

# 3GPP TR 23.872 V8.0.0 (2008-09)

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*Technical Report*

**3rd Generation Partnership Project;  
Technical Specification Group Services and System Aspects  
Study on Architecture of IMS based  
Customized Alerting Tones (CAT);  
Stage 2  
(Release 8)**



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Keywords

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UMTS, CAT, IMS, interworking

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## Foreword

This Technical Specification 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:

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- x the first digit:
  - 1 presented to TSG for information;
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- 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.

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# 1 Scope

This study intends to investigate the architectural impacts on and potential enhancements to IMS specifications to meet the normative requirements for CAT in IMS domain as specified in TS 22.182 [2]:

- Architecture and procedures to support basic call scenarios for CAT in IMS domain;
- Interaction with other service, e.g. IMS Multimedia telephony supplementary services;
- Service provision for roaming subscribers;
- Interworking between IMS CAT and CS CAT in TR 29.882 [3].

In the end, this study will provide conclusions with respects to what further specification work is required in order to fulfil the requirements for the CAT in IMS domain.

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# 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 Tones (CAT) Requirements".
- [3] 3GPP TS 23.228: "IP Multimedia Subsystem (IMS); Stage 2".
- [4] 3GPP TS 24.229: "Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3".
- [5] IETF RFC 3959: "The Early Session Disposition Type for the Session Initiation Protocol (SIP)".
- [6] IETF RFC 3960: "Early Media and Ringing Tone Generation in the Session Initiation Protocol (SIP)".
- [7] 3GPP TS 23.218: "IP Multimedia (IM) session handling; IM call model; Stage 2".
- [8] IETF RFC 2616: "Hypertext Transfer Protocol -- HTTP/1.1".
- [9] IETF RFC 3262: "Reliability of Provisional Responses in Session Initiation Protocol (SIP)".
- [10] 3GPP TS 26.234: "Transparent end-to-end Packet-switched Streaming Service (PSS)".
- [11] 3GPP2 X.S0055: "MMD Supplementary Services".
- [12] IETF RFC 2833: "RTP Payload for DTMF Digits, Telephony Tones and Telephony Signals".
- [13] IETF RFC 3841: "Caller Preferences for the Session Initiation Protocol (SIP)".
- [14] IETF RFC 4483: "A Mechanism for Content Indirection in Session Initiation Protocol (SIP) Messages".
- [15] 3GPP TS 29.163: "Interworking between the IP Multimedia (IM) Core Network (CN) subsystem and Circuit Switched (CS) networks".

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## 3 Definitions and abbreviations

### 3.1 Definitions

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

### 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

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## 4 Architecture

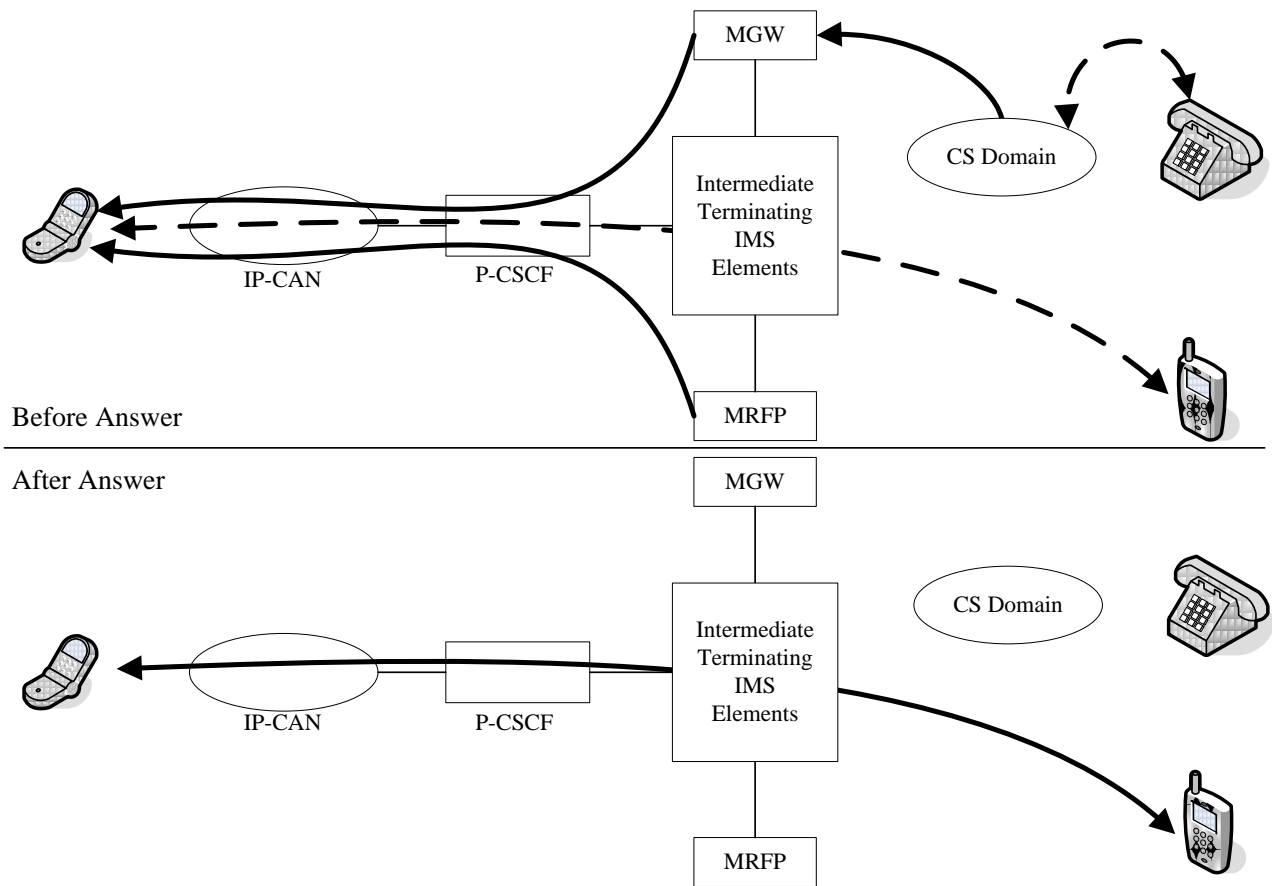
### 4.1 Architectural requirements

- The IMS CAT solution shall minimize the impact on the IMS architecture.
- The CAT solution shall be able to be deployed independently of the existing Services; and not interact unduly.
- The impact on the originating UE shall be minimized.
- The impact on the intermediate nodes in the originating network UE shall be minimized.
- CAT service shall not break legacy services.

#### 4.1.1 Multiple CAT Caused by Forking or Flexible Alerting (FA)

If the communication has been forked, or terminating side has FA service, and there're more than one terminator has provisioned CAT service, there will be multiple early media streams wish to be played by originating UE, those early media streams may be provided by MRFP in IMS network, or by CS domain through MGW.

An example of multiple CAT caused by forking or FA is illustrated in figure 4.1.1-1.



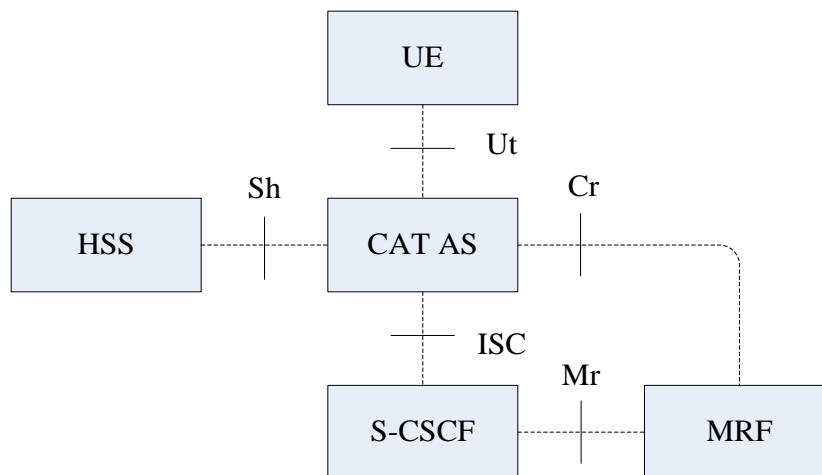
**Figure 4.1.1-1: An example of multiple CAT caused by forking or FA**

It is clarified that for the scenario of multiple CAT caused by forking or FA:

- UE shall play early media provided by network to override local generated alerting tone.
- UE shall select specific early media to play.
- Terminating IMS network shall be able to apply only one CAT service.

## 4.2 Reference architecture

*Editor's Note: This sub-clause will describe the reference model to provide CAT.*



**Figure 4.2-1: Reference Architecture**



## 4.2.1 Reference points

### 4.2.1.1 CAT Application Server – MRFC (Cr) Interface

In addition to the session control requests sent via Mr, media control related commands and resources may be passed between the Application Server and the MRF using the Cr interface as specified in TS 23.218 [7].

## 4.2.2 Functional entities

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# 5 Alternatives

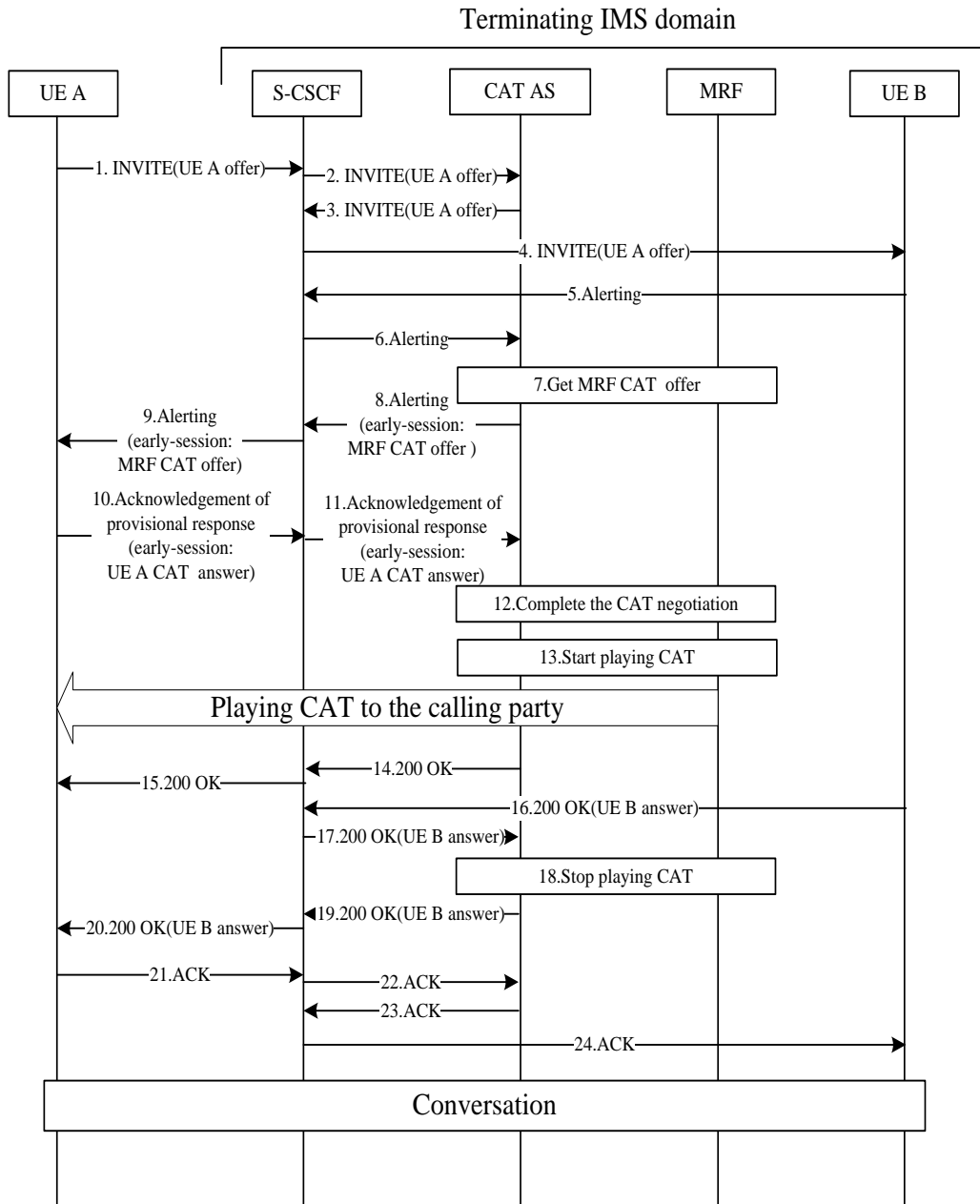
*Editor's Note: This section will describe and evaluate the detailed reference architecture, including network elements, interfaces and reference points, suitable to provide CAT.*

## 5.1 Alternative 1

### 5.1.1 Procedures

#### 5.1.1.1 CAT provided by the terminating IMS domain based on the Early Session model (Flow 1)

In figure 5.1.1.1-1, it is assumed that the called party (UE-B) has CAT active, calling party (UE-A) does not have CAT active.



**Figure 5.1.1.1-1: CAT provided by the terminating IMS domain based on the Early Session model (Flow 1)**

**Editor's Note:** The specific message used at step 8 and step 9 is FFS.

1. UE A sends INVITE to S-CSCF. The INVITE includes the SDP offer of UE A, early-session and reliable response mark in supported header indicating that UE A supports the early-session disposition type and reliability of provisional responses.
2. S-CSCF forwards the INVITE to CAT AS based on iFC.
3. CAT AS checks the subscription data of the UE B. If UE B subscribes CAT service, CAT AS forwards the INVITE to S-CSCF.
4. S-CSCF forwards the INVITE to UE B.
- 5-6. UE B responds Alerting.

7. CAT AS gets CAT SDP offer from the MRF.
- 8~9. CAT AS checks that UE A supports early session, CAT AS sends Alerting message to UE A, and the Alerting message includes CAT SDP offer as early-session disposition type.
- 10~11. UE A acknowledges to CAT AS with UE A CAT answer.
12. CAT AS completes the CAT media negotiation with MRF using the received UE A CAT answer.
13. CAT AS starts CAT playing, and MRF plays CAT to UE A.
- 14~15. CAT AS acknowledges to UE B.
- 16~17. UE B sends final successful responds to CAT AS.
18. CAT AS stops CAT playing, and indicates MRF to stop playing CAT to UE A.
- 19~24. CAT AS forwards final successful respond to UE A.

#### 5.1.1.2 CAT provided by the terminating IMS domain based on the Early Session model (Flow 2)

In figure 5.1.1.2-1, it is assumed that the called party (UE-B) has CAT active, calling party (UE-A) does not have CAT active.

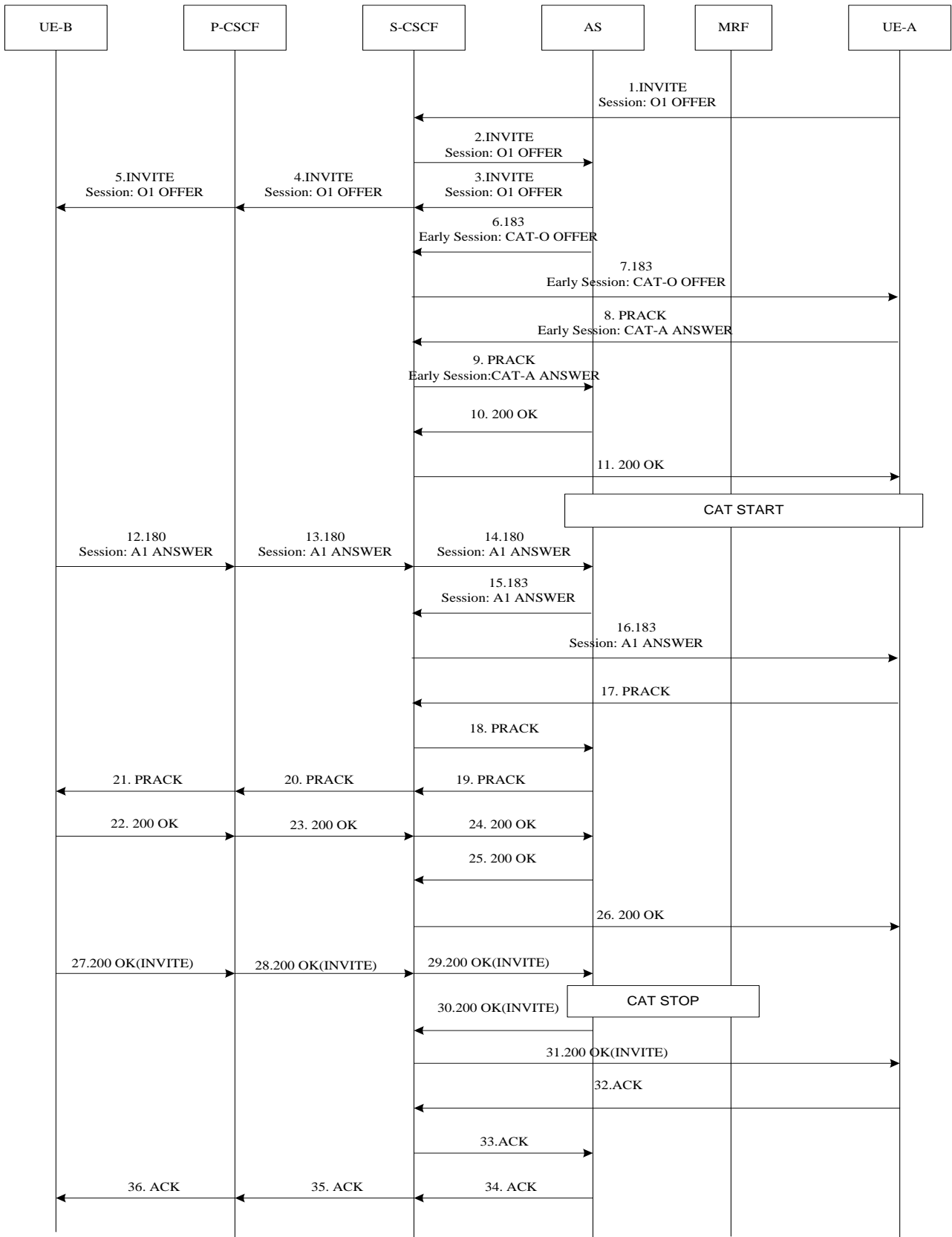


Figure 5.1.1.2-1: CAT provided by the terminating IMS domain based on the Early Session model (Flow 2)

1~2. UE-A sends INVITE with an SDP OFFER (O1) to establish a call with UE-B. The INVITE is routed to the AS due to initial Filter Criteria on the S-CSCF. UE-A includes the early-session option tag in its Supported header field of the SIP INVITE.

- 3~5. The AS sends INVITE with an SDP OFFER (O1) to the UE-B.
- 6~11. The AS determines that UE-B has CAT service and requests resources from MRFP. The AS determines that UE-A supports early session and sends a SIP 183 to UE-A with early session. Early session contains an SDP OFFER (CAT-O) which helps to establish the CAT media between the MRFP and UE-A. UE-A acknowledges SIP 183 with an SDP ANSWER (CAT-A) in early session, and AS plays CAT to UE-A. Based on operator policy, Steps 6~11 can happen right after Step 2 before the INVITE is forwarded to UE-B.
- 12~14. UE-B sends a SIP 180 with an SDP answer (A1), the response first reaches the AS.
- 15~16. The AS changes the "180 Ringing" response received from UE-B to "183 Session Progress" and forwards the response with the same SDP answer (A1) to UE-A.
- 17~26. UE-A acknowledges the reliable provisional response.
- 27~36. The UE-B answers the call. UE-B sends 200 OK to the AS, and AS stop CAT which is established by early session.

5.1.1.3 CAT provided by the terminating IMS domain based on the Early Session model (Flow 3)

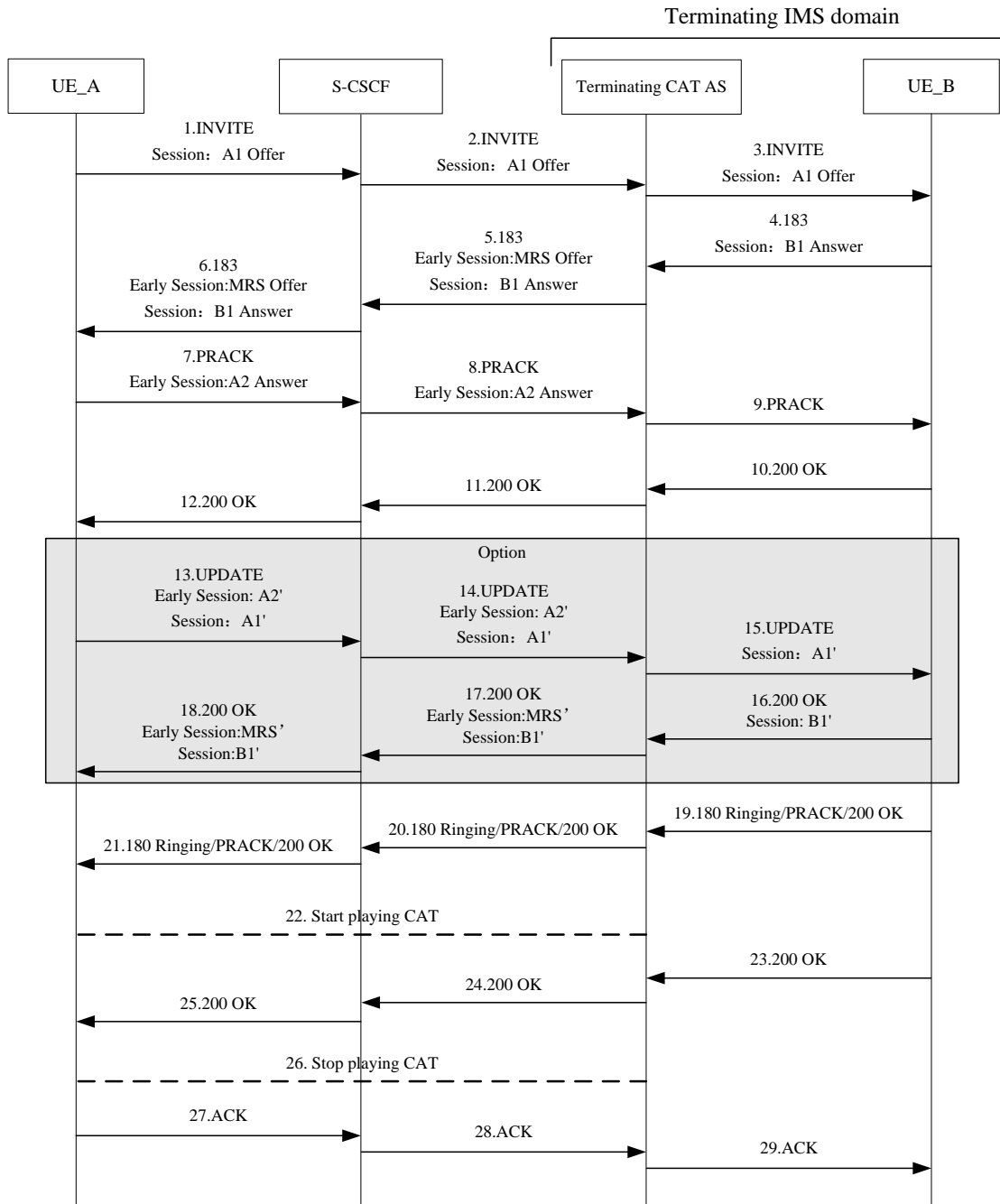


Figure 5.1.1.3-1: Call flows for CAT provided in terminating IMS domain based on AS model (Flow 3)

- 1~2. UE\_A sends an INVITE request towards the terminating IMS domain, The INVITE request includes the session SDP offer A1 and the Early Media supported indication. The S-CSCF in the terminating IMS domain forwards the INVITE request to the terminating CAT AS based on the iFC.
- 3. The terminating CAT AS gets the INVITE and checks the subscription data of the UE\_B. If UE\_B subscribes CAT service, the terminating CAT AS forwards the INVITE to UE\_B, and then gets CAT SDP offer MRS from the MRF.
- 4. UE\_B sends an 183 session progress to the INVITE request with the session SDP answer B1.
- 5~6. The terminating CAT AS sends the 183 session progress with the session SDP answer B1 and the early-session SDP offer MRS towards UE\_A through S-CSCF.

- 7~8. UE\_A sends PRACK request to the 183 session progress with the early-session SDP answer A2. The S-CSCF in the terminating IMS domain forwards the PRACK request to the terminating CAT AS.
9. The terminating CAT AS tells MRF the CAT SDP answer A2, and sends the PRACK request without early-session SDP answer A2 to UE\_B.
- 10~12. UE\_B sends a 200 OK response to the PRACK request towards UE\_A.
- 13~14. If UE\_A need reserve resources, and introduces precondition in session SDP offer A1 and early-session SDP answer MRS', UE\_A reserves the resources and sends an UPDATE request with early-session SDP offer A2' and session SDP offer A1'
15. The terminating CAT AS tells MRF the CAT SDP offer A2', and gets CAT SDP answer MRS', meanwhile, it sends the UPDATE request with session SDP offer A1'.
16. UE\_B sends a 200 OK response to the UPDATE request with session SDP answer B1'.
- 17~18. The terminating CAT AS sends the 200 OK response with early-session SDP answer MRS' and session SDP answer B1' towards UE\_A.
- 19~21. UE\_B alert and sends an 180 Ringing towards UE\_A.
22. The terminating CAT AS informs MRF to play CAT to UE\_A. This step can be happened directly after step 8 or step 14.
- 23~25. UE\_B answers and send an 200 OK response towards UE\_A.
26. The terminating CAT AS stops playing CAT.
- 27~29. UE\_A acknowledges, and sends an ACK request towards UE\_B.

#### 5.1.1.4 CAT provided by the originating IMS domain based on the Early Session model

The call flow for IMS CAT provided by the originating IMS domain is similar to the call flows provided in clauses 5.1.1.1, 5.1.1.2 and 5.1.1.3, except for the flowing differences:

- The CAT AS is in the originating IMS domain, and is serving for the originating user.
- The CAT AS is trigger by the S-CSCF in the originating IMS domain according to the originating user's iFC.
- The CAT AS provides the CAT service according to the originating user's subscription.

#### 5.1.2 Interaction with supplementary services

#### 5.1.3 Impact

The early session mechanism is not very widely used, and has so far not been adopted in TS 24.229 [4]. This means that the usage of early session mechanism would also require changes to the functional elements, both in the terminating network as well as the originating network. The impacts of the early session mechanisms are:

- The originating network needs to be upgraded to support the early sessions.
- Intermediate network functions such as IBCF, MGCF, and originating network's ASs needs support the early session mechanism, defined in RFC 3959 [5] and RFC 3960 [6], and media control functions would be impacted such as PCC.
- The originating UE must support the early session mechanism.
- The CAT AS needs to be made aware of whether the originating and visited networks support early session capabilities.

The usage of early session mechanism would only work in networks where all of these elements support the early session mechanism, defined in RFC 3959 [5] and RFC 3960 [6].

## 5.2 Alternative 2 Forking model

*Editor's Note: alternatives have to be documented as defined in alternative 1 above.*

### 5.2.1 Procedures

In the figures that pertain to the 'Signalling flows' section:

- The notation '*Dn*' within parentheses means '*SIP Dialog n*'.
- The notation '*On*' within parentheses means '*SDP Offer n*'.
- The notation '*An*' within parentheses means '*SDP Answer n*'.

#### 5.2.1.1 Procedures at the UE

The procedures in TS 24.229 [4] for session initiation and termination shall apply.

#### 5.2.1.2 Procedures at the CAT AS serving for the terminating UE

The procedures specified in 3GPP2 X.S0055 [11] and the procedures in TS 24.229 [4] for an AS acting as a routing B2BUA shall apply.

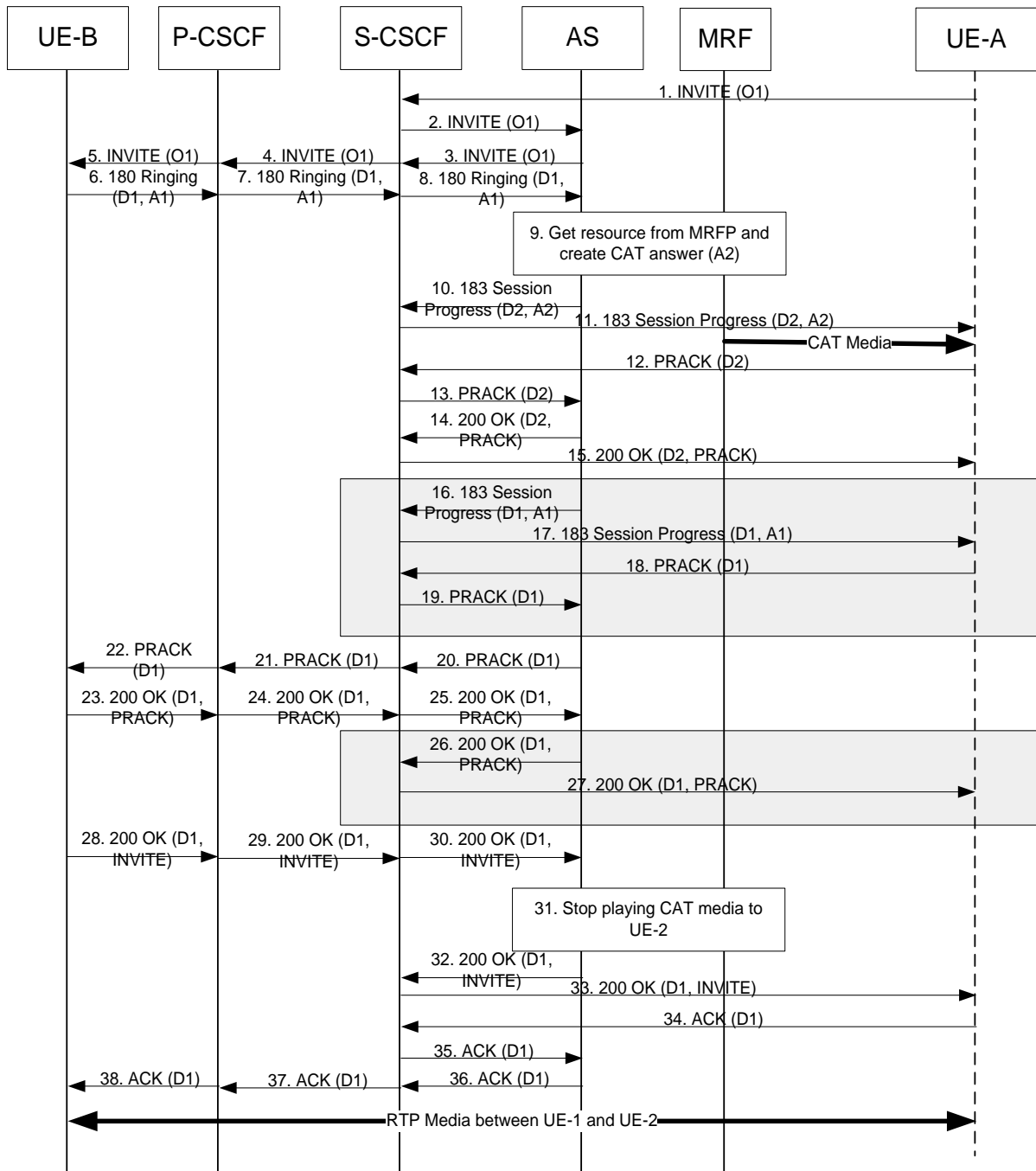
#### 5.2.1.3 Forking-based CAT provided by the terminating IMS domain

In Figure 5.2.1.3-1, it is assumed that the called party (UE-B) has CAT active and the calling party (UE-A) does not have CAT active.

The following flow assumes that UE-A does not include a "no-fork" directive in the INVITE or if included in the INVITE, the AS chooses to ignore the "no-fork" directive based on local policy configured in the AS, as specified in the clause 7.1 of IETF RFC 3841 [13].

NOTE: The CAT AS behaviour of when the "no-fork" is not ignored, is out of scope of this clause, but can be handled by basic B2BUA call procedures according to TS 24.229 [4].





**Figure 5.2.1.3-1: Forking-based CAT provided by the terminating IMS domain**

- 1~2. UE-A sends INVITE with an SDP offer (O1) to establish a call with UE-B. The INVITE is routed through the AS due to initial filter triggers on the S-CSCF.
- 3~5. The AS forwards the original INVITE to UE-B.
- 6~8. UE-B sends "180 Ringing" with an SDP answer (A 1) for an early dialog (D1), the response first reaches the AS.
- 9. The AS request resources from MRFP and creates CAT answer (A2). Based on operator policy, Steps 9~15 can happen right after Step 2 before the INVITE is forwarded to UE-B.
- 10~11. The AS generates a reliable "183 Session Progress" response to UE-A as if this is a response from a forked INVITE, which establishes an early dialog (D2). Using "183 Session Progress" avoids triggering local CAT at UE-A. This response message contains the SDP answer (A2) which helps to establish the CAT media path between the MRFP and UE-A.

- 12~13. UE-A acknowledges the reliable provisional response.
- 14~15. The AS sends 200OK to acknowledge PRACK from UE-A.
- 16~17. The AS changes the "180 Ringing" response received from UE-B to "183 Session Progress" and forwards the response with the same answer (A1) to UE-A and establishes early dialog (D1). Based on operator policy, Steps 16~19 and Steps 26~27 can also be omitted if the AS chooses to store the answer (A1) from UE-B and not to send provisional response immediately. UE-A still saves both SDP answers A1 and A2 since it has no knowledge which answer will be confirmed finally.
- 18~19. UE-A acknowledges the reliable provisional response message.
- 20~25. The AS acknowledges the reliable provisional response from UE-B.
- 28~30. The user at UE-B finally answers the call. UE-B sends 200 OK and the response reaches the AS first.
31. The AS coordinates with the MRFP to stop playing CAT.
- 32~33. The AS forwards the 200 OK to UE-A to confirm the early dialog (D1). If the AS has not sent the answer (A1) from UE-B to UE-A in step 16, the AS includes the answer (A1) in this 200 OK message and confirms dialog (D1).
- 34~38. UE-A acknowledges the confirmed dialog (D1). The call is now established between UE-A and UE-B based on SDP offer (O1) and SDP answer (A1). The early dialog (D2) set up by the "183 Session Progress" for CAT has no final response and automatically times out.

## 5.2.2 Interaction with supplementary services

## 5.2.3 Impact

## 5.3 Alternative 3 (Content Indirection)

### 5.3.1 Architectural Details

#### 5.3.1.1 Reference architecture

No additional architectural impacts are necessary to support this proposed alternative, i.e. the architecture as specified in TS 23.228 [3] can be used.

#### 5.3.1.2 Reference points

No additional reference points are necessary to support this proposed alternative for providing CAT.

#### 5.3.1.3 Functional entities

##### 5.3.1.3.1 Application Server supporting CAT

An AS supporting the CAT service on behalf of the user needs to be present in the network.

#### 5.3.1.4 Information flows and Procedures

##### 5.3.1.4.1 Procedures at the Originating UE

The UE shall follow the procedures in TS 24.229 [4] for session initiation and termination.

When receiving an URI to CAT information the UE should (taking the requirements in TS 22.182 [2] into account) retrieve and play the content until media is received on the declared ports.

5.3.1.4.2 Procedures at the AS serving the Terminating UE

Upon receiving (or generating) a SIP message where an URI to CAT information should be added, the AS generates HTTP URI(s) using standard HTTP procedures as defined in RFC 2616 [8].

5.3.1.4.3 Information flow for CAT provided by the terminating IMS domain

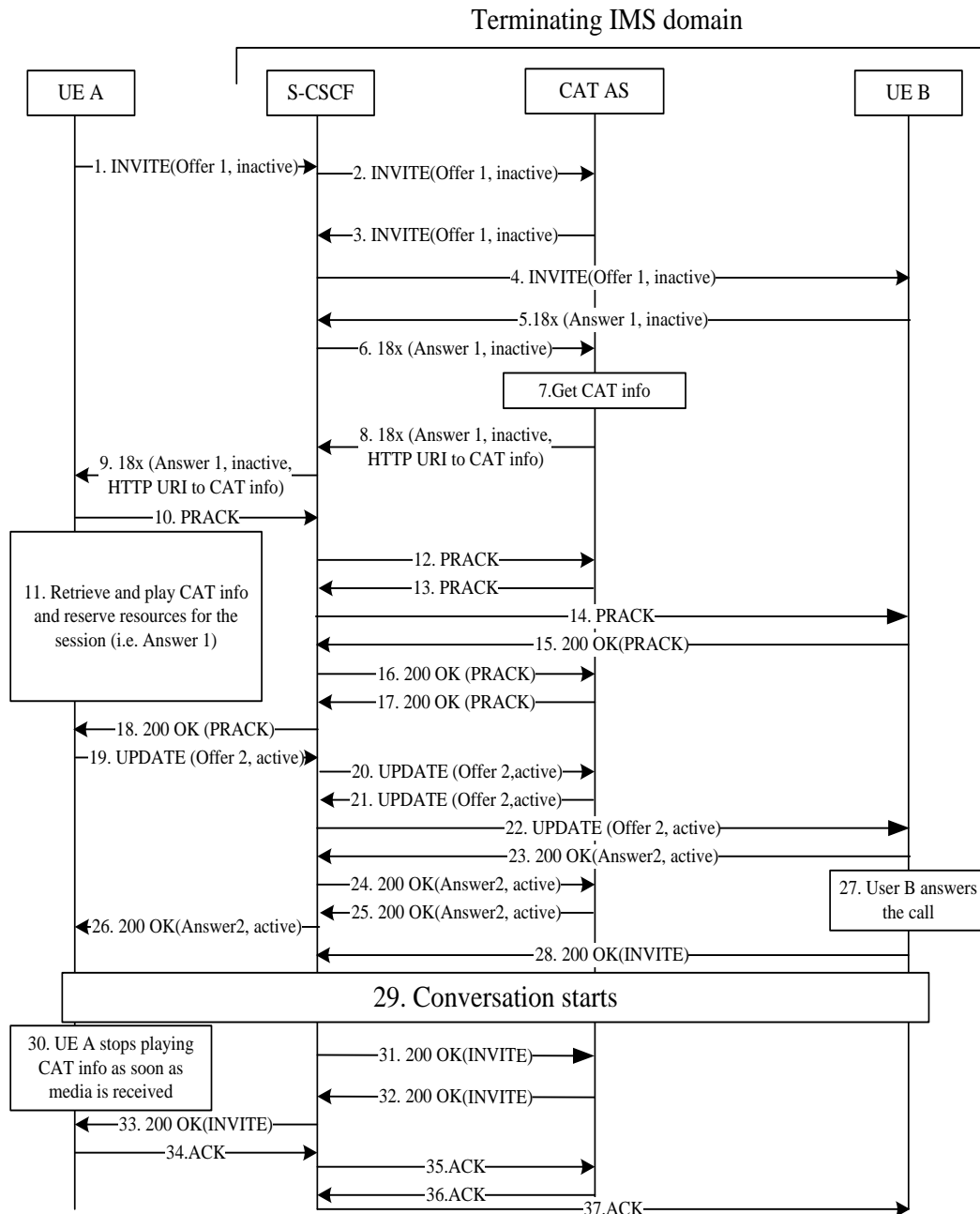


Figure 5.3.1.4.3-1: CAT info provided in terminating IMS domain based on URI in SIP header

- 1-2. UE-A sends INVITE with an SDP offer to establish a call with UE-B. The INVITE is routed through the AS due to initial filter triggers on the S-CSCF.

- 3-4. The AS forwards the original INVITE to UE-B.
- 5-6. UE-B sends an SDP answer in a 18x response, the response first reaches the AS.
7. The AS generates an HTTP URI to the CAT info.
- 8-9. The AS adds the HTTP URI in a SIP header and forwards the 18x response towards the UE-A.
- NOTE: The SIP header to be used is a stage 3 matter, but can be e.g. Alert-Info, Call-Info header or according to RFC 4483 [14].
- 10, 12-14. UE-A acknowledges the reliable provisional response.
11. UE-A starts reserving resources for the media declared in the SDP Answer and at the same time retrieves the CAT Info and plays it for the user A. The CAT information should be retrieved using progressive download of the information, see TS 26.234 [10].
- 15-18. The UE-B sends 200 OK to acknowledge PRA CK from UE-A.
- 19-22. When UE-A has reserved the resources the UE-A sends an updated Offer with media set to "active" towards UE-B
- 23-26. UE-B sends 200 OK to acknowledge the UPDATE from UE-A, which includes an SDP Answer with media set to "active".
- 27, 29. User B answers the call and the conversation starts
- 28, 31-33. UE-B sends 200 OK to acknowledge the INVITE.
30. UE-A stops playing the CAT info as soon as media is received on the declared ports
- 34-37. UE-A acknowledges the confirmed dialog

#### 5.3.1.4.4 Information flow for CAT provided by the Originating IMS domain

CAT provided by the originating IMS domain can be achieved in the same manner as described in clause 5.3.1.4.1.

#### 5.3.1.5 Interaction with supplementary services

Supplementary services may generate early media towards the calling UE. In case the early media is using same content indirection principles as described above, then the UE will be able to choose which early media to retrieve. If early media is sent in-band the UE would have to render the in-band content(s) to the user.

### 5.3.2 Impact

At a minimum the UE and the AS needs to support HTTP.

For a more enhanced experience the UE should support progressive download as described in TS 26.234 [10].

## 5.4 CAT Control

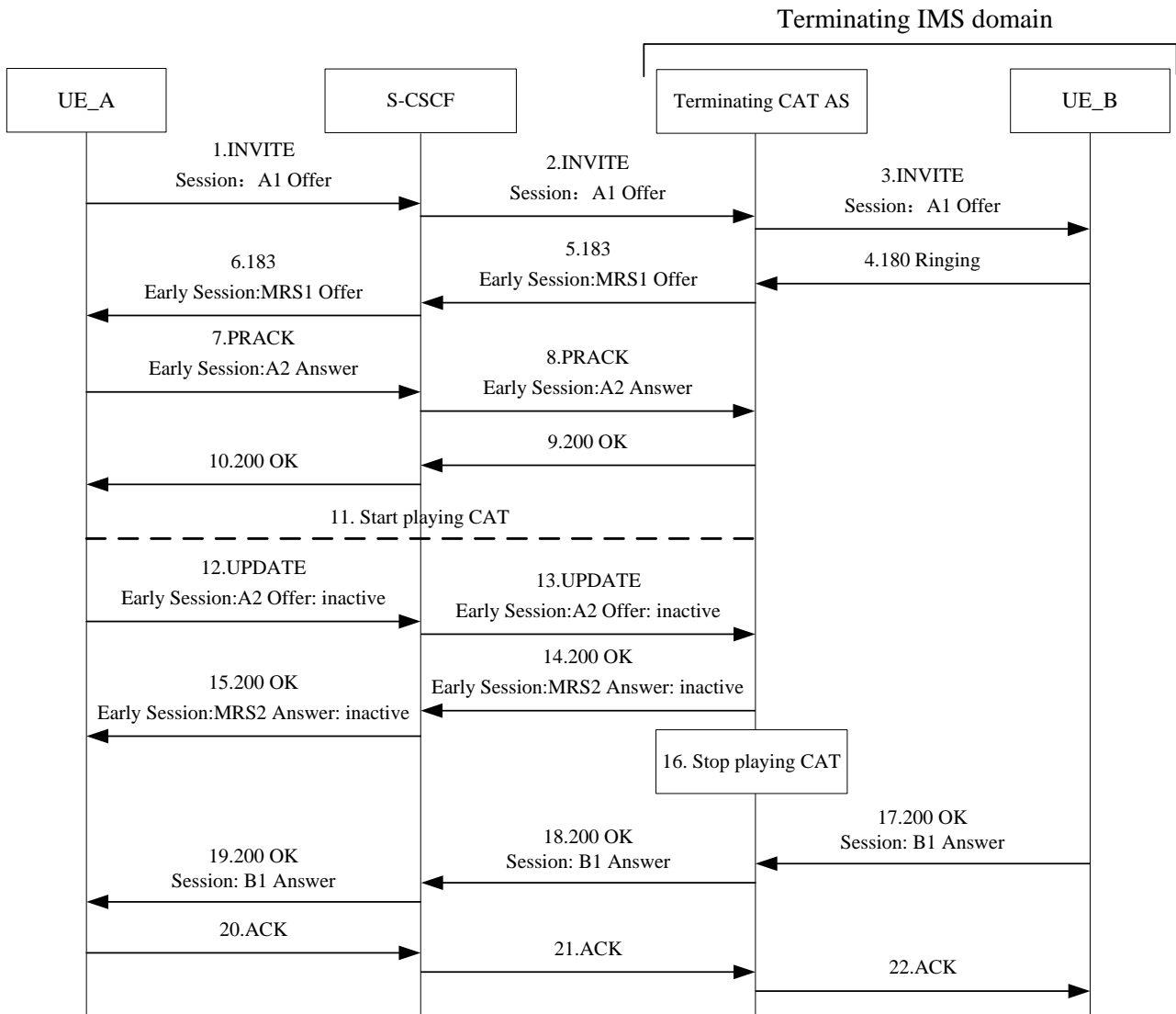
This section shows the ways to control the CAT. There are two kinds of control:

- a) UE control the CAT, to stop it, and/or, if possible, to re-start it again; and,
- b) Originating network control the CAT, to disable/enable terminating CAT according priority, or, to reject it according to rules set by user.

## 5.4.1 CAT stop alternative 1: using out-band method

### 5.4.1.1 Early-Session Model

In Figure 5.4.1.1-1, it is assumed that the called party (UE\_B) has CAT active and the calling party (UE\_A) does not have CAT active.



**Figure 5.4.1.1-1: call flows for CAT stop based on early-session model**

- 1~2. UE\_A sends an INVITE request towards the terminating IMS domain, The INVITE request includes the session SDP offer A1 and the Early Media supported indication. The S-CSCF in the terminating IMS domain forwards the INVITE request to the terminating CAT AS based on the iFC.
3. The terminating CAT AS forwards the INVITE request to UE\_B, and then gets CAT SDP offer MRS1 from the MRF.
4. UE\_B sends a 180 Ringing response to the INVITE request.
- 5~6. The terminating CAT AS sends a 183 session progress with the early-session SDP offer MRS1 towards UE\_A through S-CSCF. This step can be happened directly after step 3.
- 7~8. UE\_A sends PRACK request with the early-session SDP answer A2. The S-CSCF in the terminating IMS domain forwards the PRACK request to the terminating CAT AS.

- 9~10. The terminating CAT AS tells MRF the received early-session SDP answer A2, and sends a 200 OK response towards UE\_A.
- 11. The terminating CAT AS informs MRF to play CAT to UE\_A.
- 12~13. UE\_A wants to stop the CAT, and then sends a UPDATE request with early-session SDP offer towards UE\_A to "Stop CAT", e.g., A2 with inactive attribute for all media types.
- 14~15. The terminating CAT AS tells MRF the received early-session SDP offer A2, and gets CAT SDP answer MRS2 from the MRF with inactive attribute for all media types, and then sends a 200 OK response with early-session SDP answer MRS2 towards UE\_A through S-CSCF.
- 16. The MRF stops to play CAT to UE\_A. UE\_A may generate local ring tone to user.
- 17~19. UE\_B answers and send an 200 OK response with session SDP answer B1 towards UE\_A.
- 20~22. UE\_A acknowledges, and sends an ACK request towards UE\_B.

### 5.4.1.2 Non-Early-Session Model

In Figure 5.4.1.2-1, it is assumed that the IMS called party (UE\_B) has CAT active and the calling party (UE\_A) does not have CAT active.

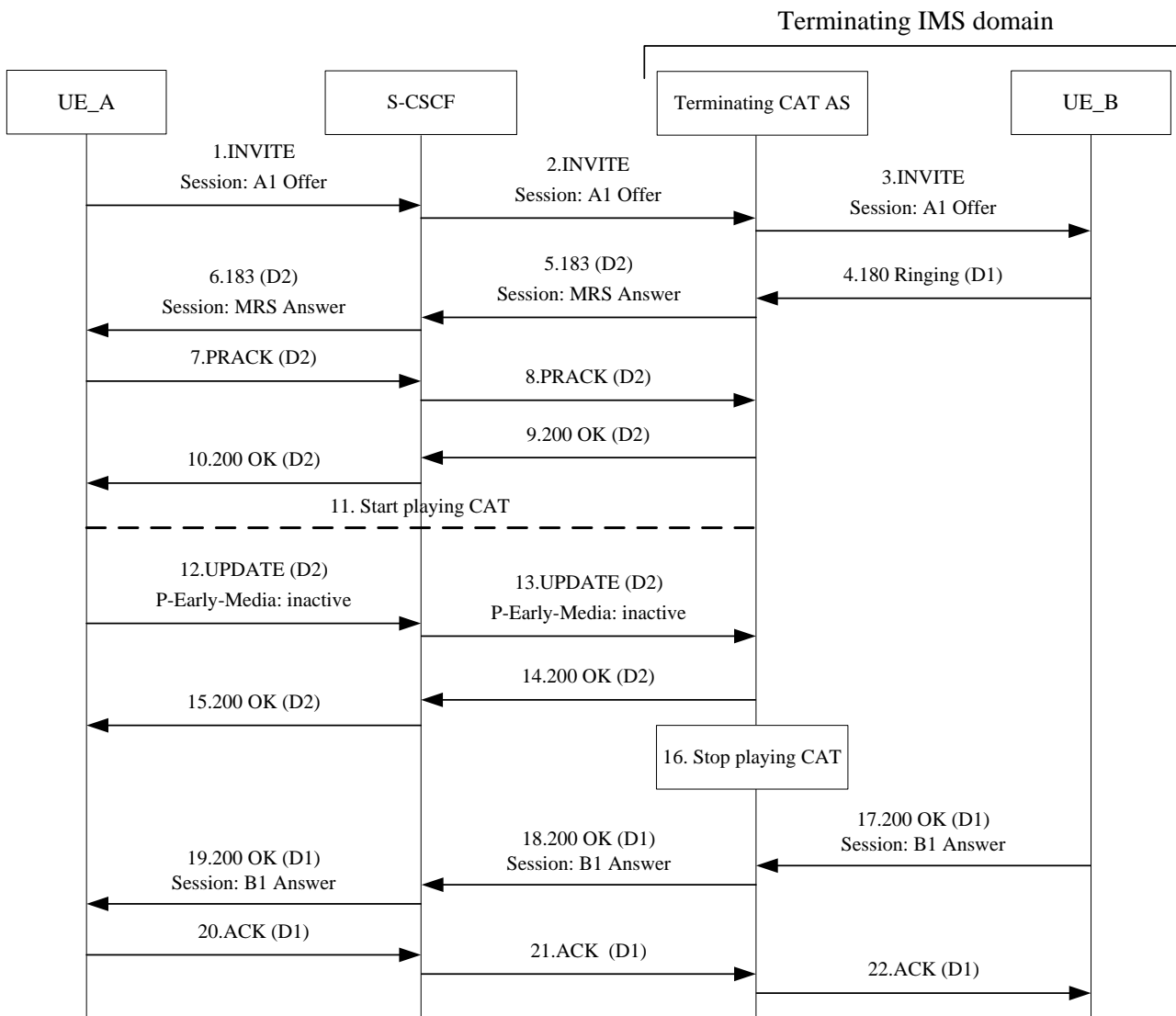
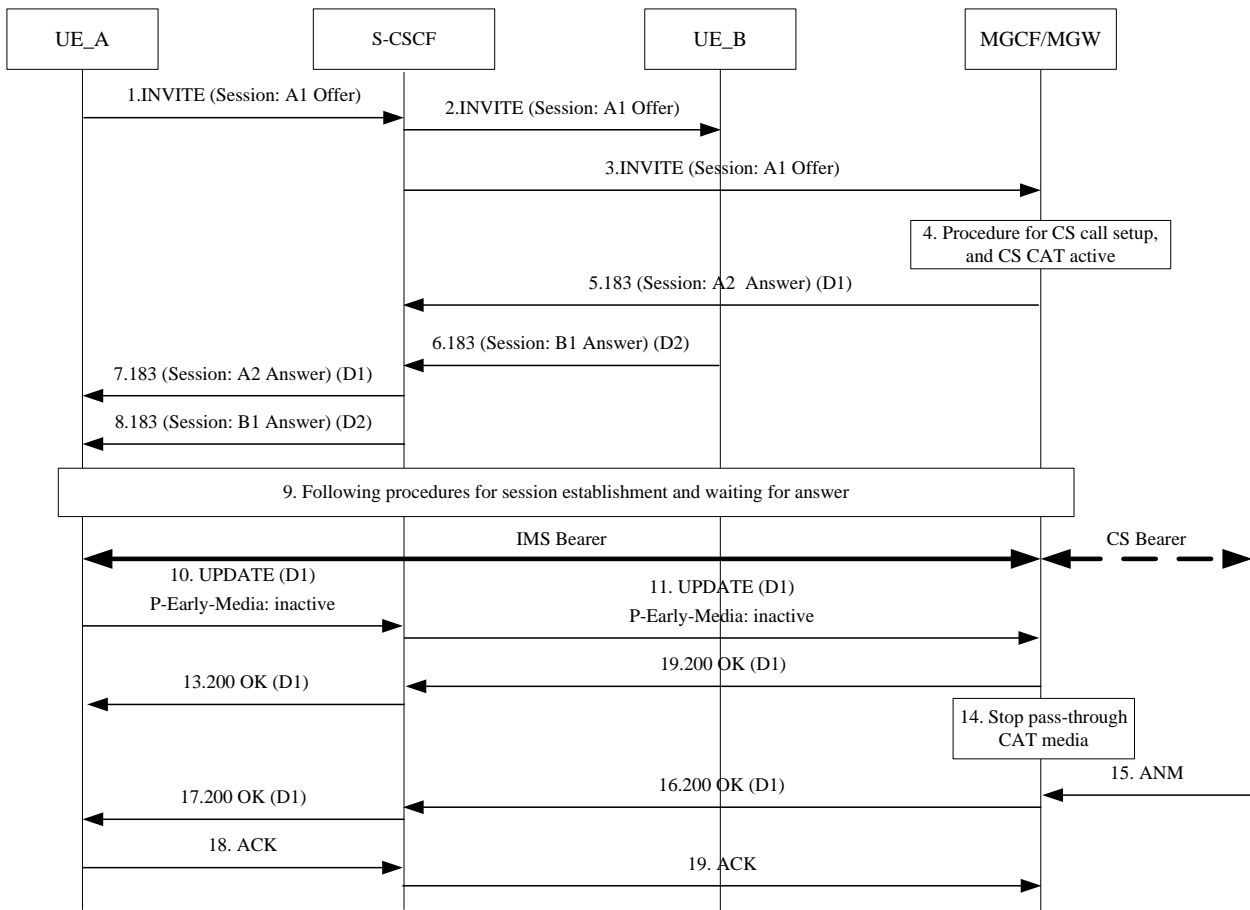


Figure 5.4.1.2-1: call flows for stop IMS CAT based on forking-based model

- 1~2. UE\_A sends an INVITE request towards the terminating IMS domain, The INVITE request includes the session SDP offer A1. The S-CSCF in the terminating IMS domain forwards the INVITE request to the terminating CAT AS based on the iFC.
3. The terminating CAT AS forwards the INVITE request to UE\_B, and then gets CAT SDP answer MRS from the MRF.
4. UE\_B sends a 180 Ringing response to the INVITE request on dialog D1.
- 5~6. The terminating CAT AS sends a 183 session progress with the session SDP answer MRS towards UE\_A through S-CSCF on dialog D2. This step can be happened directly after step 3.
- 7~8. UE\_A sends PRACK request on dialog D2. The S-CSCF in the terminating IMS domain forwards the PRACK request to the terminating CAT AS.
- 9~10. The terminating CAT AS indicates MRF to play CAT to UE\_A, and sends a 200 OK response towards UE\_A on dialog D2.
11. The MRF start to play CAT to UE\_A.
- 12~13. UE\_A wants to stop the CAT, and then sends a UPDATE request on dialog D2, which has "Stop CAT" indication, e.g., using P-Early-Media header field that has value of "inactive".
- 14~15. The terminating CAT AS indicates MRF to stop the CAT, and then sends a 200 OK response towards UE\_A through S-CSCF on dialog D2.
16. The MRF stops to play CAT to UE\_A. UE\_A may generate local ring tone to user.
- 17~19. UE\_B answers and send an 200 OK response with session SDP answer B1 towards UE\_A on dialog D1.
- 20~22. UE\_A acknowledges, and sends an ACK request towards UE\_B on dialog D1.

In Figure 5.4.1.2-2, it is assumed that the CS called party has CAT active, the calling party (UE\_A) does not have CAT active, and the call has been forked.



**Figure 5.4.1.2-2: call flows for stop CS CAT in forking case**

1. UE\_A sends an INVITE request towards the terminating network. The INVITE request includes the session SDP offer A1.
- 2~3. The S-CSCF in the terminating network forked the INVITE request, one destination is IMS UE-B, the other destination is in CS domain.
4. MGCF/MGW start the procedure for CS call setup, and the CS user has subscribed CAT in CS domain.
5. MGCF understand that CS CAT is active, so it sends 183 session progress with Session SDP answer A2 on dialog D1.
6. At the same time, UE-B sends 183 session progress with Session SDP answer B1 on dialog D2.
- 7~8. The terminating S-CSCF forwards the forked responses to UE\_A.
9. UE\_A goes on to establish session and waits for the answer. MGW pass-through CS CAT media to IMS session, so that UE\_A can experience the CS CAT.
- 10~11. UE\_A wants to stop the CAT, and then sends a UPDATE request on dialog D1, which has "Stop CAT" indication, e.g., using P-Early-Media header field that has value of "inactive".
- 12~13. The MGCF tells the MGW to stop pass-through the CS CAT media, and then sends a 200 OK response towards UE\_A through S-CSCF on dialog D1.
14. The MGW stops to pass-through CS CAT media. UE\_A may generate local ring tone to user.
15. The CS user answers the call, and the CS domain sends an ANM message to MGCF.
- 16~17. MGCF send a 200 OK response towards UE\_A on dialog D1.
- 18~19. UE\_A acknowledges, and sends an ACK request towards MGCF on dialog D1.



In Figure 5.4.1.2-3, it is assumed that the CS called party has CAT active; the calling party (UE\_A) does not have CAT active.

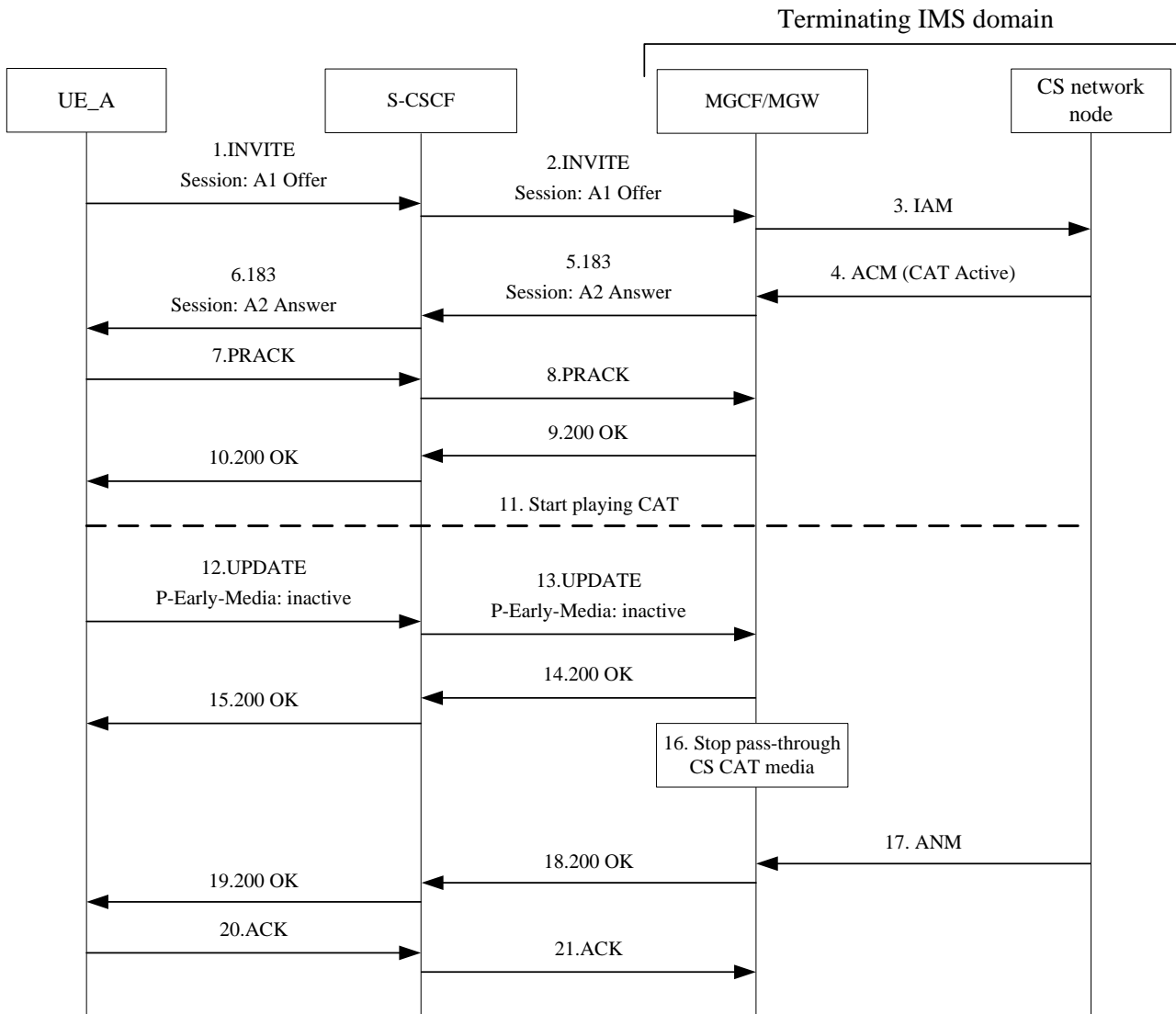
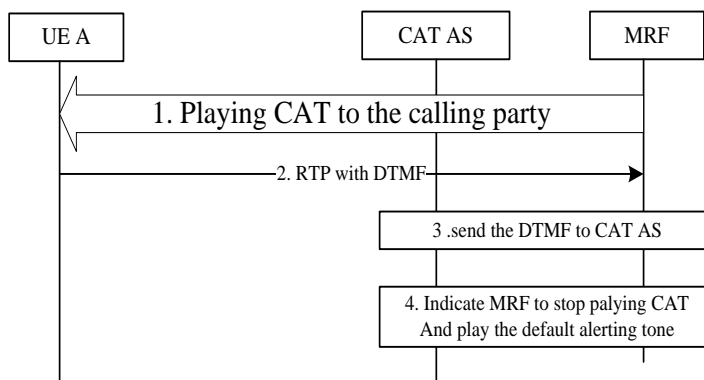


Figure 5.4.1.2-3: call flows for stop CS CAT

- 1~2. UE\_A sends an INVITE request towards the terminating IMS domain, The INVITE request includes the session SDP offer A1. The S-CSCF in the terminating IMS domain forwards the INVITE request to the MGCF based on the iFC.
- 3. The MGCF sends an IAM message to CS network.
- 4. CS network sends a ACM message with "CAT Active" indication to the MGCF.
- 5~6. The MGCF sends a 183 session progress with the session SDP answer A2 towards UE\_A through S-CSCF.
- 7~8. UE\_A sends PRACK request. The S-CSCF in the terminating IMS domain forwards the PRACK request to the MGCF.
- 9~10. The MGCF indicates MGCF to pass-through CS CAT media to UE\_A, and sends a 200 OK response towards UE\_A.
- 11. The CS CAT media server play CAT information, and the MGCF pass-through the CS CAT media to UE\_A.

- 12~13. UE\_A wants to stop the CAT, and then sends a UPDATE request, which has "Stop CAT" indication, e.g., using P-Early-Media header field that has value of "inactive".
- 14~15. The MGCF indicates MGW to stop pass-through the CS CAT media, and then sends a 200 OK response towards UE\_A through S-CSCF.
- 16. The MGW stops to pass-through CS CAT media to UE\_A. UE\_A may generate local ring tone to user.
- 17. The CS user answers the call, and the CS domain sends an ANM message to MGCF.
- 18~19. MGCF send a 200 OK response towards UE\_A.
- 20~21. UE\_A acknowledges, and sends an ACK request towards MGCF.

### 5.4.2 CAT stop alternative 2: using in-band method

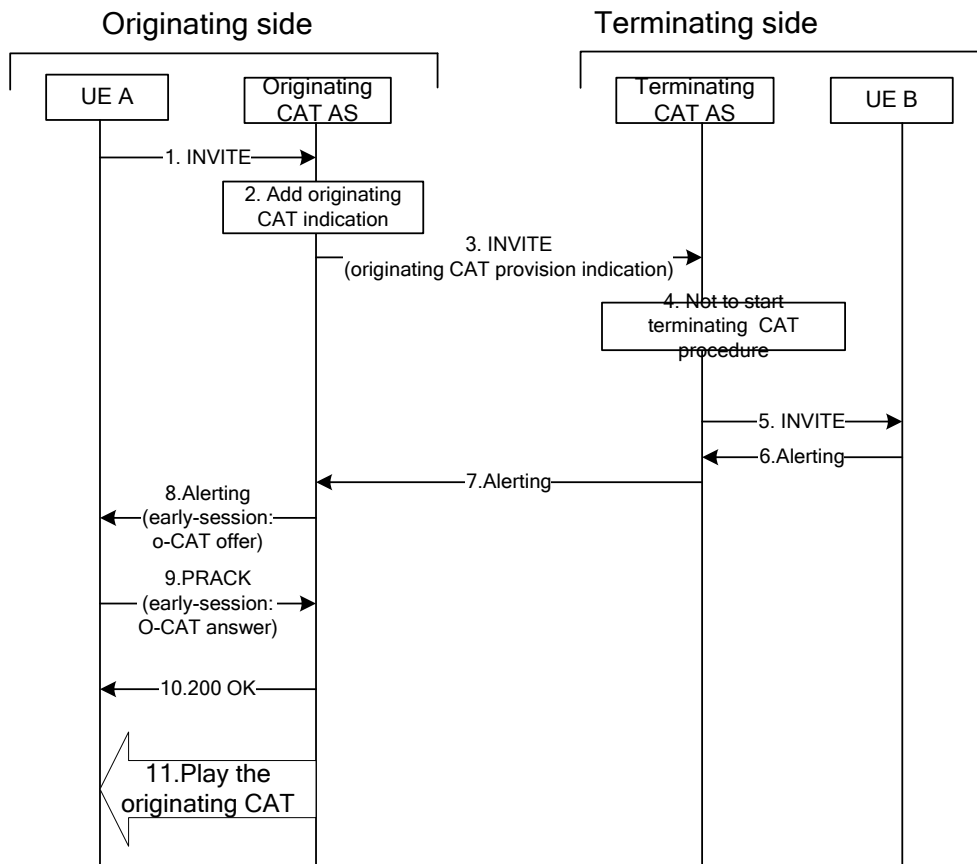


**Figure 5.4.2-1: CAT stopped by originating UE**

- 1. MRF is playing CAT to UE A.
  - 2. UE A sends DTMF for CAT stop to the MRF using RTP package (see IETF RFC 2833 [7]).
- NOTE: DTMF digit from UE A should be understood correctly by the CAT AS.
- 3. MRF sends the DTMF to the CAT AS.
  - 4. After received the DTMF, the CAT AS indicates MRF to stop palying CAT and play the default alerting tone.

## 5.4.3 CAT priority and reject alternative 1: direct way

### 5.4.3.1 IMS CAT Priority



**Figure 5.4.3.1-1: call flow for IMS CAT priority service provided by the originating CAT AS**

1. UE A sends INVITE the originating CAT AS.
- 2-3. The originating CAT AS checks the CAT priority setting. If UE A set the originating CAT has the higher priority, the originating CAT AS includes the originating CAT provision indication in INVITE message and forwards the INVITE to the terminating IMS network.
4. The terminating IMS CAT AS not start the terminating CAT procedure according to the originating CAT provision indication in the INVITE message. Multiple options are possible, two of which are shown:
  - 4a. According to the originating CAT provision indication and iFC, the terminating S-CSCF would not to trigger the terminating CAT AS.
  - 4b. Based on iFC, the terminating S-CSCF forwards the INVITE to the terminating CAT AS. And according to the originating CAT provision indication, the terminating CAT AS would not execute the terminating CAT procedure.
5. The terminating IMS network forwards the INVITE to UE B.
- 6-10. Normal call establishment and the originating CAT procedure.
11. The originating CAT AS starts to play the originating CAT to UE A.

### 5.4.3.2 IMS CAT Reject

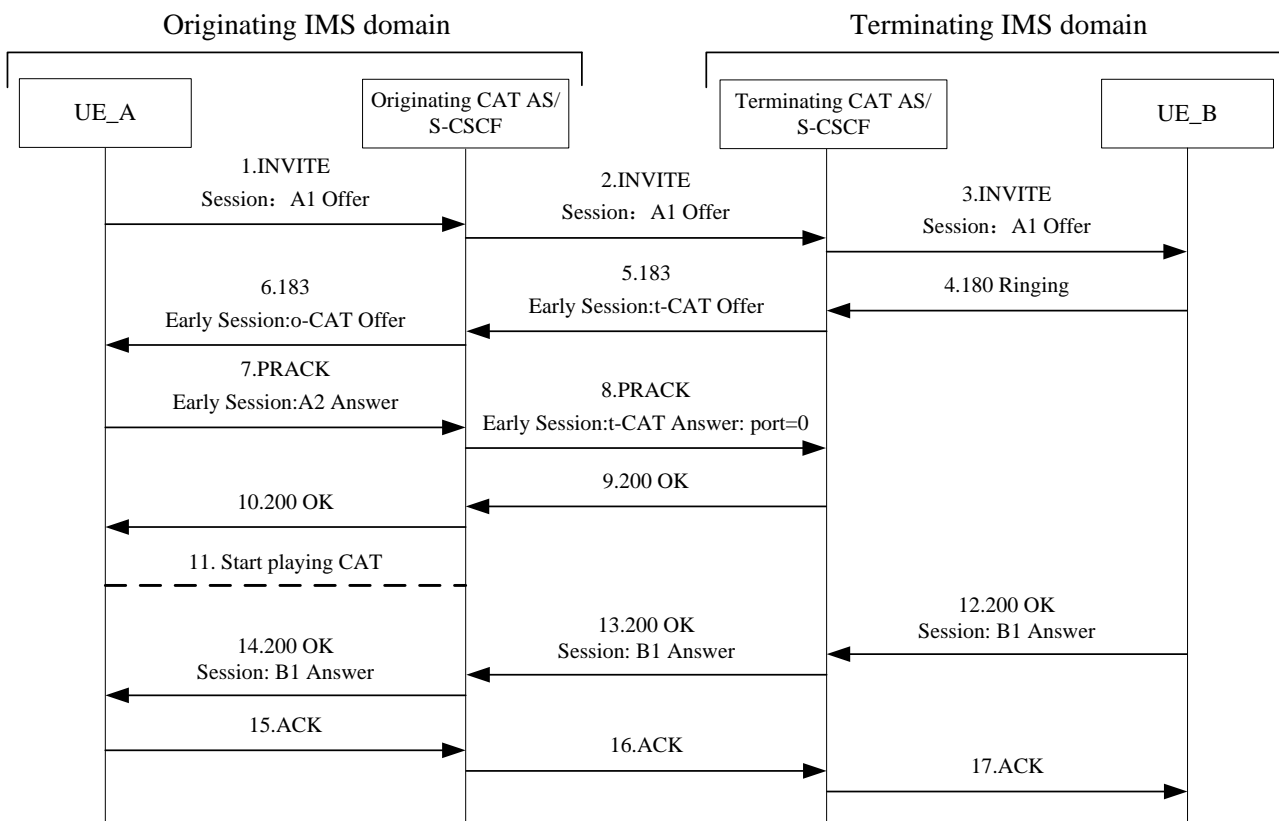
IMS CAT reject procedure is similar with IMS CAT priority in clause 5.4.3.1 with following differences:

- In step 2 and step 3, the originating CAT AS checks the CAT reject setting, and sends the INVITE message with CAT reject indication according to the CAT reject setting.
- In step 8 to step 10, Early Session CAT SDP negotiation is not needed.
- Step 11 is not needed.

### 5.4.4 CAT priority and reject alternative 2: indirect way

#### 5.4.4.1 Early-Session Model

In Figure 5.4.4.1-1, it is assumed that the called party (UE\_B) and calling party (UE\_A) both have CAT active, and originating CAT has priority than terminating CAT.



**Figure 5.4.4.1-1: call flows for CAT priority based on early-session model**

- 1~3. UE\_A sends an INVITE request towards the terminating IMS domain, The INVITE request includes the session SDP offer A1 and the Early Media supported indication. The S-CSCF in the originating/terminating IMS domain forwards the INVITE request to the originating/terminating CAT AS based on the iFC. The originating/terminating CAT AS gets CAT SDP offer from the MRF.
4. UE\_B sends a 180 Ringing response to the INVITE request.
5. The terminating CAT AS sends a 183 session progress with the early-session SDP offer t-CAT towards UE\_A through terminating S-CSCF. This step can be happened directly after step 3.

**NOTE:** The early-session SDP offer t-CAT is special for CAT service, it include indication that this is for CAT service, not for others, e.g., using special media type, or using a media type with 0 port number, other service, such as Announcement, has higher priority than CAT, so, if the early-session SDP is not CAT SDP, O-CAT may not be provide.

6. The originating CAT AS sends a 183 session progress with the early-session SDP offer o-CAT towards UE\_A through originating S-CSCF. This step can be happened directly after step 2. And according the priority, originating CAT AS does not forward the terminating CAT SDP offer t-CAT towards UE\_A.
7. UE\_A sends PRACK request with the early-session SDP answer A2. The originating S-CSCF forwards the PRACK request to the originating CAT AS.
8. The originating CAT AS sends PRACK request with an early-session SDP answer to "Reject CAT", e.g., t-CAT with 0 port number for all media types. The terminating S-CSCF forwards the PRACK request to the terminating CAT AS. This step can be happened directly after step 5.
9. The terminating CAT AS tells MRF the received early-session SDP answer, and sends a 200 OK response to the PRACK request towards UE\_A.
10. The originating CAT AS tells MRF the received early-session SDP answer, and sends a 200 OK response to the PRACK request towards UE\_A. This step can be happened directly after step 7.
11. The originating CAT AS informs MRF to play CAT to UE\_A.
- 12~14. UE\_B answers and send a 200 OK response with session SDP answer B1 towards UE\_A.
- 15~17. UE\_A acknowledges, and sends an ACK request towards UE\_B.

In Figure 5.4.4.1-2, it is assumed that the called party (UE\_B) has CAT active and the calling party (UE\_A) does not have CAT active, and originating operator has rules to reject terminating CAT.

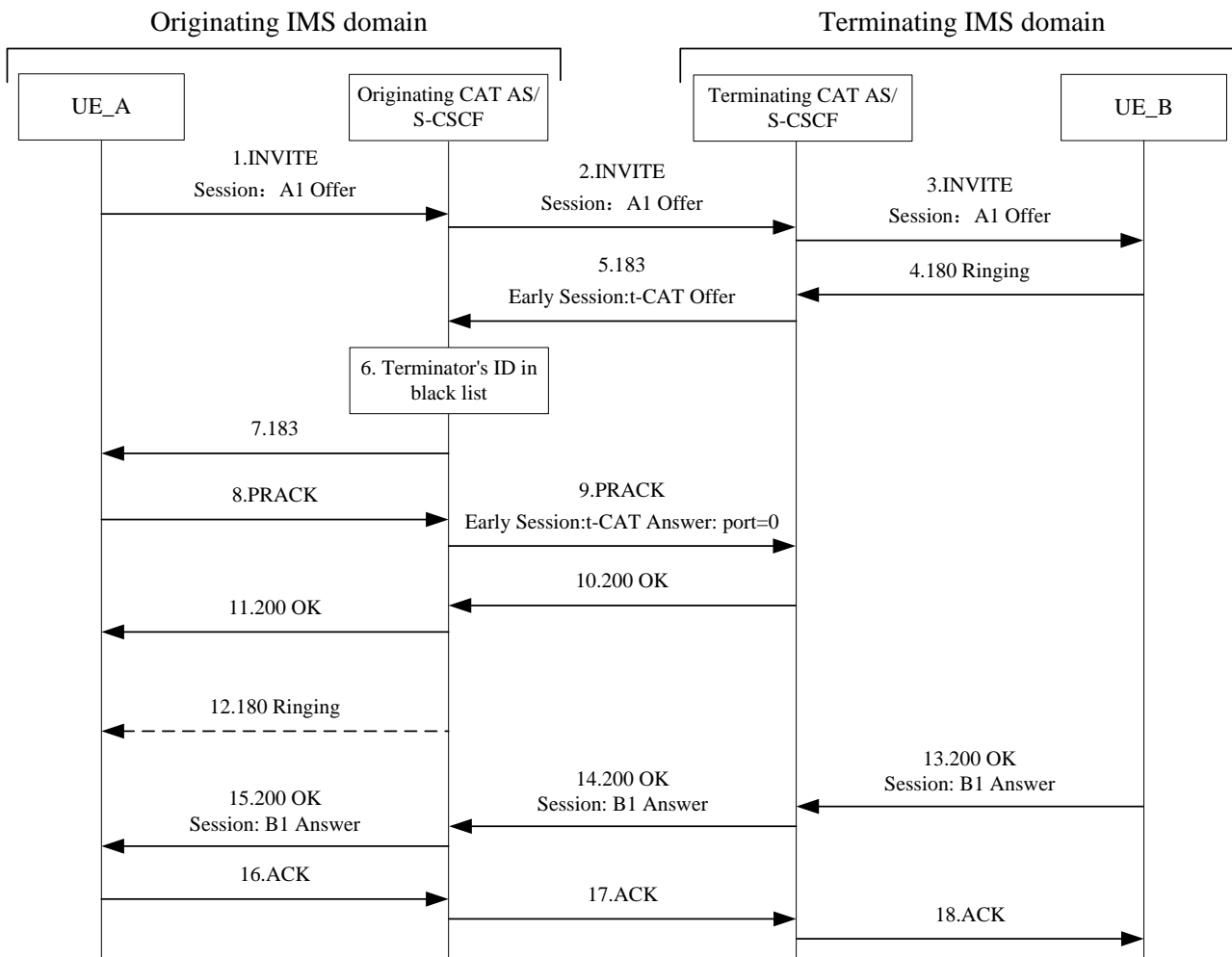
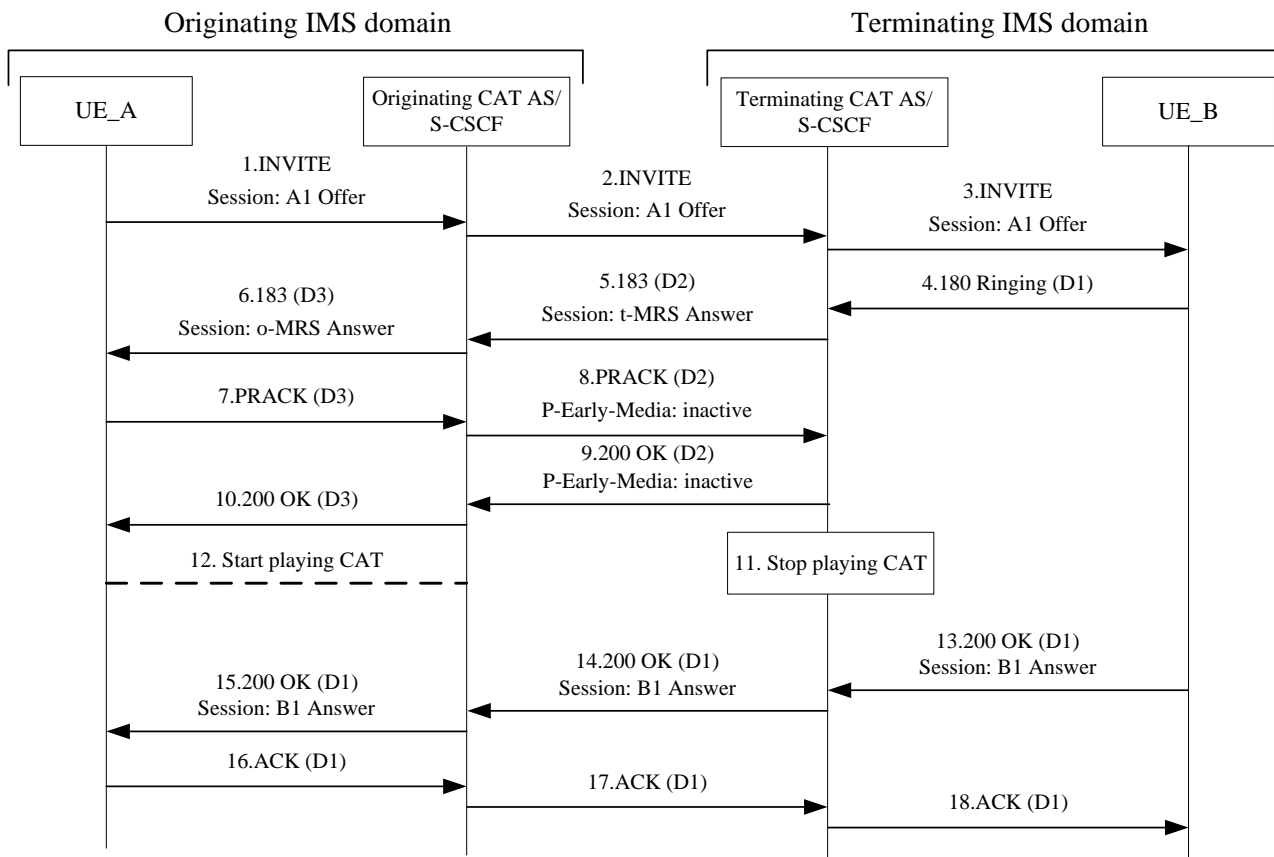


Figure 5.4.4.1-2: call flows for CAT reject based on early-session model

- 1~3. UE\_A sends an INVITE request towards the terminating IMS domain, The INVITE request includes the session SDP offer A1 and the Early Media supported indication. The S-CSCF in the originating/terminating IMS domain forwards the INVITE request to the originating/terminating CAT AS based on the iFC. The terminating CAT AS gets CAT SDP offer from the MRF because UE\_B active the CAT service.
  4. UE\_B sends a 180 Ringing response to the INVITE request.
  5. The terminating CAT AS sends a 183 response with the early-session SDP offer t-CAT towards UE\_A through terminating S-CSCF. This step can be happened directly after step 3.
- NOTE: The early-session SDP offer t-CAT is special for CAT service, it include indication that this is for CAT service, not for others, e.g., using special media type, or using a media type with 0 port number, other service, such as Announcement, has higher priority than CAT, so, if the early-session SDP is not CAT SDP, CAT rejection may not be executed.
6. According to the rule, e.g., black list of terminator's ID, the originating CAT AS decides to reject the terminating CAT because, say, the terminator's ID in the black list.
  7. The originating CAT AS removes the early-session SDP in the 183 response and forwards it towards UE\_A through originating S-CSCF.
  8. UE\_A sends PRACK request. The originating S-CSCF forwards the PRACK request to the originating CAT AS.
  9. The originating CAT AS forwards the PRACK request with an early-session SDP answer to "Reject CAT", e.g. t-CAT with 0 port number for all media types.
  - 10~11. The terminating CAT AS tells MRF the received early-session SDP answer, and sends a 200 OK response to the PRACK request towards UE\_A.
  12. Optionally, the originating CAT AS may send a 180 Ringing response to UE\_A in order to trigger the local tone of UE\_A.
  - 13~15. UE\_B answers and send an 200 OK response with session SDP answer B1 towards UE\_A.
  - 16~18. UE\_A acknowledges, and sends an ACK request towards UE\_B.

#### 5.4.4.2 Forking-Based Model

In Figure 5.4.4.2-1, it is assumed that the called party (UE\_B) and calling party (UE\_A) both have CAT active, and originating CAT has higher priority than terminating CAT.

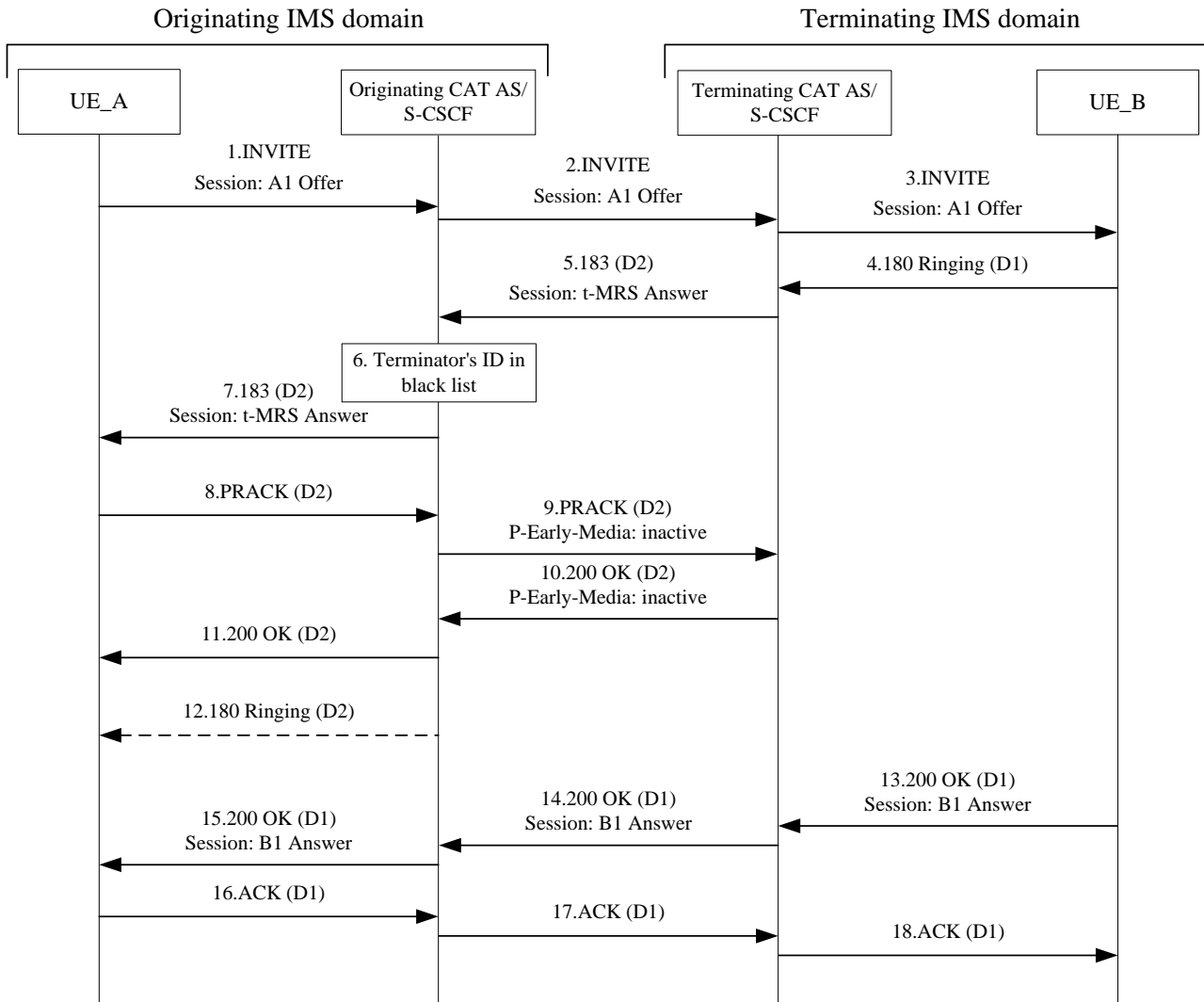


**Figure 5.4.4.2-1: call flows for CAT priority based on forking-based model**

- 1~3. UE\_A sends an INVITE request towards the terminating IMS domain, The INVITE request includes the session SDP offer A1. The S-CSCF in the originating/terminating IMS domain forwards the INVITE request to the originating/terminating CAT AS based on the iFC. The originating/terminating CAT AS gets CAT SDP answer o-MRS/t-MRS from the MRF.
- 4. UE\_B sends a 180 Ringing response to the INVITE request on dialog D1.
- 5. The terminating CAT AS sends a 183 session progress with the session SDP answer t-MRS towards UE\_A through terminating S-CSCF on dialog D2. This step can be happened directly after step 3.
- 6. The originating CAT AS sends a 183 session progress with the session SDP answer o-MRS towards UE\_A through originating S-CSCF on dialog D3. This step can be happened directly after step 2. And according the priority, originating CAT AS does not forward the terminating CAT SDP answer t-MRS towards UE\_A.
- 7. UE\_A sends PRACK request on dialog D3. The originating S-CSCF forwards the PRACK request to the originating CAT AS.
- 8. The originating CAT AS sends PRACK request with "Reject CAT" indication on dialog D2, e.g., using P-Early-Media header field that has value of "inactive". The terminating S-CSCF forwards the PRACK request to the terminating CAT AS. This step can be happened directly after step 5.
- 9. The terminating CAT AS sends a 200 OK response towards UE\_A on dialog D2, with indication that the rejection has been accepted, e.g., using P-Early-Media header field with value of "inactive".
- NOTE: "Reject CAT" indication will only be understood by CAT service, other service will not impact. If there's no rejection accepted indication, then O-CAT may not be played and the message for dialog D2 need to be sent to UE\_A, because other service, e.g., Announcement, has higher priority than CAT.
- 10. The originating CAT AS sends a 200 OK response towards UE\_A on dialog D3. This step can be happened directly after step 7.

11. The terminating MRF stop playing CAT to UE\_A.
12. The originating CAT AS informs MRF to play CAT to UE\_A.
- 13~15. UE\_B answers and send a 200 OK response with session SDP answer B1 towards UE\_A on dialog D1.
- 16~18. UE\_A acknowledges, and sends an ACK request towards UE\_B on dialog D1.

In Figure 5.4.4.2-2, it is assumed that the called party (UE\_B) has CAT active and the calling party (UE\_A) does not have CAT active, and originating operator has rules to reject terminating CAT.



**Figure 5.4.4.2-2: call flows for CAT reject based on forking-based model**

- 1~3. UE\_A sends an INVITE request towards the terminating IMS domain, The INVITE request includes the session SDP offer A1. The S-CSCF in the originating/terminating IMS domain forwards the INVITE request to the originating/terminating CAT AS based on the iFC. The terminating CAT AS gets CAT SDP answer t-MRS from the MRF because UE\_B active the CAT service.
4. UE\_B sends a 180 Ringing response to the INVITE request on dialog D1.
5. The terminating CAT AS sends a 183 session progress with the session SDP answer t-MRS towards UE\_A through terminating S-CSCF on dialog D2. This step can be happened directly after step 3.
6. According to the rule, e.g., black list of terminator's ID, the originating CAT AS decides to reject the terminating CAT because, say, the terminator's ID in the black list.
7. The originating CAT AS forwards the 183 session progress towards UE\_A through originating S-CSCF.



8. UE\_A sends PRACK request on dialog D2. The originating S-CSCF forwards the PRACK request to the originating CAT AS.
  9. The originating CAT AS forwards the PRACK request with "Reject CAT" indication towards UE\_B, e.g., using P-Early-Media header field with the value of "inactive", and then the terminating S-CSCF forwards the PRACK request to the terminating CAT AS.
  10. The terminating CAT AS sends a 200 OK response towards UE\_A on dialog D2, with indication that the rejection has been accepted, e.g., using P-Early-Media header field with value of "inactive".
- NOTE: "Reject CAT" indication will only be understood by CAT service, other service will not impact. If there's no rejection accepted indication, then O-CAT may not be played, because other service, e.g., Announcement, has higher priority than CAT.
11. The originating CAT AS sends a 200 OK response towards UE\_A on dialog D2.
  12. Optionally, the originating CAT AS may send a 180 Ringing response towards UE\_A on dialog D2 in order to trigger local tone of UE\_A.
  - 13~15. UE\_B answers and send an 200 OK response with session SDP answer B1 towards UE\_A on dialog D1.
  - 16~18. UE\_A acknowledges, and sends an ACK request towards UE\_B on dialog D1.

## 5.5 IMS CAT service notification

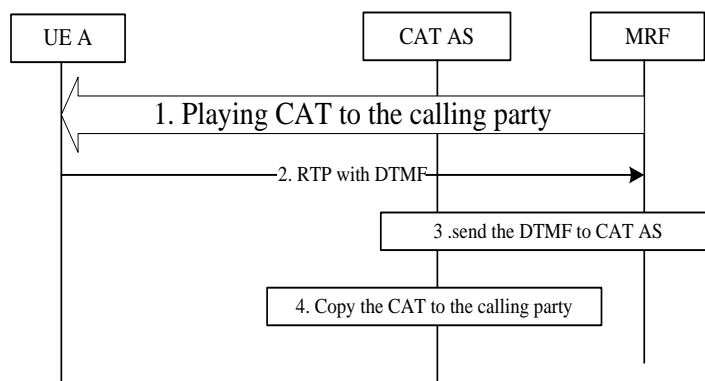
IMS CAT AS shall be able to send the notification message to the serving UE to inform about the status and changes in his CAT service e.g. the system will periodically check subscription record, and if the CAT service will expire, the system sends a CAT expiration notification to the subscriber. The notification can be sent by existing methods such as SMS, MMS and SIP MESSAGE.

*Editor's notes: It is for further study what level of specification is required for this feature.*

## 5.6 IMS CAT copy

### 5.6.1 Alternative 1: using in-band method

The following figure shows how the CAT AS copies the terminating CAT as the originating CAT, when the CAT AS is serving for the originating UE and the terminating UE.



**Figure 5.6.1-1: IMS CAT copy procedure**

1. MRF is playing CAT to UE A.
2. UE A sends DTMF for CAT copy to the MRF using RTP package (see IETF RFC 2833 [12]).
3. MRF sends the DTMF to the CAT AS.

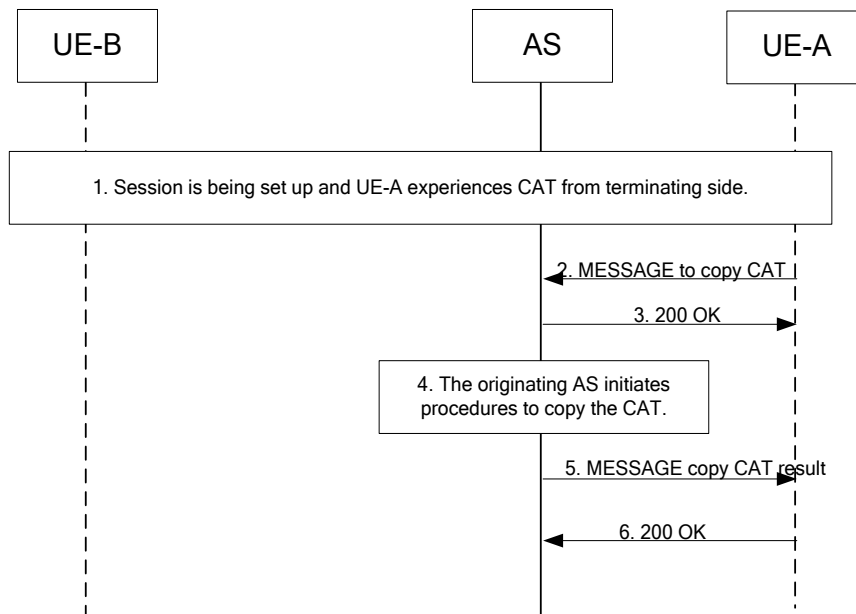
4. CAT AS identifies that the received DTMF is CAT copy instruction, and the CAT AS copies the playing CAT as the UE A's CAT.

## 5.6.2 Alternative 2: using out-band method

### 5.6.2.1 SIP MESSAGE usage for copying CAT or changing CAT

In Figure 5.6.2.1-1 below it is shown how UE-A uses SIP MESSAGE to inform the AS that it wishes to copy the CAT content. Other methods are possible, and in particular the Ut interface could be used to offline request the copying of a CAT previously experienced.

Analogously to Figure 5.6.2.1-1, UE-B can use SIP MESSAGE to change the CAT that is currently played towards UE-A.



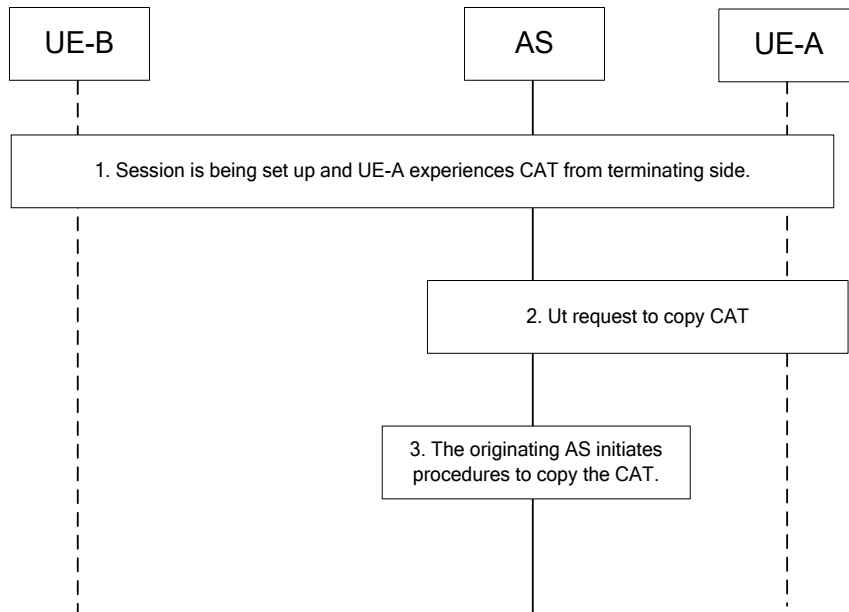
**Figure 5.6.2.1-1: SIP MESSAGE used to invoke the Copy CAT function**

1. The call is set up in accordance with according to the CAT procedures. User A experiences the CAT provided by User B. User A decides to copy the CAT and use it as his/hers own.
2. A SIP message requesting to copy the CAT is sent to the CAT AS in the originating network .
3. The CAT AS generates a 200 OK to acknowledge the receipt of the SIP MESSAGE.
4. The AS initiates procedures to copy the CAT.
- 5~6. Optionally the AS sends a SIP MESSAGE to notify UE-A about the outcome of the copy CAT operation. The arrival of this MESSAGE is acknowledged by UE-A

### 5.6.2.2 Ut usage for copying CAT or changing CAT

In Figure 5.6.2.2-1 below it is shown how UE-A uses Ut to inform the AS that it wishes to copy the CAT content. The UE-A could e.g. receive a list of the last calls it made and the ring signals it can Copy.

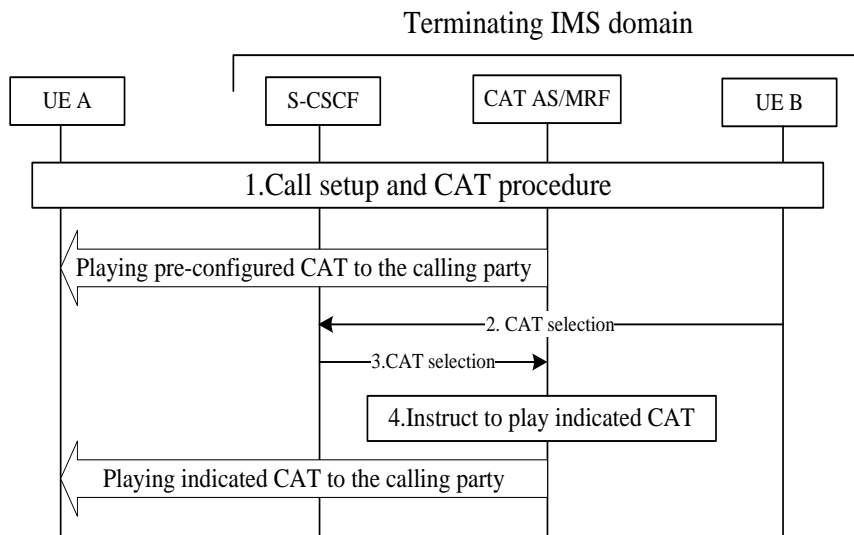
Analogously to Figure 5.6.2.2-1, UE-B can use Ut to change the CAT that is currently played towards UE-A.



**Figure 5.6.2.2-1: Ut interface used to invoke the Copy CAT function**

1. The call is set up in accordance with according to the CAT procedures. User A experiences the CAT provided by User B. User A decides to copy the CAT and use it as his/hers own.
2. UE-A contacts the AS using Ut, requesting to copy the CAT. This step may occur after the session where CAT is experienced is terminated.
3. The CAT AS performs internal logic to copy the CAT and add this to the user's list of ring tones.

## 5.7 CAT selection by the called party



**Figure 5.7-1: call flow for selecting CAT by the called party**

1. The CAT AS plays pre-configured CAT to the calling party using the normal call setup and CAT procedure.
- 2-3. The UE B sends a CAT selection to the CAT AS to indicate which CAT to be played to the calling party, e.g. index of the CAT pre-configured in the CAT AS.

4. According to the received CAT selection, the CAT AS instructs the MRF to play the selected CAT to the UEA.

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## 6 Assessment

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## 7 Interaction with other features

*Editor's Note: This clause will describe the CAT service interactions with other features.*

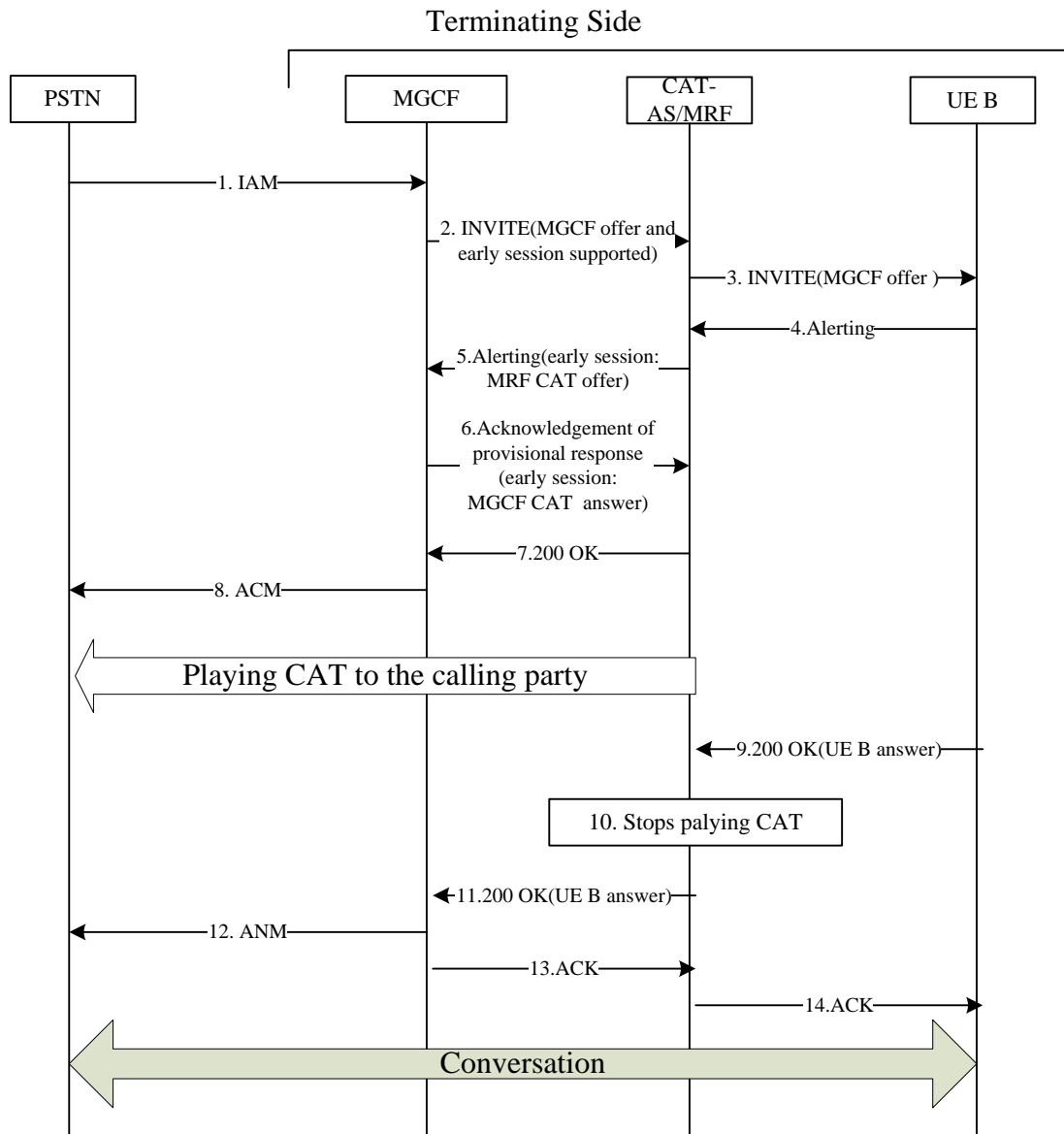
### 7.1 Interaction with other services and functions

### 7.2 Interaction with charging

# 8 Interworking with CS domain

## 8.1 Alternative 1

### 8.1.1 Call flow for providing the IMS CAT to the originating UE in CS domain



**Figure 8.1.1-1: call flows for providing the IMS CAT to the originating UE in CS domain**

1. PSTN sends IAM to MGCF.
2. The MGCF sends INVITE to CAT AS. The INVITE includes the MGCF SDP offer, early session supported indication.
3. The CAT AS sends INVITE to UE B.
4. UE B responds Alerting.

5. CAT AS/MRF checks that MGCF supports early session, and sends Alerting to MGCF, which includes the MRF CAT early session offer.
  - 6-7. MGCF acknowledges to the CAT AS/MRF with MGCF CAT early session answer.
- NOTE: The early session negotiation shown from step 4 to step 7 could be accomplished by SIP 183 procedure, which are shown in clauses 5.1.1.2 and 5.1.1.3, and after that, the CAT AS continues the Alerting procedure.
8. The MGCF sends ACM to the PSTN.
  9. UE B sends final successful response to CAT AS with the SDP answer of UE B.
  10. CAT AS stops CAT playing.
  11. CAT AS forwards final successful response to MGCF
  12. The MGCF sends ANM to PSTN.
  - 13-14. The MGCF acknowledges the final successful response to UE B.

## 8.2 Alternative 2

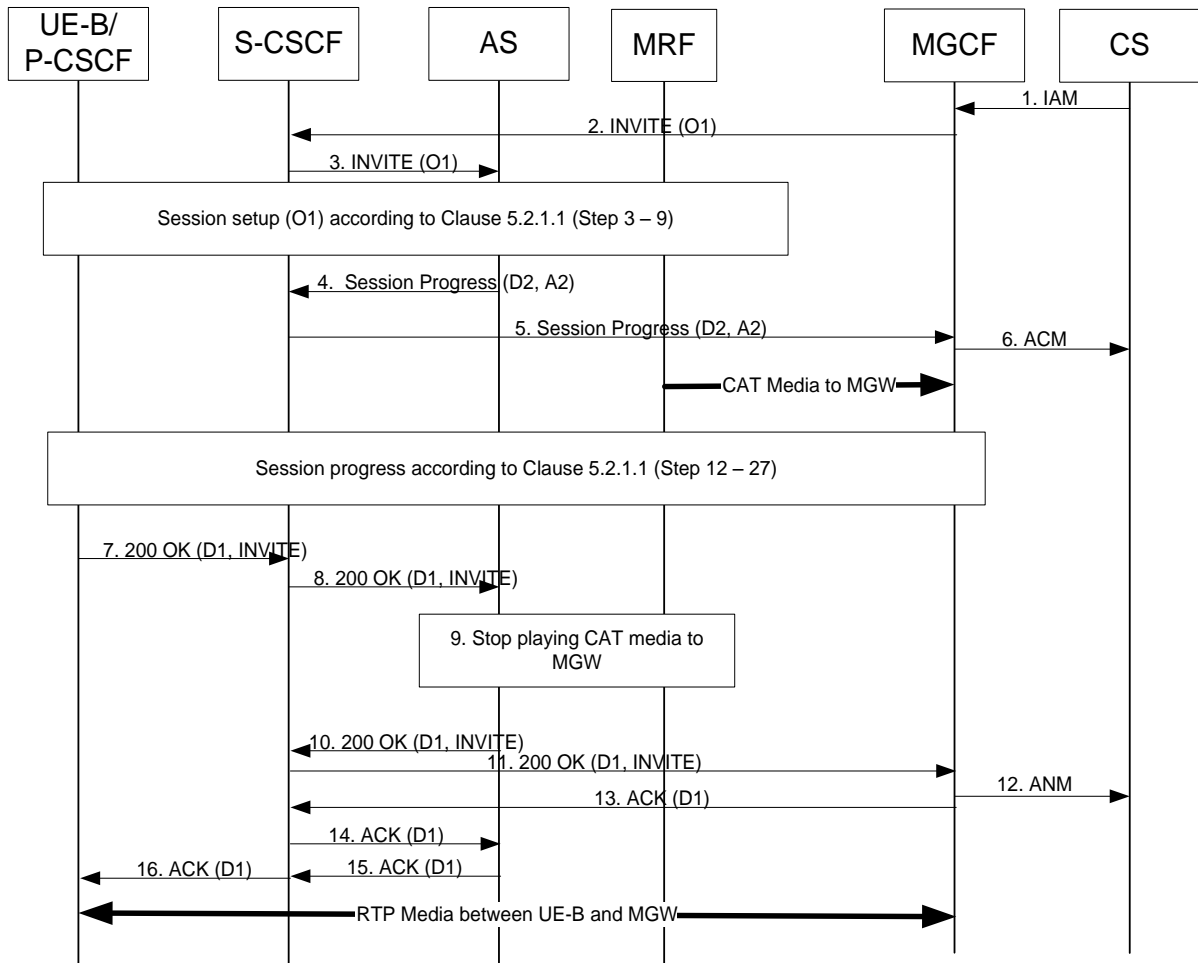
### 8.2.1 Procedures

In the figures that pertain to the 'Signalling flows' section:

- The notation '*Dn*' within parentheses means '*SIP Dialog n*'
- The notation '*On*' within parentheses means '*SDP Offer n*'
- The notation '*An*' within parentheses means '*SDP Answer n*'

#### 8.2.1.1 Session-based CAT provided by the terminating IMS domain

In Figure 8.2.1.1-1, it is assumed that the called party (UE-B) has CAT active. The calling party in CS network is assumed to not have CAT active.



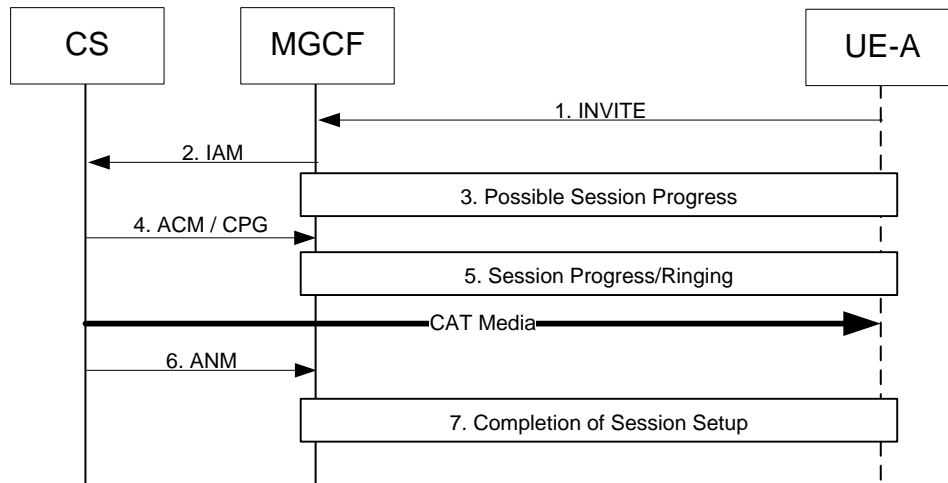
**Figure 8.2.1.1-1: Session-based CAT provided by the terminating IMS domain**

- 1-3. The MGCF sends INVITE with an SDP offer (O1) to establish a call with UE-B. The INVITE is routed through the AS due to initial filter triggers on the S-CSCF. The call proceeds as in steps 3-9 in clause 5.2.1.3, Figure 5.2.1.3-1.
- 4-6. The AS generates a reliable Session Progress response to the MGCF as if this is a response from a forked INVITE, which establishes an early dialog (D2). This response message contains the SDP answer (A2) which the MGCF provides to the MGW to establish the CAT media path between the MRFP and the MGW. The ACM message is sent towards the CS network, enabling CAT to be provided to the originating UE.
- The call proceeds as in steps 12-27 in clause 5.2.1.3, Figure 5.2.1.3-1.
- 7-8. The user at UE-B answers the call. UE-B sends 200 OK and the response reaches the AS.
9. The AS coordinates with the MRFP to stop playing CAT.
- 10-11. The AS forwards the 200 OK to the MGCF to confirm the dialog (D1). If the AS has not already sent the answer (A1) from UE-B to the MGCF, the AS includes the answer (A1) in this 200 OK message and confirms dialog (D1).
- 12-16. The MGCF acknowledges and starts to use the confirmed dialog (D1). An ANM message is sent towards the CS network. The call is now established between the MGCF/MGW and UE-B based on SDP offer (O1) and SDP answer (A1). The early dialog (D2) set up by the "Session Progress" for CAT has no final response and automatically times out.

## 8.3 CAT provided by the terminating CS domain

The following flow for interworking procedures for CAT provided by the terminating CS domain is independent of the CAT model used in the IMS domain (forking or early session model).

In Figure 8.3-1, it is assumed that the called party in the CS network has CAT active and the calling party (UE-A) does not have CAT active. These procedures are based on and compliant with the existing procedures defined in TS 29.163 [15].



**Figure 8.3-1: Session-based CAT provided by the terminating IMS domain**

1. UE-A sends INVITE with an SDP offer to establish a call with a user in the CS network.
2. The MGCF sends an IAM to the CS network.
3. The MGCF may send a session progress to UE-A.
4. The CS network sends an ACM (or CPG) to the MGCF.
5. The MGCF sends an updated session progress or a ringing message. If the MGCF supports early media indication, the MGCF includes an early media indication provided an early media indication was received in step 1. CAT media can flow from CS network to UE-A.

NOTE: PSTN media supports both the CAT media and the normal CS media.

- 6~7. The user in the CS network answers the call. This ends the playing of CAT media. The session setup is completed.

## 9 Conclusion

SA2 were given an exception by TSG SA as follows:

"SA WG2 should decide on a path forward for some solutions for CAT work and may bring CRs as a result of this Study Item in order to do fulfil the intention of the 3GPP2 joint Workshop conclusions, to include some CAT functionality in Rel-8."

To address the exception from SA, this study concludes that both the Forking model and Early-Session model need to be specified in Release 8.

The Gateway model as described in RFC 3960 [6] supports CAT provided by the terminating IMS network without additional specification at stage 2.

CAT inter-working between CS and IMS is included in release 8, as described in clause 8.



Service Notification requires no additional specification at stage 2.

Content indirection is not to be included.

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## Annex A: Change history

Change history								
Date	TSG #	TSG Doc.	CR	Rev	Cat	Subject/Comment	Old	New
2008-06	SP-40	SP-080355	-	-	-	MCC Editorial update for presentation to TSG SA for Information	0.4.1	1.0.0
2008-09	SP-41	SP-080551	-	-	-	MCC Update for presentation to TSG SA#41 for approval	1.2.0	2.0.0
2008-09	SP-41	-	-	-	-	MCC Update of approved TR for publication (Release 8)	2.0.0	8.0.0