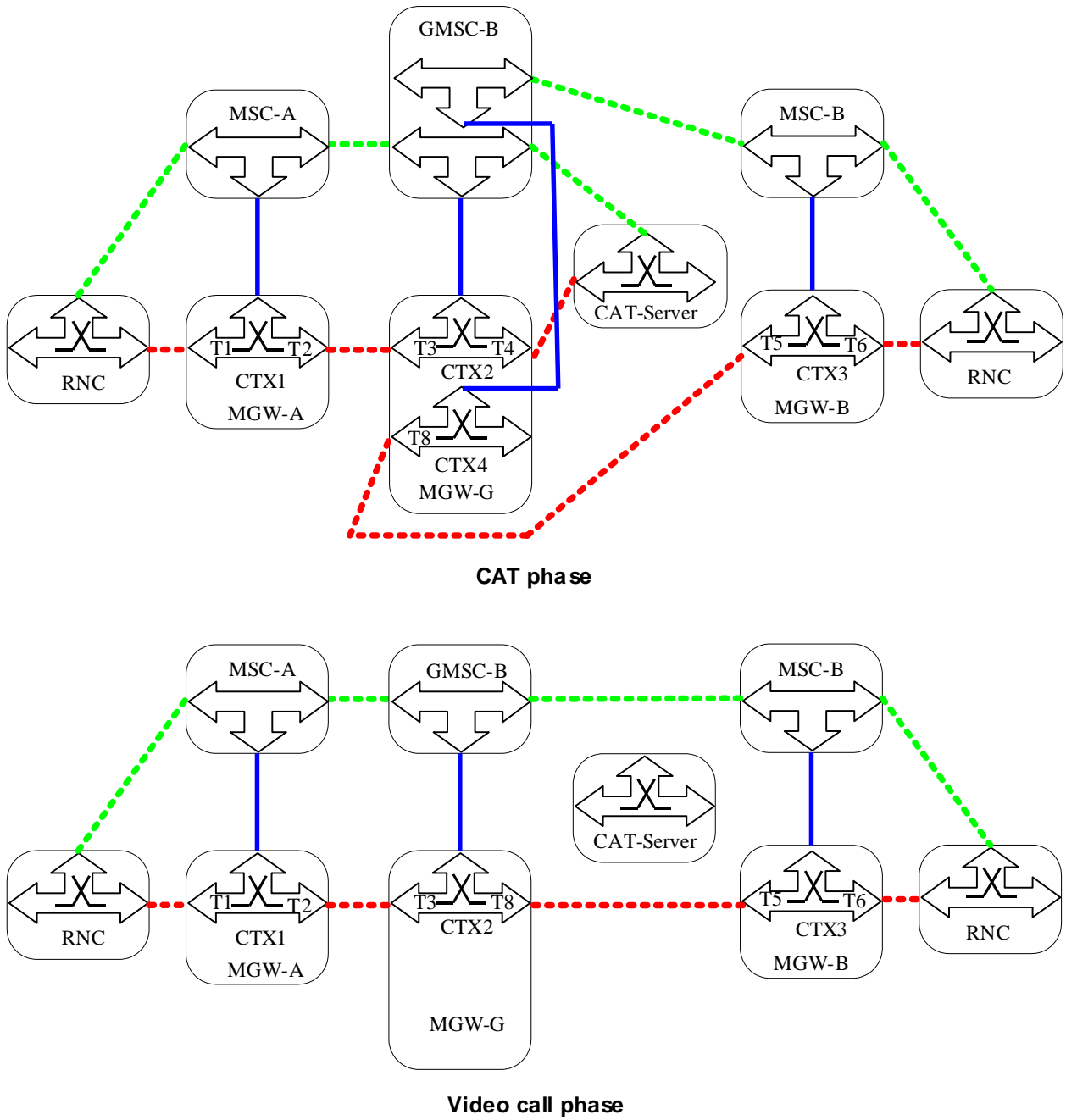
Figure 7.4.3.2.2.3 (G)MSC Server switch architecture use based on UE capabilities (CAT capable UE) (network model)

UE-A   MSC-A   MGW-A   GMSC-B   MGW-g   HLR B   CAT Server B   MSC-B   MGW-B   UE-B

1 Setup (CAT-UE)

2 IAM[BC]

3 ADD.req $($)

7 ADD.req $(T3)

4 ADD.rep C1(T1)

8 ADD.rep C2(T3)

5 ADD.req C1($)

9 SRI [BC]

10 PRN

6 ADD.rep C1(T2)

11 PRN_ACK

12 SRI_ACK(OSS=CAT subs),MSRN]

HLR A

13 ATI[UE-A MSISDN, MS-Classmark]

14 PSI [UE-A MSISDN, MS-Classmark]

15 PSI_ack [Classmark 2= CAT-UE]

16 ATI_ack[Classmark 2=CAT-UE]

17 ADD.req $($)

18 ADD.rep C4(T8)

19 IAM [A-number, MSRN]

20 SETUP

21 ADD.req $($)

22 ADD.rep C3(T5)

23 ADD.req C3(T6)

24 ADD.rep C3(T6)

Called Party Alerting

26 ACM[subs. free]

25 Alerting

27 ADD.req C2($)

28 ADD.rep C2(T4)

29 IAM [A-number, MSISDN B]

30 ACM[OBCi]

31 ANM

32 ACM/CPG[OBCi]

33 MOD.req C1(T1)

34 MOD.rep C1(T1)

35 Alerting (two-way-inband info)

36 Setup H.245

37 Play Video CAT to the calling party

38 Connect

39 MOD.req C3(T6)

40 MOD.rep C3(T6)

41 Connect_ACK

42 ANM

43 REL

44 Release H.245 CAT-Server- UE-A

45 RLC

46 SUB.req C2(T4)

47 SUB.rep C2(T4)

48 MOV.req C2(T8)

49 MOV.rep C2(T8)

50 ANM

51 Connect

52 Connect_ACK

53 Setup 2nd H.245

54 Video Call

Figure 7.4.3.2.2.4 (G)MSC Server switch architecture use based on UE capabilities (CAT capable UE)

1 to 6   As per normal mobile originating call scenario as defined in the clause 6.1 of 3GPP TS 23.205. The Setup message includes information (classmark 2 field) that UE is CAT capable.

7 to 12 The GMSC Server reserves the incoming side termination and interrogates the HLR. GMSC Server receives an OSS which includes information about the CAT subscription of the called subscriber and the MSRN of the called subscriber.

13 GMSC initiates ATI (AnyTime Interrogation) operation to the calling subscriber's HLR for examining if UE-A is CAT capable.

14-15 HLR request the Classmark 2 of UE-A from the originating MSC Server with the PSI (Provide Subscriber Information) operation.

16 GMSC Server receives the ATI-ack and notices that UE-A is CAT capable. GMSC Server initiates a call-setup in which the CAT-Server is used only during the CAT phase (as described in (G)MSC Server switch architecture)

17 to 19 The GMSC Server establishes a call to the MSC-B Server.

20 to 25 As per normal mobile terminating call scenario as defined in the clause 6.2 of 3GPP TS 23.205.

26 to 29 GMSC Server receives ACM with indication that B-subscriber is free. GMSC Server establishes a call to the CAT-server.

30 to 32 upon reception of the ACM with "inband information available" in the optional backward call indicator and ANM message from CAT Server the ACM with "inband information available" is sent to the MSC-A Server.

33 to 35 In MSC-A Server the call will be bothway through connected and an Alert message with a mark (two-way inband info) to the UE-A will be sent if the call is a multimedia call and the ACM&CPG included inband info available information in the Optional Backward Call Indicator. This triggers CAT capable UEs to start H.245 negotiation.

36 to 37 H.245 is setup between UE-A and the CAT-Server. The CAT Server plays the Video CAT to UE-A.

38 to 42   As per normal mobile terminating call scenario as defined in the clause 6.2 of 3GPP TS 23.205 after the called party answers.

43 to 44 The GMSC Server releases the connection to the CAT-Server.with a REL-message. The CAT server removes the video CAT and releases the H.245 connection to UE-A.

45 to 49 After the CAT Server has acknowledged the release, GMSC Server releases the termination towards the CAT Server in the MGW-g and through connects the path between UE-A and UE-B.

50 to 52 MSC-A Server receives the answer message, starts the charging and sends a Connect message to UE-A for triggering a new H.245 negotiation with UE-B.

53 to 54 UE-A establishes a new H.245 connection towards UE-B.

7.4.3.2.3   Use of CAT capable indication in SETUP message (CAMEL solution)

A spare bit of the Classmark 2 field is used for signalling that an UE is CAT capable in the SETUP message from UE-A to MSC-A Server. Classmark 2 field can be interrogated by the HLR with a MAP Provide Subscriber Information (PSI) from the MSC-A Server. This interrogation can be initiated by an SCP with the Any Time Interrogation (ATI) MAP operation.

The signaling forward to the CAT server and signaling backward to the MSC-A to indicate support by the Ue and inclusion of a video CAT respectively as described in Clause 7.1.3.2 also applies.

CAT phase

Video call phase

Figure 7.4.3.2.3.1 (G)MSC Server switch architecture use based on UE capabilities (non CAT capable UE) (network model)

UE-A   MSC-A   MGW-A   GMSC-B   MGW-g   HLR B   SCP   MSC-B   MGW-B   UE-B

1 Setup (no CAT-UE)

2 IAM[BC]

3 ADD.req $($)

7 ADD.req $(T3)

4 ADD.rep C1(T1)

8 ADD.rep C2(T3)

9 SRI[BC]

5 ADD.req C1($)

10 SRI_ACK[T-CSI, (CAT subs)]

6 ADD.rep C1(T2)

11 IDP[T-CSI,BC]

HLR A

12 ATI[UE-A MSISDN, MS-Classmark]

13 PSI [UE-A MSISDN, MS-Classmark]

14 PSI _ack[Classmark 2= no CAT-UE]

15 ATI_ack[Classmark 2=no CAT-UE]

16 CONNECT [CAT-Server Address]

17 ADD.req C2($)

HLR B   CAT
            Server B

18 ADD.rep C2(T4)

19 IAM [A-number, MSISDN B]

20 IAM [A-number, MSISDN B]

21 SRI [supress T-CSI]

22 PRN

23 PRN_ACK

24 SRI_ACK[MSRN]

25 ADD.req $($)

26 ADD.rep C4(T7)

27 ADD.req C4($)

28 ADD.rep C4(T8)

29 IAM [A-number, MSRN]

30 SETUP

31 ADD.req $($)

32 ADD.rep C3(T5)

33 ADD.req C3(T6)

34 ADD.rep C3(T6)

Called Party Alerting

35 Alerting

36 ACM[subs. free]

37 ACM[subs. free]

38 ACM[OBCi]

39 ACM/CPG[OBCi]

40 MOD.req C1(T1)

41 MOD.rep C1(T1)

42 Connect

43 Connect_ACK

44 Setup H.245

46 Connect

45 Play Video CAT to the calling party

47 MOD.req C3(T6)

48 MOD.rep C3(T6)

49 Connect_ACK

50 ANM

51 ANM

52 Setup 2nd H.245

53 Remove Video CAT
to the calling party;
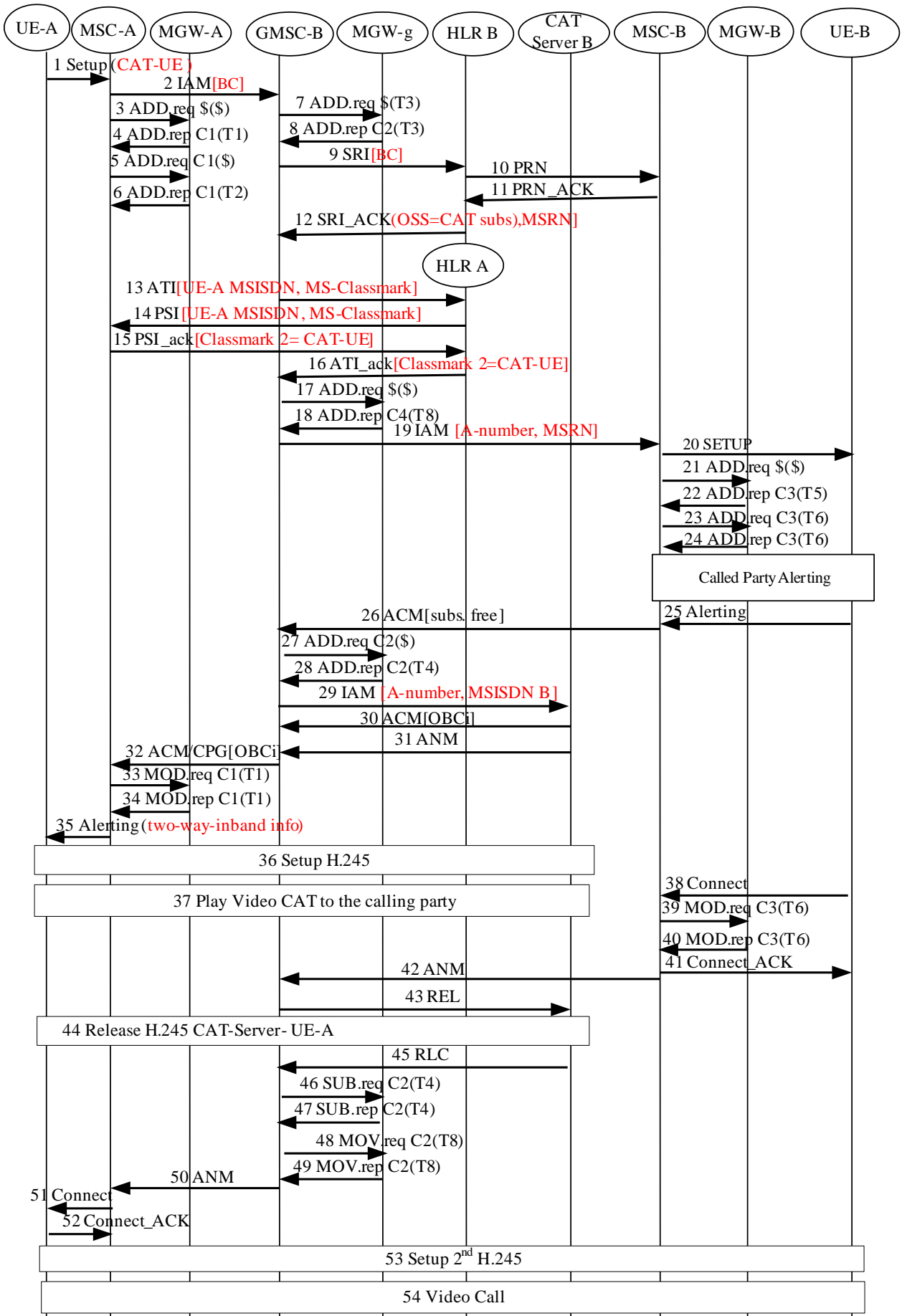bridge UE-A - UE-B

54 Video Call

55 ANM

56 ANM

Figure 7.4.3.2.3.2 (G)MSC Server switch architecture use based on UE capabilities (non CAT capable UE)

1 to 6 As per normal mobile originating call scenario as defined in the clause 6.1 of 3GPP TS 23.205. In the Setup message is no information that UE is CAT capable.

7 to 10 The GMSC Server reserves the incoming side termination and interrogates the HLR. GMSC Server receives the T-CSI which includes information about the CAT subscription of the called subscriber.

11 Initial DP is sent to the SCP.

12 SCP initiates ATI (AnyTime Interrogation) operation to the calling subscriber's HLR for examining if UE-A is CAT capable.

13-14 HLR requests the Classmark 2 of UE-A from the originating MSC Server with the PSI (Provide Subscriber Information) operation.

15 to 20 SCP receives the ATI-ack and notices that UE-A is non-CAT capable. SCP sends a Connect message with the CAT-Server Address to the GMSC server. That means GMSC Server will initiate a call-setup in which the CAT-Server stays in the call path (as described in CAT-B server switch architecture with routing back to MSC-Server).

21 to 24 The GMSC Server inquires HLR (T-CSI is suppressed) for the roaming number.

25 to 29 The GMSC Server establishes a call to the MSC-B Server.

30 to 36 As per normal mobile terminating call scenario as defined in the clause 6.2 of 3GPP TS 23.205.

37 The GMSC Server sends the address complete message with subscriber free indication to the CAT Server

38 to 39 The GMSC Server receives ACM/CPG with inband info available in the optional Backward Call Indicator from the CAT Server and sends it to the MSC-A Server.

40 to 43 In MSC-A Server the call will be bothway through connected and a Connect to the UE-A will be sent if the call is a multimedia call and the ACM&CPG included inband info available information in the Optional Backward Call Indicator.

44 to 45 H.245 is setup between UE-A and the CAT-Server. The CAT Server plays the Video CAT to UE-A.

46 to 50 As per normal mobile terminating call scenario as defined in the clause 6.2 of 3GPP TS 23.205 after the called party answers.

51 to 54 The GMSC Server sends the Answer message to the CAT Server. The CAT server sets up a H.245 connection towards UE-B, removes the video CAT to the calling party and bridges between UE-A and UE-B in the CAT Server.

55 The CAT server sends the Answer message to the GMSC Server.

56 MSC-A Server receives the Answer message from GMSC Server and starts the charging.
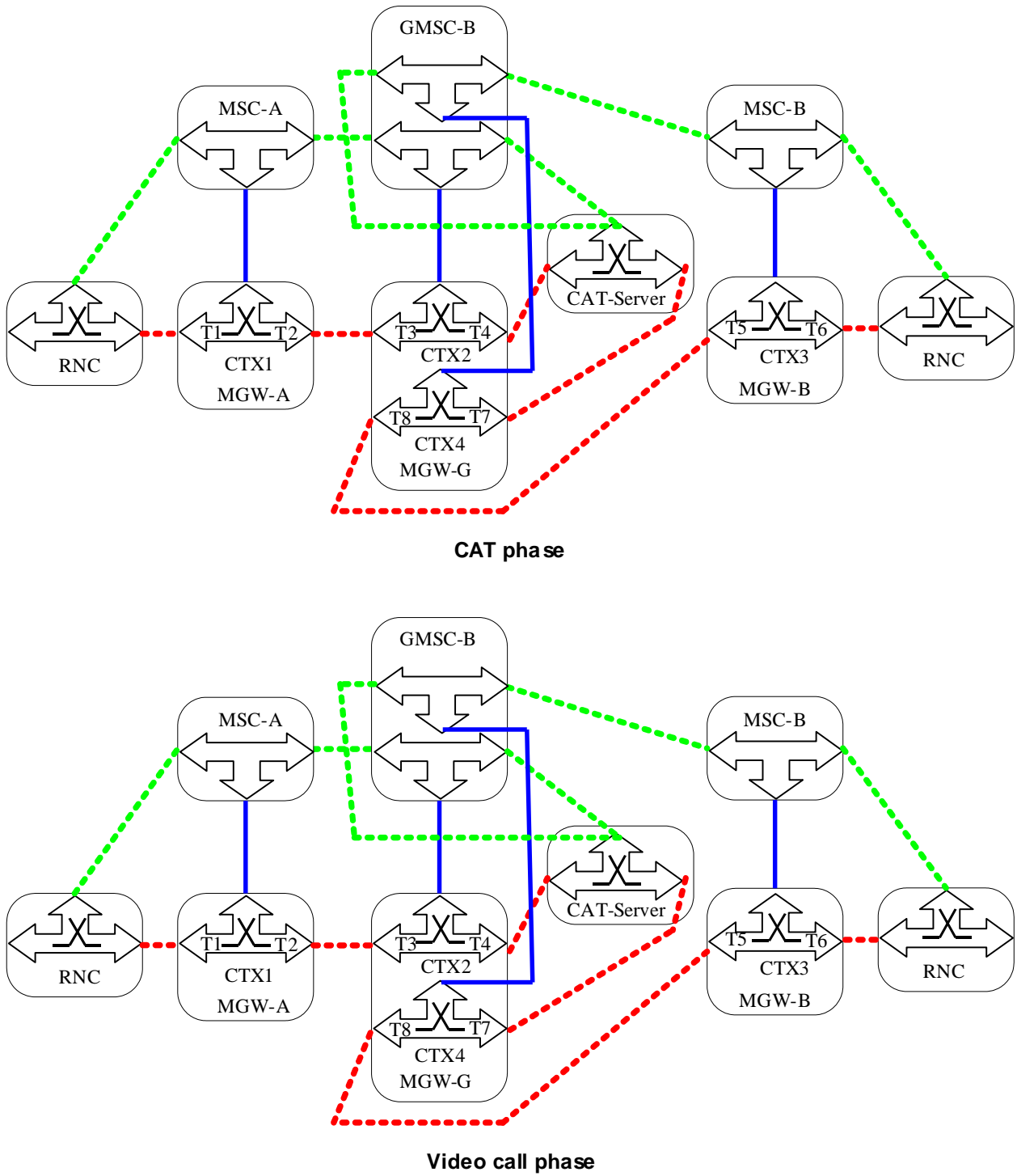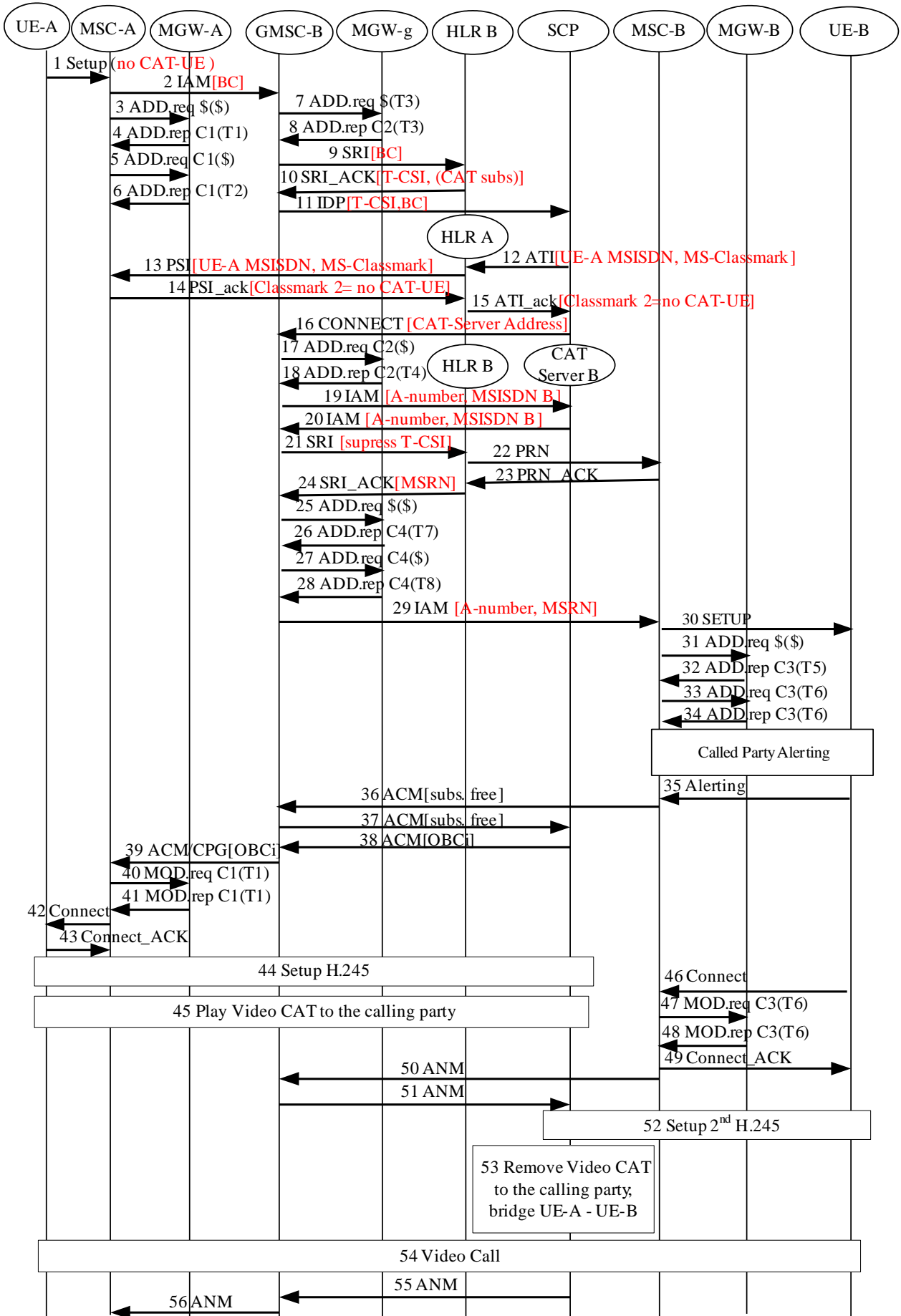
CAT phase

Video call phase
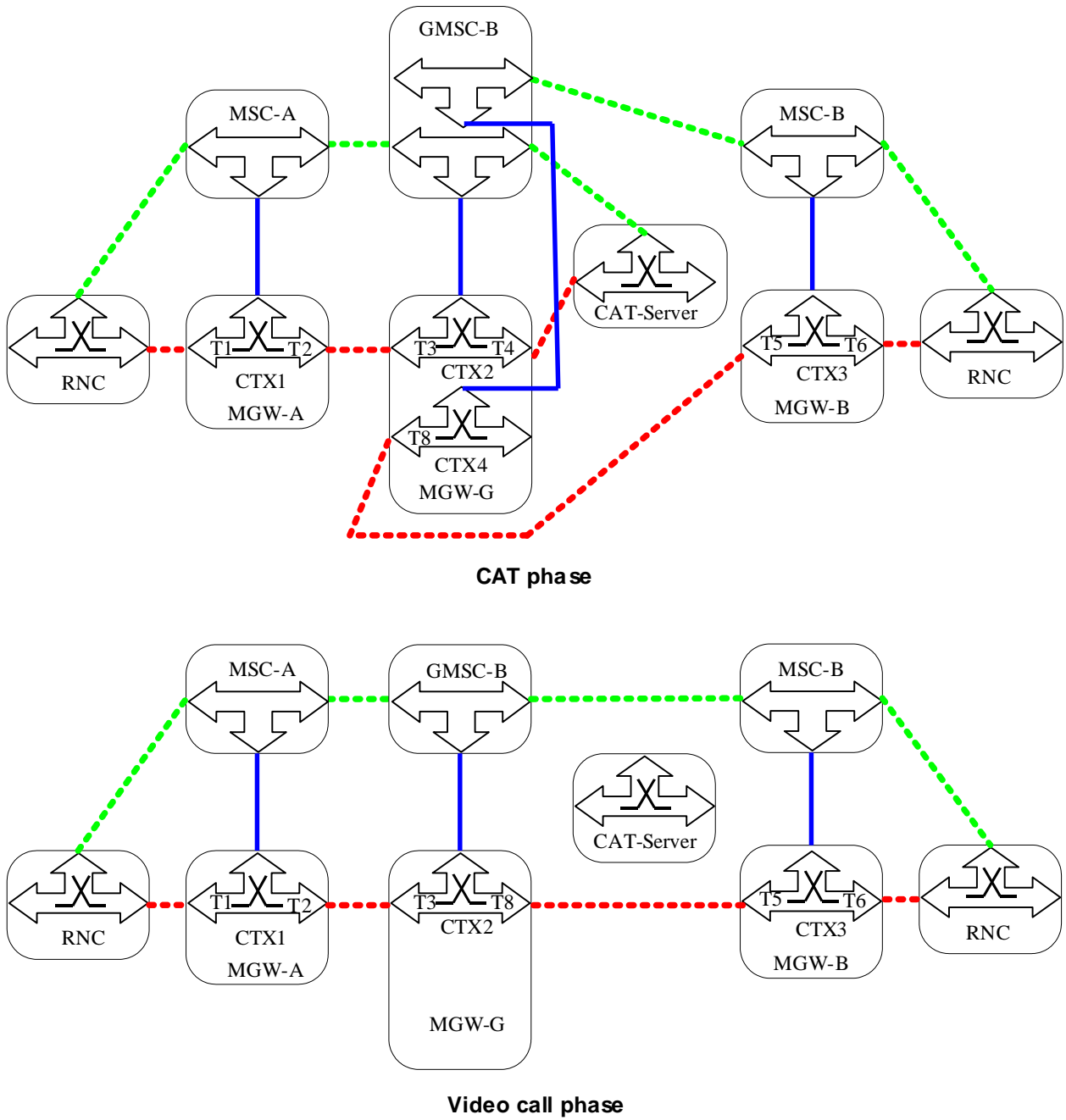
**Figure 7.4.3.2.3.3 (G)MSC Server switch architecture use based on UE capabilities (CAT capable UE)
(network model)**

UE-A   MSC-A   MGW-A   GMSC-B   MGW-g   HLR B   SCP   MSC-B   MGW-B   UE-B

1 Setup (CAT-UE)
2 IAM[BC]
3 ADD.req $($)
7 ADD.req $(T3)
8 ADD.rep C2(T3)
4 ADD.rep C1(T1)
9 SRI[BC]
5 ADD.req C1($)
10 SRI_ACK[T-CSI, (CAT subs)]
6 ADD.rep C1(T2)
11 IDP[T-CSI,BC]

HLR A

13 PSI[UE-A MSISDN, MS-Classmark]
12 ATI[UE-A MSISDN , MS-Classmark]
14 PSI_ack[Classmark 2= CAT-UE]
15 ATI_ack[Classmark 2=CAT-UE]
16 RRBCSM, CONTINUE

HLR B

17 SRI [supress T-CSI]
18 PRN
19 PRN_ACK
20 SRI_ACK[MSRN]
21 ADD.req $($)
22 ADD.rep C4(T8)
23 IAM [A-number, MSRN]
24 SETUP
25 ADD.req $($)
26 ADD.rep C3(T5)
27 ADD.req C3(T6)
28 ADD.rep C3(T6)

SCP   CAT
          Server B

Called Party Alerting

30 ACM[subs. free]
29 Alerting
31 ERB[Alert]
32 ETC[CSI,CAT Server Address,A-number,OCD,SII2]
33 ADD.req C2($)
34 ADD.rep C2(T4)
35 IAM [A-number, MSISDN B]
36 ACM[OBCi]
37 ANM
38 ACM/CPG[OBCi]
39 MOD.req C1(T1)
40 MOD.rep C1(T1)
41 Alerting (two-way-inband info)

42 Setup H.245
44 Connect
45 MOD.req C3(T6)
43 Play Video CAT to the calling party
46 MOD.rep C3(T6)
47 Connect_ACK
48 ANM
49 ERB (ANM) ;
50 DFCwA (CS1)
51 REL

52 Release H.245 CAT-Server- UE-A

53 RLC
54 SUB.req C2(T4)
55 SUB.rep C2(T4)
56 MOV.req C2(T8)
57 MOV.rep C2(T8)
58 ANM
59 Connect
60 Connect_ACK

61 Setup 2nd H.245

62 Video Call

Figure 7.4.3.2.3.4 (G)MSC Server switch architecture use based on UE capabilities (CAT capable UE)

1 to 6 As per normal mobile originating call scenario as defined in the clause 6.1 of 3GPP TS 23.205. The Setup message includes information that UE is CAT capable.

7 to 10 The GMSC Server reserves the incoming side termination and interrogates the HLR. GMSC Server receives the T-CSI which includes information about the CAT subscription of the called subscriber.

11 Initial DP is sent to the SCP.

12 SCP initiates ATI (AnyTime Interrogation) operation to the calling subscriber's HLR for examining if UE-A is CAT capable.

13-14 HLR request the Classmark 2 of UE-A from the originating MSC Server with the PSI (Provide Subscriber Information) operation.

15 to 16 SCP receives the ATI-ack and notices that UE-A is CAT capable. SCP sends a Continue and a RRBCSM message to the GMSC server. That means GMSC Server will initiate a call-setup in which the CAT-Server is used only during the CAT phase (as described in (G)MSC Server switch architecture)

17 to 20 The GMSC Server inquires HLR (T-CSI is suppressed) for roaming number.

21 to 23 The GMSC Server establishes a call to the MSC-B Server.

24 to 29 As per normal mobile terminating call scenario as defined in the clause 6.2 of 3GPP TS 23.205,

30 to 35 GMSC Server receives ACM with indication that B-subscriber is free. GMSC reports Alerting to the SCP. The SCP orders the GMSC Server to establishe a call to the CAT-server with an Establish Temporary Connection operation.

36 to 38 upon reception of the ACM with "inband information available" in the optional backward call indicator and ANM message from CAT Server the ACM with "inband information available" is sent to the MSC-A Server.

39 to 41 In MSC-A Server the call will be bothway through connected and an Alert message with a mark (two-way inband info) to the UE-A will be sent if the call is a multimedia call and the ACM&CPG included "inband info available" information in the Optional Backward Call Indicator. This triggers CAT capable UEs to start H.245 negotiation.

42 to 43 H.245 is setup between UE-A and the CAT-Server. The CAT Server plays the Video CAT to UE-A.

44 to 48   As per normal mobile terminating call scenario as defined in the clause 6.2 of 3GPP TS 23.205 after the called party answers.

49 to 52 The GMSC server report the Answer to the SCP. The SCP orders the GMSC Server to releases the connection to the CAT-Server with a DFCwA-message. The CAT server removes the video CAT and releases the H.245 connection to UE-A.

53 to 57 After the CAT Server has acknowledged the release, GMSC Server releases the termination towards the CAT Server in the MGW-g and through connects the path between UE-A and UE-B.

58 to 60 MSC-A Server receives the Answer message, starts the charging and sends a Connect message to UE-A for triggering a new H.245 negotiation with UE-B.

61 to 62 UE-A establishes a new H.245 connection towards UE-B.

7.4.4   Abnormal call flows

7.4.5   Fallback call flows

7.4.5.1   CAT server failure / CAT server refuses to deliver a CAT

Same handling in sub-section 7.1.5.1 for the (G)MSC Server switch architecture can be used for the (G)MSC Server switch architecture use based on UE capabilities.

7.4.5.2 Multimedia call not possible towards called party

Same handling in sub-section 7.1.5.2 for the (G)MSC Server switch architecture can be used for the (G)MSC Server switch architecture use based on UE capabilities.

7.4.5.3 Handover during video CAT

Same handling in sub-section 7.1.5.3 for the (G)MSC Server switch architecture can be used for the (G)MSC Server switch architecture use based on UE capabilities.

7.5 Alternative 5 – Terminating MSC Server switch architecture

7.5.1 Triggering methods

One or several marks, e.g. specific OSSS code(s) or routing information (e.g. routing code – new subscription information)., are configured in the HLR on a per subscriber's record to indicate support of audio or/and multimedia CAT-A and CAT-B services.

When the called party is located in its HPLMN, the terminating VMSC triggers CAT-B service upon arrival of an incoming call to a CAT subscriber having subscribed and activated the CAT-B service. The terminating VMSC retrieves the subscription data of the subscriber during the location update procedure.

> NOTE: When the called party is roaming in a VPLMN, the GMSC triggers CAT-B service upon arrival of an incoming call to a CAT subscriber having subscribed and activated the CAT-B, as specified in the alternative 1 "(G)MSC-Server switch architecture".

> Editor's Note: Support of CAT-A by this architecture is ffs.

## 7.5.2 Trigger points in the call

The terminating MSC server shall trigger the called party configured CAT service if the call party has subscribed and activated the CAT service. When the CAT media is to be played, MSC-B sends a message with in-band info available to UE-A for H.245 negotiation between UE-A and CAT server. CAT is played.

7.5.3 Nominal call flows

7.5.3.1 Speech call

This call flow shows the leg-control phases with the arrow 5'where the MSC-B establishes the leg toward the CAT Server as shown in Figure 5.2.2.1. Because MSC-B controls the establishment, switch and release of the leg, it is difficult to provide CAT service in a case that UE-B is a roaming user. However, MSC-B knows UE-B's status at once and UE-B's information such as CAT activation when UE-B registers its location to MSC-B. So, MSC-B can easily response to the called party's behaviour such that MSC-B applies fast connection to the call procedure and attach announcement depending on the UE-B's status. For the roaming service, other alternative method can be supported. Unlike the multimedia call, the parameters for the CAT subscription are not considered, because MSC-B knows that UE-B's CAT is activated when UE-B registers its location to MSC-B. Figure 7.5.3.1.1 shows the audio ring back tone service controlled by MSC-B.
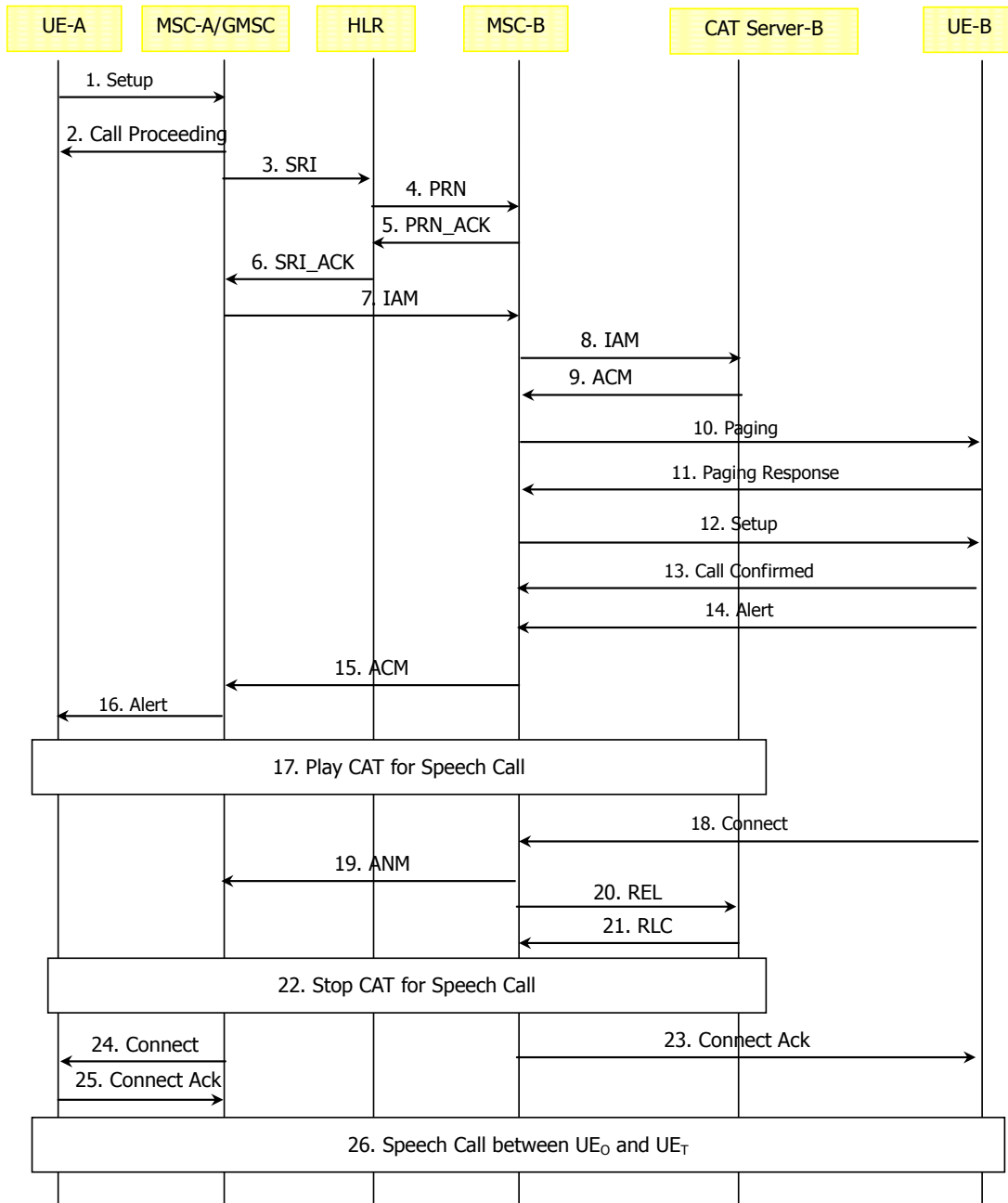
Figure 7.5.3.1.1: Audio ring back tone service controlled by MSC-B

1 to 6 Normal mobile terminating call procedure starts. For starting of the speech call, UE-A sends a call setup message. MSC-A/GMSC sends the Call proceeding message to UE-A. After that MSC-A/GMSC sends SRI(Send Routing Information) to HLR-B for looking at the called user's location and HLR-B delivers PRN (Provide Roaming Number).

7 to 14 After receiving SRI_ACK, MSC-A/GMSC sends IAM(Initial Address Message) to MSC-B for requesting connection and receives ACM for notifying the UE-B's location. MSC-B sends a paging message and receives the paging response. MSC-B requests a call setup, and then UE-B notifies the call confirmed message and sends Alert to MSC-B.

15 to 16 MSC-B sends ACM (Address Complete Message) to MSC-A/GMSC, and MSC-A/GMSC sends Alert.

17 CAT is played.

18 to 25 If UE-B receives a call, then UE-B sends a Connect message to MSC-B. MSC-B sends REL to CAT server B, CAT server B responds to MSC-B by RLC. CAT stops. MSC-B sends ANM (Answer Message) to MSC-A/GMSC. MSC-A/GMSC sends a Connect message to UE-A and receives its ACK.

26   Speech call is established.

Editor's Note: Because MSC-B knows that the CAT for UE-B is activated (When UE-B registers its location to MSC-B, the corresponding info is delivered to MSC-B.) and controls the CAT leg toward CAT server in this scenario, MSC-B can send Step 15 and 16 in advance. In order to reduce the paging time (fast connection), the steps can be changed as follows: After Step 8 and 9 for looking at UE-B's location, MSC-B starts paging process, at the same time, MSC-B can send ACM at Step 15 and Alert at Step 16 to MSC-A/GMSC and UE-A, sequentially.

7.5.3.2   Multimedia call

This call flow shows the leg-control phases with the arrow 5'where the MSC-B establishes the leg toward the CAT Server as shown in Figure 5.2.1.6.1.

Figure 7.5.3.2.1 shows video ring back tone service controlled by MSC-B.
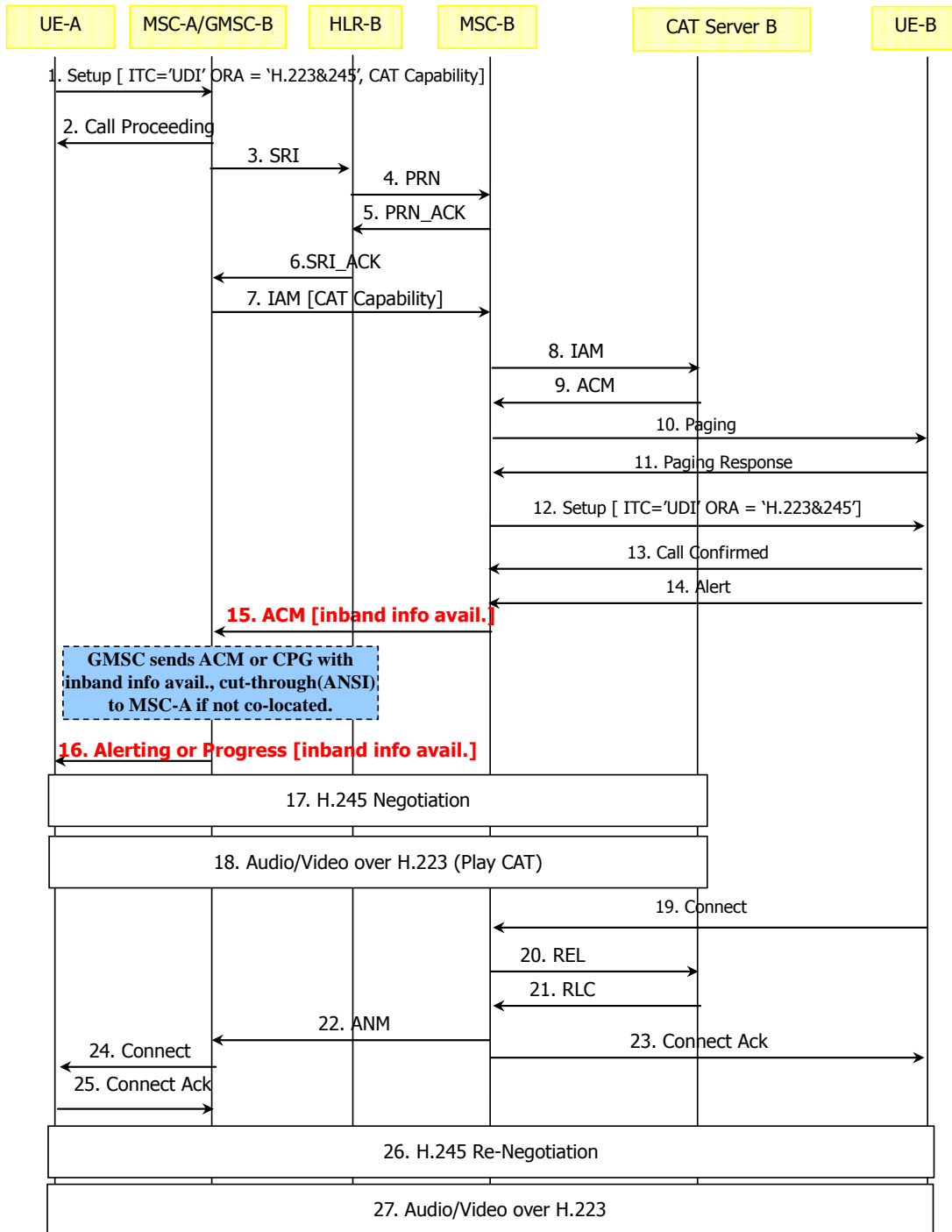
Figure 7.5.3.2.1: Video ring back tone service controlled by MSC-B

1 to 6 Normal mobile terminating call procedure starts. With starting of the video call, UE-A sends a call setup message with UDI(Unrestricted Digital Information) in ITC(Information Transfer Capability), 324M protocol indication (H.223&245) in ORA(Other Rate Adaptation) and CAT capability indicator to indicate if the calling party UE is a CAT capable UE. MSC-A/GMSC sends the Call proceeding message to UE-A. After that MSC-A/GMSC sends SRI(Send Routing Information) to HLR-B for looking at the called user's location and HLR-B delivers PRN (Provide Roaming Number).

7 to 14 After receiving SRI_ACK, MSC-A/GMSC-B sends IAM(Initial Address Message) with CAT capability indicator to MSC-B for requesting connection and receives ACM for notifying the UE-B's location. The CAT capability indicator is to indicate if the calling party UE is a CAT capable UE. MSC-A can send to GMSC-B an IAM message with the CAT capability indicator if they are separated. MSC-B sends a paging message and

receives the paging response. MSC-B requests a call setup, and then UE-B notifies the call confirmed message and sends Alert to MSC-B.

NOTE: In order to reduce the paging time, the steps can be changed as follows: After Step 8 and 9, MSC-B starts paging process, at the same time, MSC-B can send ACM at Step 15 to MSC-A/GMSC and Alert at Step 16 to UE-A, sequentially.

Editor's Note: Coding of the CAT capability indicator is FFS.

15 to 16 MSC-B sends ACM (Address Complete Message) with in-band information indicator. If GMSC-B and MSC-A are not co-located, GMSC sends an ACM or CPG message to MSC-A with the *In-band information indicator* of the Optional backward call indicators IE set to "in-band information or an appropriate pattern is now available" to inform the originating MSC that a video CAT is available. MSC-A/GMSC sends Alerting or Progress message with inband info avail. for H.245 negotiation.

Editor's Note: For H.245 negotiation, the inband info is contained in the messages at Step 15 and 16. This inband info for H.245 negotiation can be encoded as a new value. FFS is needed.

17 H.245 negotiation between CAT server B and UE-A is proceeded.

18 After H.245 negotiation, CAT is played.

19 to 25 If UE-B receives a call, then UE-B sends a Connect message to MSC-B. MSC-B sends REL to CAT server B, CAT server B responds to MSC-B by RLC. CAT stops. MSC-B sends ANM (Answer Message) to MSC-A/GMSC. MSC-A/GMSC sends a Connect message to UE-A and receives its ACK.

26 H.245 renegotiation between UE-A and UE-B is proceeded.

27 AV data for video call is delivered over H.233 protocol.

7.5.4 Abnormal call flows

7.5.5 Fallback call flows

7.6 Alternative 6 – (G)MSC Server bridge architecture

7.6.1 Triggering methods

Same triggering methods specified in sub-section 7.1.1 for the (G)MSC Server switch architecture is used for the (G)MSC Server bridge architecture.

7.6.2 Trigger points in the call

Same triggering points specified in sub-section 7.1.2 for the (G)MSC Server switch architecture is used for the (G)MSC Server bridge architecture.

7.6.3 Nominal call flows

7.6.3.1 Speech call

The audio CAT nominal call flow for the (G)MSC Server bridge architecture is the same as the flow for the (G)MSC Server switch architecture (see sub-section 7.1.3.1).
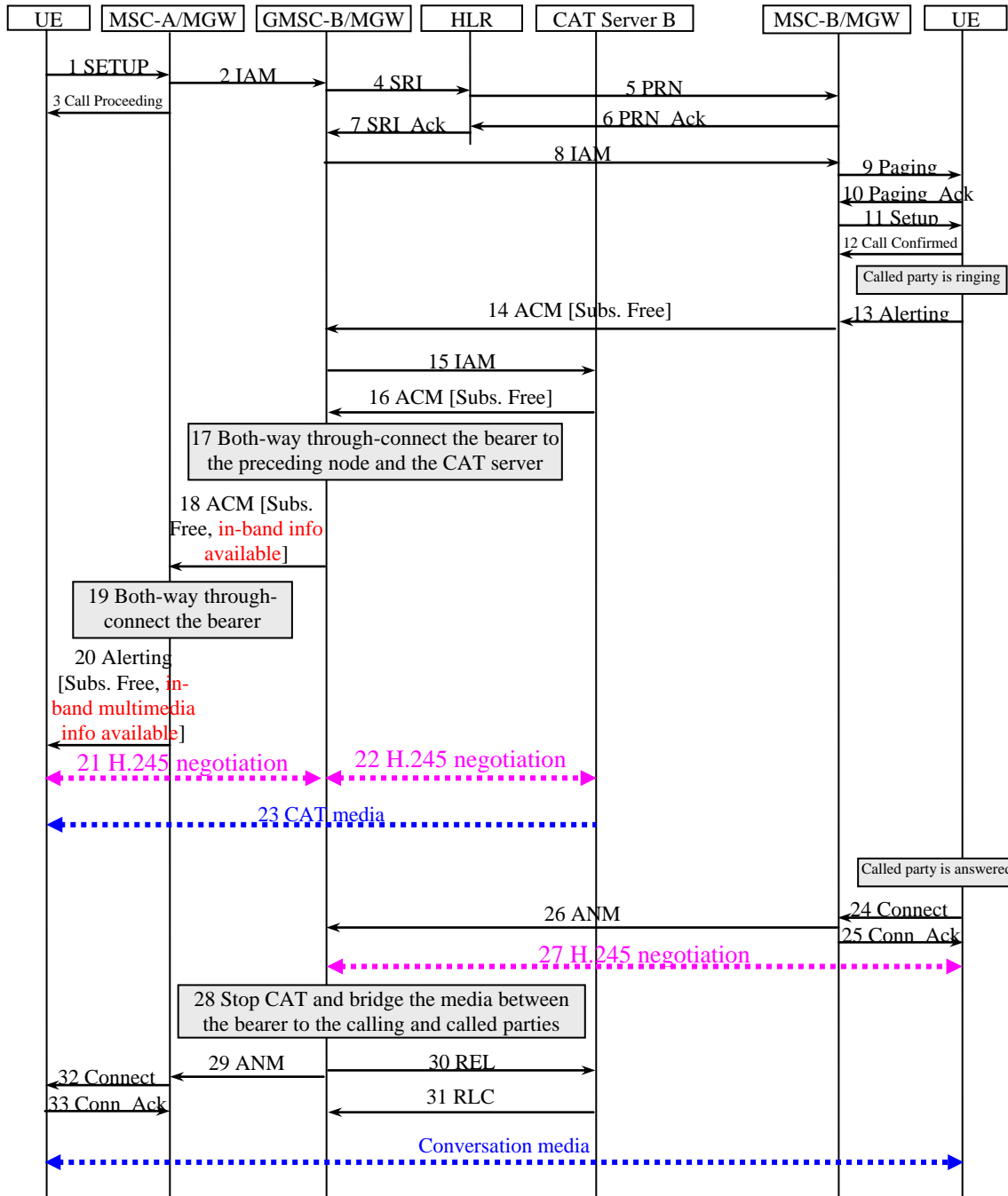
7.6.3.2 Multimedia call

It is assumed in that sub-clause that the calling party has either not subscribed or not activated CAT service, or that it has activated CAT service but with CAT settings indicating preferences to CAT-B service. It is also assumed that the CAT server support H.324m.

To play the video CAT, three successive H.245 negotiations are performed:

- A first one between the calling party's UE and the (G)MSC server through the MGW under the control of the (G)MSC server during the alerting phase; the end to end bearer connection between the calling party and the (G)MSC server shall be two-way through-connected to allow the H.245 negotiation;

- A second one between the (G)MSC server and the CAT server during the alerting phase.

- A third one between the (G)MSC server and the called party's UE through the MGW under the control of the (G)MSC server when the called party answers the calls.

Video CATs can only be delivered to handsets supporting the corresponding capabilities (not supported by pre-Rel8 handsets).

Editor's Note: The multimedia interworking procedures on Mn interface can be possibly re-used for bridging the multimedia call establishment to the calling and called parties. The impact on Mc interface is FFS.

Figure 7.6.3.2.1: Video CAT provided by CAT server B

1 to 14 As per normal mobile originating/terminating multimedia call, with the following additions:
- SRI ACK includes a mark to indicate that the called party is a CAT subscriber.

15-16 GMSC-B places a multimedia call to CAT Server B to request the CAT playing with the called party number set as UE-B's MSISDN.

17 GMSC-B both-way through-connects the bearer to the preceding node and the CAT server.

18 GMSC-B send ACM message to the preceding node as normal call, with the following additions:
- In the ACM message, *In-band information indicator* of the Optional backward call indicators information element is set to "*in-band information or an appropriate pattern is now available*".

19 MSC-A process the ACM as normal call with the following additions:
- both-way through-connect the bearer to the succeeding node with the preceding node to enable the H.245 negotiation.

20 MSC-A send Alerting to the UE-A as normal call with the following additions:
- With additional information to indicate that "in-band multimedia info is available".

Editor's note: How the "in-band multimedia info is available" flags are encoded on the MSC-UE interface is FFS.

21-23 For multimedia call, the UE-A with the (G)MSC server and the (G)MSC server will start the in-band H.245 negotiation to establish the multimedia bearer through the fully connected bearer respectively. After the completion of the H.245 negotiations, the UE-A receives multimedia customized alerting tone media and plays it to the calling subscriber.

24-26 As per normal mobile terminating (multimedia call).

27 GMSC-B starts the in-band H.245 negotiation with the UE-B.

28 After the completion of the H.245 negotiation with the UE-B, GMSC-B bridges the media between the bearer towards the preceding and succeeding nodes.

29 GMSC-B sends ANM message to the preceding node, MSC-A as per normal mobile multimedia call.

30-31 GMSC-B release the "call" to the CAT server.

32-33 As per normal multimedia call.

7.6.4 Abnormal call flows

7.6.5 Fallback call flows

7.6.5.1 CAT server failure / CAT server refuses to deliver a CAT

Same handling in sub-section 7.1.5.1 for the (G)MSC Server switch architecture can be used for the (G)MSC Server bridge architecture.

7.6.5.2 Multimedia call not possible towards called party

Same handling in sub-section 7.1.5.2 for the (G)MSC Server switch architecture can be used for the (G)MSC Server bridge architecture.

7.6.5.3 Handover during video CAT

Same handling in sub-section 7.1.5.3 for the (G)MSC Server switch architecture can be used for the (G)MSC Server bridge architecture.

8 Interaction with other features

8.1 Interaction with supplementary services

8.1.1 Line identification services

8.1.1.1 Calling Line Identification Presentation (CLIP)

No interaction.

The *Calling Party Number* and *Generic Number – Additional Calling Party Number* are not impacted by the CAT service. They are forwarded to the called party as received from the calling party.

In all architectures the same *Calling Party Number* and *Generic Number – Additional Calling Party Number* are also sent in the IAM message to the CAT Server.

8.1.1.2 Calling Line Identification Restriction (CLIR)

The *Address Presentation Restriction Indicator* is not modified by the CAT service. It is forwarded to the terminating node as received from the calling party.

In all architectures the same *Address Presentation Restriction Indicator* is also sent in the IAM message to the CAT Server.

As specified in 3GPP TS 22.182 [2], the CLIR service shall take precedence over the CAT service subscribed by the called party. I.e. if the called party has a CAT associated to the calling party's identity, the service shall not be invoked; if the called party has a CAT not associated to the calling party's identity then the service shall be invoked. The CAT Server is the single entity responsible for making those checks and possibly rejecting the requested CAT service; in the latter case, the (G)MSC Server shall pursue the call establishment without delivering CAT to the calling party.

>   NOTE: In the CAT Server switch architecture, the call is routed through the CAT Server even if ultimately no CAT is delivered because of CLIR precedence. It is ffs if in that case the CAT server remains part of the bearer path throughout the call.

>   Editor's note: 3GPP TS 22.182 also indicates that the CLIR service takes precedence over the CAT Service subscriber by the calling party. This requirement needs to be verified with SA1 as does not seem relevant.

8.1.1.3 Connected Line Identification Presentation / Restriction (COLP/COLR)

The *Connected Number* and the *Generic Number – Additional Connected Number*, including the related *Address Presentation Restriction Indicators,* and the *Redirection Number* and *Redirection Number Restriction Indicator* are not impacted by the CAT service. They are sent in the backward direction to the calling party as received from the called party.

To ensure that the right connected number is sent to the originating UE, in the (G)MSC Server switch architecture and the (G)MSC Server bridge architecture,

-   any Connected Number, Generic Number – Additional Connected Number, Redirection Number or Redirection Number Restriction Indicator IE received from the CAT Server shall be discarded and not passed on in backward direction;

-   if an ANM message is received from the CAT server, it shall not be sent in the backward direction towards the calling party; the (G)MSC Server shall send instead an ACM or CPG message.

In the CAT Server switch architecture,

-   CAT Server shall not change the Connected Number, Generic Number – Additional Connected Number, Redirection Number and Redirection Number Restriction Indicator IE received from the succeeding node.

Editor's Note: it is ffs if there are really no interactions for the originating MSC returns the CONNECT message to the originating UE before receiving an indication that the call is accepted by the called party (ANM or CONNECT message). This may lead to send an incorrect connected number in the CONNECT message, e.g. if the call is forwarded by the called party. 3GPP TS 24.008 currently states that the CONNECT message shall be sent to the originating UE upon receiving an indication that the call is accepted.

3GPP TS 22.182 [2] requires that the COLR service takes precedence over the CAT service subscribed by the calling party. If the calling party has a CAT associated to the called party's identity, the service shall not be invoked. If the calling party has a CAT not associated to the called party's identity then the service shall be invoked. The CAT service can take precedence over the COLR service when the calling party has an override category, such as the police, for which the COLR service is not applied.

Whether / how the above COLR and COLR override requirements can be implemented is ffs since this raises the following concerns :

- the Connected Line Number and Connected Line *Address presentation restricted indicator* are known at the time the called is answered, i.e. after the CAT is played;

- the selection of the CAT by the CAT server can therefore only take into account the called party number, not the connected number. Whether the called or connected party has subscribed or not to the COLR service can not be taken into account when deciding whether a CAT shall be played;

- the COLR override indicator is only known by the originating MSC; the indicator is not transmitted in ISUP/BICC signalling.

NOTE: In the CAT Server switch architecture, the call is routed through the CAT Server even if ultimately no CAT is delivered because of COLR precedence.

Editor's note: 3GPP TS 22.182 also indicates that the COLR service takes precedence over the CAT Service subscriber by the called party. This requirement needs to be verified with SA1 as does not seem relevant.

8.1.2 Call forwarding services

8.1.2.1 General Principles

If Call Forwarding is invoked before the original called party's alerting, e.g. CFU or Call Forwarding on no paging response, the original called party's CAT during alerting phase won't be triggered, and the CAT of Forwarded-to-party(C), if subscribed, can be played by the (G)MSC-C following the normal procedures. If C party forwards the call to D party before C party alerts, the CAT-D can be played, if applicable.

If Call Forwarding is invoked during the original called party's alerting, e.g. CFNRy, how to play the CAT of the Forwarded-to-party (C) is specific to each architecture.

8.1.2.2 (G)MSC Server switch architecture

If Call Forwarding is invoked during the original called party's alerting, e.g. CFNRy, the (G)MSC-C plays the CAT-C, if applicable, upon receiving the indication that C party is being alerted, following the normal procedures. If C party has not subscribed the CAT during alerting phase, the calling party will experience the default ring back tone from terminating MSC-C for an audio call.

Editor's note: which alerting indication is experienced for a multimedia call if C party has not subscriber CAT is ffs.

3GPP TS 22.182 [2] sub-clause 4.2.4.3 requires that "A experiences CAT-B until B's CFNRy timer has expired. Then experiences CAT-C"; however :

- Upon expiry of CFNRy timer, MSC-B may not send a Call Forwarding notification to the GMSC-B (CPG with CF indicator), therefore GMSC-B may not be able to stop the CAT-B until C party starts being alerted.

- If video CAT-B is stopped as early as the CPG(CF indicator) arrives in GMSC-B, and MSC-B can not insert video indication on call forwarding, the calling user may experience an uncomfortable long "silent" interval between CAT-B and CAT-C. So keeping on playing CAT-B by GMSC-B until C party enters alerting phase can shorten the uncomfortable "silent" gap. (*In-band information indicator* of the Optional backward call

indicators information element is set to 'in-band information or an appropriate pattern is now available 'in CPG message)

NOTE: To avoid a "silent" period during C party alerting, GMSC-B might, as an option, keep on playing CAT-B till C party picks up the call if there is no called party's CAT configured and activated for the C party.

- In audio call, MSC-B may play an announcement or send forwarding tones to the calling party to indicate the call is being forwarded after sending CPG with CF indicator to GMSC. Based on the local policy, GMSC may stop audio CAT-B and connect calling party with MSC-B in user plane to play call forwarding indicator, or may keep playing audio CAT-B until C party alerting.

Figure 8.1.2.2.1 shows the case of CFNRy for an audio call, audio CAT-B is stopped upon CPG(CF indicator).
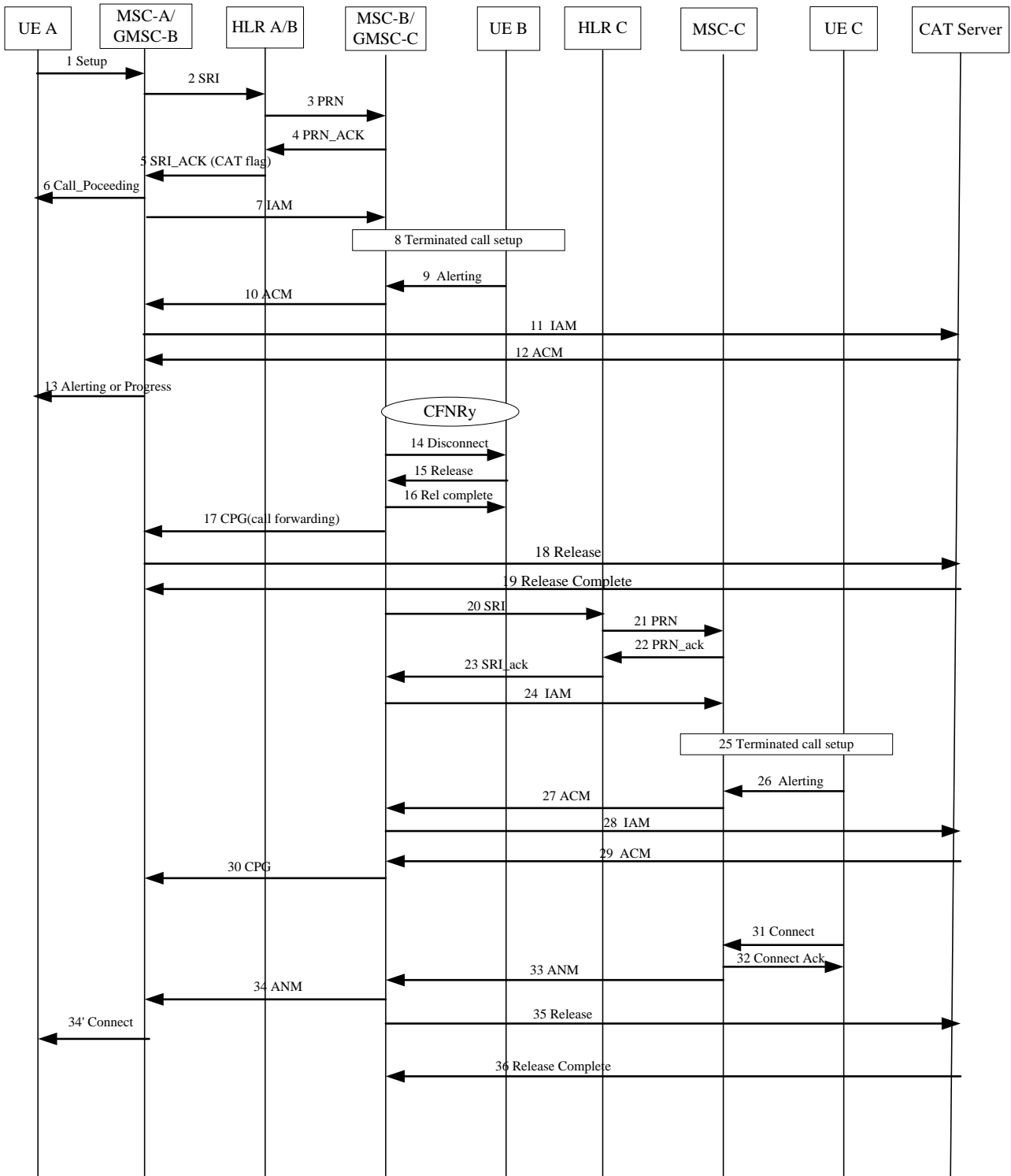
UE A | MSC-A/ GMSC-B | HLR A/B | MSC-B/ GMSC-C | UE B | HLR C | MSC-C | UE C | CAT Server

1 Setup

2 SRI

3 PRN

4 PRN_ACK

5 SRI_ACK (CAT flag)

6 Call_Poceeding

7 IAM

8 Terminated call setup

9 Alerting

10 ACM

11 IAM

12 ACM

13 Alerting or Progress

CFNRy

14 Disconnect

15 Release

16 Rel complete

17 CPG(call forwarding)

18 Release

19 Release Complete

20 SRI

21 PRN

22 PRN_ack

23 SRI_ack

24 IAM

25 Terminated call setup

26 Alerting

27 ACM

28 IAM

29 ACM

30 CPG

31 Connect

32 Connect Ack

33 ANM

34 ANM

34' Connect

35 Release

36 Release Complete

Figure 8.1.2.2.1: Call forwarding of an audio call, audio CAT-B stopped upon CPG(CF indicator)

Figure 8.1.2.2.2 shows the case of CFNRy for a multimedia call, video CAT-B is stopped upon party C's alerting.
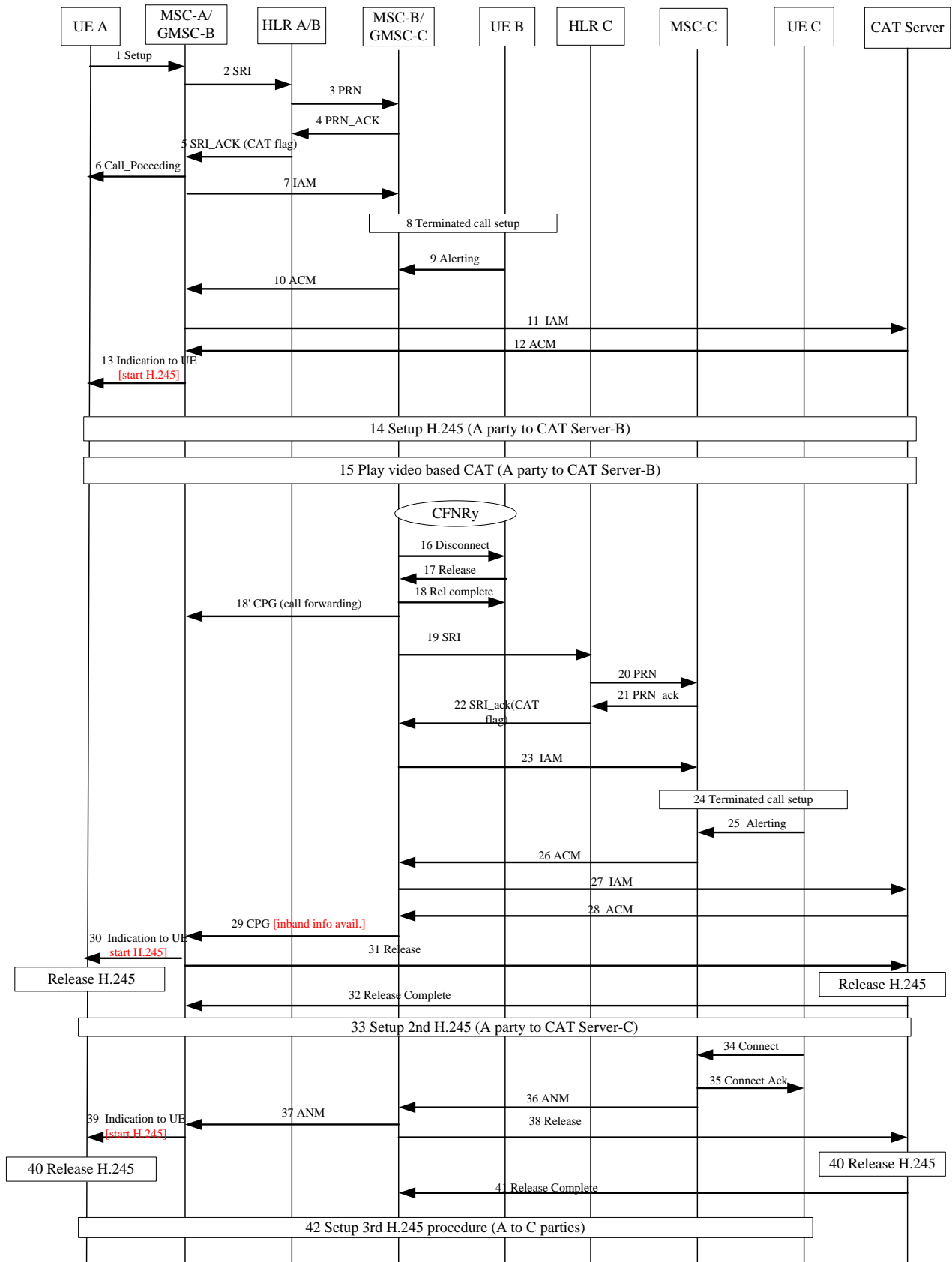
Figure 8.1.2.2.2: Call forwarding of a multimedia call, video CAT-B stopped upon party C's alerting

Steps 37 and 38 are performed in parallel.

Step 39: upon receipt of the Indication (start H.245) from MSC-A, the UE locally releases H.245 call and re-establishes a new one towards the called party.

Editor'note: how to indicate UE to start/release H245 in step 13,30,39 is ffs.

Step 41 may happen before step 40 is actually finished.

NOTE: The CAT servers of the called party and forwarded-to party may be different CAT servers.

8.1.2.3 CAT Server switch architecture

FFS

8.1.2.4 (G)MSC Server bridge architecture

Same interaction as described in sub-clause 8.1.2.2 for the (G)MSC Server switch architecture with the following modifications:

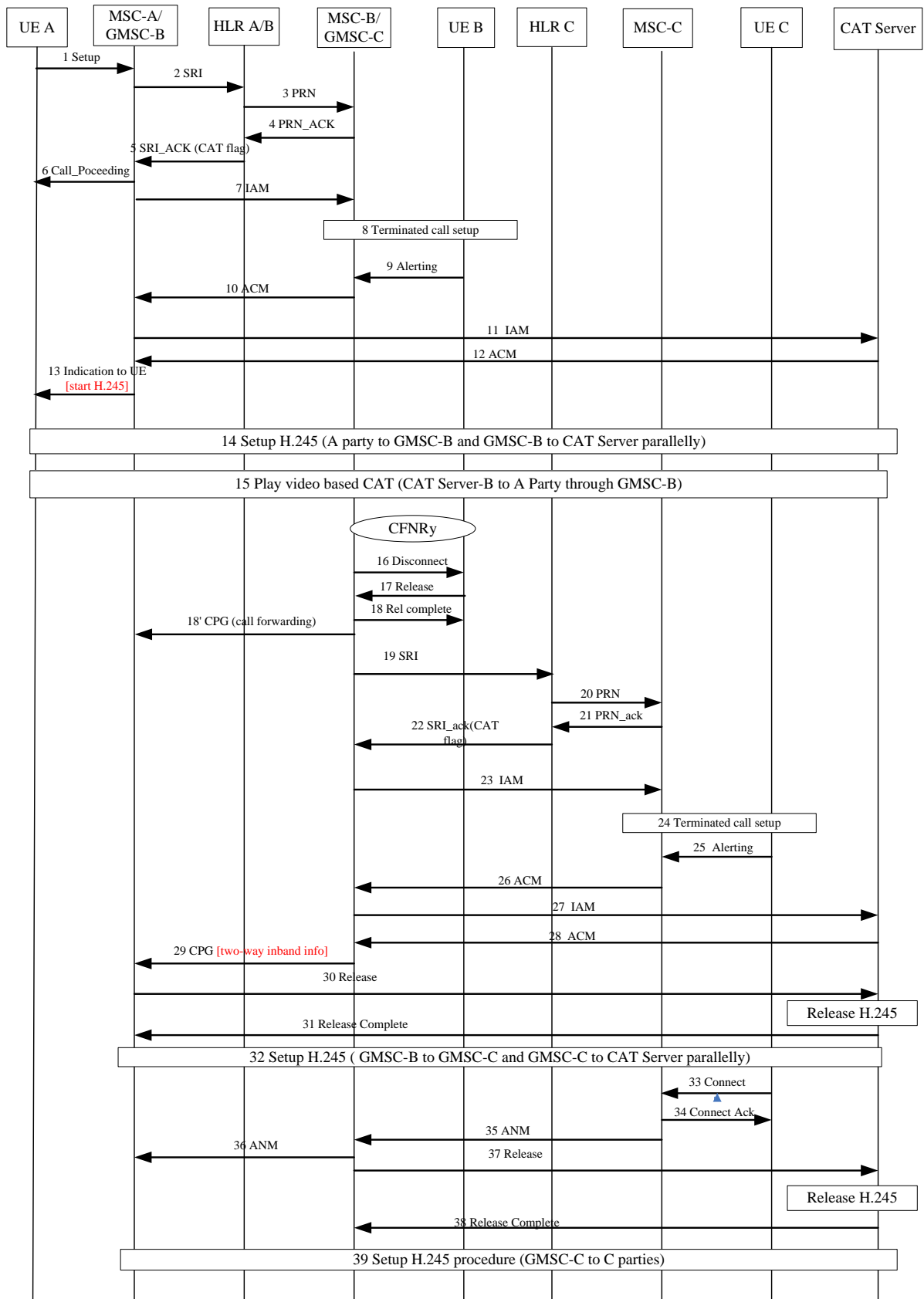- The flow of CFNRy interaction with multimedia CAT is shown in diagram 8.1.2.4.1.

Figure 8.1.2.4.1: Call forwarding of a multimedia call, audio CAT-B stopped upon party C's alerting

Step 39 may happen before step 38 is actually finished.

NOTE: The CAT servers of the called party and forwarded-to party may be different CAT servers.

8.1.2.5 Terminating MSC Server switch architecture

8.1.2.5.1 Speech call

This call flow shows the call forwarding service where the MSC-B establishes the leg toward the CAT Server. After CFNRy or UDUB status, the first CAT content is turned off and the new CAT content from the second called party is delivered to the calling party.

In Figure 8.1.2.5.1.1, after alerting CFNRy and UDUB at Step 18, MSC-B releases the CAT server. The remained call procedure is same as the nominal call procedure.
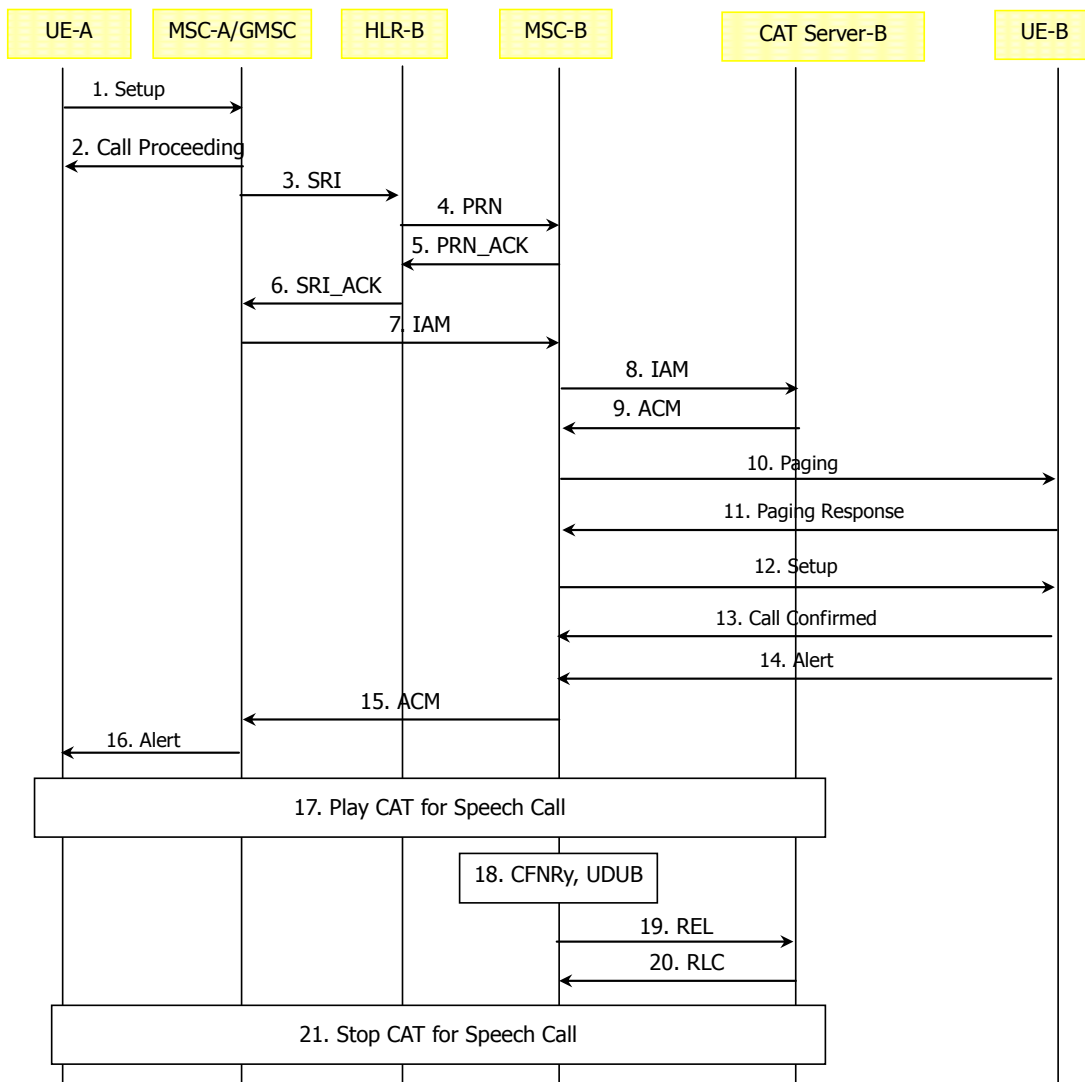
Figure 8.1.2.5.1.1 Call forwarding flow for speech call between UE-A and UE-B

1 to 6   Normal mobile terminating call procedure starts. For starting of the speech call, UE-A sends a call setup message. MSC-A/GMSC sends the Call proceeding message to UE-A. After that MSC-A/GMSC sends SRI(Send Routing Information) to HLR-B for looking at the called user's location and HLR-B delivers PRN (Provide Roaming Number).

7 to 14 After receiving SRI_ACK, MSC-A/GMSC sends IAM(Initial Address Message) to MSC-B for requesting connection. MSC-B sends a paging message and receives the paging response. MSC-B requests a call setup, and then UE-B notifies the call confirmed message and sends Alerting to MSC-B.

15 to 16   MSC-B sends ACM (Address Complete Message) to MSC-A/GMSC, and MSC-A/GMSC sends Alert.

17   CAT-B is played.

18 CFNRy, UDUB

19 to 21 MSC-B sends REL to CAT server B, CAT server B responses to MSC-B by RLC. CAT playing stops.

NOTE: Because MSC-B knows that the CAT for UE-B is activated (When UE-B registers its location to MSC-B, the corresponding info is delivered to MSC-B.) and controls the CAT leg toward CAT server in this scenario, MSC-B can send Step 15 and 16 in advance. In order to reduce the paging time (fast connection), the steps can be changed as follows: After Step 8 and 9 for looking at UE-B's location, MSC-B starts paging process, at the same time, MSC-B can send ACM at Step 15 and Alert at Step 16 to MSC-A/GMSC and UE-A, sequentially.
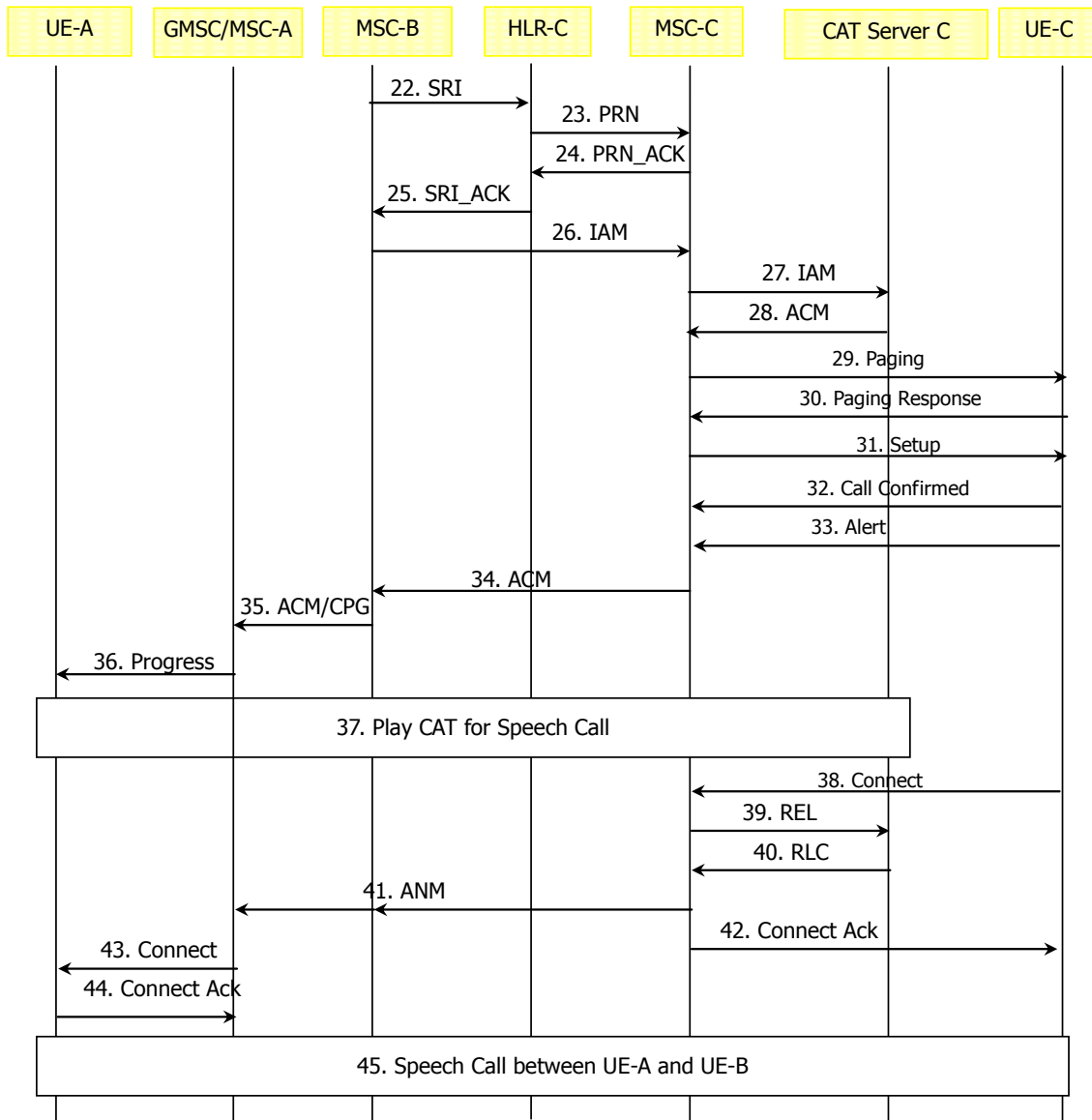

Figure 8.1.2.5.1.2 Call forwarding flow for speech call between UE-A and UE-C

22 to 25 MSC-B sends SRI(Send Routing Information) to HLR-C for looking at the UE-C's location and HLR-C delivers PRN (Provide Roaming Number) to MSC-C.

26 to 33 After receiving SRI_ACK, MSC-B sends IAM(Initial Address Message) to MSC-C for requesting connection. MSC-C sends a paging message and receives the paging response. MSC-C requests a call setup, and then UE-C notifies the call confirmed message and sends Alert to MSC-C.

34 to 36 MSC-C sends ACM (Address Complete Message) to MSC-B. MSC-B sends CPG to MSC-A/GMSC, and MSC-A/GMSC sends Progress.

37 CAT-C content is played.

38 to 44   If UE-C receives a call, then UE-C sends a Connect message to MSC-C. MSC-C sends REL to CAT
server C, CAT server C responds to MSC-C by RLC. CAT stops. MSC-C sends ANM (Answer Message) to
MSC-A/GMSC through MSC-B. MSC-A/GMSC sends a Connect message to UE-A and receives its ACK.

45 Speech call starts.

NOTE: During changing the CAT content, a user may experience sudden CAT stop. The silence section can be
reduced if MSC-B controls the release of CAT service until MSC-B receives ACM from MSC-C. As
other approaches, UE-A or MSC-C can play the default sound. More progress for call forwarded
notification UE-A is needed and MSC-C also has to contain such functionality by itself. Or MSC-B can
send UE-A announcement that the call was forwarded.

8.1.2.5.2   Multimedia call

This call flow shows the call forwarding service where the MSC-B establishes the leg toward the CAT Server. After
CFNRy or UDUB status, the first CAT content is turned off and the new CAT content from the second called party is
delivered to the calling party. For the start and release of H.245 negotiation, the parameters for the CAT subscription
information are needed.

In Figure 8.1.2.5.2.1, after alerting CFNRy and UDUB at Step 19, MSC-B releases the CAT service and sends MSC-
A/GMSC a CPG message with call forwarding for releasing H.245 negotiation. MSC-A/GMSC delivers a Progress
message with inband info. avail. for releasing H.245 negotiation to UE-A. Also, GMSC has to send inband info avail.
for releasing H.245 negotiation to MSC-A if they are not co-located.

Figure 8.1.2.5.2.2 shows call forwarding procedure through MSC-B. After disconnection of CAT service from CAT
Server B, MSC-B forwards a call to MSC-C for communications with UE-C. At Step 38 to 40, the inband info avail for
H.245 negotiation is delivered from MSC-C to MSC-A/GMSC and UE-A through MSC-B, and CAT service is
provided from CAT Server C in which UE-C subscribes CAT service. The remained call procedure is same as the
nominal call procedure.
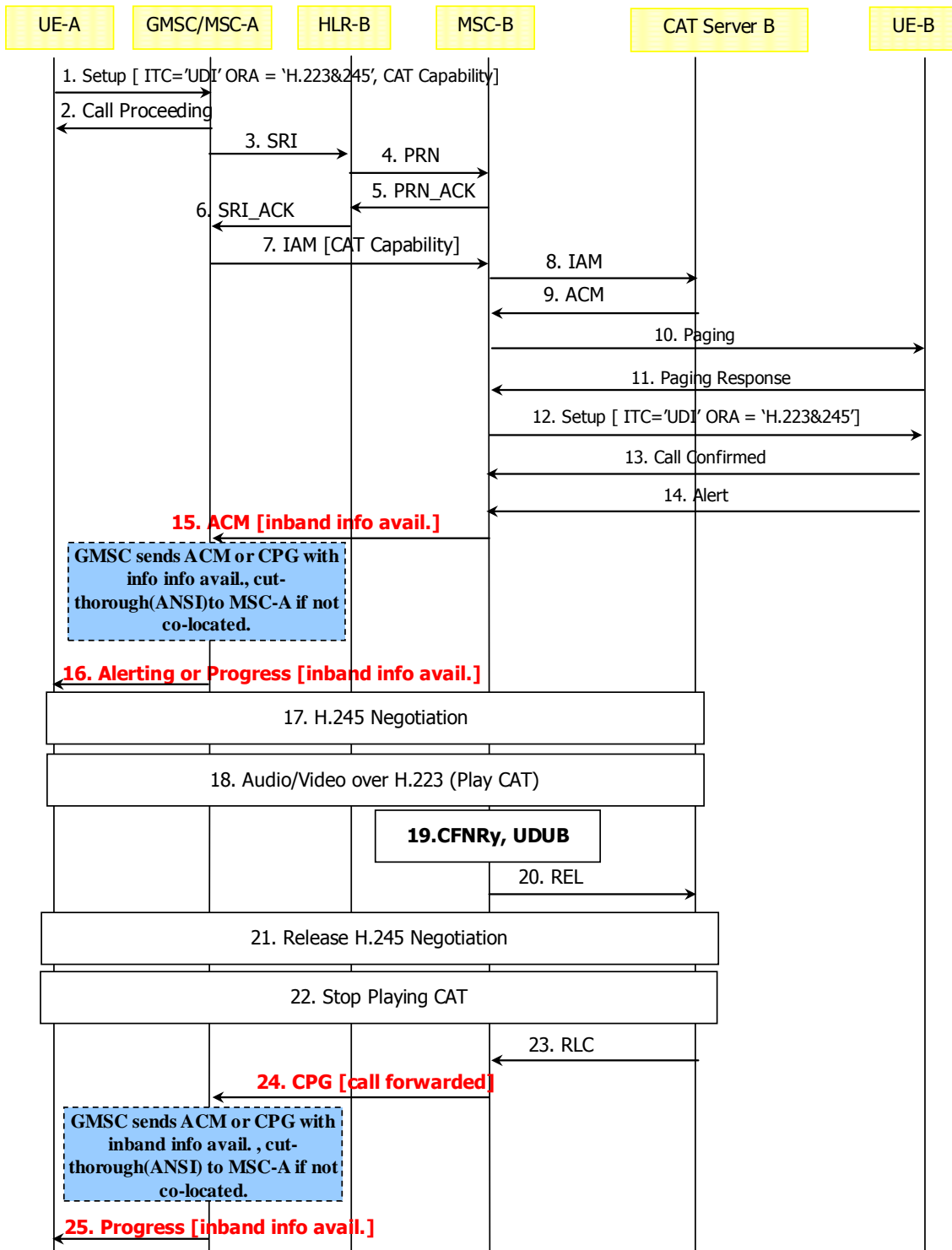
Figure 8.1.2.5.2.1 Call forwarding flow for multimedia call between UE-A and UE-B

1 to 6 Normal mobile terminating call procedure starts. With starting of the video call, UE-A sends a call setup message with UDI(Unrestricted Digital Information) in ITC(Information Transfer Capability), 324M protocol indication (H.223&245) in ORA(Other Rate Adaptation) and CAT capability indicator to indicate if the calling party UE is a CAT capable UE. MSC-A/GMSC sends the Call proceeding message to UE-A. After that MSC-A/GMSC sends SRI(Send Routing Information) to HLR-B for looking at the called user's location and HLR-B delivers PRN (Provide Roaming Number).

Editor's Note: In order to reduce the paging time (fast connection), the steps can be changed as follows: After Step 8 and 9, MSC-B starts paging process, at the same time, MSC-B can send ACM at Step 15 to MSC-A/GMSC and Alert at Step 16 to UE-A, sequentially.

7 to 14   After receiving SRI_ACK, MSC-A/GMSC sends IAM (Initial Address Message) with CAT capability indicator to MSC-B to request connection. The CAT capability indicator is to indicate if the calling party UE is a CAT capable UE. MSC-A can send to GMSC-B an IAM message with the CAT capability indicator if they are separated. MSC-A/GMSC-B receives ACM to notify the UE-B's location. MSC-B sends a paging message and receives the paging response. MSC-B requests a call setup, and then UE-B notifies the call confirmed message and sends Alert to MSC-B.

Editor's Note: Coding of the CAT capability indicator is FFS.

15 to 16   MSC-B sends ACM (Address Complete Message) with in-band information indicator. If GMSC-B and MSC-A are not co-located, GMSC sends an ACM or CPG message to MSC-A with the *In-band information indicator* of the Optional backward call indicators IE set to "in-band information or an appropriate pattern is now available" to inform the originating MSC that a video CAT is available. MSC-A/GMSC sends UE-A Alerting or Progress message with inband info avail. for H.245 negotiation.

17   H.245 negotiation between CAT server B and UE-A is proceeded.

18   After H.245 negotiation, CAT is played.

19   CFNRy, UDUB

20   MSC-B sends REL to CAT server B.

21 to 22   H.245 release procedure. CAT stops.

23   CAT server B responds to MSC-B by RLC.

24 to 25   MSC-B sends MSC-A/GMSC ACM (Address Complete Message) with *call forwarded*, and MSC-A/GMSC sends UE-A Alerting with Progress with inband info avail. for H.245 negotiation which means the session to be closed.

Editor's Note: For H.245 negotiation, the CAT inband info field is contained in the messages at Step 15, 16, 22 and 23. This CAT inband info field can be encoded as a new value or normal inband info field with USI (= multimedia call). FFS is needed.

Editor's Note: Because MSC-B knows that the CAT for UE-B is activated (When UE-B registers its location to MSC-B, the corresponding info is delivered to MSC-B.) and controls the CAT leg toward CAT server in this scenario, MSC-B can send Step 15 and 16 in advance. In order to reduce the paging time (fast connection), the steps can be changed as follows: After Step 8 and 9 for looking at UE-B's location, MSC-B starts paging process, at the same time, MSC-B can send ACM at Step 15 to MSC-A/GMSC and Alert at Step 16 to UE-A, sequentially.
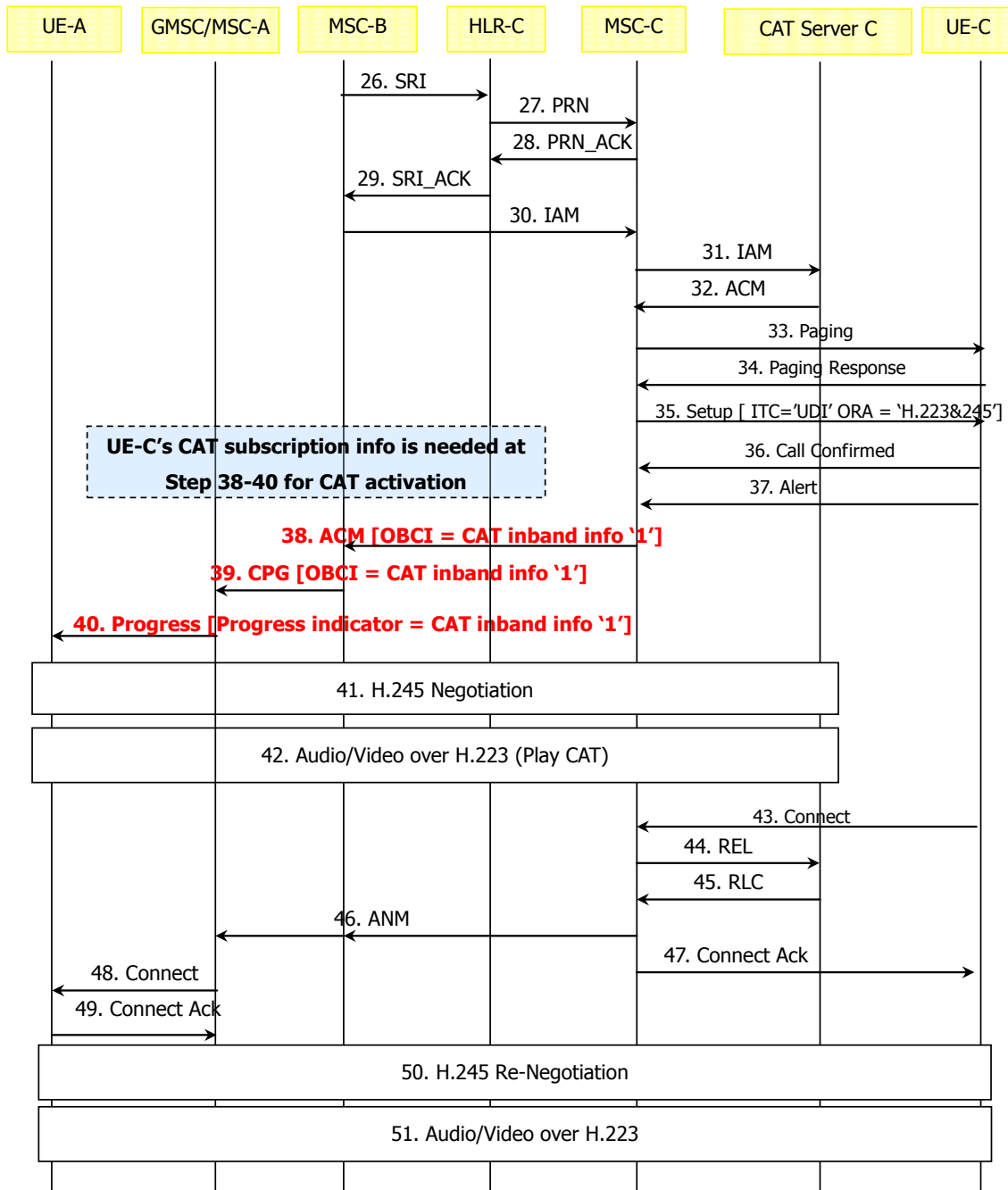
Figure 8.1.2.5.2.2 Call forwarding flow for multimedia call between UE-A and UE-C

26 to 29   MSC-B sends SRI(Send Routing Information) to HLR-C for looking at the UE-C's location and HLR-C delivers PRN (Provide Roaming Number) to MSC-C.

30 to 37   After receiving SRI_ACK, MSC-B sends IAM(Initial Address Message) with the CAT capability indicator to MSC-C for requesting connection and receives ACM for notifying the UE-C's location. MSC-C sends a paging message and receives the paging response. MSC-C requests a call setup, and then UE-C notifies the call confirmed message and sends Alert to MSC-C.

38 to 40   MSC-C sends ACM (Address Complete Message) to MSC-B with the UE-C's CAT inband info available which means the second session to be reopened. MSC-B sends CPG to MSC-A/GMSC with the UE-C's inband info available which means the second session to be reopened and MSC-A/GMSC sends Progress with inband info available which means the second session to be reopened.

41   H.245 negotiation between CAT server C and UE-A is proceeded.

42   After H.245 negotiation, CAT is played.

43 to 49   If UE-C receives a call, then UE-C sends a Connect message to MSC-C. MSC-C sends REL to CAT
            server C, CAT server C responds to MSC-C by RLC. CAT stops. MSC-C sends ANM (Answer Message) to
            MSC-A/GMSC through MSC-B. MSC-A/GMSC sends a Connect message to UE-A and receives its ACK.

50   H.245 renegotiation between UE-A and UE-C is proceeded.

51   AV data for video call is delivered over H.233 protocol.

Editor's Note: For H.245 negotiation, the CAT inband info field is contained in the messages at Step 38-40. This
            CAT inband info field can be encoded as a new value or normal inband info field with USI (= multimedia
            call).

Editor's Note: Because MSC-C knows that the CAT for UE-C is activated (When UE-C registers its location to
            MSC-C, the corresponding info is delivered to MSC-C.) and controls the CAT leg toward CAT server in
            this scenario, MSC-C can send Step 38-40 in advance. In order to reduce the paging time (fast
            connection), the steps can be changed as follows: After Step 31 and 32 for looking at UE-B's location,
            MSC-C starts paging process, at the same time, MSC-C can send ACM at Step 38 to MSC-B, CPG at
            Step 39 to MSC-A/GMSC and Progress at Step 40 to UE-A, sequentially.

8.1.2.6   CAT Server switch architecture with routing back to GMSC Server

8.1.2.6.1   Speech call

8.1.2.6.2   Multimedia call

This multimedia call flow shows a call forwarding service during original called party's alerting (f.e. CFNRy or UDUB).
The time when the removal of the CAT-B to UE-A occurs in CAT-B server is defined by local policy. It can happen
either when the CAT-B Server receives the call forwarding indication or when a CAT-B Server receives indication that
a CAT-C (in-band info available in CPG message) is connected like in the example call flow below.

Figure 8.1.2.6.1 CAT phase called B-subscriber

Figure 8.1.2.6.2 CAT phase called C-subscriber
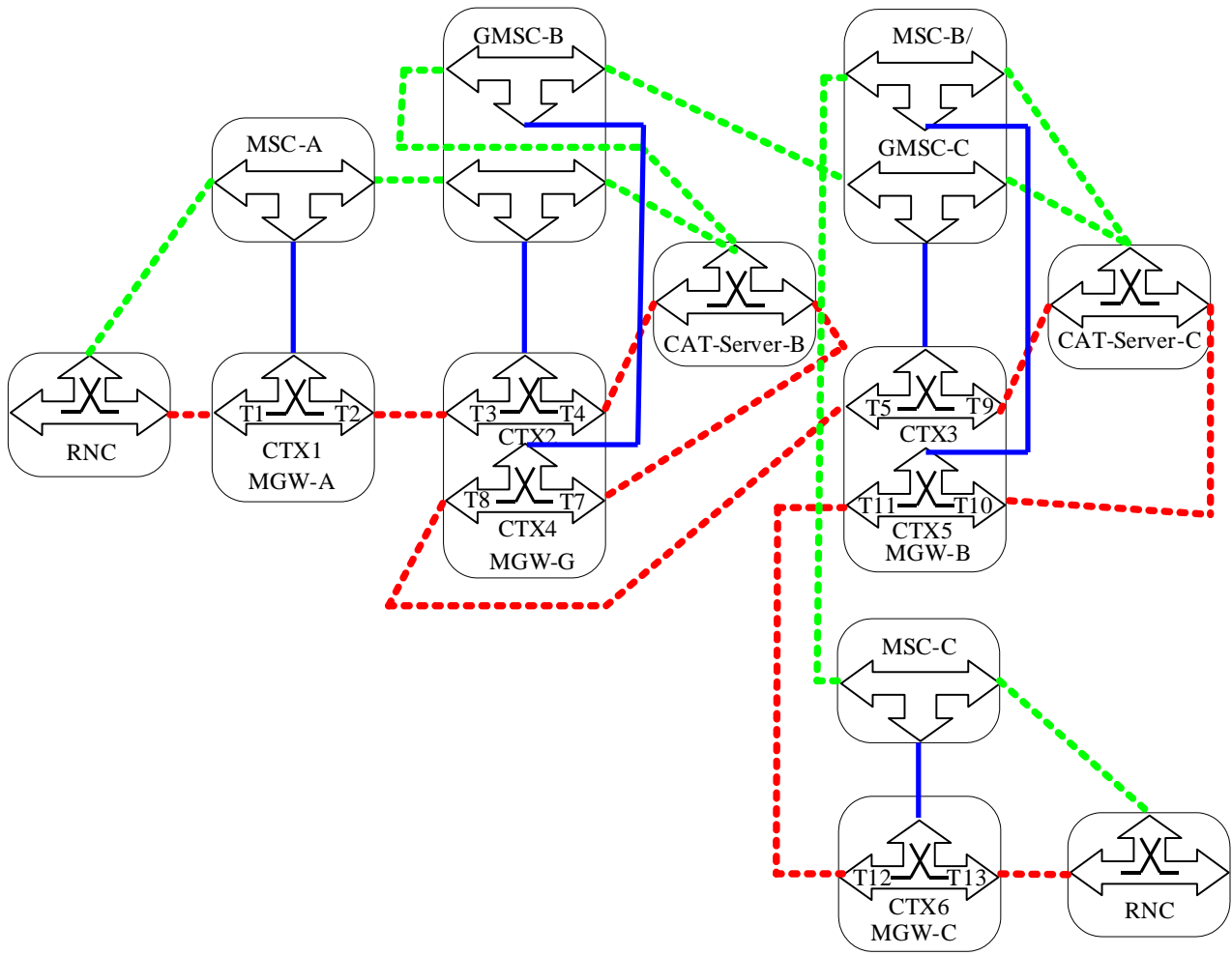
Figure 8.1.2.6.3 Video call phase
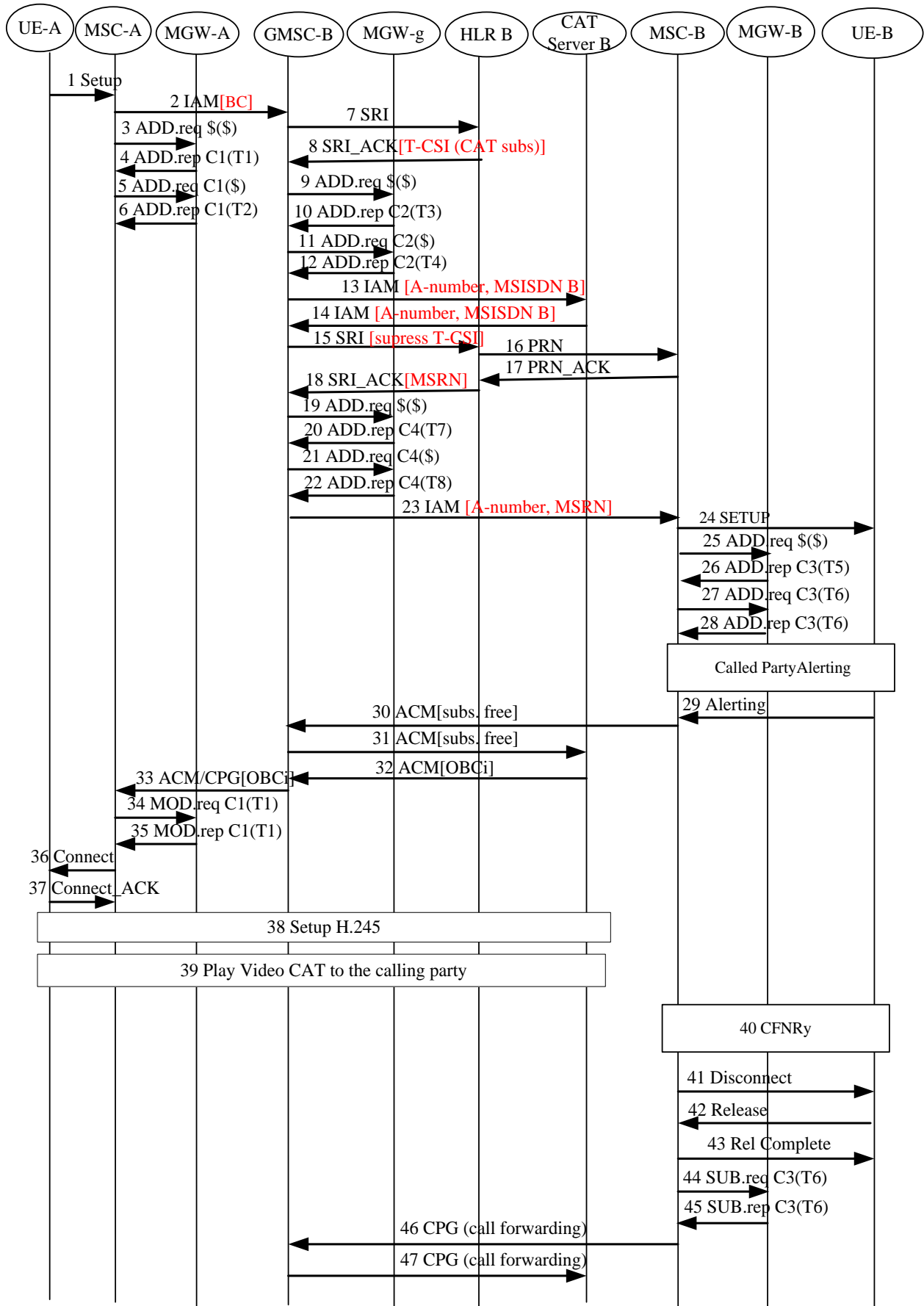
Figure 8.1.2.6.4 Call forwarding of a multimedia call
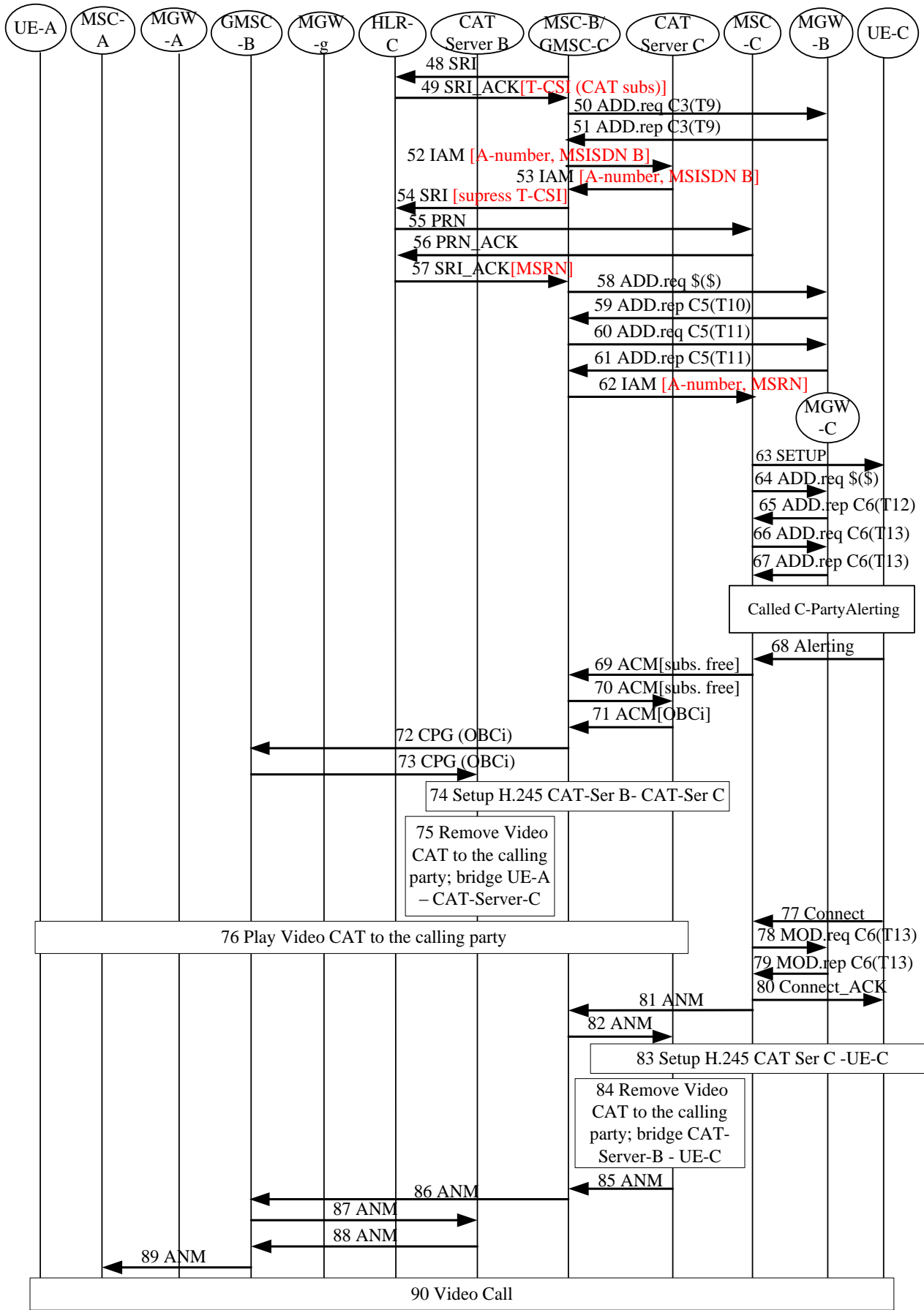
Figure 8.1.2.6.5 Call forwarding of a multimedia call

1 to 39 Normal multimedia call set-up as decribed in chapter 7.3.3.2 CAT Server switch architecture with routing back to GMSC Server.

40 to 47   Call forwarding no reply (CFNRy) occurs the signalling connection towards B-party is released in MSC-B and a CPG message with call forwarding indication sent to GMSC Server-B. GMSC Server B sends this CPG message to the CAT Server-B.

48 to 72   In the example the MSC-B and GMSC-Server-C are co-located. The C-party CAT is provided by CAT-Server-C. The connection to the CAT- Server C by GMSC-Server C is established as described in chapter 7.3.3.2 CAT Server switch architecture with routing back to GMSC Server

73 to 75   GMSC Server B reports the CPG with the inband-info available to the CAT Server B. CAT-Server B sets up the H.245 towards CAT-Server-C. CAT Server B removes the video CAT to the calling party and bridges between UE-A and CAT Server-C.

76   CAT-Server C plays the video CAT to the calling party.

77 to 88   After UE-C answers the video CAT is removed and H.245 between CAT-Server C and UE-C established as described in chapter 7.3.3.2 CAT Server switch architecture with routing back to GMSC Server.

89 to 90 The ANM message is received by the MSC-A Server which starts the charging.

8.1.2.7 (G)MSC server switch architecture use based on UE capabilities

8.1.2.7.1 Speech call

8.1.2.7.2 Multimedia call

This multimedia call flow shows a call forwarding service during original called party's alerting (f.e. CFNRy or UDUB). The time when the removal of the CAT-B to UE-A occurs in CAT-B server is defined by local policy. It can happen either when the CAT-B Server receives the call forwarding indication or when a CAT-B Server receives indication that a CAT-C (in-band info available in CPG message) is connected like in the example call flow below.
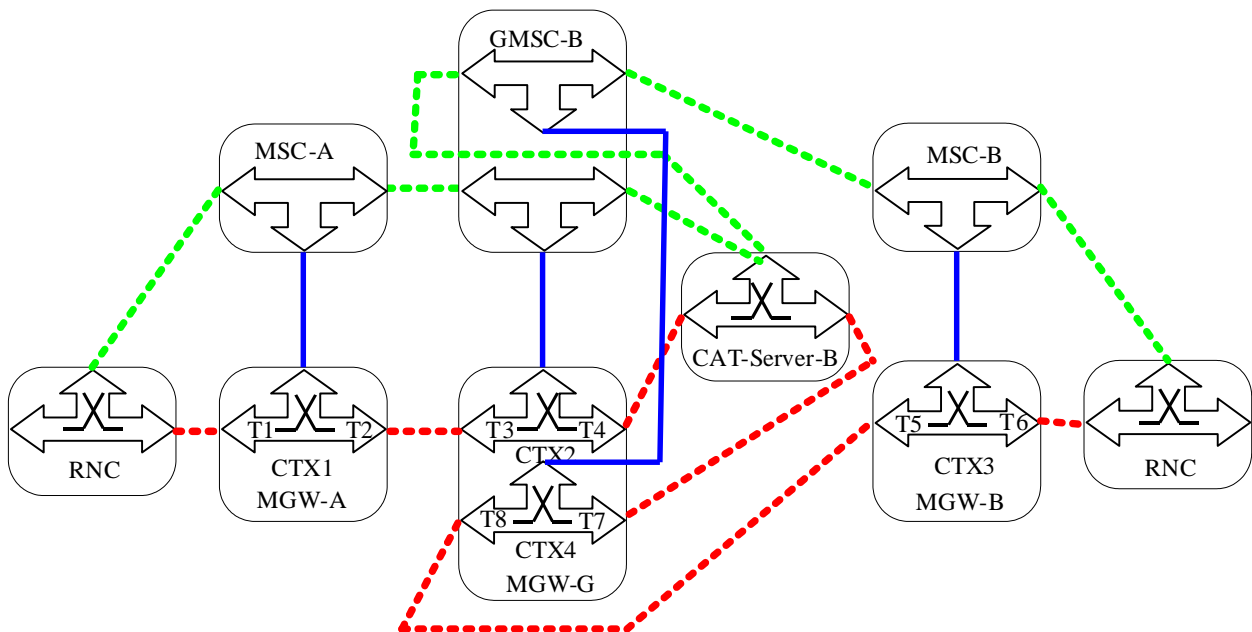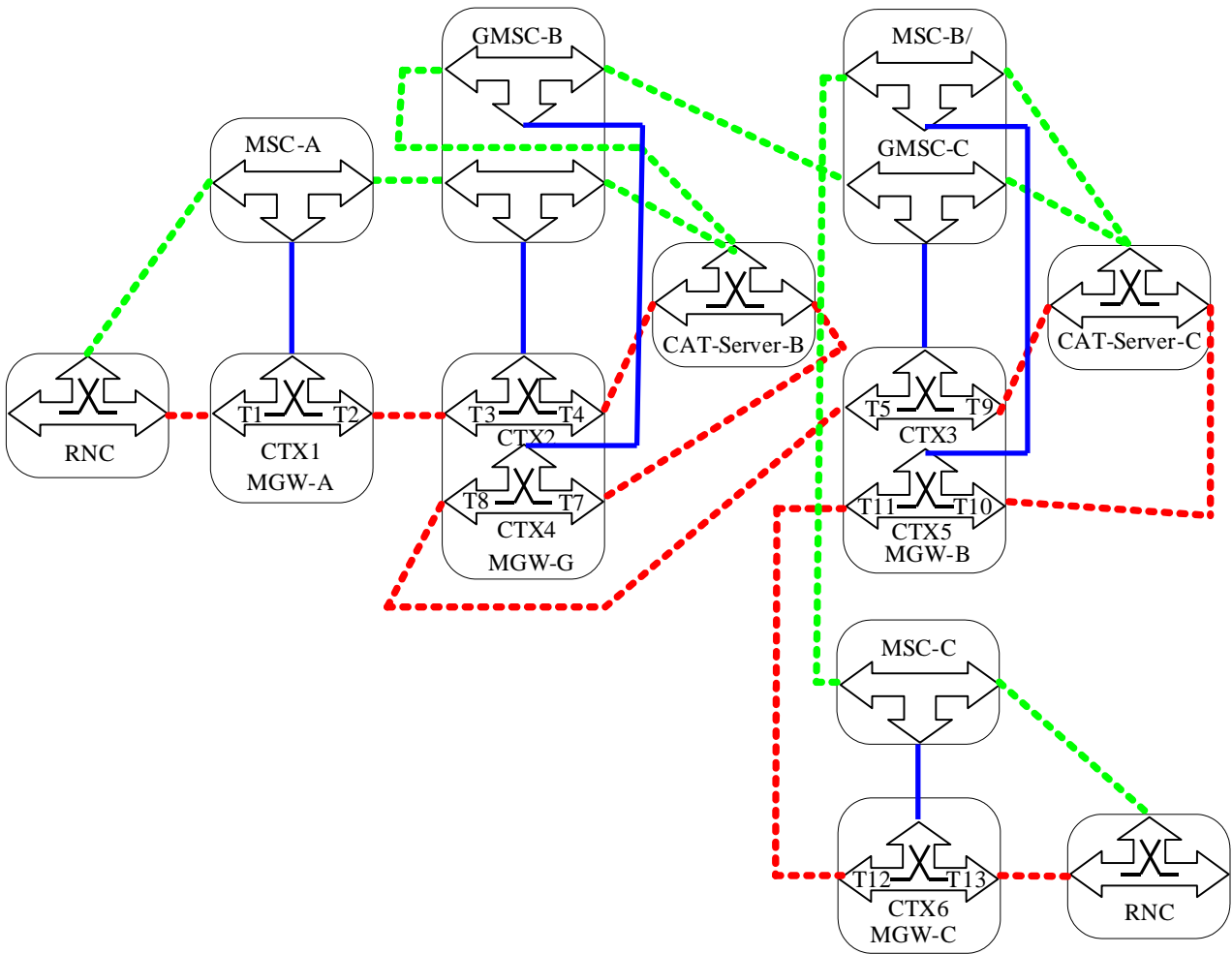

CAT phase called B-subscriber
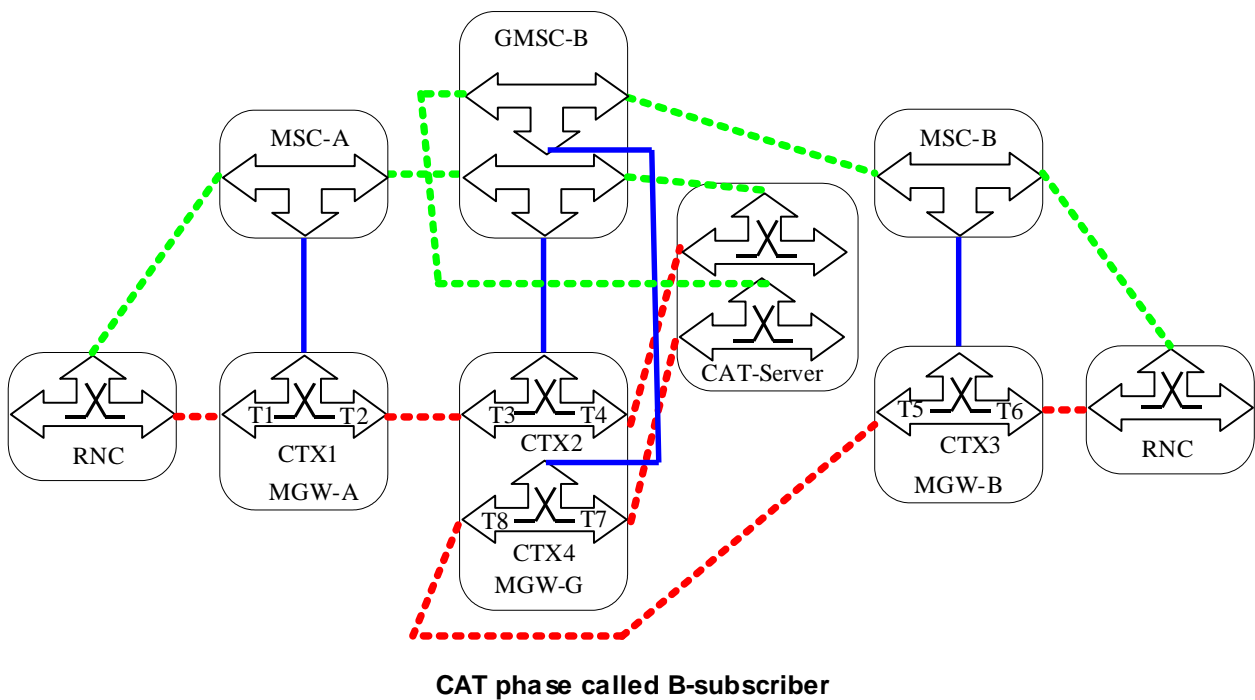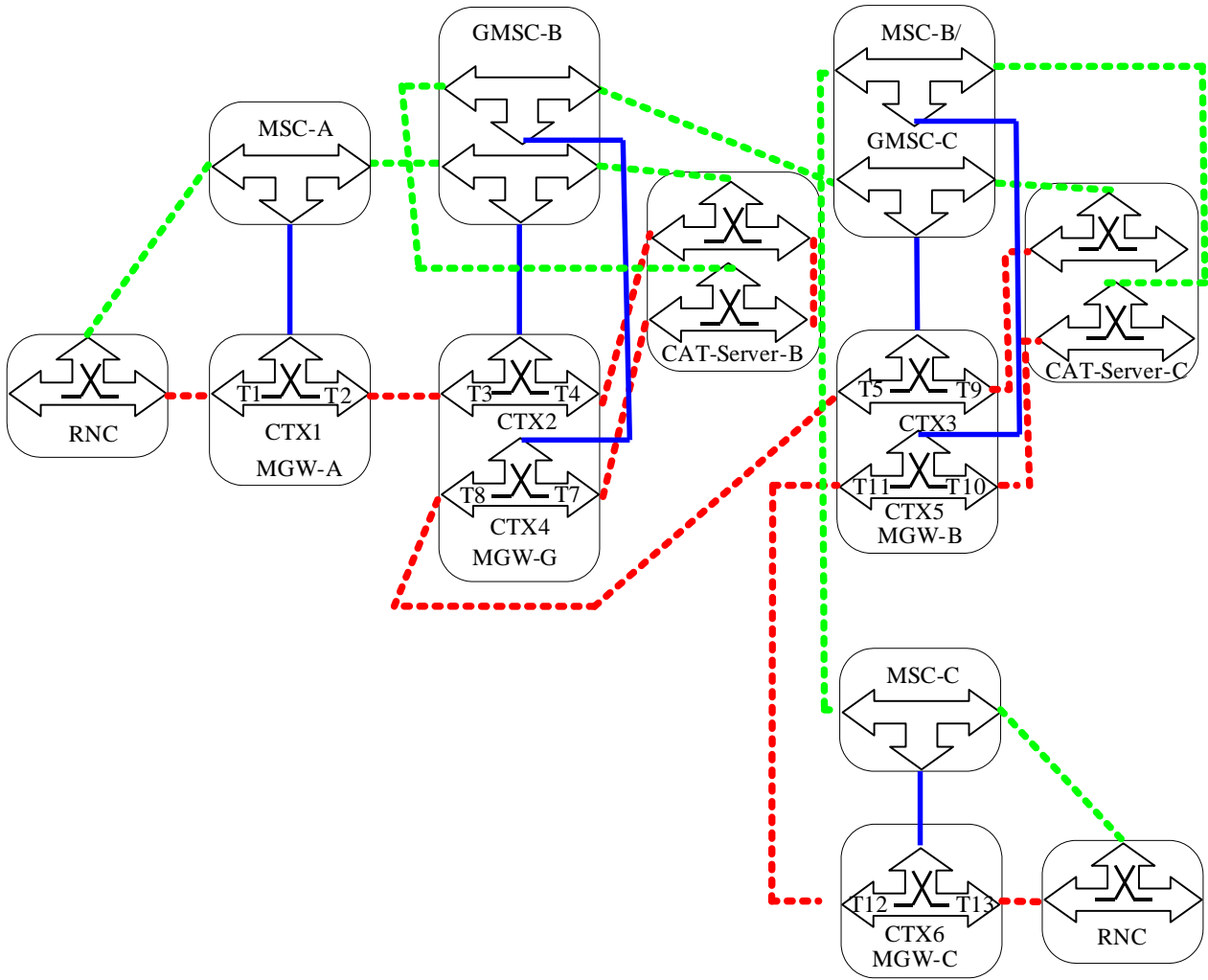
CAT phase called C-subscriber
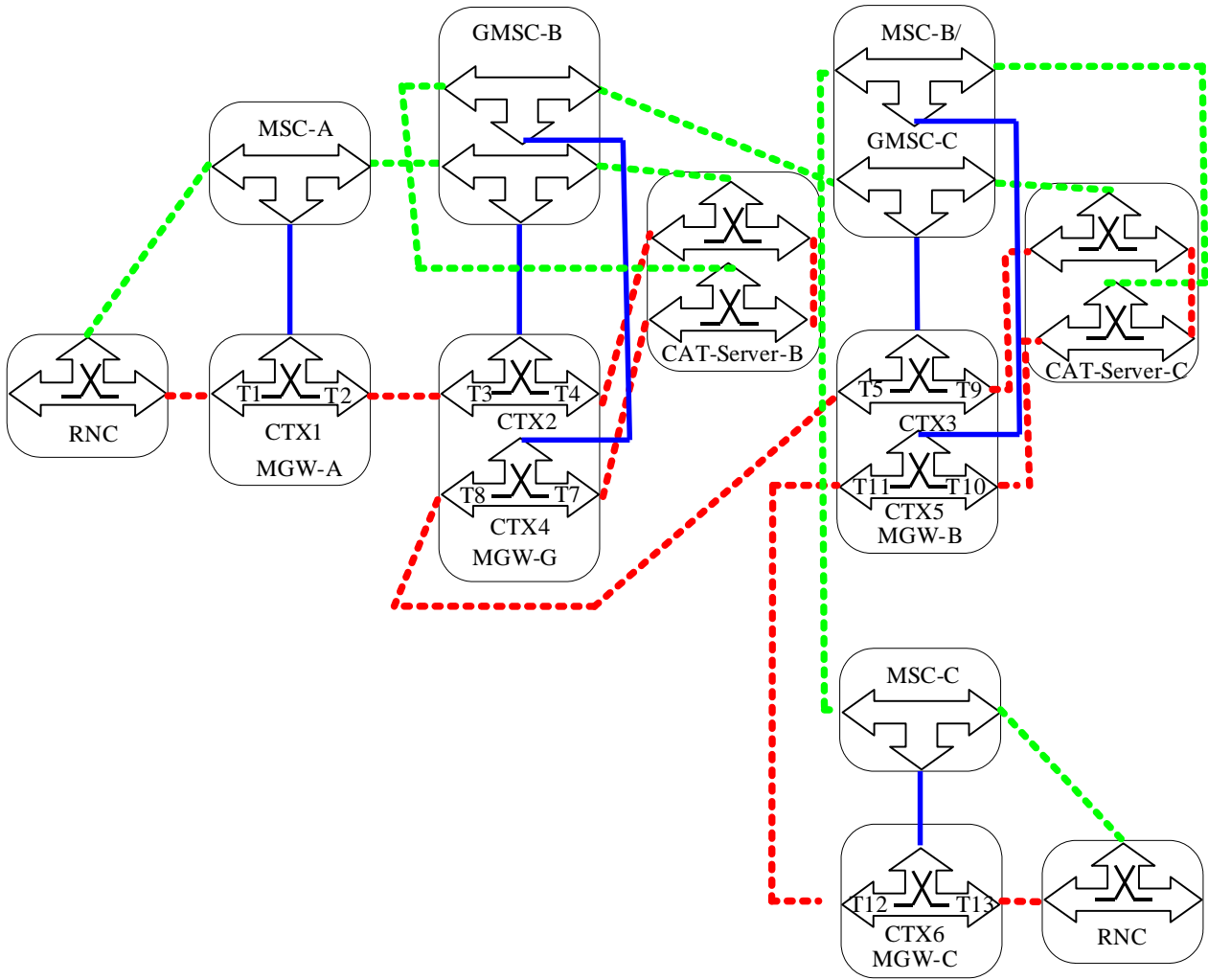
Video call phase

Figure 8.1.2.7.1 (G)MSC Server switch architecture use based on UE capabilities (UE no session reset support) (network model)
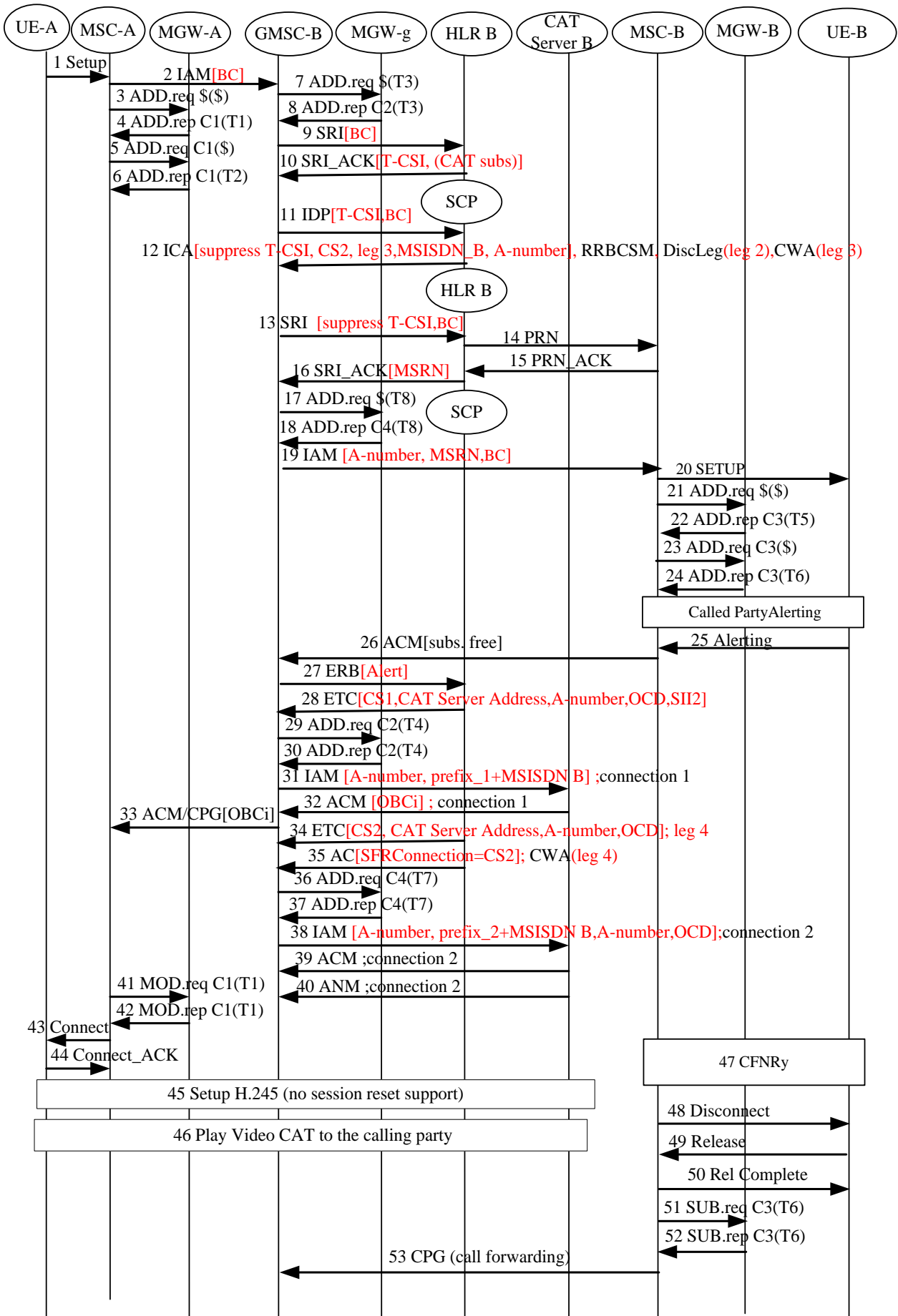
Figure 8.1.2.7.2 Call forwarding of a multimedia call (UE no session reset support)

Figure 8.1.2.7.3 Call forwarding of a multimedia call (UE no session reset support)

Figure 8.1.2.7.4 Call forwarding of a multimedia call (UE no session reset support)

1 to 46 Normal multimedia call set-up as decribed in chapter 7.4.3.2 (G)MSC server switch architecture use based on UE capabilities with UE no session reset support.

47 to 53   Call forwarding no reply (CFNRy) occurs the signalling connection towards B-party is released in MSC-B Server and a CPG message with call forwarding indication sent to GMSC Server-B

54 to 85   In the example the MSC-B and GMSC-Server-C are co-located. The c-party CAT is provided by CAT-Server-C. The connection to the CAT- Server C by GMSC-Server C is established as described in chapter 7.4.3.2 (G)MSC server switch architecture use based on UE capabilities with UE no session reset support.

86 to 90   GMSC server B reports call forwarding to the SCP. SCP sends Continue with arguments. GMSC Server B informs the CAT-Server B about the call forwarding with a ISUP Facility message including the Generic Notification indicator set to "call is diverting". CAT-Server B sets up the H.245 towards CAT-Server-C. CAT Server B removes the video CAT to the calling party and bridges between UE-A and CAT Server-C.

    NOTE: TS 23.078 does at the moment not support the Forwarded Call information element in an Event report BCSM operation for the NP state model.

91 CAT-Server C plays the video CAT to the calling party.

92 to 101   After UE-C answers the video CAT is removed and H.245 between CAT-Server C and UE-C established as described in chapter 7.4.3.2 (G)MSC Server switch architecture use based on UE capabilities with UE no session reset support.

102 to 106   When GMSC Server B receives the ANM message in reports the answer to the SCP. SCP sends Continue with arguments. GMSC Server B informs the CAT-Server B about the answer with a second ISUP Facility message including the Generic Notification indicator set to "call is diverting". CAT-Server B generates the ANM message on connection 1.

107 to 108   MSC-A Server receives the answer message from GMSC Server B and starts the charging.

CAT phase called B-subscriber
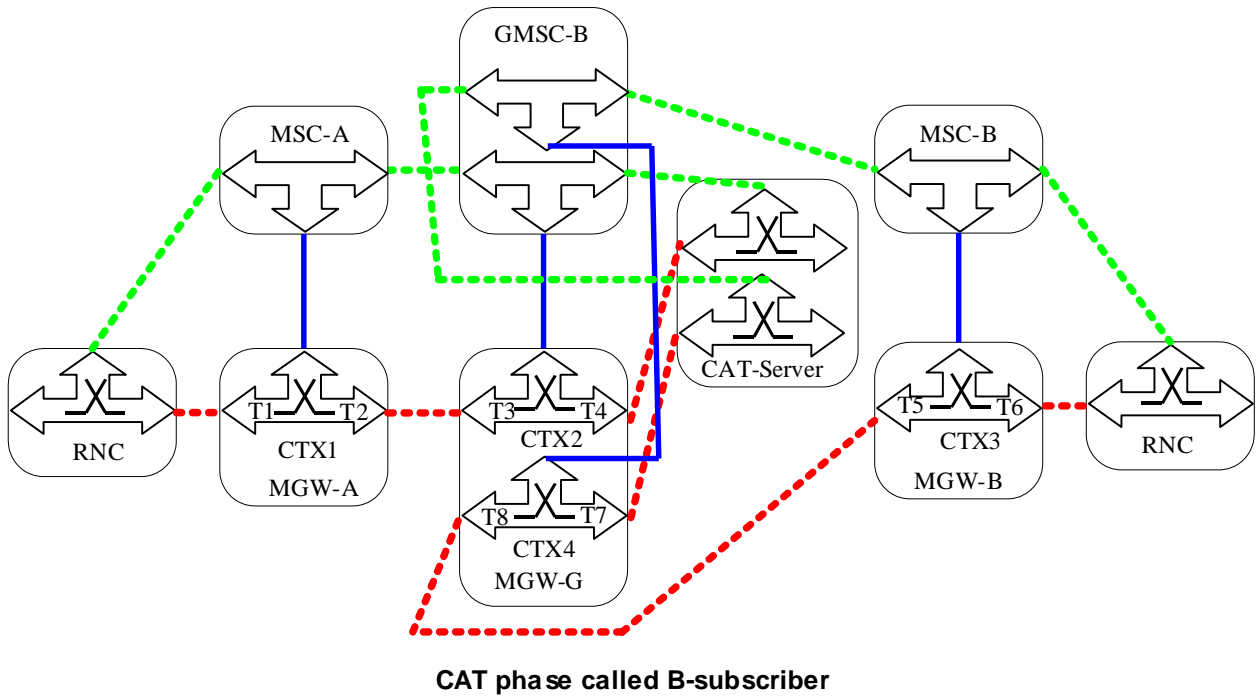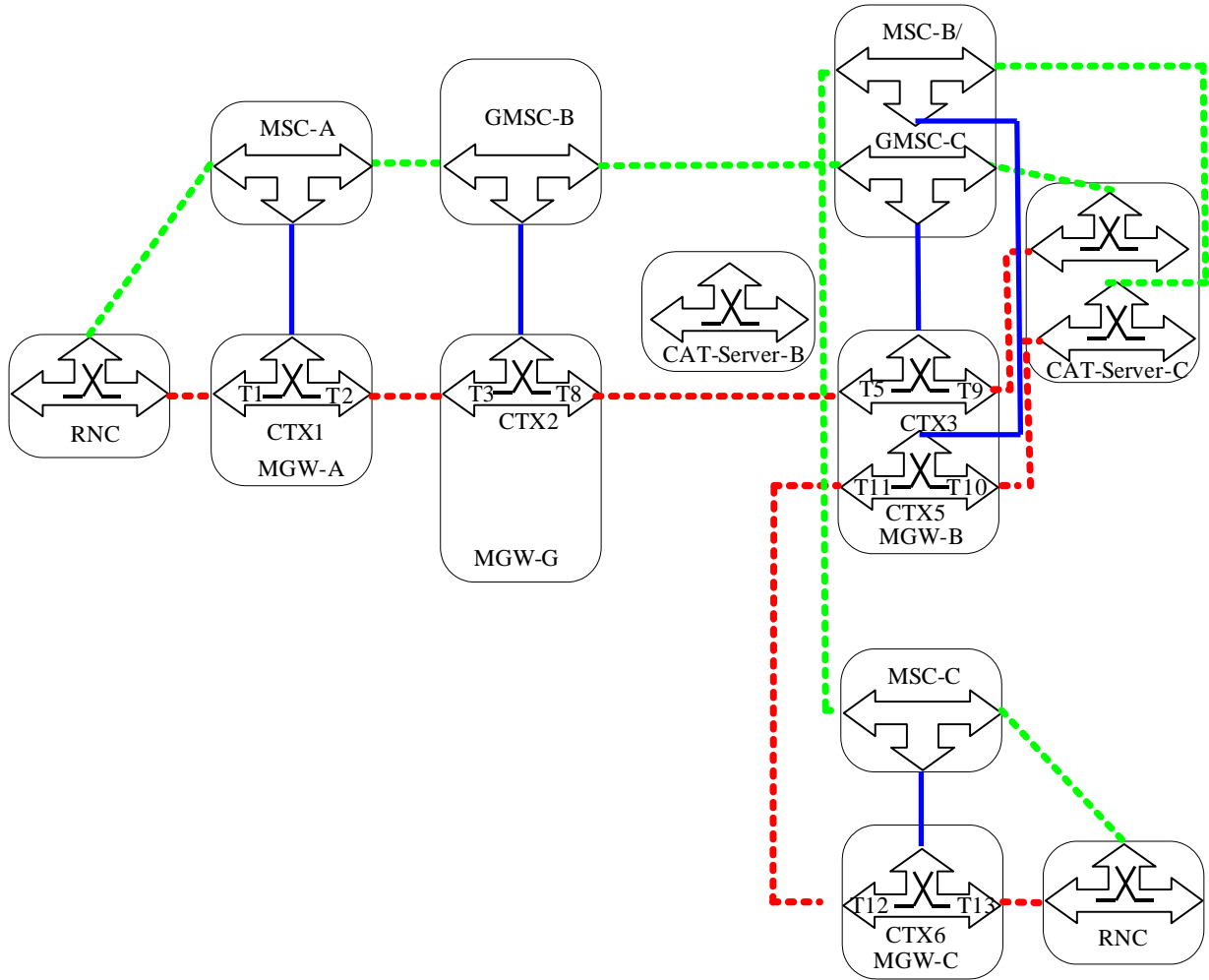
CAT phase called C-subscriber
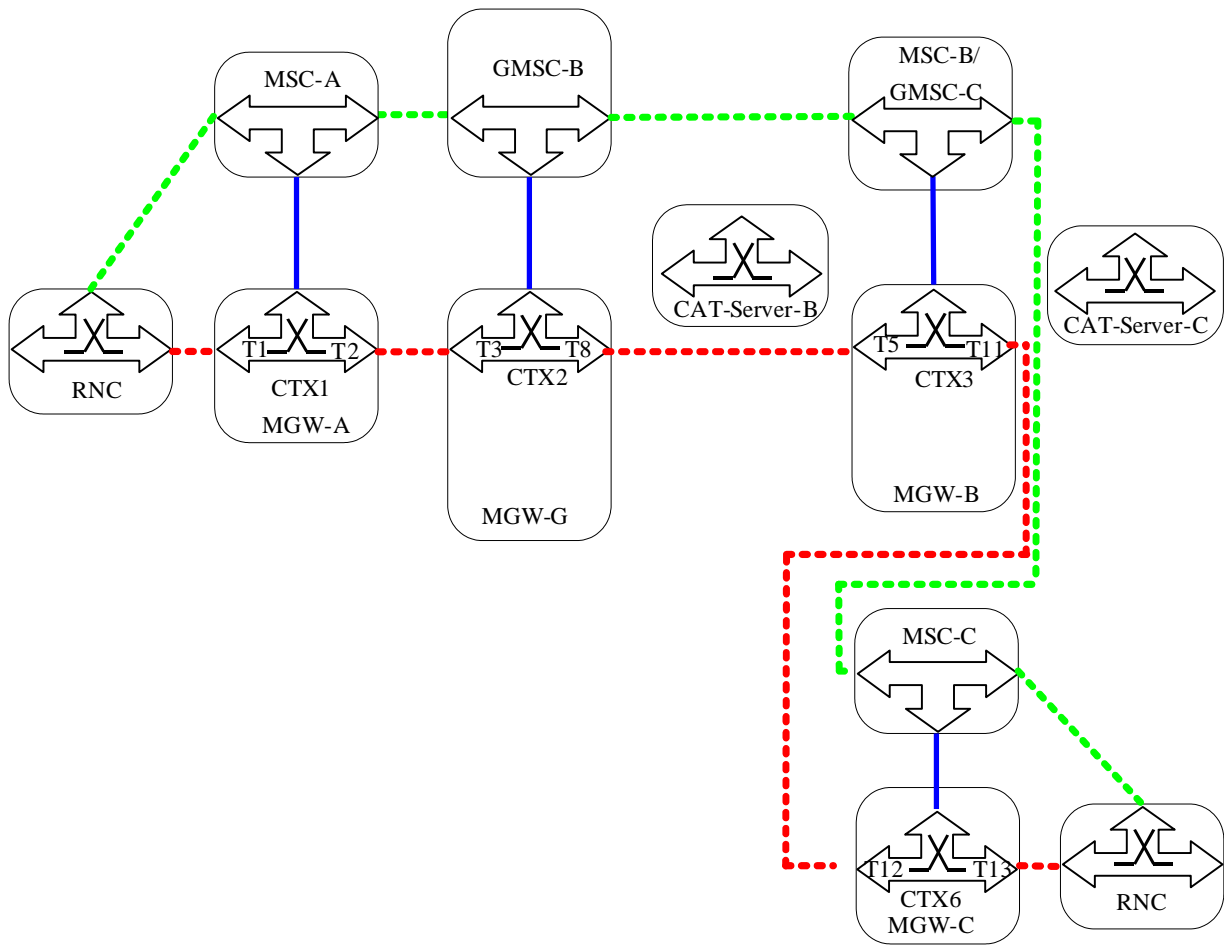
Video call phase

Figure 8.1.2.7.5 (G)MSC Server switch architecture use based on UE capabilities (UE session reset support) (network model)
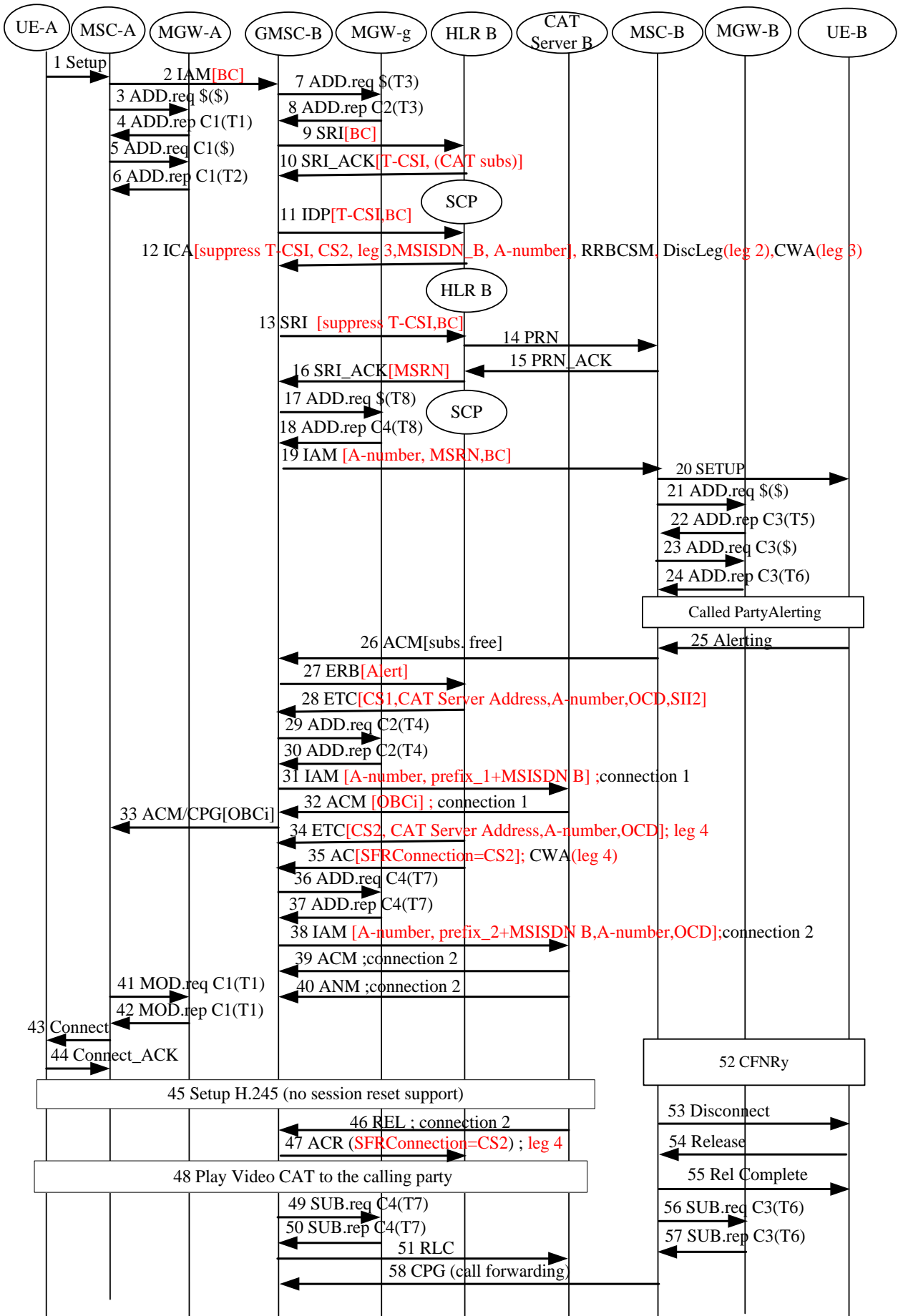
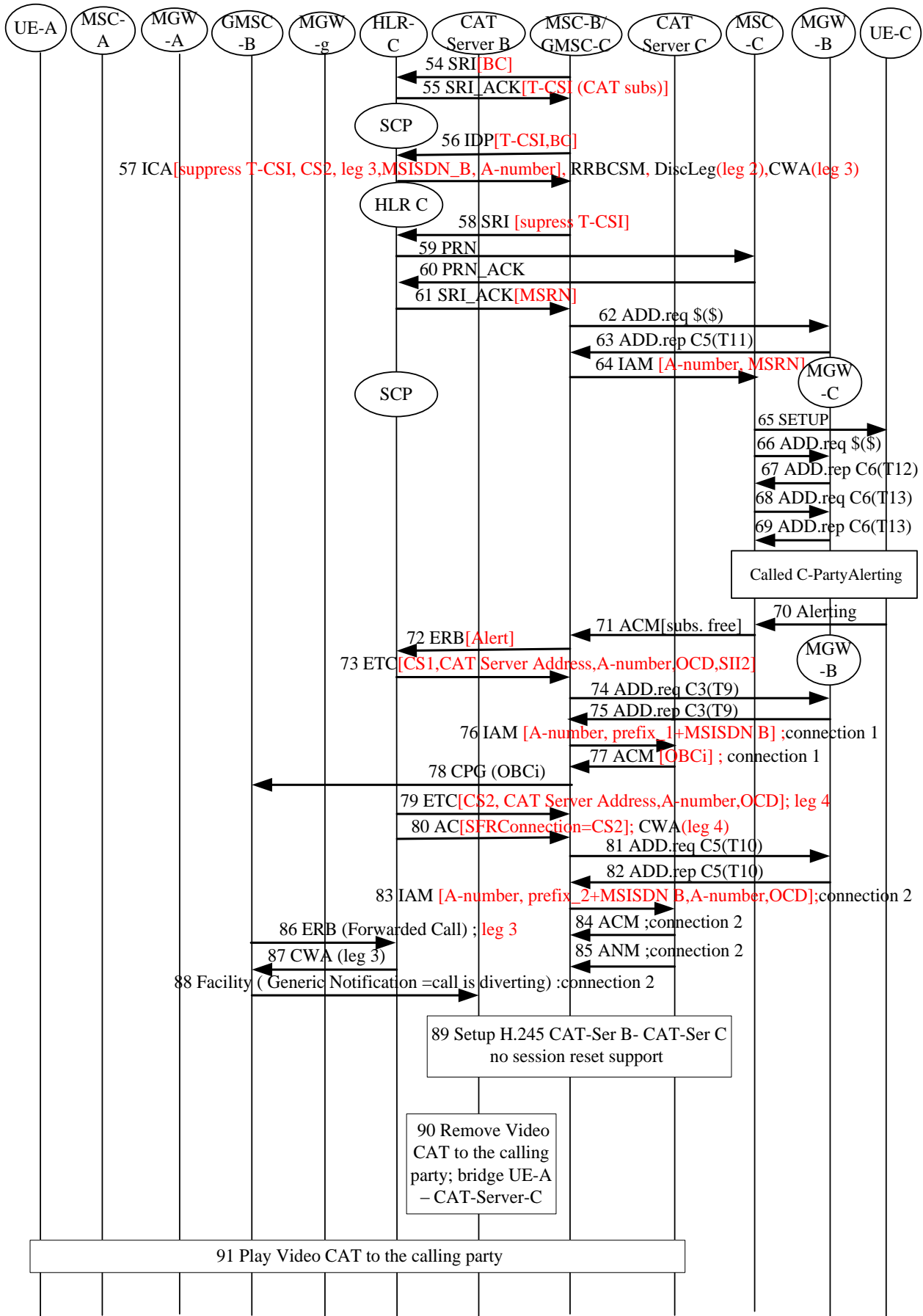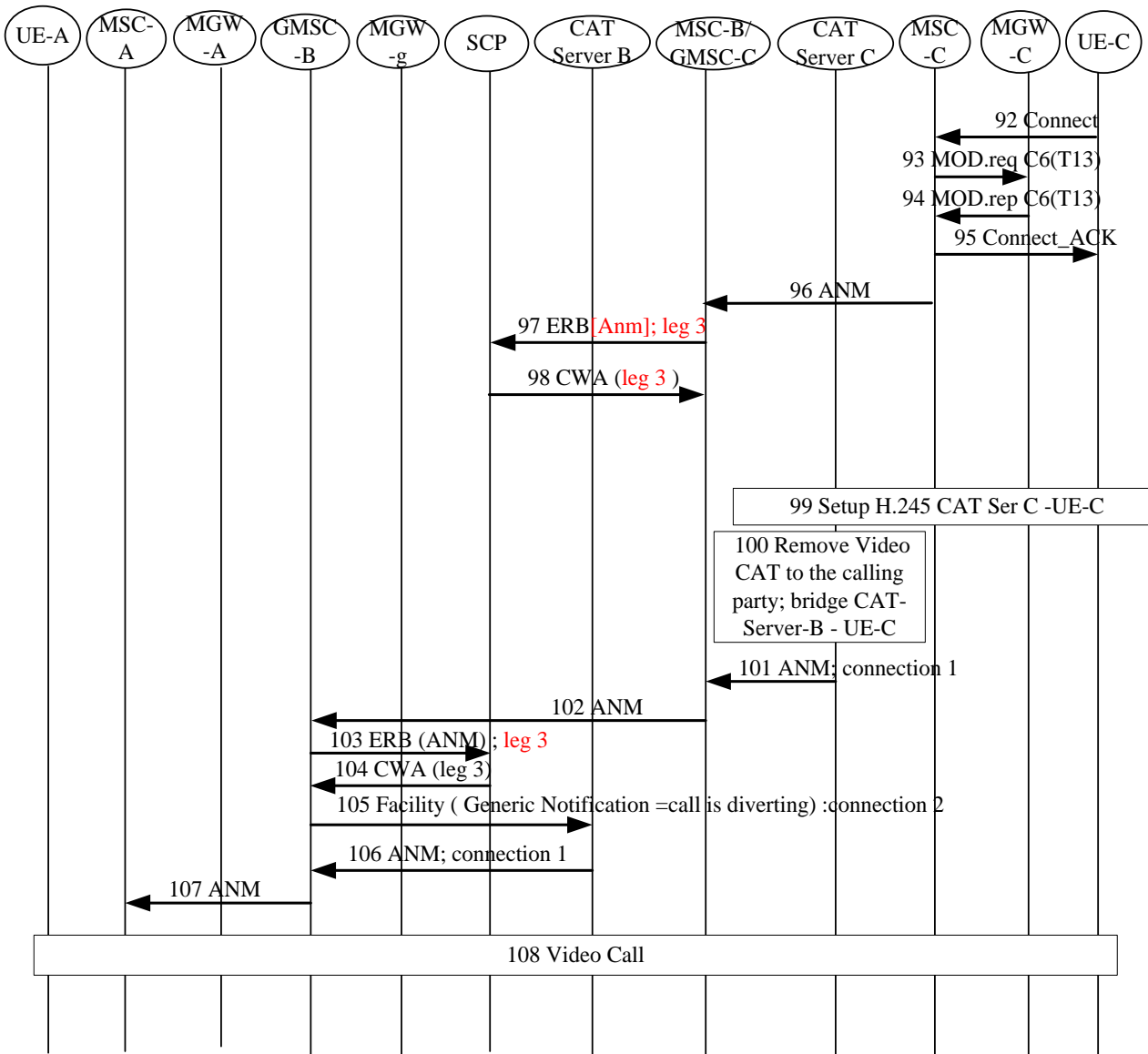**Figure 8.1.2.7.6 Call forwarding of a multimedia call (UE session reset support)**
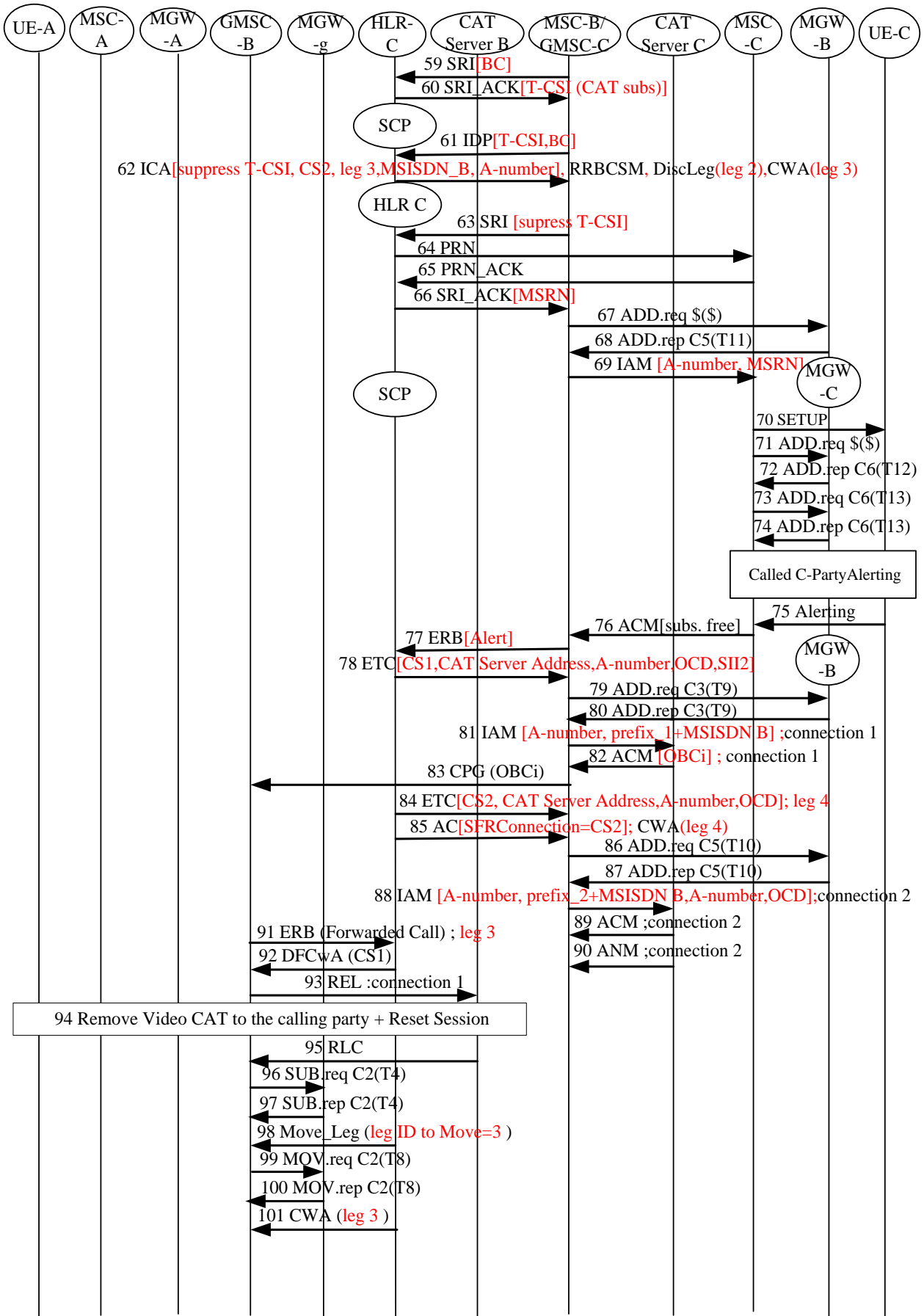
Figure 8.1.2.7.7 Call forwarding of a multimedia call (UE session reset support)
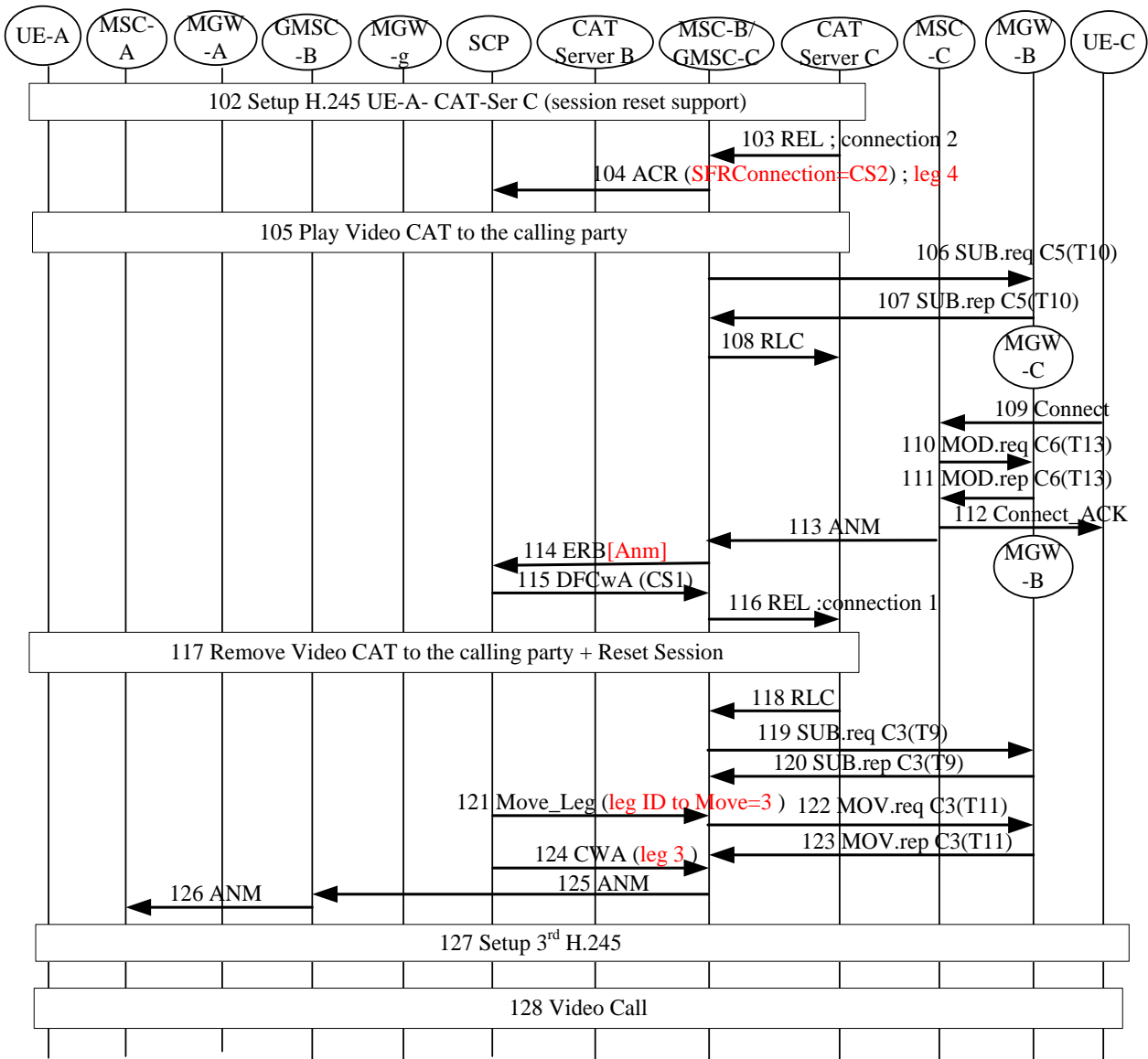
Figure 8.1.2.7.8 Call forwarding of a multimedia call (UE session reset support)

1 to 51 Normal multimedia call set-up as decribed in chapter 7.4.3.2 (G)MSC server switch architecture use based on UE capabilities with UE session reset support.

52 to 58   Call forwarding no reply (CFNRy) occurs the signalling connection towards B-party is released in MSC-B Server and a CPG message with call forwarding indication sent to GMSC Server-B

59 to 90   In the example the MSC-B and GMSC-Server-C are co-located. The C-party CAT is provided by CAT-Server-C. The connection to the CAT- Server C by GMSC-Server C is established as described in chapter 7.4.3.2 (G)MSC Server switch architecture use based on UE capabilities with UE session reset support.

91 to 101 GMSC server B reports call forwarding to the SCP. SCP has already the information that UE-A supports session reset so it initiates a Disconnect Forward Connection with Argument operation for removing also the first connection to the CAT Server B. GMSC Server B initiates the release towards the CAT Server B. The CAT Server B removes the Video CAT and sends a H.324 session reset to UE-A. After the CAT Server has acknowledged the release, GMSC Server B releases the termination towards the CAT Server B in the MGW -g. The SCP initiates a Move Leg operation for through connecting the terminations towards MSC-A Server and MSC-B Server.

   NOTE: TS 23.078 does at the moment not support the Forwarded Call information element in an Event report
   BCSM operation for the NP state model.

102 to 108 A H.245 connection is set up between UE-A and CAT Server C and CAT-Server C plays the video CAT to the calling party as described in chapter 7.4.3.2 (G)MSC Server switch architecture use based on UE capabilities with UE session reset support.

109 to 128 After UE-C answers the call, the video CAT from CAT-Server C is removed, a session reset by CAT-server C towards UE-A is initiated, the connection between GMSC-C and CAT Server-C is released and a H.245 between UE-A and UE-C is established. This is handled as described in chapter 7.4.3.2 (G)MSC Server switch architecture use based on UE capabilities with UE session reset support.

8.1.3 Call waiting

8.1.3.1 Basic interactions

Upon arrival of an incoming waiting call, the terminating MSC may send towards the calling party :

- a "call waiting" signalling notification, e.g. return an ACM or CPG containing "call is a waiting call" in Notification indicator in Generic notification indicator; or/and

- a call waiting announcement, e.g return an ACM or CPG to the GMSC indicating "in-band information available";

No CAT-A nor CAT-B should have been initiated yet in that case, unless the call was forwarded (e.g. CFNRy).

Editor's Note: 3GPP TS 22.182 sub-clause 4.2.4.4 states that CAT-A / CAT-B may be sent in case of call waiting scenario. Unless call was forwarded, this should normally not occur actually, unless CAT were initiated prior to receiving the indication that the called party is alerted.

Upon receipt of indication that in-band information is available, the originating MSC and (G)MSC should through-connect the calling party to the in-band information, stopping any CAT-A/CAT-B previously started. This may however be controlled by a configurable option in the MSC Server.

NOTE: The originating MSC / (G)MSC may not know whether the in-band information is a call waiting announcement, a busy tone, or any other kind on in-band information.

Upon receipt of a "call waiting" signalling notification, the originating MSC and (G)MSC propagate the notification to the calling party.

8.1.3.2 'Call waiting' CAT

As an option, the (G)MSC of the called party may establish a connection towards the CAT server of the B party to play a call waiting CAT towards the calling party, as specified for nominal call flows in sub-clause 7.

The (G)MSC could indicate to the CAT Server that this is a waiting call by setting the notification indicator in Generic notification indicator to 'call is a waiting call'.

8.1.4 Call Hold

8.1.4.1 Basic interactions

No impact.

8.1.4.2 'Call hold' CAT

As an option, the (G)MSC of the subscriber putting the call on hold may establish a connection towards the CAT server of the subscriber. This is ffs.

8.1.5 Multiparty

No interaction for video CAT (multiparty not supported for multimedia calls).

A multiparty call may involve one or more calls which are subject to audio CAT. Any call to expand a multiparty call is treated as a normal mobile originated call, which can involve CAT. Only the party controlling the MPTY service can hear the CAT of the new party. DTMF received from the party controlling the MPTY service should be sent towards the new called party (based on the transaction identifier in the "START DTMF" message) to support copy and stop CAT command for the new call.

8.1.6 Explicit Call Transfer

No impact if ECT is invoked by subscriber A after both calls A-B and A-C are answered.

If ECT is invoked by subscriber A after A-B call is answered but during A-C call is alerting, CAT-C, if being played to subscriber A, shall be played to subscriber B as well after invocation of ECT. If a CAT-A was being played to subscriber A, it is not played towards subscriver B; in that case, CAT-B will not be played to subscriber B (as per 3GPP TS 22.182, sub-clause 4.2.4.5).

8.1.7 Call barring

8.1.7.1 Barring of all Incoming Calls (BAIC)

No interaction.

Barring of all Incoming Calls (BAIC) is invoked in the HLR during routing interrogation. BAIC therefore takes precedence over CAT-B service, i.e. CAT-B is not invoked for calls being subject to BAIC.

8.1.7.2 Barring of all Incoming Calls when Roaming Outside the HPLMN Country (BICroam)

No interaction.

If BICroam is active and operative, the call is barred in the HLR during routing interrogation. The interaction is therefore the same as with BAIC.

8.1.7.3 Barring of all Outgoing Calls (BAOC)

No interaction.

The originating MSC checks whether the call shall be barred before triggering any CAT service, i.e. CAT-A is not invoked for calls being subject to BAOC.

8.1.7.4 Barring of Outgoing International Calls (BOIC)

No interaction. Same as with BAOC.

8.1.7.5 Barring of Outgoing International Calls except to HPLMN Country (BOICexHC)

No interaction. Same as with BAOC.

8.1.8 Closed user group

No interaction.

The *Closed user group interlock code* is not impacted by the CAT service. They are forwarded to the called party as received from the calling party.

NOTE: In the CAT Server switch architecture, the CAT Server shall forward the *Closed user group interlock code* with no modification.

8.1.9 User to User signalling

No interaction.

The *User-to-user indicators and User-to-user information* is not impacted by the CAT service. They are forwarded to the called/calling party as received from the calling/called party.

> NOTE: In the CAT Server switch architecture, the CAT Server shall forward *the User-to-user indicators and the User-to-user information* with no modification.

8.1.10 Advice of charge

For alternatives sending CONNECT message after the called party answers the call, the CAT service does not affect the timepoint for MSC to send and receive the AoC related messages such as CONNECT, FACILITY.

For alternatives using CONNECT message already in the alerting phase the CONNECT message should include AoC parameters indicating the correct charging information for the CAT phase. When the call is answered the originating MSC Server receives the ANM message. The originating MSC server should then send an additional FACILITY message indicating AOC charging information for the call.

Since the call charging remains independent from the CAT charging, the CAT charging does not need to be notified to the calling/called parties in the AoC's charging information.

8.1.11 Voice group call service (VGCS), Voice broadcast service (VBS)

Voice group call service (VGCS) and Voice broadcast service (VBS) is only for speech calls and there is no interaction with CAT service.

8.2 Interaction with other services and functions

8.2.1 CAMEL services

8.2.2 Lawful Interception

CAT may contain a personal message and it therefore comes down under the scope of interception.

> Editor's Note: an LS has been sent to SA3-LI to confirm whether CATs should be intercepted, and if yes, to clarify which exact requirements should be supported for the CAT service.

8.2.3 Operator determined barring

No interaction.

8.2.4 Unstructured Supplementary Service Data (USSD)

No interaction.

8.2.5 Carrier selection

The CAT service shall not affect the selection of the carrier preferred by the subscriber for calls requiring routing via an inter-exchange carrier.

In the CAT Server switch architecture, where the call is routed through the CAT Server, the originating MSC (for CAT-A service) and GMSC (for CAT-B service) shall indicate the carrier preferred by the subscriber in the outgoing IAM message sent to the CAT Server through the called party number or the ISUP Transit Network Selection IE. The CAT Server should then route the outgoing call according to the preferred carrier.

The other CAT architectures do not interact with Carrier selection.

8.2.6   DTMF

For speech calls, DTMF sending shall be performed as specified in 3GPP TS 23.205 [3] or 3GPP TS 23.231 [10].

DTMF sending during multimedia calls is not currently permitted by 3GPP. 3GPP TS 23.014 [9] says : "The use of DTMF is only permitted when the speech teleservice is being used or during the speech phase of alternate speech/data and alternate speech/facsimile teleservices. The responsibility for checking this lies in the MS".

It is proposed to allow DTMF sending during multimedia calls for the purpose of CAT copy/stop commands.

However, since the (G)MSC in all CAT architectures except the (G)MSC Server bridge architecture, and intermediary nodes can not insert in-band information into the end-to-end video stream, transmission of DTMF from the calling UE to the CAT Server during a multimedia call can only rely on the following approaches:

- The calling UE transmits the DTMF to the CAT Server in-band within the H.245 signalling stream via the UserInputIndication message, as per ITU H.245[8]; or

- The calling UE sends the DTMF to the CAT Server out-of-band end end to end. This approach would however not allow DTMF transmission if end to end DTMF out of band signaling is not possible, e.g. if an ISUP leg exists in the path between the calling UE and CAT Server.

It is therefore proposed that multimedia capable UEs support, as a recommended option, the transmission of DTMFs during multimedia call through the H.245 UserInputIndication message.

8.2.7   Optimal routeing

In the (G)MSC Server switch architecture and (G)MSC Server bridge architectures, the GMSC shall, upon receipt of a MAP "RESUME CALL HANDLING" message, follow procedures similar to those specified in sub-clause 8.1.2 for the call forwarding services, with the exception of the Optimal Routing handling. In particular, the GMSC may interrupt the CAT-B of the original called party if were already started to be played towards the calling party, and may start instead the CAT-B of the forwarded-to party.

Editor's Note : How the interaction is handled in other architectures is ffs.

8.2.8   SCUDIF

8.2.9   TFO / TrFO

8.3   Interaction with charging

The operator shall be able to charge for the CAT service according to the different charging mode, as per 3GPP TS 22.182 [2] and table 8.3.1.

Table 8.3.1: CAT charging modes

Index	Charging mode	Example
1	Service monthly fee	Fixed (for example monthly) expense for the CAT service.
2	Fee of purchasing CAT	A subscriber is charged by the system when he purchases CAT, including copying CAT.
3	Fee of configuring CAT	A subscriber may be charged by the system when he set his CAT or updates his CAT setting.
4	Fee per CAT usage	Advertising CAT. High/low quality CAT

CAT-A/CAT-B charging is handled separately by the CAT server, i.e. the CAT server is responsible for generating charging tickets e.g. upon CAT purchase, configuration or usage, as specified above. I.e. no specific charging evolutions are expected from (G)MSC servers to allow CAT charging.

The (G)MSC server shall generate the CDRs as per current 3GPP requirements.

There is no particular charging issue for speech calls. Video CAT could potentially cause a specific charging issue because it requires to setup a both-way bearer through connection from the calling party to the CAT server before the call is answered by the called party. To avoid charging a calling party for an unanswered call with CAT-A/CAT-B being played (i.e. to avoid generating in the originating MSC and (G)MSC CDRs containing the information that the call is answered) :

- the CAT Server in the (G)MSC Server switch architecture and the (G)MSC Server bridge architecture should either not return an ANM message to the (G)MSC ; otherwise the (G)MSC Server shall not pass it back to the originating network, but instead generate an ACM or CPG.

- the CAT Server in the CAT Server switch architecture shall never return an ANM message to the originating MSC prior to the call being answered by the called or forwarded-to party. Besides, the originating MSC shall consider the call as answered only upon receipt of the ANM message (for calls other than intra-MSC calls) or upon receipt of the CONNECT message of the called party (for intra-MSC calls), i.e. and not when it sends the CONNECT message to the originating UE (which occurs beforehand to establish the multimedia session towards the CAT server).

8.4 Interaction with H.245 and MONA call setup time

8.4.1 Video session setup time impacts over the CAT service

The time elapsed to establish a video session significantly affects the end user's perception of the video CAT service. The video session setup time should be minimized so that it is much smaller than the average time taken by the called party to answer the call to make the video CAT service worthwhile.

In addition, in the (G)MSC Server switch architecture, the multimedia call towards the called party is established in sequence after the release of the first multimedia call towards the CAT server. This introduces a period during which no video is further diplayed by the calling party. The time to establish the multimedia session towards the called party should therefore also be minimized.

Few seconds are typically required to setup a H.324m session. The actual duration depends on the radio error conditions and each H.324m implementation (e.g. how the H.245 messages are grouped together, whether WNSRP -Windowed Simple Retransmission protocol - is supported or not …), but is typically greater or equal to 3-5 seconds (possibly significantly greater), because of the numerous exchanges required by H.245 (H.223 multiplexer level detection, Terminal Capability Exchange, Master-Slave Determination, Open Logical Channels, Multiplexer Table Entries exchange). Once the multimedia session is setup, time is also required to transfer the media itself, in particular the Initial video frame.

The H.324m video session time is much reduced and typically reduced down to around 1 second by the Media Oriented Negotiation Acceleration procedures specified in ITU-T H.324 Annex K [7], by substantially reducing the number of exchanges during the video session setup and by starting media sending during the media session setup itself.

[y] already recommends terminals to implement MONA procedures.

CAT Servers should also be highly recommended to support MONA procedures.

8.4.2 CAT service impacts over the end to end call setup time

The CAT service should not negatively affect the end to end call setup time, as if no CAT were sent at all.

In the (G)MSC Server switch architecture, the time to release the video session between the calling party and the CAT server shall be shortened as much as feasible. Therefore upon receipt of the indication that the called party answered the call, the (G)MSC shall send the ANM message (or CONNECT message) towards the calling party as soon as the connection towards the CAT Server is released successfully, as illustrated in in section 7.1.3.2.

In the CAT Server switch architecture and in the (G)MSC Server bridge architecture, where two H.245 call setups are cascaded, the node bridging the two H.245 calls (respectively the CAT Server and the (G)MSC Server) should support MONA to ensure that the end to end time setup is not increased when both the calling and called parties support MONA.

In the CAT Server switch architecture, the end to end delay may also be increased because of the need to route the call through the CAT Server, e.g. a call between 2 end users in close vicinity may be routed through the CAT Server, instead of being through-connected locally on the same MSC/MGW.

9 Interworking with other networks

Editor's Note: This sub-clause will address interworking of CAT services with other domains, e.g. IMS. Aspects that are speficic to a given alternative, if any, will be documented in dedicated sub-clauses.

10   Technical analysis &architectures assessment

10.1   General technical considerations

10.1.1   Triggering of the H.245 call setup towards the CAT Server

10.1.1.1   Problem description

Two different approaches are considered in the Technical Report to trigger the H.245 negotiation from the originating UE to the CAT Server for video CAT:

-    Approach 1 : the H.245 negotiation with the CAT Server is initiated by the originating UE upon receipt of the ALERTING or CALL PROGRESS message. Upon subsequent receipt of the CONNECT message, the originating UE releases the H.245 call to the CAT server and starts a new H.245 negotiation with the called party. This is the approach retained currently e.g. in the (G)MSC Server switch architecture and in the (G)MSC Server bridge architecture.

-    Approach 2 : the H.245 negotiation with the CAT Server is initiated by the originating UE upon receipt of the CONNECT message. Once the called party picks up the call, a new H.245 negotiation takes place between the CAT Server B and the called party, without involving the originating UE. This is the approach retained currently e.g. in the CAT Server switch architecture and in the CAT Server switch architecture with routing back to the GMSC Server.

10.1.1.2   Analysis

1/ It is desirable to be able to offer CAT services to non CAT capable UEs. Approach 1 does not allow this.

2/ As per 3GPP TS 24.008 sub-clause 9.3.5.1, the CONNECT message is used "to indicate call acceptance by the called user". As such, this message should normally be sent to the calling UE only once the called party picks up the call. In the approach 2, this would not be the case since the CONNECT message would be sent during the alerting phase.

3/ One motivation to divert the normal protocol usage of the CONNECT message in the approach 2 is to try to avoid impacting handsets, and therefore try to allow support of video CAT services by non CAT capable UE. This however relies on the assumption that the H.245 call with the CAT Server will always be successfully setup and maintained during its entire duration since a failure of the H.245 call would lead those non CAT capable UE to abort the complete call. The following reasons might in practice prevent the successful setup of the H.245 call towards the CAT Server :

-    scenarios where an end to end bothway through-connection would not be ensured between the UE and the CAT Server during the alerting phase.

     A both-way through connection is required by the following specifications :

        3GPP TS 23.205 sub-clause 6.2.1.1.6 requires that the GMSC both-way through-connects the bearer during the alerting phase.

        ITU-T Q.764 sub-clause 2.1.1.2.c requires an intermediate node to bothway through-connects the bearer during the alerting phase

     However a both-way through connection is not required during the alerting phase in the following specification.

        ANSI ISUP T1.113-2000 sub-clause 2.1.1.2 allows delaying the bothway through-connection until receipt of ACM or CPG with an interworking indicator or the *User-Network Interaction Indicator* in the Optional Backward Call Indicator indicating '*user network interaction occurs, cut through* in *both directions*' or receipt of ANM, as per following excerpt. Though the User-Network Interaction IE could be sent by GMSC in pure ANSI network, it is not ensured that this would be set in case of calls spanning over ANSI and ITU networks.

> 2.1.1.2 Actions required at an intermedia exchange
> […]
>
> 3) Completion of transmission path: For a speech, 3.1 kHz audio, or UDI-TA call, through connection of the transmission path in the backward direction shall be completed at an intermediate exchange no later than at receipt of an Address Complete Message (see 2.1.4.2).
>
> For any call, through connection in both directions shall be completed no later than at receipt of an interworking or answer indication (see 2.1.4.2).

> 4A.6.2 Actions at an intermedia exchange
>
> Clause 2.1.4.2 shall apply.When the User-Network Interaction indicator indicates "user-network interaction occurs, cut through in both directions', the exchange shall through connect the transmission paths in both connections, if not already connected. […]

Non-standard implementations may not also bothway through-connect the bearer during the alerting phase. Implementations deviating from this were already encountered.

However a both-way through-connection during the alerting phase could normally be ensured within the PLMNs of operators supporting the CAT service (products under operator's control, CAT can be delivered to the calling party only if both originating and terminating PLMNs support CAT). This may not be ensured when the call between the calling party and the CAT server goes through a transit network (products not under operators' control) or through non standard implementations.

- Scenarios with CAT Server misbehaviours (e.g. node failure, signalling or bearer failure …) could also lead to prevent the successful setup of the multimedia call between the calling party and CAT Server, or lead to the failure of the call after its establishment.

It was agreed that, with the approach 2, the call from the calling party to the called party would fail upon occurrence of an error during the setup of the H.245 call between the calling UE and the CAT Server, or during the lifetime of this H.245 connection with the CAT Server (i.e. during the alerting phase of the call).

However it could not be agreed whether this is a frequent problem or not, and therefore whether this is a serious problem or not.

In comparison, the approach 1 requires the (impacted) UE to not abort the complete call if a failure occurs during the alerting phase, and to restart a new H.245 call setup towards the called party upon receipt of the CONNECT message. I.e. approach 1 is resilient to H.245 call failure towards the CAT Server.

> Editor's Note: the exact behaviour of the UE upon occurrence of a H.245 failure is ffs, e.g. how long does it take for the UE to drop the call after a H.245 failure, or whether the UE could be configured to re-attempt several times to re-establish the H.245 call.

The drawback of approach 1 is that this requires new multimedia capable UEs to receive video CAT, but changes are anyway expected to satisfy also other requirements, e.g. the sending of DTMF during the multimedia session to stop or copy an on-going CAT.

10.1.1.3   Conclusion

It is for further study whether :

- a mix of both approaches could be retained. The originating MSC could use the approach 2 with non CAT capable UEs and the approach 1 with new CAT capable UEs, according to the UE capabilities reported to the network.

- the choice of the method could be decided on a per local operator policy.

- it could be envisaged to limit the use of approach 2 to scenarios for which an end to end both way through connection is guaranteed between the calling UE and CAT Server, e.g. in scenarios where the originating MSC and GMSC are co-located.

10.2 Comparison of the different alternatives

10.2.1 Technical impacts

Table 10.2.1.1: technical impacts on speech CAT for each alternative

alternative	UE	O-MSC	GMSC	T-MSC	MGW	Protocol	miscellaneous
(G)MSC Server switch architecture	None	Provides the Originating party configured CAT service	Provides the terminating party configured CAT service	None	None		
CAT Server switch architecture	None	Routing the call to the CAT server for the calling party configured CAT service	Routing the call to the CAT server for the called party configured CAT service	None	None		
CAT Server switch architecture with routing back to GMSC Server							
(G)MSC Server switch architecture use based on UE capabilities							
Terminating MSC Server switch architecture							
(G)MSC Server bridge architecture	Same as "(G)MSC Server switch architecture".						

Table 10.2.1.2: technical impacts on multimedia CAT for each alternative

alternative	UE	O-MSC	GMSC	T-MSC	MGW	Protocol	miscellaneous
(G)MSC Server switch architecture	More than one H.245 negotiation is required	Indicate the calling party for multiple round H.245 negotiation during the alerting and active phase	Indicate the O-MSC that "in-band info is available" in a multimedia call for the CAT media playing	None	None	NAS-signalling: Setup, Alerting	the call setup time is increased by the duration of release the first H.245 connection
CAT Server switch architecture	None	Routing the call to the CAT server for the calling party configured CAT service	Routing the call to the CAT server for the called party configured CAT service	None	None		
CAT Server switch architecture with routing back to GMSC Server		Connect/Alerting sending based on CAT capable UE				NAS-signalling: Setup, Alerting	
(G)MSC Server switch architecture use based on UE capabilities a.) Session reset support b.) SETUP /OSS code c.) SETUP /CAMEL	b.) c.) More than one H.245 negotiation is required	b.)c.) Connect/Alerting sending based on CAT capable UE	b.)MAP:ATI			a) CAMEL b.)c.) NAS-signalling: Setup (Classmark 2), Alerting	
Terminating MSC Server switch architecture							
(G)MSC Server bridge architecture	None	involved in the H.245 negotiation for the calling party configured CAT service	involved in the H.245 negotiation for the called party configured CAT service	None	involved in the H.245 negotiation		

Editor's Note: this table is based on the analysis of CAT-B. Similar comparison can be applied to CAT-A.

10.2.2 Pros & cons

Table 10.2.2.1: pros and cons for each alternative

alternative	Pros	cons
(G)MSC Server switch architecture	1) The (G)MSC server and MGW is not needed to be involved into the H.245 negotiation and less impact on the (G)MSC server and the MGW 2) The CAT Server does not remain in call, pooling of CAT server resources is possible.	1) No multimedia CAT during the second H.245 negotiation, MONA is able to shorten this period if it is supported by both the calling party and called party UE 2) Cannot provide the CAT service to non CAT capable UE.
CAT Server switch architecture	1) CAT service may be supported for non CAT capable UE.NOTE1 2) The (G)MSC server and MGW is not needed to be involved into the H.245 negotiation and less impact on the (G)MSC server and the MGW	1) The CAT server remains in call, pooling of CAT server resources is not possible. 2) The end to end service may be limited by the CAT server multimedia capabilities (e.g. supported codecs, MONA support) and CAT Server call control capabilities (e.g. negotiation of speech or multimedia at call setup (SCUDIF), change from multimedia to speech (and vice-versa) during on-going call, Nb bearers, 3GPP codec negotiation, SIP-I preconditions…), if some multimedia or 3GPP features are not supported by the CAT server. The CAT Server may also limit future applications or services not yet developped in the 3GPP CSCN. 3) Call may fail when providing CAT to non CAT capable UE. NOTE1. Besides, sending the CONNECT message to the (non CAT capable) calling UE before the call is accepted by the called user deviates from the normal call processing and therefore further impacts the MSC-Server. 4) Prevents optimal call routeing, optimized transport and MGW selection (CAT Server remains in call). 5) Extra signalling and user plane interworking required when CAT server signalling/transport differs from what is supported upstreams/downstreams.
CAT Server switch architecture with routing back to GMSC Server	Same as for CAT Server switch architecture, with the following additions (if any).	Same as for CAT Server switch architecture, with the following additions (if any).

(G)MSC Server switch architecture use based on UE capabilities a.) Session reset support NOTE2 b.) SETUP /OSS code c.) SETUP /CAMEL	1) The CAT Server does not remain in call for CAT capable UE. Pooling of CAT server resources is partially possible. 2) CAT service may be supported for non CAT capable UE.NOTE1 3) The (G)MSC server and MGW is not needed to be involved into the H.245 negotiation and less impact on the (G)MSC server and the MGW 4) For Session reset support: no change to UE-MSC Interface	1) Same as for CAT Server switch architecture for non CAT capable UE, with the following additions. 2) For Session reset support: solution relying on CAMEL phase 4 Call Party Handling is complex to implement (CAMEL phase 4 not widely available yet) and involves a high increase of (G)MSC Server signalling which will noticeable affect the (G)MSC capacity. 3) For CAT capable UEs/session reset support: No multimedia CAT during the second H.245 negotiation, MONA is able to shorten this period if it is supported by both the calling party and called party UE
Terminating MSC Server switch architecture	1) The CAT Server does not remain in call, pooling of CAT server resources is possible. 2) The terminating MSC server and MGW is not needed to be involved into the H.245 negotiation and less impact on the MSC server and the MGW	1) no support of CAT-A service. 2) no support of CAT-B service when the called party is roaming in a VPLMN.
(G)MSC Server bridge architecture	1) CAT service may be supported for non CAT capable UE. NOTE1 2) Multimedia CAT during the H.245 negotiation with called party 3) The CAT Server does not remain in call, pooling of CAT server resources is possible.	1) GMSC server and MGW impacts as being involved in the H.245 negotiation. 2) Call may fail when providing CAT to non CAT capable UE. NOTE1 3) MGW capacity impact : bridging of 2 H.245 calls for each multimedia call with CAT, for the entire duration of the call.
NOTE1: if the bearer is not bothway through connected during the alerting phase, and the O-MSC requests the calling party UE to connect to CAT server, the call will fail because of the H.245 negotiation. This may occur when the call goes through a transit network between the calling party and the CAT server or through non standard implementations, See subclause 10.1.1. NOTE2: It needs to be further checked If the session reset can be used in this way.		

11   Conclusions and recommendations

11.1   Feasibility & Limits of CAT services in the CS domain

Through the preceding technical investigation within this technical report, it is concluded that:

- - Providing audio CAT-A and CAT-B services in the CS domain indicating that the called party is being alerted is possible. Providing audio CAT has no requirement on the calling party UE.

- - Providing multimedia CAT-A and CAT-B services in the CS domain indicating that the called party is being alerted is possible with UEs enhanced with CAT capabilities. The calling party may not be able to experience the multimedia CAT when the call spans over ANSI and ITU networks or traverses non-standard transit nodes that do not both-way through connect the bearer during the alerting phase.

Solutions to provide multimedia CAT in the CS domain towards a non CAT capable UE may work but in some cases the call will fail (if the end to end bearer is not both-way through-connected during the alerting phase) due to H.245 signalling being unsuccessful.

Some companies expressed the view that supporting CAT services towards non-CAT capable UEs is required and that the CAT Server Switched architecture may be used for this purpose, on a per operator's policy, provided an end to end both-way through-connection can be ensured between the calling party and the CAT Server. Those companies have the concern that if only CAT-capable UEs are supported, the introduction of CAT services in a network will be unnecessarily delayed. It can not be foreseen that all the multimedia UE will be updated to be CAT capable. Once the called party activates the CAT service, the subscriber will expect the calling party user experience his CAT, independently if the calling party UE is CAT capable or not. Those companies recommend to operators that want to support multimedia CAT for non-CAT capable UEs to follow the solutions in this technical report which offer support for non-CAT capable UEs.

Other views were expressed that any standardisation work on the CAT Server Switched architecture should be discontinued since the solution cannot guarantee consistent behaviour, requires changes to the existing MSC-UE call handling, prevents pooling of CAT resources and limits multimedia calls – both before and after the CAT phase - due to the permanent involvement of the CAT server and MGW. Those companies also considered that UEs are evolving and if a subscriber wants to receive multimedia CAT service then there is an additional market force for new terminals that support this, the type of user that demands this service changes their terminals more quickly than the network can be upgraded. The changes to the terminal are small compared to the network impacts for either solution.

- The CAT copy and CAT stop commands can be supported through the use of DTMF within the same PLMN (as per the stage 1 requirements). CAT can only be copied between calling and called subscribers of the same PLMN since no interface is standardized to copy CAT between CAT Servers. The CAT copy and CAT stop requests for an audio CAT may not work between PLMNs when the call spans over ANSI and ITU networks or traverses non-standard transit nodes that do not both-way through connect the bearer during the alerting phase.

Further analysis would be required to consider whether the following customized alerting tones could be supported:

- the progress of communication request (Call Forward, Call Wait etc.);

- any alerting event during a call session.

CAT is an optional feature for an operator to deploy. CAT services shall not have an impact on a network that does not support CAT service.

11.2   Preferred solution(s)

11.2.1   Audio CAT

The preferred solution is to use the GMSC Server Switched Architecture.

11.2.2   Multimedia CAT

The preferred solution is to use the GMSC Server Switched Architecture with multimedia UEs enhanced with CAT capabilities. CAT is an optional feature for an operator to deploy. If it is deployed, it is recommended that multimedia UEs support CAT capabilities.

If an operator's policy is to support CAT service towards the calling party multimedia UE which has not been enhanced with CAT capabilities, the CAT Server Switch architecture may be used in this case, however due to the number of limitations there was no consensus to pursue this alternative as a standardised solution.

11.2.3   Signalling of calling UE's CAT capability to the GMSC

The calling UE's CAT capability should be signalled to the GMSC. This may be done either via the signalling of a new specific CAT indicator through the call control signalling protocol (ISUP/BICC/SIP-I) or via the interrogation of the originating MSC through the MAP Anytime Interrogation / Provide Subscriber Info messages. No objection was raised to further study either approach during the normative work.

The method taking use of UEs session reset capability and transporting this information from the CAT-server to the GMSC Server requires a complex CAMEL 4-architecture and should therefore not be pursued.

11.3   Way forward

It is recommended to 3GPP that the necessary detail within this report be used as a basis for further technical work within the Release 8 timeframe. It is further recommended that changes required by the GMSC Server switch architecture be specified within existing specifications as defined within Annex A.

Annex A (informative): Impacts to Existing Specifications

Table A.1 identifies the existing specifications that require modification to support CAT in the 3GPP CS domain.

Table A.1

Existing Specification	Responsible WG	Brief summary of impacts
3GPP TS 24.008	CT1	Addition of new terminal capabilities for CAT capable UEs (multiple H.245 call negotiations, transmission of DTMFs during multimedia call through the H.245 UserInputIndication message). Modify contents of NAS signalling to allow CAT capable UE to report its CAT capabilities to the MSC, and to allow the MSC to request UE to initiate a multimedia CAT call (H.324M connection during the alerting phase).
3GPP TS 23.205 3GPP TS 23.231	CT4	Modify procedures to allow the originating MSC to both-way through-connect a multimedia call during the alerting phase. Modify call control signalling to carry CAT indicators (note): for the GMSC to know whether it can initiate CAT service for the originating MSC to know whether CAT is provided downstreams to allow CAT-A/CAT-B priority
3GPP TS 29.002	CT4	ATI from GMSC to HLR-A
3GPP TS 23.014	CT1	Allows DTMF sending during multimedia calls.
Note: Might also require ISUP/BICC signalling evolutions which are out of the scope of 3GPP.		

Table A.2 identifies the new specifications that are required to support CAT in the 3GPP CS domain.

Table A.2

New Specification	Responsible WG	Brief summary of impacts
None		

Annex B:
Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2008-09	CT#41	CP-080479			V2.0.0 was presented for approval	2.0.0	8.0.0
2008-12	CT#42				Copyright Notification updated	8.0.0	8.0.1