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SERIES Q: SWITCHING AND SIGNALLING

Signalling requirements and protocols for the NGN – Service and session control protocols – supplementary services

Signalling requirements and protocol profiles for customized ring-back tone service

Recommendation ITU-T Q.3610

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Recommendation ITU-T Q.3610

Signalling requirements and protocol profiles for customized ring-back tone service

Summary

Recommendation ITU-T Q.3610 specifies the signalling requirements and protocol profiles for NGN customized ring-back tone (CRBT) service in support of customized multimedia ringing (CMR).

Source

Recommendation ITU-T Q.3610 was approved on 7 May 2009 by ITU-T Study Group 11 (2009-2012) under Recommendation ITU-T A.8 procedures.

Keywords

CRBT, IMS, NGN, SDP, SIP.

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1 Scope

This Recommendation specifies signalling requirements and protocol profiles of customized ring-back tone (CRBT) service in support of customized multimedia ringing (CMR). This Recommendation also contains signalling flows.

The CRBT service is defined in next generation networks (NGNs) including IP multimedia subsystems (IMS) and call-server based networks.

This Recommendation covers the protocol profiles over the user-network interface (UNI) and network-to-network interface (NNI) based on [ITU-T Q.3402] and [ITU-T Q.3401], respectively. In addition, it also covers [ITU-T H.248.1] based protocol profile for the interface between the access media gateway functional entity (AMG-FE) and the service control functions. More detailed protocol profiles for other interfaces may be subject to future specifications.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T H.248.1] Recommendation ITU-T H.248.1 (2005), *Gateway control protocol: Version 3*.

[ITU-T Q.3401] Recommendation ITU-T Q.3401 (2007), *NGN NNI signalling profile (Protocol Set 1)*; Amendment 1 (2008).

[ITU-T Q.3402] Recommendation ITU-T Q.3402 (2008), *NGN UNI signalling profile (Protocol Set 1)*.

[ITU-T T.81] Recommendation ITU-T T.81 (1992) | ISO/IEC 10918-1:1994, *Information technology – Digital compression and coding of continuous-tone still images: Requirements and guidelines*.

[ITU-T Y.2012] Recommendation ITU-T Y.2012 (2006), *Functional requirements and architecture of the NGN release 1*.

[ITU-T Y.2701] Recommendation ITU-T Y.2701 (2007), *Security requirements for NGN release 1*.

[IETF RFC 2616] IETF RFC 2616 (1999), *Hypertext Transfer Protocol – HTTP/1.1*.

[IETF RFC 3261] IETF RFC 3261 (2002), *SIP: Session Initiation Protocol*.

[IETF RFC 3262] IETF RFC 3262 (2002), *Reliability of Provisional Responses in the Session Initiation Protocol (SIP)*.

[IETF RFC 3311] IETF RFC 3311 (2002), *The Session Initiation Protocol (SIP) UPDATE Method*.

[IETF RFC 3372] IETF RFC 3372 (2002), *Session Initiation Protocol for Telephones (SIP-T): Context and Architectures*.

[IETF RFC 3959] IETF RFC 3959 (2004), *The Early Session Disposition Type for the Session Initiation Protocol (SIP)*.

[IETF RFC 3960] IETF RFC 3960 (2004), *Early Media and Ringing Tone Generation in the Session Initiation Protocol (SIP)*.

[IETF RFC 4566] IETF RFC 4566 (2006), *SDP: Session Description Protocol*.

[IETF RFC 5009] IETF RFC 5009 (2007), *Private Header (P-Header) Extension to the Session Initiation Protocol (SIP) for Authorization of Early Media*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 early media [IETF RFC 3959]: The media (e.g., audio and video) that is exchanged before a particular session is accepted by the called user.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 calling CRBT service subscriber: The calling party who subscribes to the CRBT service.

3.2.2 called CRBT service subscriber: The called party who subscribes to the called party configured CRBT service.

3.2.3 CRBT service user: The calling party who experiences the CRBT service.

3.2.4 early media for CRBT: The early media that is delivered to the calling party with the media contents configured by the service subscriber. It can be generated by the originating network or the terminating network, depending on the location of service subscriptions.

3.2.5 icon ring tone server (IRT server): Icon ring tone (IRT) server stores the ringing tone media such as audio, video and picture files. The IRT server behaves as a web server and can be provided by content providers or operators. A user terminal can interact with the IRT server via, for example, HTTP to download the ringing tone media.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ACM Address Complete Message

AGC-FE Access Gateway Control Functional Entity

AMG-FE Access Media Gateway Functional Entity

ANM Answer Message

AS Application Server

AS-FE Application Support Functional Entity

AVP Audio Video Profile

B2BUA Back-to-Back User Agent

BGC-FE Breakout Gateway Control Functional Entity

CDIV	Communication DIVersion
CFNR	Call Forwarding on No Reply
CRBT	Customized Ring-Back Tone
CRBT-O	Customized Ring-Back Tone by Originating network
CRBT-T	Customized Ring-Back Tone by Terminating network
CSN	Circuit Switched Network
ECT	Explicit Communication Transfer
EUF	End-User Functions
GSM	Global System for Mobile communications
HOLD	Communication HOLD
HTTP	HyperText Transfer Protocol
IAM	Initial Address Message
IBC-FE	Interconnection Border Gateway Control Functional Entity
I-CSC-FE	Interrogating Call Session Control Functional Entity
IMS	IP Multimedia Subsystem
IRT	Icon Ring Tone
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
MGCF	Media Gateway Control Function
MGC-FE	Media Gateway Control Functional Entity
MRC-FE	Media Resource Control Functional Entity
MRFC	Media Resource Function Controller
MRP-FE	Media Resource Processing Functional Entity
MSC	Mobile Switching Centre
NGN	Next Generation Network
NNI	Network-to-Network Interface
OIP	Originating Identification Presentation
OIR	Originating Identification Restriction
P-CSC-FE	Proxy Call Session Control Functional Entity
POTS	Plain Old Telephone Service
PSTN	Public Switched Telephone Network
RTCP	RTP Control Protocol
RTP	Real-Time Transport Protocol
SCF	Service Control Functions
S-CSC-FE	Serving Call Session Control Functional Entity
SDP	Session Description Protocol
SG-FE	Signalling Gateway Functional Entity

SIP	Session Initiation Protocol
SIP UA	SIP User Agent
SUP-FE	Service User Profile Functional Entity
TIP	Terminating Identification Presentation
TIR	Terminating Identification Restriction
TMG-FE	Trunk Media Gateway Functional Entity
UAC	User Agent Client
UAS	User Agent Server
UDP	User Datagram Protocol
UE	User Equipment
UE-A	User Equipment for user A
UE-B	User Equipment for user B
UNI	User-to-Network Interface
URL	Uniform Resource Locator
UUI	User-to-User Information

5 CRBT service and architecture

5.1 General description

Customized ring-back tone (CRBT) service provides the calling party with the called/calling party's customized ring-back tone. The service is based on subscription and can be subscribed by the called party or the calling party. The service is invoked to provide customized ring-back tone to the calling party, according to the service configuration. The CRBT contents can be image, audio, video, text or a combination of all.

5.2 General architecture

The CRBT service is defined and provided in the NGN architecture, which is either IMS-based or call-server based. Figure 5-1 shows a general architecture that is compliant to [ITU-T Y.2012] for providing the CRBT service based on IMS, and/or call-server networks.

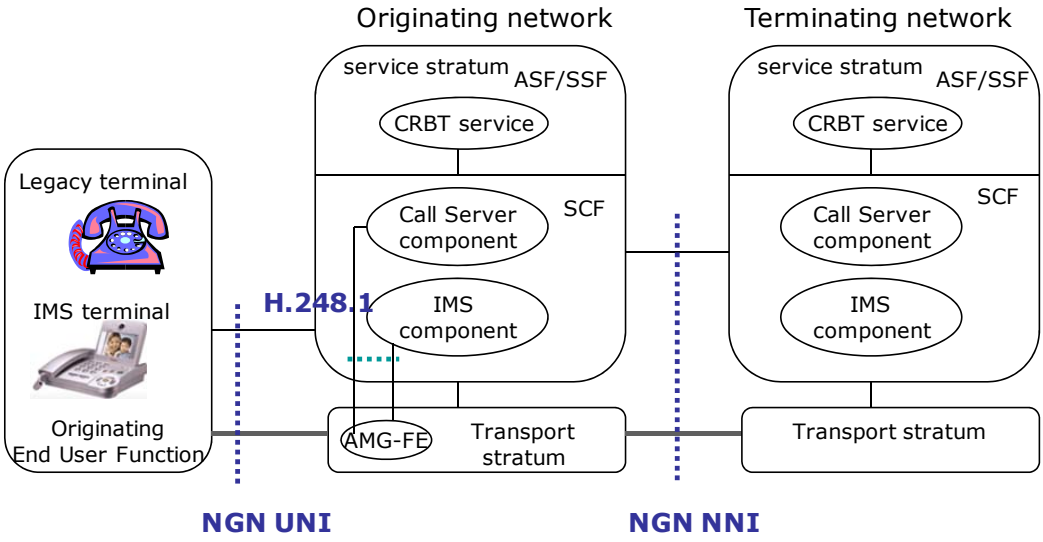
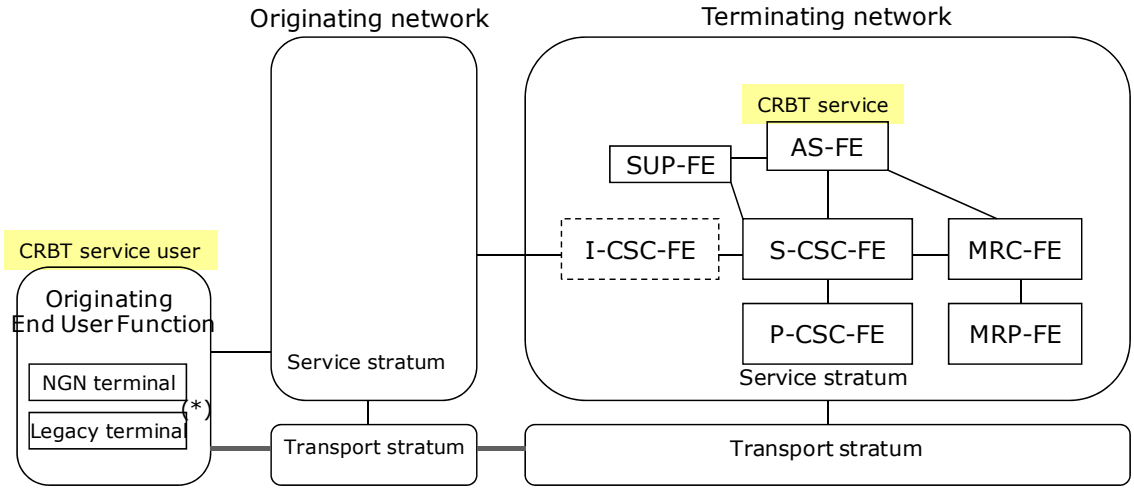


Figure 5-1 – CRBT service functional architecture

5.3 Possible CRBT service architectures

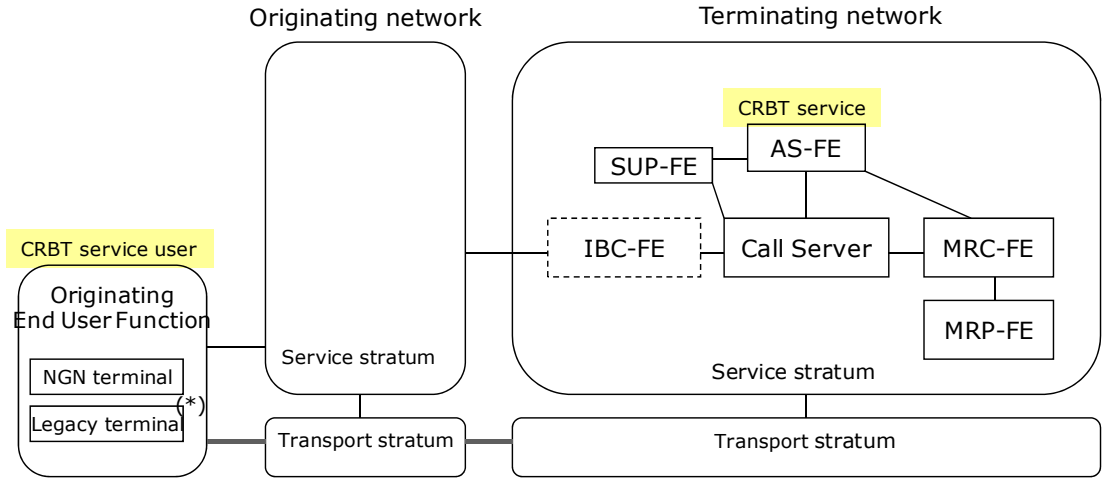
Terminating IMS-based and call-server based architectures for CRBT services are shown in Figures 5-2 and 5-3, respectively. The originating IMS-based and call-server based architectures for CRBT services are shown in Figures 5-4 and 5-5, respectively. These figures show general scenarios assuming that the originating network is different from the terminating network.

Although functional architectures are different for IMS- and call-server based networks, the service control mechanisms are identical.



(*) If the originating network is call-server based, the legacy terminal is accommodated.

Figure 5-2 – Terminating IMS-based CRBT service architecture



(*) If the originating network is call-server based, the legacy terminal is accommodated.

Figure 5-3 – Terminating call-server based CRBT service architecture

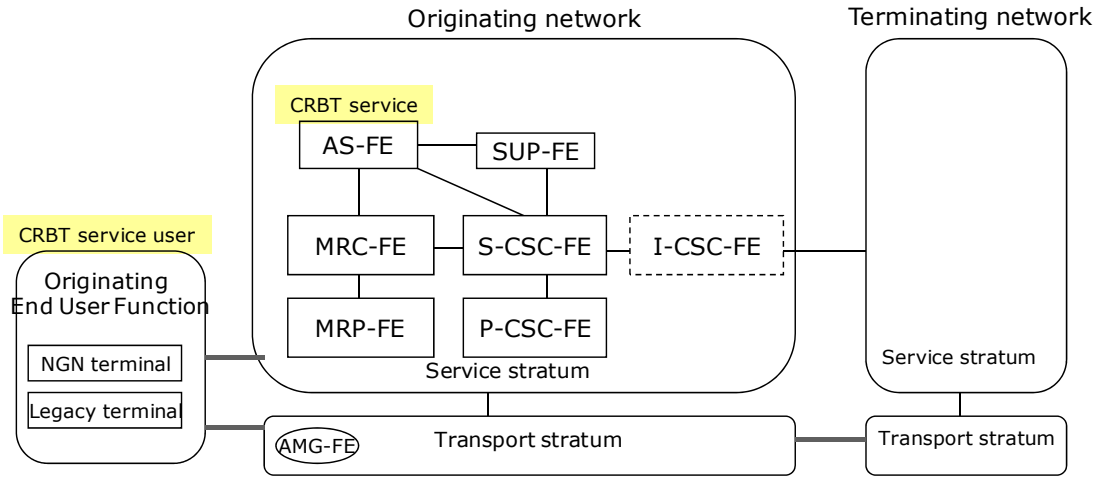


Figure 5-4 – Originating IMS-based CRBT service architecture

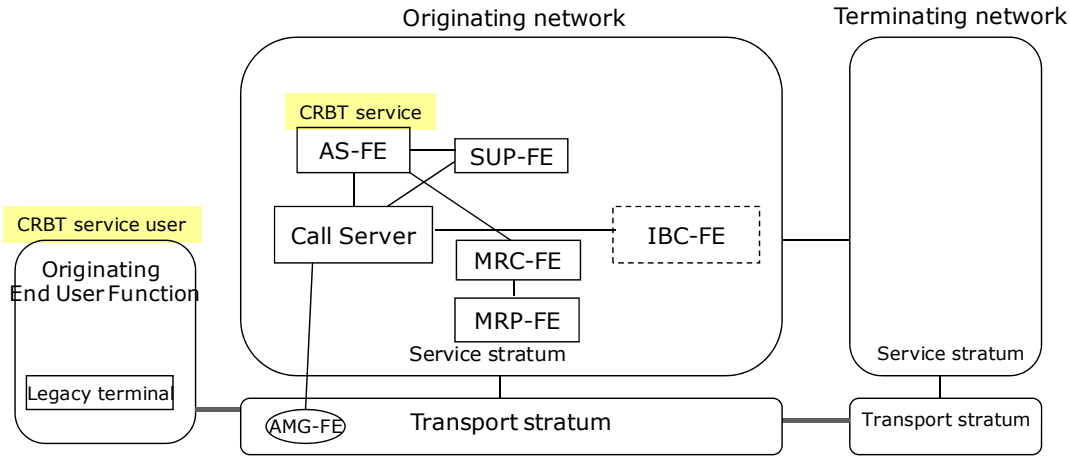


Figure 5-5 – Originating call-server based CRBT service architecture

6 Service models

There are three models for ring-back tone generations. The CRBT service is provided based on at least one of these service models, and can be provided with more than one model.

– **Gateway model** is to establish early media sessions in the same way as regular sessions, using offer/answer exchanges. The gateway model consists of managing early media sessions using offer/answer exchanges in reliable provisional exchanges, PRACKs, and UPDATEs [IETF RFC 3960]. In case of non-reliable provisional exchanges, re-INVITE can be used.

– **Application server model** is to establish early media by distinguishing early sessions from regular sessions by using the early-session option tag. By indicating support of the early-session disposition type in the user agent client (UAC), the user agent server (UAS) knows that offer/answer exchanges for early media (early-session disposition type) are kept separate from regular media (session disposition type) [IETF RFC 3960].

– **HTTP model** is to provide the web URL of the subscriber's repository for the CRBT contents to be presented during early session. This information is filled by and delivered from the CRBT service system, within the response bearing a 18x code, responding to the initial INVITE.

7 Media formats

In order to guarantee a certain level of early media support and compatibility between the calling and called party terminals, appropriate media formats shall be negotiated or selected to play the CRBT contents.

7.1 Audio

If audio is supported, the codec list shall be as specified in clause 8.1 of [ITU-T Q.3401] and [ITU-T Q.3402].

7.2 Video

If video is supported, the codec list shall be as specified in clause 8.1 of [ITU-T Q.3401] and [ITU-T Q.3402].

7.3 Text

If plain text is supported, any character encoding (charset) that contains a subset of the logical characters (e.g., Unicode [b-Unicode]) can be used.

7.4 Still image

If still image is supported, JPEG encoding in compliance with [ITU-T T.81] shall be supported. In addition, the interchange format described in [b-JFIF] may be used with JPEG. Other encoding formats (e.g., GIF ([b-GIF87a], and [b-GIF89a]), or PNG [b-IETF RFC 2083]) may be supported.

8 Signalling requirements

The following clauses describe the signalling requirements for providing CRBT services in each functional entity.

8.1 Requirements for the originating UE

8.1.1 Requirements for supporting CRBT on gateway model

If the originating user equipment (UE) wishes to receive early media authorization indication, it should add the P-Early-Media header, which has value of "supported" to the initial INVITE request as described in [IETF RFC 5009].

The originating UE does not need to distinguish early media and regular media before and after a final answer is received, so there is no requirement for the originating UE when the called user answers the communication.

8.1.2 Requirements for supporting CRBT on application server model

If the originating UE wishes to receive early media authorization descriptions, as described in [IETF RFC 3959], it shall set the "early-session" option tag in the supported header field to the initial INVITE request.

If the originating UE wishes to exchange reliable provisional responses, it shall set the "100rel" option tag in the supported header field to the initial INVITE request as defined in [IETF RFC 3262].

If the originating UE uses different media port and/or connection address for regular media and early media, when regular media is received, or a final answer is received on the dialog, the originating UE should stop playing early media.

8.1.3 Requirements for supporting CRBT on HTTP model

The originating UE shall support Alert-Info and/or Call-Info header field as specified in [IETF RFC 3261].

If the media file indicated in the Alert-Info and/or Call-Info header field has been downloaded, the originating UE shall play the downloaded information to override the local ring-back information, except if the user denies or stops it.

The originating UE should stop playing the downloaded information, except when the local policy determines to keep playing the CRBT contents, when a final answer is received on the dialog.

8.1.4 Requirements for supporting multiple CRBT service models

When multiple service models are applied, the originating UE may be configured to determine whether to play downloaded information and/or early media information, if different media types are involved, and if the same media type is involved, then the preference is set by the local policy.

8.2 Requirements for the originating P-CSC-FE

8.2.1 Requirements for supporting CRBT on gateway model

The P-CSC-FE may add, remove, or modify the P-Early-Media header field within the forwarded SIP requests and responses, according to the procedures in [IETF RFC 5009].

8.2.2 Requirements for supporting CRBT on application server model

The P-CSC-FE may add, remove, or modify, the early-session SDP within the forwarded SIP requests and responses, according to the procedures in [IETF RFC 3959].

8.2.3 Requirements for supporting CRBT on HTTP model

The P-CSC-FE may have local policy to remove, or modify the Alert-Info, and/or Call-Info header field.

8.3 Requirements for the I-CSC-FE

CRBT has no impact on this FE.

8.4 Requirements for the S-CSC-FE

CRBT has no impact on this FE.

8.5 Requirements for the IBC-FE

8.5.1 Requirements for supporting CRBT on gateway model

The IBC-FE may add, remove, or modify, the P-Early-Media header field within the forwarded SIP requests and responses, according to the operator's policy.

8.5.2 Requirements for supporting CRBT on application server model

The IBC-FE may add, remove, or modify, the early-session SDP within the forwarded SIP requests and responses, according to the operator's policy.

8.5.3 Requirements for supporting CRBT on HTTP model

The IBC-FE may have local policy to remove, or modify the Alert-Info, and/or Call-Info header field.

8.6 Requirements for the AMG-FE

CRBT has no impact on this FE.

8.7 Requirements for the call server

CRBT has no impact on this FE.

8.8 Requirements for the AS-FE

The requirements in this clause are for invocation and operation to the CRBT service. The activation, deactivation, and configuration of the CRBT service are out of scope of this Recommendation.

The AS-FE provides CRBT service regardless of whether the network is call-server based or IMS-based.

8.8.1 Requirements for providing CRBT service on gateway model

After receiving an initial INVITE request with an SDP offer from the originating UE or receiving an 18x response to the initial INVITE request from the terminating UE, the AS-FE shall:

a) Acquire SDP for CRBT from MRC-FE;

   NOTE – The SDP for CRBT can be acquired by sending an INVITE request without SDP to MRC-FE.

b) Send SDP answer for CRBT via a response bearing a 18x code to the initial INVITE request with "100rel" option tag in the Require header.

The AS-FE may set all the media's bandwidth in SDP towards the terminating side to 0, in order to avoid RTCP error.

For preconditions on the gateway model, when sending an SDP offer towards the terminating side to establish communication with the media types expected by the originating user, the AS-FE may add the missing media types, according to the media types received in the previous SDP answer from the terminating side.

If a final answer is received by the AS-FE on a dialog, the CRBT managed by the AS-FE on the dialog should be stopped.

Before forwarding the final answer, the AS-FE shall send the UPDATE request with the terminating UE's SDP answer, then after updating the session description, the AS-FE shall send it via a "200 OK" response without SDP towards the originating side.

8.8.2 Requirements for providing CRBT service by application server model

If the initial INVITE request with "early-session" option tag in the supported header, then, according to [IETF RFC 3959], the AS-FE shall:

a) Acquire SDP for CRBT from MRC-FE;

NOTE – The SDP for CRBT can be acquired by sending an INVITE request without SDP to MRC-FE.

b) Add a new message body that has an early-session disposition type in the provisional response to contain the acquired SDP;

c) Set "early-session" option tag in the Require header field if it does not exist;

d) Set "100rel" option tag in the Require header field if it does not exist;

e) Send the provisional response towards the originating UE.

If a final answer is received by the AS-FE on a dialog, the CRBT managed by the AS-FE on the dialog should be stopped.

8.8.3 Requirements for providing CRBT service by HTTP model

If an initial INVITE request has been received, then when the first provisional response bearing a 18x code to the INVITE request is received, according to [IETF RFC 3261], the CRBT AS-FE is required to act as following:

a) If an iconic photo, photo explanation text, and/or card information need to be presented on the originating UE's screen, the AS-FE should add a Call-Info header field, and, according to [IETF RFC 3261], set the HTTP URL of the iconic photo file in the Call-Info header field using "icon" value for the purpose parameter, set the photo explanation text in the Call-Info header field using "info" value for the purpose parameter, and/or set the card information in the Call-Info header field using "card" value for the purpose parameter;

b) If multimedia information need to be played on the originating UE, the AS-FE may add an Alert-Info and/or Call-Info header field, and set the HTTP URL of the multimedia file to the value of the Alert-Info/Call-Info header field;

c) If the INVITE request does not carry "early-session" option tag in the Supported header, the AS-FE shall send the provisional response bearing a 18x code towards the originating UE;

d) Otherwise, proceed as described in clauses 8.8.1 and 8.8.2.

NOTE – It is recommended that the size of the multimedia file and photo file be small in order not to delay communication establishment.

8.8.4 Requirements for supporting multiple models

It is the operator's policy (e.g., according to the subscriber's profile) to specify which model is applied when the originating UE supports multiple models.

It is recommended for the operator policy to have a rule to apply the AS-model, if the Supported/Required header field of the initial INVITE request has an early-session option tag and the AS-FE supports the AS model.

In case the gateway model or the application server model is applied, the AS-FE should have the policy to determine whether to play downloaded information and/or early media information, if different media types are involved, and if the same media type is involved, then the preference is set by the policy.

This policy should be configured by the calling CRBT service subscriber, the called CRBT service subscriber, the originating network's operator and the terminating network's operator.

8.8.5 Requirements when providing interoperation from AS model to gateway model

If a provisional response bearing a 18x code with session SDP is received by the AS-FE on a dialog, and neither the originating nor the terminating UE supports the application server model, the AS-FE shall add early-session option tag in the Supported header field to the forwarded 18x response.

If successive PRACK/UPDATE request with early-session SDP Offer is received, the AS-FE shall:

a) Generate session SDP Offer based on the early-session SDP Offer,

b) Remove the early-session SDP Offer, and

c) Add the session SDP Offer into the request, and forward the request.

The AS-FE may add more media type information in the session SDP Offer, which is in the original session SDP Offer/Answer.

And if the "200 OK" response with session SDP Answer to the PRACK/UPDATE request is received, the AS-FE shall:

a) Generate early-session SDP Answer based on the session SDP Answer,

b) Remove the session SDP Answer, and

c) Add the early-session SDP Answer into the response, and forward the response.

8.9 Requirements for the MRC-FE

CRBT impact on this FE is for further study.

8.10 Requirements for the terminating P-CSC-FE

CRBT has no impact on this FE.

8.11 Requirements for the terminating UE

CRBT has no impact on this FE.

9 Protocol profiles

The protocol profiles for CRBT services shall be based on the following ITU-T Recommendations.

Table 9-1 – Base Recommendations for CRBT protocol profiles

Profile	Interval	Protocol	Recommendation
NGN UNI	Between the originating end user function and the service control function in the originating network	SIP/SDP	[ITU-T Q.3402]
NGN NNI	Between the service control functions of the originating and terminating networks	SIP/SDP	[ITU-T Q.3401]
Gateway control protocol	Between the AMG-FE and service control functions in the originating network	H.248/SDP	[ITU-T H.248.1]

This clause provides CRBT service specific messages and headers, among the above Recommendations and relevant IETF RFCs.

Other messages and headers that are not specific for CRBT may be supported as specified in the base Recommendations in Table 9-1, if they are not explicitly specified in this Recommendation.

9.1 IMS-based CRBT service

9.1.1 Protocol profiles for gateway model

Initial INVITE shall include SDP. If early media session establishes with the reliable provisional response, the 'PRACK' method shall be used as defined in [IETF RFC 3262].

If the early media connection is established by the exchanges of initial INVITE and non-reliable provisional response, after finishing early media session, regular session can be made by media re-negotiation exchanging second Offer SDP and Answer SDP after completion of the first dialogue.

Unidirectional early media may also be supported by responding to initial INVITE with non-reliable provisional response before sending actual media. Regular session is then established by responding with a final SDP answer to the initial INVITE.

Table 9-2 illustrates the SIP messages that are specific to the CRBT service. Other SIP messages may be supported, as specified in the base Recommendations in Table 9-1.

Table 9-2 – CRBT service specific methods and headers for gateway model

a) Early session establishment

Originating EUF → SCF/CRBT AS-FE						
Early session establishment	**Request Method**	**code**	**Header**	**code**	**Description**	**References**
Reliable provisional response-based	INVITE	M	Supported	M	Supported100rel	IETF RFC 3262
			Require	O	Require:100rel	
	PRACK	M	RAck	M		
Non-Reliable provisional response-based	INVITE	M	–	–	–	IETF RFC 3261
SCF/CRBT AS-FE → Originating EUF						
Early session establishment	**Response**	**code**	**Header**	**code**	**Description**	**References**
Reliable provisional response-based	18x	M	RSeq	M		IETF RFC 3262
			Require	M	Require:100rel	
Non-Reliable provisional response-based	18x	M	–	–	–	IETF RFC 3261

b) Regular session establishment

Method/response	code	Header	code	Description	Reference
UPDATE – 200 OK	M	–	–	–	IETF RFC 3311
re-INVITE – 200 OK	O	–	–	–	IETF RFC 3261

See clauses I.1 and I.2 for signalling flows and message usages.

If the CRBT service is provided to the legacy terminal with the IMS based PSTN/ISDN emulation systems, the same H.248.1 profile, which is described in clause 9.2.1, shall be applied to the CRBT services.

9.1.2 Protocol profiles for application server model

9.1.2.1 SIP profile

Initial INVITE shall include SDP. If early media session is established with the reliable provisional response, the option tag "100rel" shall be supported and PRACK method shall be used as defined in [IETF RFC 3262]. If early media session is provided, option tag "early-session" shall be supported, the disposition type "early-session" shall be supported, and the content type "multipart/mixed" may be supported, to specify distinctive session types (e.g., regular session and early session) within a single message, as defined in [IETF RFC 3959].

Table 9-3 illustrates the SIP messages that are specific to the CRBT service. Other SIP messages may be supported, as specified in the base Recommendations in Table 9-1.

Table 9-3 – CRBT service specific methods and headers for application server model

Originating EUF → SCF/CRBT AS-FE					
Request method	**code**	**Header**	**code**	**Description**	**References**
INVITE	M	Supported	M	Supported:100rel, early-session	IETF RFC 3262
		Require	O	Require:100rel, early-session	
		Content-Type	O	Content-Type: multipart/mixed	
PRACK	E	RAck	M	–	

SCF/CRBT AS-FE → Originating EUF					
Response	**code**	**Header**	**code**	**Description**	**References**
18x	M	RSeq	O	–	IETF RFC 3262
		Require	O	Require:100rel, early-session	IETF RFC 3959

See clause I.3 for signalling flows and message usages.

9.1.2.2 SDP profile

Different types of media such as audio, video, text and image can be utilized as different ring-back tones and ringing tones. Each media type shall be specified in "m =" line (i.e., m = text, m = audio, m = video).

9.1.3 Protocol profiles for HTTP model

If the CRBT URL information is delivered in provisional response, a response bearing a 18x code shall include Call-Info header and 'purpose' parameters or/and Alert-Info header as defined in [IETF RFC 3261].

Table 9-4 illustrates the SIP messages that are specific to the CRBT service.

Table 9-4 – CRBT service specific methods and headers for HTTP model

SCF/CRBT AS-FE →Originating EUF					
Method/response	**Code**	**Header**	**Code**	**Description**	**Reference**
18x	M	Call-Info	O	purpose	IETF RFC 3261
180	M	Alert-Info	O	–	

The calling party shall support HTTP/1.1 as defined in [IETF RFC 2616] in order to get CRBT contents.

See clause I.4 for signalling flows and message usages.

9.2 Call server-based CRBT service

9.2.1 Protocol profiles for gateway model

The access media gateway control shall be supported based on [ITU-T H.248.1] and as described in Table 9-5. The basic packages of Annex E of [ITU-T H.248.1] are applied to CRBT services. The SIP profile described in clause 9.1.1 is applicable.

Table 9-5 – H.248.1 packages and SDP

	H.248.1 packages	**SDP**
Early and regular media session	Annex E basic packages	IETF RFC 4566 H.248.1 clause C.11

9.2.2 Protocol profiles for application server model

The call-server based CRBT service is provided by an AS-FE connected to and controlled by a call-server. The AS-FE may support application server (AS) model regardless of whether the session system is call-server or IMS-based. The call-server under the control of AS-FE may relay SIP messages for service control to the originating network, or may map between the SIP and H.248.1 and the service control for the plain old telephone service (POTS) terminal.

In the following cases, the AS model is not applicable:

a) The originating network provides call-server based CRBT.

b) The terminating network provides call-server based CRBT, and the originating network is the call-server.

In the following case, the SIP and SDP profiles described in clause 9.1.2 are applicable:

a) The terminating network provides call-server based CRBT, and the originating network is IMS.

9.2.3 Protocol profiles for HTTP model

It may be possible that the AMG-FE receives specific tone information from the AS-FE delivered through the Ut1 interface [b-ITU-T Y.2031], but this usage is for further study.

Otherwise, this model is not applicable to POTS subscribers of the call-server.

The calling party shall support HTTP/1.1 as defined in [IETF RFC 2616] in order to get the CRBT contents.

10 Interactions between networks

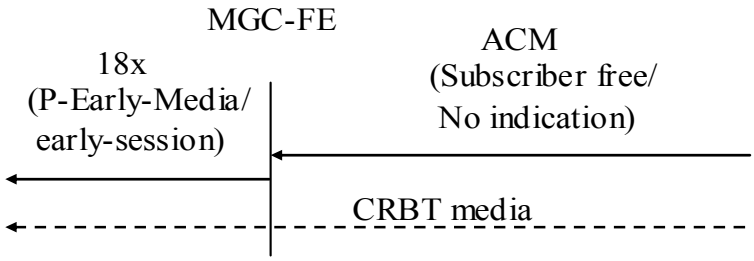
10.1 Providing circuit-switched network CRBT to the originating UE in the IMS domain

When the calling party in the IMS domain makes a session with the called party in the circuit-switched network, the call request from the calling party first arrives at the MGC-FE. MGC-FE is responsible for communicating with the called party in the circuit-switched network (CSN) and holds an early media session negotiation with the calling party. If negotiation is successful, the circuit-switched network plays CRBT to the calling party. When the called party answers the call, PSTN stops playing CRBT and the MGC-FE connects the calling party.

The CRBT service is activated within circuit-switched networks such as PSTN or GSM, upon receipt of one of the following messages:

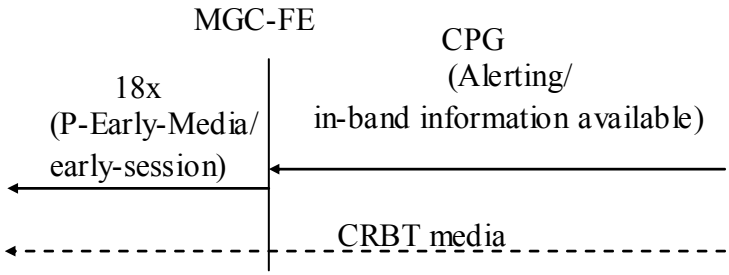
a) Address complete message (ACM) with the value of the called party's status indicator "subscriber free"; or

b) ACM with the value of the called party's status indicator "no indication", optionally, the ACM also has "in-band information indicator" set to 1 (in-band info), or "ISDN User Part indicator" set to 0 (ISDN User Part not used all the way);



c) CPG message, when:

- Event indicator is set to alerting; or
- Event indicator is set to "in-band information or an appropriate pattern is now available"; or
- Event indicator is set to "Progress", optionally, the CPG also has "in-band information indicator" set to 0 (in-band info), or "ISDN User Part indicator" set to 0 (ISDN User Part not used all the way).



If the MGC-FE supports the P-Early-Media header as a network option, and

a) has received the P-Early-Media header in the INVITE request; and

b) has not already sent a provisional response including a P-Early-Media header with the parameters indicating authorization of early media; and

c) preconditions are not used or applicable preconditions have been met,

then the gateway model is applied and the MGC-FE shall send a response bearing a 18x code with a P-Early-Media header.

Or if the MGC-FE supports the early-session SDP as a network option, and

a) has received "early-session" option tag in the INVITE request; and

b) has not already sent a provisional response including an early-session SDP indicating authorization of early media,

then the application server model is applied and the MGC-FE shall send a response bearing a 18x code with early-session SDP.

The HTTP model is not applicable in this case.

See clause I.9 for the signal flow.

10.2 Providing IMS CRBT to the originating UE in circuit switched network

When the calling party in the circuit switched network makes a session with the called party in the IMS-based network, the call request from the calling party arrives at MGC-FE. MGC-FE triggers the CRBT service and is responsible for communicating with the CRBT AS-FE. If the UE in the CSN is capable of video, the CRBT AS-FE decides to play the CRBT to the calling party, and if CRBT SDP contains the video stream, the MGC-FE should ask the MSC to connect the calling party, according to the message from the CRBT AS-FE and holds an early media session negotiation with the calling party. If negotiation is successful, MRC/P-FE plays the CRBT to the calling party. When the called party answers the call, MRC/P-FE stops playing the CRBT and MGC-FE connects the calling party.

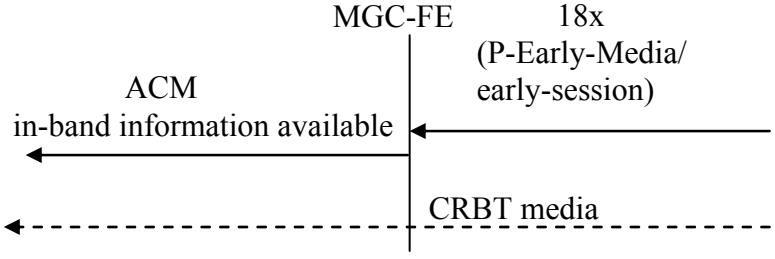
If the Address Complete Message (ACM) has not yet been sent, and either of the following conditions are met, the MGC-FE shall send the Address Complete Message (ACM) with "in-band information indicator" set to 1 (in-band info):

a) the reception of the first response bearing a 18x code that includes a P-Early-Media header authorizing early media; and

b) SDP preconditions are not used, or applicable SDP preconditions have been met;

Or when the application server model is applied, and if the MGC-FE supporting the early-session SDP as a network option; and

a) the reception of the first response bearing a 18x code that includes early-session SDP authorizing early media.



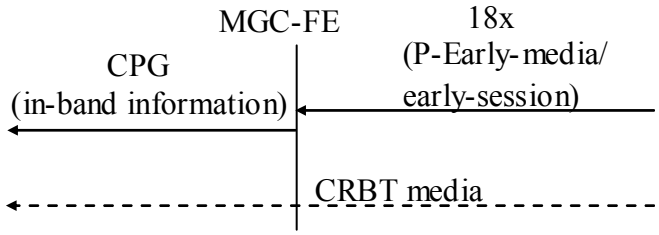
If the Address Complete Message (ACM) has already been sent, at an MGC-FE and either of the following conditions are met, the MGC-FE shall send Call Progress Message (CPG) that Event indicator is set to "in-band information or an appropriate pattern is now available".

When the gateway model is applied, and if the MGC-FE supporting the P-Early-Media header as a network option, and

a) the reception of a response bearing a 18x code that includes the first P-Early-Media header authorizing early media,

Or when the application server model is applied, and if the MGC-FE supporting the early-session SDP as a network option, and

a) the reception of a response bearing a 18x code that includes early-session SDP authorizing early media.



See clause I.10 for the signal flow.

The HTTP model is not applicable in this case.

11 Interactions with other services on NGN

11.1 Originating identification presentation (OIP)

No impact on the CRBT service.

11.2 Originating identification restriction (OIR)

No impact on the CRBT service.

11.3 Terminating identification presentation (TIP)

No impact on the CRBT service.

11.4 Terminating identification restriction (TIR)

If the CRBT service is associated with the terminator's id information, the terminating side CRBT AS-FE shall not apply the service on the communication if TIR service has restriction rules on the terminating identity information.

11.5 Communication HOLD (HOLD)

No impact on the CRBT service.

11.6 Communication DIVersion (CDIV) services

11.6.1 General

If the diverting party has both CRBT service and CDIV active, and the diverted-to party has CRBT service active, then the CRBT service of the diverted-to party should be applied to the session by the AS-FE providing the CRBT service of diverted-to party, except in the case of CFNR. The interaction of CRBT service with call forwarding on no reply (CFNR) is described in clause 11.6.2.

If the diverting party has CRBT service and CDIV active, and the diverted-to party does not have an active service, no CRBT service should be applied to the session when CDIV is invoked.

As a network operator option, the CRBT service of the diverting party may be applied to the session by the AS-FE providing the CRBT service for the diverting party, without the CRBT service for the diverted-to party applied to the session.

NOTE – The above network operator option can be deployed in cases where diversion of the call is hidden from the calling party.

11.6.2 Call forwarding on no reply (CFNR)

If the diverting party has both CRBT service and CFNR active, and the diverted-to party has CRBT service active, then the CRBT service of the diverting party should be applied to the session by the AS-FE providing the CRBT service for the diverting party until the CFNR timer expires. Upon the CFNR timer expiry, the AS providing the CRBT service for the diverting party should stop applying the CRBT for the diverting user and the AS providing the CRBT service for the diverted-to party should apply the CRBT service of the diverted-to party.

If the diverting party has CRBT service and CFNR active, and the diverted-to party does not have an active service, the CRBT service of the diverting party should be applied to the session by the AS providing the CRBT service for the diverting party until the CFNR timer expires.

As a network operator option, the CRBT service of the diverting party may be applied to the session by the AS-FE providing the CRBT service for the diverting party, without the CRBT service for the diverted-to party applied to the session.

NOTE – The above network operator option can be deployed in cases where diversion of the call is hidden from the calling party.

11.7 Explicit communication transfer (ECT) service

If the transfer target has CRBT service active, the AS-FE providing the CRBT service shall apply the transfer target's CRBT in the case of blind transfer. The AS-FE providing the CRBT service shall not apply the transfer target's CRBT in the case of consultative transfer while the call is being transferred to the transfer target.

The CRBT service of the transferor shall not be applied when ECT is invoked.

11.8 Originating CRBT service interacting with terminating CRBT service

If the originating CRBT service is triggered and the terminating CRBT service is also triggered, and as both services provide early media to the calling party, a conflict occurs.

In this case, some priority mechanism as to which CRBT (the originating CRBT or the terminating CRBT) should be played is required and the priority mechanism within SIP is for further study.

A no other mechanism is to configure the priority between service operators by pre-arrangement. The configuration is set on the service profiles by the subscribers or the operators. In this case, since the calling party is usually the subscriber of the originating CRBT, the originating CRBT has higher priority over the terminating CRBT. The priority also can be configured in the terminal by an individual subscriber.

The signal flow for priority service between the originating and the terminating CRBT is presented in clause I.8.

11.9 Terminating early media services to calling party other than CRBT

If the originating CRBT and the terminating early media services toward the calling party such as announcement, interactive voice response (IVR) or voice mail service (VMS) are invoked, and as both services provide early media to the calling party, a conflict occurs.

When a terminating early media service to the calling party is an announcement providing network or services information, or IVR services such as prepaid or VMS, the terminating early media service is more important than the originating CRBT. In this case, the terminating early media service has priority over the originating CRBT.

In order to control priority, the terminating early media service may send an indication to the originating system that the terminating service will provide early media toward the calling party, in order for the originating service to decide its service invocation or not.

A priority mechanism within SIP requires further study.

If the terminating CRBT and the terminating early media services toward the calling party are invoked in parallel, the priority is set according to the service operator's policy.

12 Security considerations

The CRBT service is required to use the appropriate security mechanisms to meet the general security requirements of NGN [ITU-T Y.2701].

Also, as the CRBT service provides early/regular media transport and signalling messages, the NGN network infrastructure for CRBT service should ensure the confidentiality and integrity of the signalling flows transported on it.

Therefore, it is recommended to provide the transport and/or network security (respectively, e.g., TLS [b-IETF RFC 2246] and/or IPSec [b-IETF RFC 2401]) and/or the application security (such as S/MIME [b-IETF RFC 2633]) for signalling messages using SIP between two endpoints, as described in the security considerations of the core SIP specification [IETF RFC 3261], the Early Media and Ringing Tone Generation specification [IETF RFC 3960], and Session Initiation Protocol for Telephones (SIP-T [IETF RFC 3372]).

In the gateway model and the AS model, the transport and network security and/or the application security should be applied.

In the HTTP model, the application-layer security should be applied, because the body of the signalling message (e.g., Alert-info of SIP [IETF RFC 3261]) contains the web URL. Placing the URL in the header field can pose a security risk. If a called party (UE-B) fetches the URLs provided by a malicious caller (UE-A), the called party may be at risk for displaying inappropriate or offensive content, dangerous or illegal content, and so on. Hence, the application security (e.g., S/MIME) should be applied in order to provide the message authentication mechanism.

Annex A

Multi-dialog model

(This annex forms an integral part of this Recommendation)

A.1 General description

The multi-dialog model establishes both early and regular dialog together during the establishment of the communication. Since it uses a forking mechanism for making both dialogs, they are correlated with the CRBT service.

A.2 Signalling requirements

A.2.1 Requirements for the originating UE

If the originating UE wishes to receive early media authorization indications, as described in [IETF RFC 5009], it shall add the P-Early-Media header, which has the value of "supported" to the initial INVITE request.

A.2.2 Requirements for the AS-FE

If the initial INVITE request with P-Early-Media header that has "supported" value, and without "early-session" option tag in the Supported header, then, according to [IETF RFC 5009], the AS-FE shall:

a) Acquire SDP for CRBT from MRFC;

NOTE 1– The SDP for the CRBT can be acquired by sending an INVITE request without SDP to MRFC.

b) Create a new provisional response bearing a 18x code;

c) Set the To header tag value of the new provisional response bearing a 18x code different from the To header tag value in the received provisional response bearing a 18x code;

d) Add a P-Early-Media header field in the new provisional response; the value of the P-Early-Media header field has one of the following values: "sendonly", or "inactive";

e) Add a message body that has session disposition type in the new provisional response to contain the acquired SDP;

f) Send the new provisional response bearing a 18x code and the received provisional response bearing a 18x code towards the originating UE.

NOTE 2 – If the CRBT AS-FE wants to provide CRBT information with the new media type, the CRBT AS-FE shall send out an UPDATE request.

Appendix I

Signalling flows

(This appendix does not form an integral part of this Recommendation)

The detailed message examples are not shown for simplicity and most of the headers are shown in the first message which includes the significant ones.

I.1 IMS-based CRBT service by gateway model with PRACK and UPDATE (Originating IMS-UE case)

Figure I.1 signalling flow shows an IMS-based CRBT service provided by the gateway model scenario with PRACK and UPDATE.

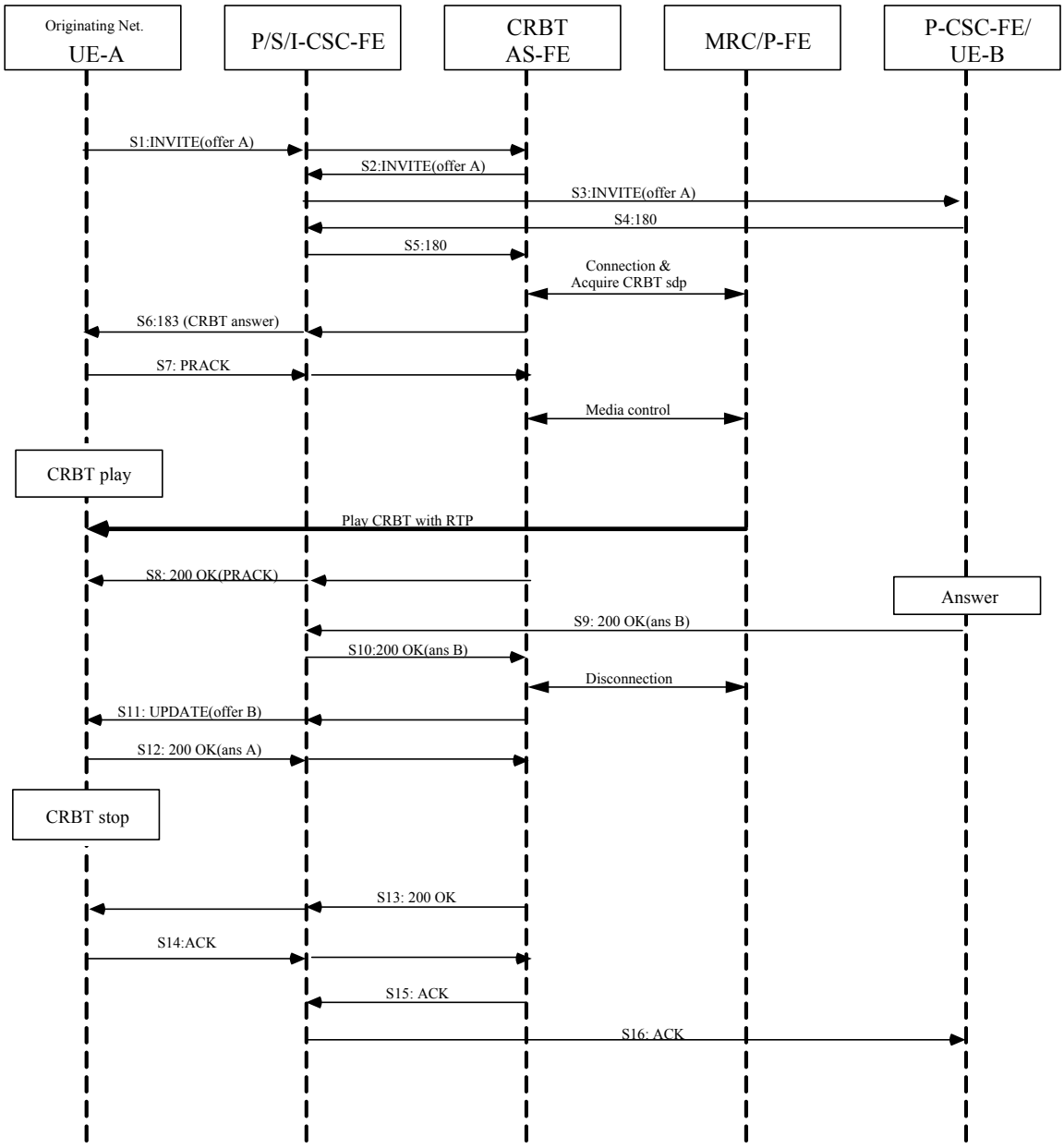


Figure I.1 – IMS-based CRBT service by gateway model with PRACK and UPDATE

S1 INVITE (UE-A toward S-CSC-FE)

The INVITE request is sent from the UE-A to S-CSC-FE of the terminating side. The S-CSC-FE evaluates the initial filter criteria and forwards the INVITE to the CRBT AS-FE. The contact value includes UE-A's SIP URI that contains the IP address.

```
INVITE sip:ue-b@term_ngn.net SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>
Call-ID: ueacb03a0suea00234123
Cseq: 1 INVITE
P-Preferred-Identity: <sip:ue-a@orig_ngn.net>,<tel:+1-222-555-3333>
Privacy: none
Contact: <sip:192.100.200.51:5090>
Supported: timer,100rel
Accept: application/sdp
Session-Expires: 3600;refresh=uac
Content-Type: application/sdp
...
```

S3 INVITE (S-CSC-FE toward UE-B)

INVITE is sent toward the UE-B through network elements (AS-FE should be B2BUA server). The contact value includes AS-FE's SIP URI.

```
INVITE sip:192.100.200.52:5080 SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag=asfe171828
To: <tel:+1-222-333-4444>
Call-ID: asfed03a0sasfe0234123
Cseq:1 INVITE
Contact: <sip:192.100.100.100:5070>
Content-Type: application/sdp
...
```

S4-5 180 (UE-B toward AS-FE)

180 (ringing) is sent toward the AS-FE through network elements. The contact value includes UE-B's SIP URI.

```
SIP/2.0 180 Ringing
From: <sip:ue-a@orig_ngn.net>;tag=asfe171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : asfed03a0sasfe0234123
CSeq: 1 INVITE
Contact: <sip:192.100.200.52:5080>
```

S6 183 with SDP (AS-FE toward UE-A)

The AS-FE sends an 183 provisional response with the SDP of MRP-FE. The contact value includes AS-FE's SIP URI.

```
SIP/2.0 183 Session Progress
From: <sip:ue-a@ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=asfe22222122
Call-ID : ueacb03a0suea00234123
Require:100rel
Contact: <sip:192.100.100.100:5070>
Content-Type: application/sdp
...
```

S7 PRACK (UE-A toward AS-FE)

The UE-A sends a PRACK request, which acknowledges the SIP 183 (Session Progress) provisional response, to the AS-FE.

```
PRACK 192.100.100.100:5070 SIP/2.0
From: <sip:ue-a@ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=asfe22222122
Call-ID : ueacb03a0suea00234123
Cseq: 1 PRACK
Contact: <sip:192.100.200.51:5090>
...
```

S8 200 OK (AS-FE toward UE-A)

The AS-FE sends a 200 OK response to the PRACK request (7). The S-CSC-FE forwards the 200 OK response to the UE-A.

```
SIP/2.0 200 OK
From: <sip:ue-a@ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=asfe22222122
Call-ID : ueacb03a0suea00234123
Cseq: 1 PRACK
...
```

S9-10 200 OK (UE-B toward AS-FE)

When the called party answers, the UE-B sends a 200 OK (with SDP B) final response to the INVITE request (3). The S-CSC-FE forwards the 200 OK response to the AS-FE.

```
SIP/2.0 200 OK
From: <sip:ue-a@ngn.net>;tag=asfe171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : asfed03a0sasfe0234123
Cseq: 1 INVITE
Contact: <sip:192.100.200.52:5080>
Content-Type: application/sdp
...
```

S11 UPDATE (AS-FE toward UE-A)

The AS-FE sends an UPDATE request containing the SDP received in the 200 OK (10) from the UE-B.

```
UPDATE sip:192.100.200.51:5090 SIP/2.0
From: <tel:+1-222-333-4444>;tag=asfe22222122
To: <sip:ue-a@ngn.net>;tag=171828
Call-ID : ueacb03a0suea00234123
Cseq: 1 UPDATE
Contact: <sip:192.100.100.100:5070>
Content-Type: application/sdp
...
```

S12 200 OK (UE-A toward AS-FE)

The UE-A sends a 200 OK to the UPDATE request (11). The S-CSC-FE forwards the 200 OK response to the AS-FE.

```
SIP/2.0 200 OK
From: <tel:+1-222-333-4444>;tag=asfe22222122
To: <sip:ue-a@ngn.net>;tag=171828
Call-ID : ueacb03a0suea00234123
Cseq: 1 UPDATE
Contact: <sip:192.100.200.51:5090>
Content-Type: application/sdp
...
```

S13 200 (OK) response to INVITE (AS-FE toward UE-A)

The AS-FE sends a 200 OK final response to the INVITE request (1). The S-CSC-FE forwards the 200 OK response to the UE-A.

```
SIP/2.0 200 OK
From: <sip:ue-a@ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=asfe22222122
Call-ID : ueacb03a0suea00234123
Contact: <sip:192.100.100.100:5070>
Cseq: 1 INVITE
...
```

S14 ACK (UE-A toward AS-FE)

The UE-A responds to the 200 OK (13) with an ACK request toward AS-FE.

```
ACK sip:192.100.100.100:5070 SIP/2.0
From: <sip:ue-a@ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=asfe22222122
Call-ID : ueacb03a0suea00234123
Cseq: 1 ACK
...
```

S15-16 ACK (AS-FE toward UE-B)

The AS-FE responds to the 200 OK (9) with an AC request toward the UE-B.

```
ACK sip:192.100.200.52:5080 SIP/2.0
From: <sip:ue-a@ngn.net>;tag=asfe171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : asfed03a0sasfe0234123
Cseq: 1 ACK
...
```

I.2 IMS-based CRBT service by gateway model with re-INVITE (Originating IMS-UE case)

Figure I.2 signalling flow shows an IMS-based CRBT service provided by the gateway model scenario with non-reliable provisional response in the IMS-UE originating case:

NOTE – This signalling flow shows the case of regular session establishment with re-INVITE.

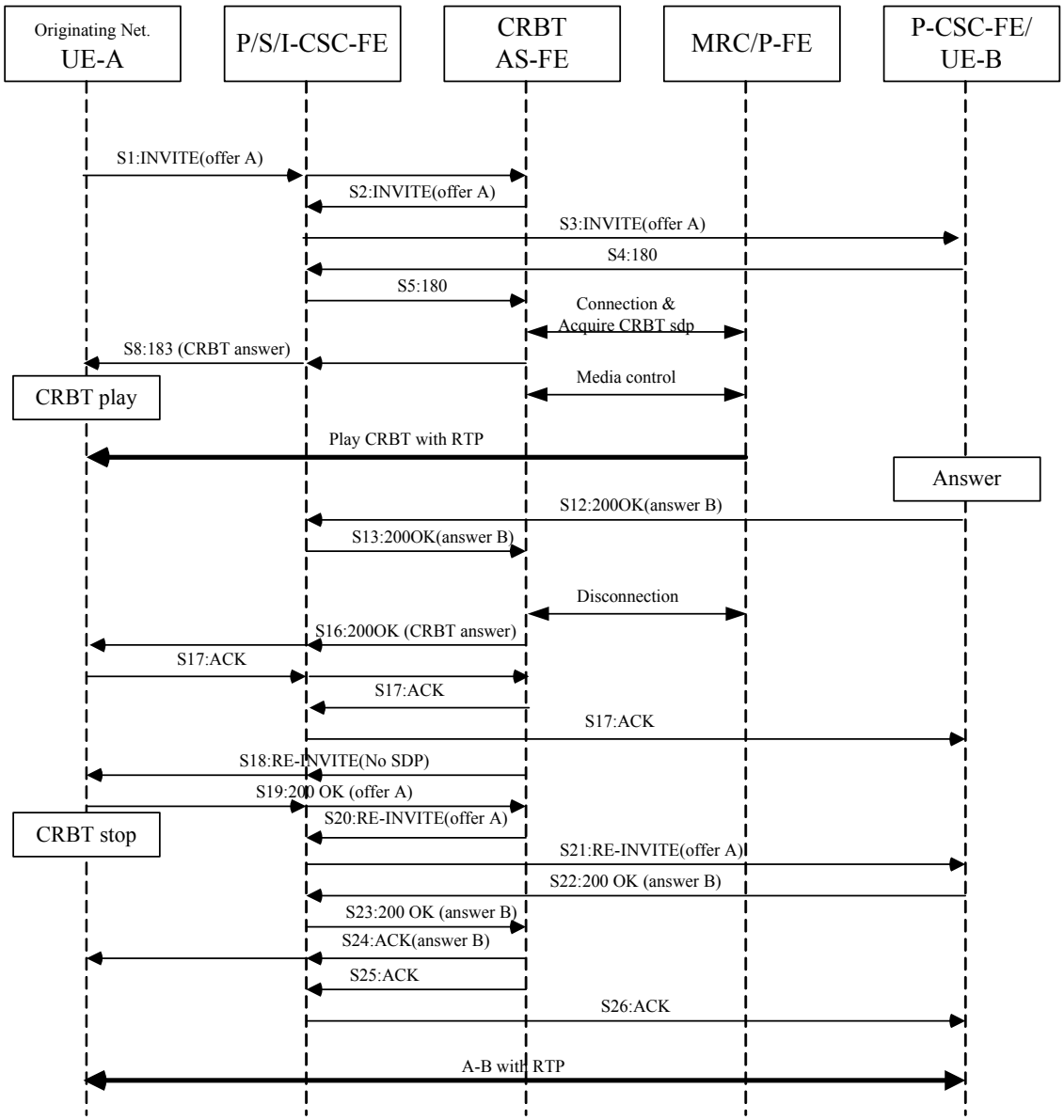


Figure I.2 – IMS-based CRBT service by gateway model with re-INVITE

The procedures of SIP signalling are as follows:

S1 INVITE (UE-A toward S-CSC-FE/AS-FE)

The INVITE request is sent from the UE-A to S-CSC-FE of the terminating side. The S-CSC-FE evaluates the initial filter criteria and forwards the INVITE to the CRBT AS-FE. The contact value includes UE-A's SIP URI that contains the IP address.

```
INVITE sip:ue-b@term_ngn.net  SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
P-Preferred-Identity: <sip:ue-a@orig_ngn.net>, <tel:+1-222-555-3333>
Privacy: none
Contact: <sip:192.100.200.51:5090>
Supported: timer
Accept: application/sdp
Session-Expires: 3600;refresher=uac
Content-Type: application/sdp
...
```

S2-3 INVITE (AS-FE/S-CSC-FE toward UE-B)

INVITE is sent toward the UE-B through network elements (AS-FE should be B2BUA server). The contact value includes AS-FE's SIP URI.

```
INVITE sip:192.100.200.52:5080 SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag=asfe171828
To: <tel:+1-222-333-4444>
Call-ID : asfed03a0sasfe0234123
CSeq: 1 INVITE
Contact: <sip:192.100.100.100:5070>
Content-Type: application/sdp
...
```

S4-5 180 (UE-B toward AS-FE)

180 (ringing) is sent toward the AS-FE through network elements. The contact value includes UE-B's SIP URI.

```
SIP/2.0 180 Ringing
From: <sip:ue-a@orig_ngn.net>;tag=asfe171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : asfed03a0sasfe0234123
CSeq: 1 INVITE
Contact: <sip:192.100.200.52:5080>
...
```

S8 183 with SDP (AS-FE toward UE-A)

The AS-FE sends an 183 provisional response with the SDP of the MRP-FE. The contact value includes AS-FE's SIP URI.

```
SIP/2.0 183 Session Progress
From: <sip:ue-a@ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=asfe22222122
Call-ID : ueacb03a0suea00234123
Contact: <sip:192.100.100.100:5070>
Content-Type: application/sdp
...
```

S12-13 200 OK (UE-B toward AS-FE)

When the called party answers, the UE-B sends a 200 OK (with SDP B) final response to the INVITE request (3). The S-CSC-FE forwards the 200 OK response to the AS-FE.

```
SIP/2.0 200 OK
From: <sip:ue-a@orig_ngn.net>;tag= asfe171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : asfed03a0sasfe0234123
CSeq: 1 INVITE
Contact: <sip:192.100.200.52:5080>
Content-Type: application/sdp
...
```

S16 200 OK (AS-FE toward UE-A)

The AS-FE sends a 200 OK without SDP for SDP offer-answer model [b-IETF RFC 3264]. The S-CSC-FE forwards the 200 OK response to the UE-A.

```
SIP/2.0 200 OK
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag= asfe22222122
Call-ID : ueacb03a0suea00234123
Contact: <sip:192.100.100.100:5070>
Cseq: 1 INVITE
...
```

S17 ACK (UE-A toward P/S-CSC-FE)

The UE-A responds to the 200 OK with an ACK request towards the UE-B.

```
ACK sip:192.100.100.100:5070 SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag= asfe22222122
Call-ID : ueacb03a0suea00234123
Cseq: 1 INVITE
...
```

S18 Re-INVITE (AS-FE toward UE-A)

The AS-FE should exchange session information with the UE-A. Therefore, the AS-FE sends the re-INVITE (without SDP) request to the UE-A. The contact value includes AS-FE's SIP URI.

```
INVITE sip:192.100.200.51:5090 SIP/2.0
From: : <tel:+1-222-333-4444>;tag= asfe22222122
To : <sip:ue-a@orig_ngn.net>;tag=171828
Call-ID : ueacb03a0suea00234123
Contact: <sip:192.100.100.100:5070>
Cseq: 1 INVITE
...
```

S19 200 OK (UE-A toward AS-FE)

The UE-A responds to the re-INVITE (without SDP) request with 200 OK (with SDP A). The contact value includes UE-A's SIP URI.

```
SIP/2.0 200 OK
From: : <tel:+1-222-333-4444>; tag= asfe22222122
To : <sip:ue-a@orig_ngn.net>;tag=171828
Call-ID : ueacb03a0suea00234123
Contact: <sip:192.100.200.51:5090>
CSeq: 1 INVITE
Content-Type: application/sdp
...
```

S20-21 Re-INVITE (AS-FE toward UE-B)

The AS-FE generates the re-INVITE request with the SDP of the UE-A. Then, the AS-FE sends the re-INVITE request to the UE-B. The contact value includes AS-FE's SIP URI.

```
INVITE sip:192.100.200.52:5080 SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag= asfe171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : asfed03a0sasfe0234123
Contact: <sip:192.100.100.100:5070>
CSeq: 2 INVITE
Content-Type: application/sdp
...
```

S22-23 200 OK (UE-B toward AS-FE)

The UE-B responds to the re-INVITE request with 200 OK (with SDP B). The contact value includes UE-B's SIP URI.

```
SIP/2.0 200 OK
From: <sip:ue-a@orig_ngn.net>;tag= asfe171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : asfed03a0sasfe0234123
Contact: < sip:192.100.200.52:5080>
Cseq: 2 INVITE
Content-Type: application/SDP
...
```

S24 ACK (AS-FE toward UE-A)

The AS-FE responds to the 200 OK (19) response with an ACK (with SDP B) request to the UE-A.

```
ACK sip:192.100.200.51:5090 SIP/2.0
From: : <tel:+1-222-333-4444>; tag= asfe22222122
To : <sip:ue-a@orig_ngn.net>;tag=171828
Call-ID : ueacb03a0suea00234123
Cseq: 1 INVITE
Content-Type: application/sdp
...
```

S25-26 ACK (AS-FE toward UE-B)

The AS-FE responds to the 200 OK (23) response with an ACK request to the UE-B.

```
ACK sip:192.100.200.52:5080 SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag= asfe171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : asfed03a0sasfe0234123
Cseq: 2 INVITE
...
```

I.3 CRBT service by application server model

Figure I.3 signalling flow shows a CRBT service provided by the application server model scenario:

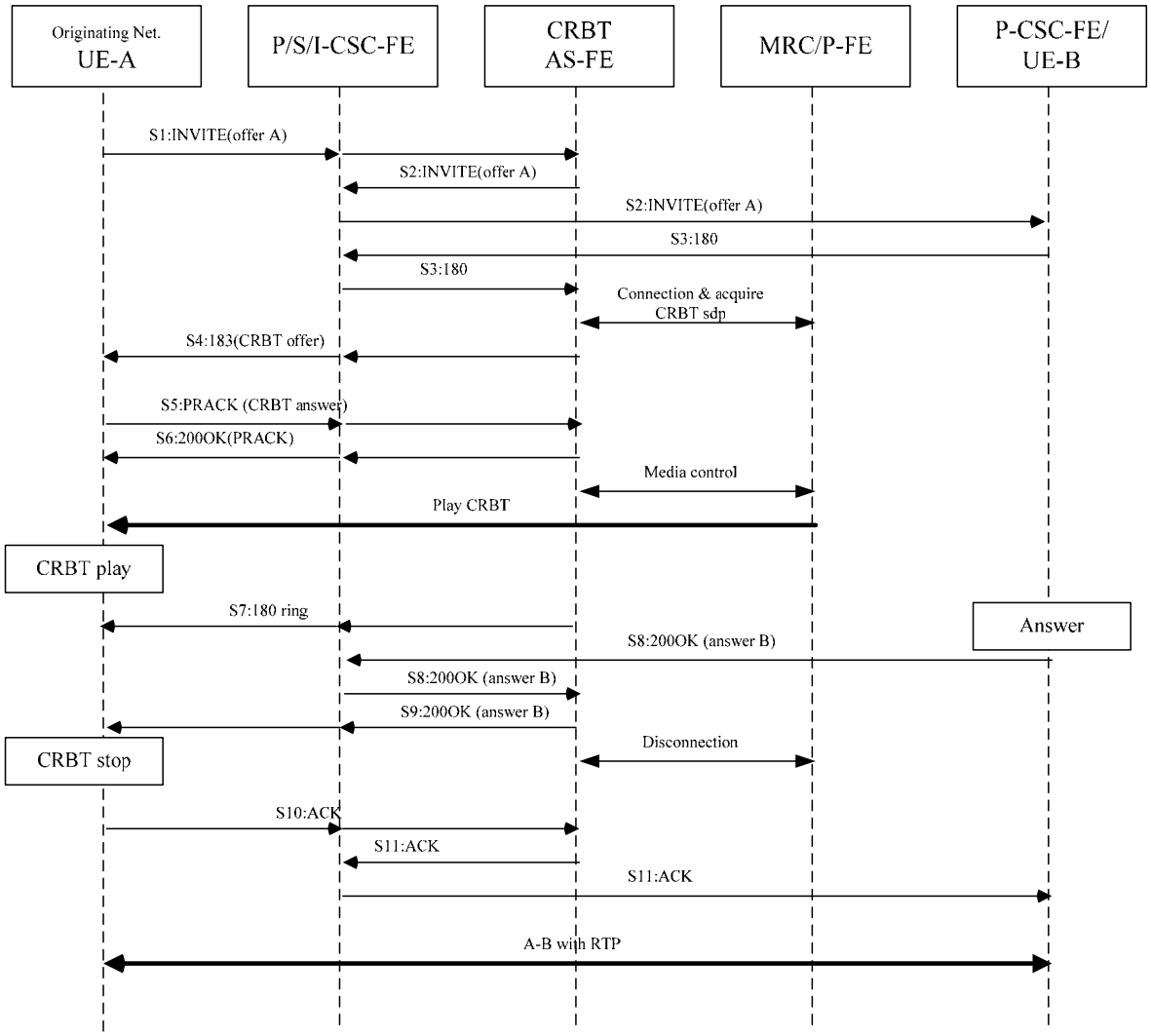


Figure I.3 – CRBT service provided by application server model

The procedures of SIP signalling are as follows:

S1 INVITE (UE-A toward S-CSC-FE)

The INVITE request is sent from the UE-A to S-CSC-FE of the terminating side. The S-CSC-FE evaluates the initial filter criteria and forwards the INVITE to the CRBT AS-FE. The contact value includes UE-A's SIP URI that contains the IP address.

```
INVITE sip:ue-b@term_ngn.net SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
P-Preferred-Identity: <sip:ue-a@orig_ngn.net>, <tel:+1-222-555-3333>
Privacy: none
Contact: <sip:192.100.200.51:5090>
Supported: timer, early-session, 100rel
Accept: application/sdp
Session-Expires: 3600;refresher=uac
Content-Type: application/sdp
...
```

S2 INVITE (AS-FE toward UE-B)

INVITE is sent toward the UE-B through network elements (AS-FE may be the Proxy server). The contact value includes UE-A's SIP URI.

```
INVITE sip:192.100.200.52:5080 SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Supported: timer, early-session, 100rel
Contact: <sip:192.100.200.51:5090>
Content-Type: application/sdp
...
```

S3 180 (UE-B toward AS-FE)

180 (ringing) is sent toward the AS-FE through network elements. The contact value includes UE-B's SIP URI.

```
SIP/2.0 180 Ringing
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Contact: <sip:192.100.200.52:5080>
...
```

S4 183 (AS-FE toward UE-A)

The AS-FE inserts an early-session SDP within an 183 (Session Progress) provisional response. 183 is sent toward the UE-A through network elements.

```
SIP/2.0 183 Session Progress
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Require: early-session, 100rel
Contact: <sip:192.100.200.52:5080>
Content-Type: application/sdp
Content-Disposition: early-session
...
```

S5 PRACK (UE-A toward AS-FE)

PRACK is sent toward the AS-FE through network elements.

```
PRACK sip:ue-b@term_ngn.net SIP/2.0
From: <sip:crbt@as-fe.term_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>; tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 PRACK
Contact: <sip: 192.100.200.51:5090>
Content-Type: application/sdp
Content-Disposition: early-session
...
```

S6 200 (AS-FE toward UE-A)

200 (OK) is sent toward the UE-A through network elements. The contact value includes UE-B's SIP URI.

```
SIP/2.0 200 OK
From: <sip:crbt@as-fe.term_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>; tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 PRACK
Contact: <sip: 192.100.200.52:5080>
Content-Length: 0
```

S7 180 (AS-FE toward UE-A)

180 (ringing) is sent toward the UE-A through network elements. The contact value includes UE-B's SIP URI.

```
SIP/2.0 180 Ringing
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Contact: <sip:192.100.200.52:5080>
...
```

S8-9 200 (UE-B toward UE-A)

200 (OK) is sent toward the UE-A through network elements. The contact value includes UE-B's SIP URI.

```
SIP/2.0 200 OK
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Contact: <sip:192.100.200.52:5080>
Content-Type: application/sdp
Content-Disposition: session
...
```

S10-11 ACK (UE-A toward UE-B)

UE-A responds to the 200 OK with an ACK request to the UE-B.

```
ACK sip:192.100.200.52:5080 SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Content-Length: 0
```

I.4 CRBT service by HTTP model (Originating IMS-UE case)

Figure I.4 signalling flow shows a CRBT service provided by the HTTP model scenario:

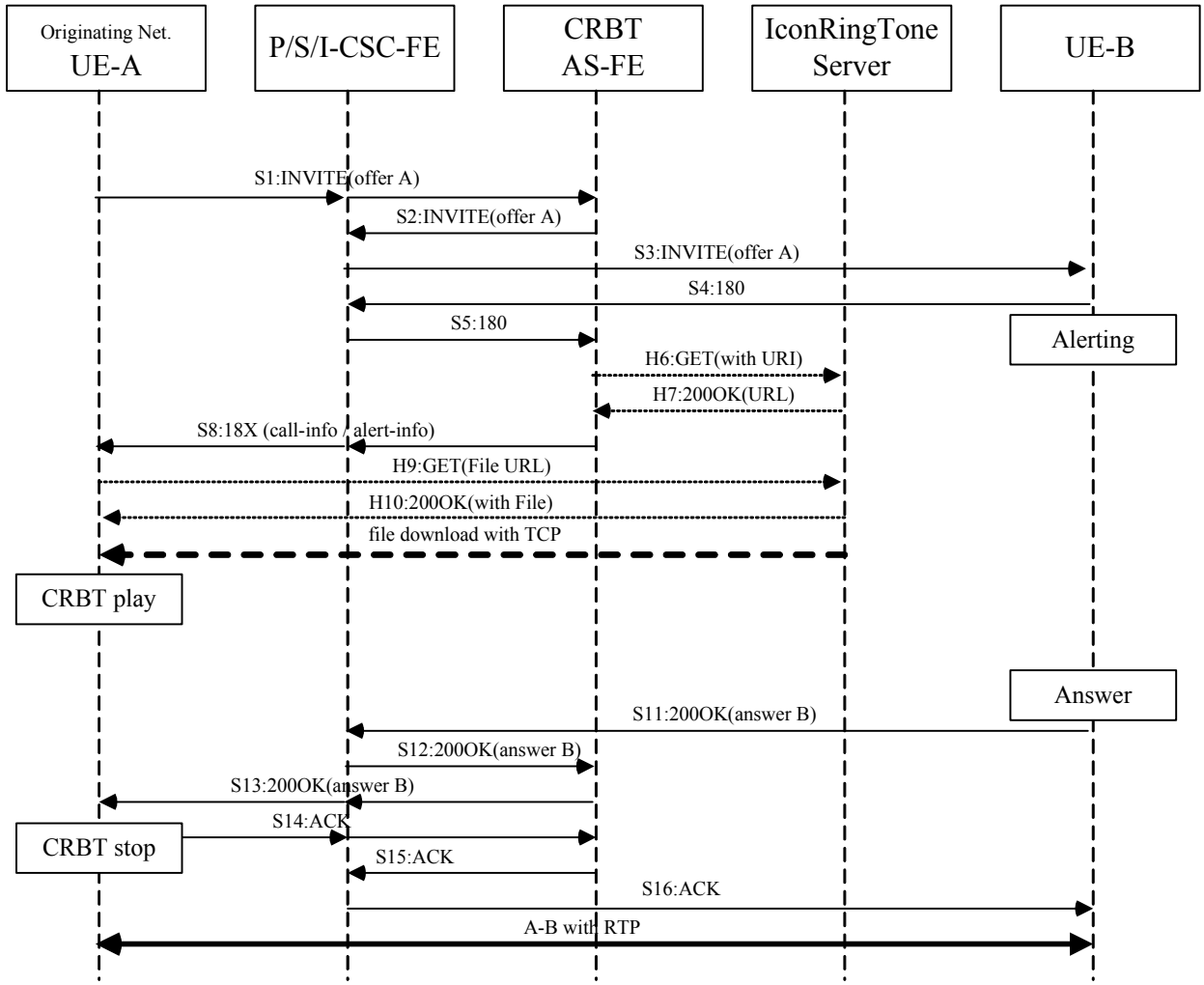


Figure I.4 – CRBT service by HTTP model (Originating IMS-UE case)

The procedures of SIP signalling are as follows:

S1 INVITE (UE-A toward S-CSC-FE)

The INVITE request is sent from the UE-A to the S-CSC-FE of the terminating side. The S-CSC-FE evaluates the initial filter criteria and forwards the INVITE to the CRBT AS-FE. The contact value includes UE-A's SIP URI that contains the IP address.

```
INVITE sip:ue-b@term_ngn.net SIP/2.0
Route: <sip:crbt@as-fe.term_ngn.net; lr>, <sip:1.23.233143.23@s-csc-fe.term_ngn.net;lr>
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
P-Preferred-Identity: <sip:ue-a@orig_ngn.net>, <tel:+1-222-555-3333>
Privacy: none
Contact: <sip:192.100.200.51:5090>
Supported: timer, early-session
Allow: INVITE, ACK, OPTIONS, BYE, CANCEL, MESSAGE, INFO, REFER, NOTIFY, SUBSCRIBE
Accept: application/sdp
Session-Expires: 3600;refresher=uac
Content-Type: application/sdp
...
```

S2-3 INVITE (AS-FE toward UE-B)

INVITE is sent toward the UE-B through network elements (AS-FE may be the Proxy server). The contact value includes UE-A's SIP URI.

```
INVITE sip:192.100.200.52:5080 SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Contact: <sip:192.100.200.51:5090>
Content-Type: application/sdp
...
```

S4-5 180 (UE to AS-FE)

180 (ringing) is sent toward the AS-FE through network elements. The contact value includes UE-B's SIP URI.

```
SIP/2.0 180 Ringing
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Contact: <sip:192.100.200.52:5080>
...
```

H6-7 HTTP or SOAP (between CRBT AS-FE and CRBT HTTP server).

The AS-FE gets the URL of the CRBT from the HTTP server using any TCP-based protocol.

S8 18x (AS-FE toward UE-A)

The AS-FE inserts Call-Info header or Alert-Info header within the provisional response bearing a code 18x. 18x is sent toward the UE-A through network elements.

```
SIP/2.0 18x
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Call-Info : <http://crbt_as.ngn.com/mmcid/bimg20001000000001731.gif>; purpose=icon,
            <http://crbt_as.ngn.com/mmcid/user_info_0251148012.xml>; purpose=info
Alert-Info : http://crbt_as.ngn.com/mmcid/bimg20001000000001731.wav
...
```

H9-10. HTTP GET and File downloading (between CRBT AS-FE and CRBT HTTP server).

The UE-B requests HTTP GET Message with URL. Then, the UE-B downloads and plays the CRBT media file.

S11-13 200 OK (UE-B toward UE-A)

When the called party answers, the UE-B sends a 200 OK (with SDP B) final response to the INVITE request. Then, the UE-B stops the CRBT media. The contact value includes UE-B's SIP URI.

```
SIP/2.0 200 OK
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Contact: <sip:192.100.200.52:5080>
Content-Type: application/sdp
...
```

S14-16 ACK (UE-A toward UE-B)

The UE-A responds to the 200 OK with an ACK request to the UE-B.

```
ACK sip:192.100.200.52:5080 SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
...
```

I.5 CRBT service by gateway model (Originating PSTN/ISDN interworking case)

Figure I.5 signalling flow shows a CRBT service provided by the gateway model scenario in interworking with the originating PSTN/ISDN case:

NOTE 1 – Messages from M1 ~ M8 are shown as examples and are based on [ITU-T H.248.1].

NOTE 2 – This signalling flow shows the case of regular session establishment with re-INVITE.

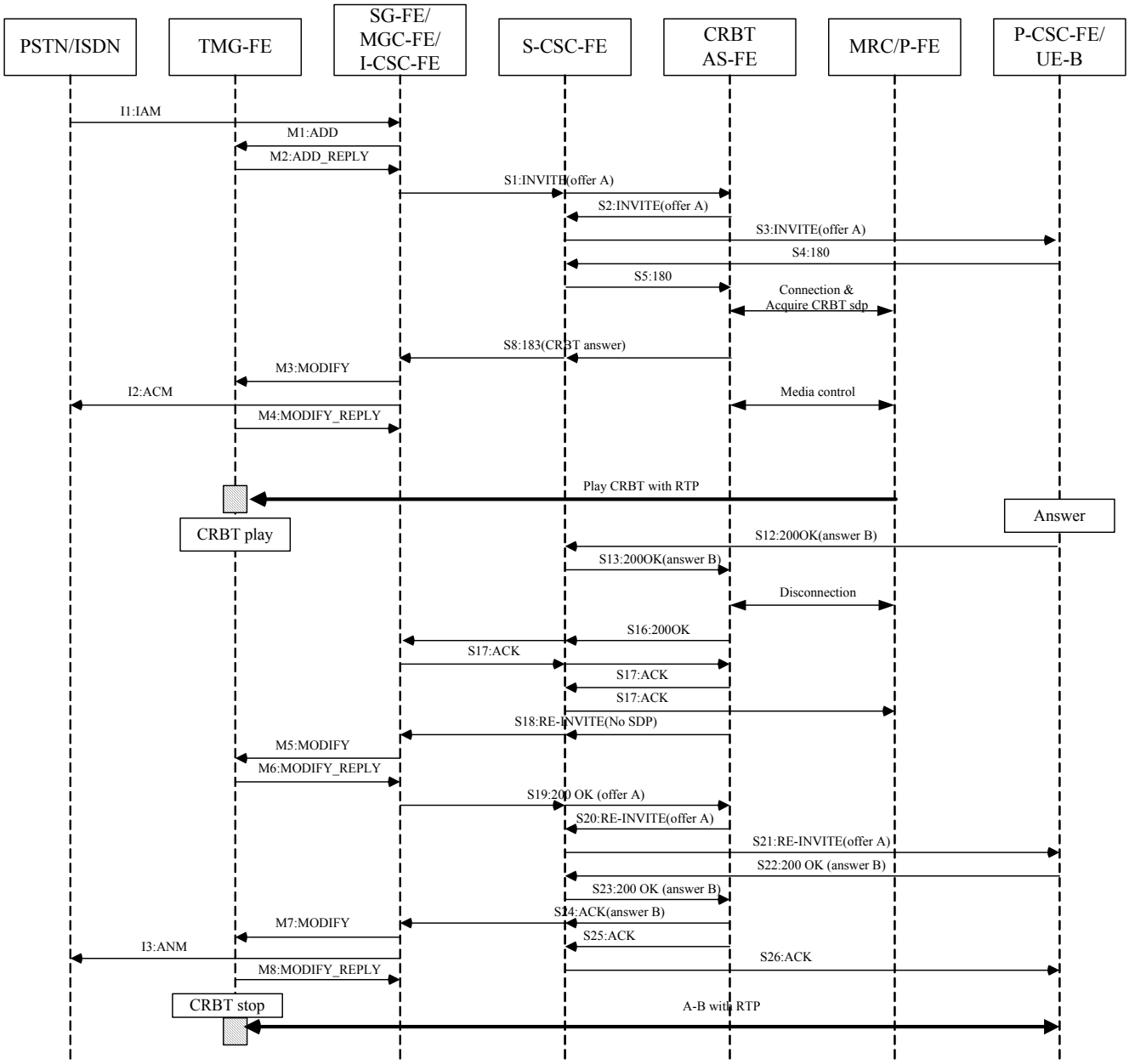


Figure I.5 – CRBT service by gateway model (Originating PSTN/ISDN interworking case)

The procedure of the SIP signalling is the same as the IMS-based gateway model, and the significant messages of ISUP and H.248 signalling are shown as follows:

I1 IAM (PSTN/ISDN to SG-FE/MGC-FE)

Called Party Number = 02223334444

Calling Party's Category

Nature of Connection Indicators

Forward Call Indicators

Transmission Medium Requirement

Calling Party Number = 2225553333

...

M1 ADD_REQUEST (MGC-FE to TMG-FE)

H.248/1[192.100.101.230]:2944..Transaction=79764497{..Context=$${..Add=C2/21/1{..Media{..Stream=1{..LocalControl{..Mode=ReceiveOnly..}..}..},..Events=79764497{..ctyp/dtone..}..},..Add=${..Media{..Stream=1{..LocalControl{..Mode=SendReceive..},..Local{..v=0..c=IN IP4 $..m=audio $ RTP/AVP 8 0 4 18..}..}..}..}..}..}

M2 ADD_REPLY (TMG-FE to MGC-FE)

H.248/1 [192.100.101.240]:2944.Reply = 79764497 {.Context = 9578 {.Add = C2/21/1,.Add = EPH1004 {..Media {..Local{..v=0..o=gw-vendor 1 208926965 1208926965 IN IP4 192.100.101.240..s=H.248 Call..c=IN IP4 192.100.101.240..t=0 0..m=audio 22008 RTP/AVP 8..a=ptime:10.. }.}.}.}.}.

M3 MODIFY_REQUEST (MGC-FE to TMG-FE)

H.248/1[192.100.101.230]:2944..Transaction=81861649{..Context=9578{..Modify=C2/21/1{..Media{..Stream=1{..LocalControl{..Mode=SendReceive..}..}..},..Events=81861649{..ctyp/dtone..},..Signals{....}..},..Modify=EPH1004{..Media{..Stream=1{..LocalControl{..Mode=SendReceive..},..Remote{..v=0..o =as-vendor 1079426802 1 IN IP4 192.100.100.200..s=media-server..c=IN IP4 192.100.100.200..t=0 0..m=audio 49300 RTP/AVP 8....}..}..}..}..}..}

I2 ACM (SG-FE/MGC-FE to PSTN/ISDN)

Called Party Number = 02223334444

Calling Party's Category

Nature of Connection Indicators

Forward Call Indicators

Transmission Medium Requirement

Calling Party Number = 2225553333

M4 MODIFY_REPLY (TMG-FE to MGC-FE)

H.248/1[192.100.101.240]:2944..Reply=81861649{..Context=9578{..Modify=C2/21/1,.Modify = EPH1004..}..}.

M5 MODIFY_REQUEST (MGC-FE to TMG-FE)

H.248/1[192.100.101.230]:2944..Transaction=163642882{..Context=9578{..Modify=C0/26{..Media{..Stream=1{..LocalControl{..Mode=SendReceive..}..}..},..Events=163642882{..al/on,al/fl,ctyp/dtone..},..Signals{....}..},..Modify=
EPH1004{..Media{..Stream=1{..LocalControl{..Mode=SendReceive..},..Local{..v=0..c=IN IP4 $..m=audio $ RTP/AVP 8 0 4 18..}..}..}..}..}..}

M6 MODIFY _REPLY (TMG-FE to MGC-FE)

H.248/1 [192.100.101.240]:2944.Reply=163642882{..Context=9578 ...Modify=C0/26, ..Modify= EPH1004{....Media{.. Local{..v=0..o=gw-vendor 1 208926965 1208926965 IN IP4 192.100.101.240..s=H.248 Call..c=IN IP4 192.100.101.240..t=0 0..m=audio 22008 RTP/AVP 8..a=ptime:10.. }..}..}..}

M7 MODIFY_REQUEST (MGC-FE to TMG-FE)

H.248/1[192.100.101.230]:2944..Transaction=83958801{..Context=9578{..Modify=C2/21/1{..Media{..Stream=1{..LocalControl{..Mode=SendReceive..}..}..},..Events=83958801{..ctyp/dtone..},..Signals{....}..},..Modify=EPH1004{..Media{..Stream=1{..LocalControl{..Mode=SendReceive..},..Remote{..v=0..o=ip-phone-vendor 1208972718 0 IN IP4 192.100.200.52..s=ip-

phone-vendor IP_CALL.. c=IN IP4 192.100.200.52..t=0 0..m=audio 10262 RTP/AVP 8..b=AS:96..a=rtpmap:8 PCMA/8000..a=sendrecv....}..}..}..}..}..}

I3 ANM (SG-FE/MGC-FE to PSTN/ISDN)

Called Party Number = 02223334444

Calling Party's Category

Nature of Connection Indicators

Forward Call Indicators

Transmission Medium Requirement

Calling Party Number = 2225553333

M8 MODIFY _REPLY (TMG-FE to MGC-FE)

H.248/1[192.100.101.240]:2944.Reply=83958801{..Context=9578{..Modify=C2/21/1,.Modify = EPH1004..}..}

I.6 CRBT service by gateway model (Originating POTS-UE case)

Figure I.6 signalling flow shows a IMS-based CRBT service by the gateway model scenario in the POTS-UE originating case:

NOTE 1 – This signalling flow shows the case of regular session establishment with re-INVITE.

NOTE 2 – Messages from M1 ~ M14 are shown as examples and are based on [ITU-T H.248.1].

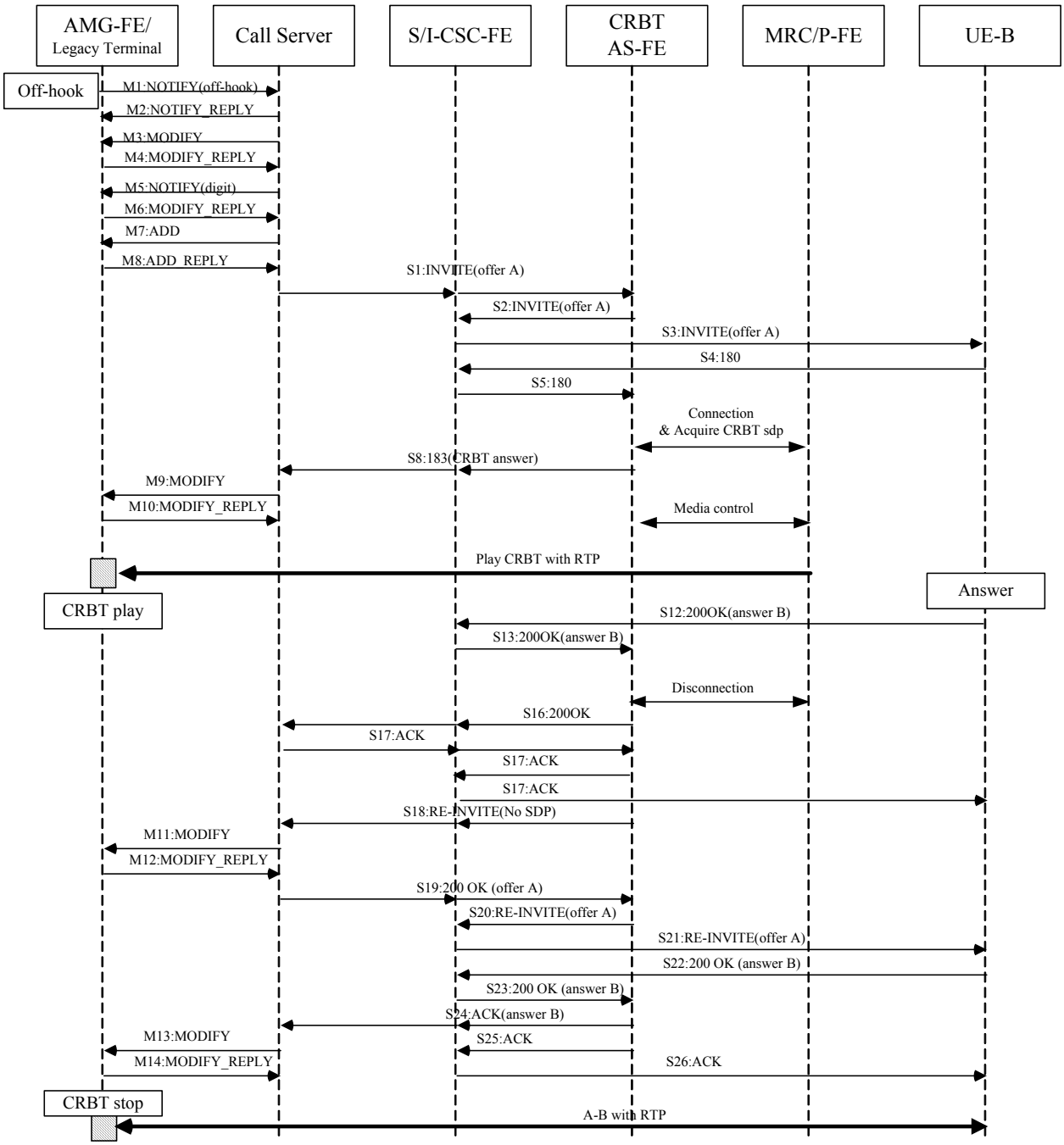


Figure I.6 – IMS-based CRBT service by gateway model (Originating POTS-UE case)

The procedure of the SIP signalling is the same as the IMS-based gateway model.

The procedure of H.248 signalling is as follows and significant messages are shown in detail:

M1-M6 Collecting dialled digits based on provided digit maps

M7 ADD (AGC-FE to AMG-FE)

H.248/1[192.100.101.210]:2944..Transaction=146865666{..Context=${..Add=C0/26{..Media {..Stream=1{..LocalControl{..Mode=ReceiveOnly..}..}..},..Events=146865666{..al/on,al/fl,dd/ce { DigitMap = dialplan0}..},..EventBuffer{..dd/ce..},..DigitMap=dialplan0{..T:4,S:0,L:4,([0-9EF])..}..},..Add=$ {..Media {..Stream=1 {..LocalControl{..Mode=SendReceive..},..Local{..v=0..c=IN IP4 $..m=audio $ RTP/AVP 8 0 4 18..}..}..}..}..}..}

M8 ADD_REPLY (AMG-FE to AGC-FE)

H.248/1 [192.100.101.220]:2944.Reply=146865666{..Context=134217744 {...Add=C0/26, ...Add=Eph100015{....Media{.. Local{..v=0..o=gw-vendor 1 208926965 1208926965 IN IP4 192.100.101.220..s=H.248 Call..c=IN IP4 192.100.101.220..t=0 0..m=audio 22008 RTP/AVP 8..a=ptime:10.. }...}...}..}.}.

M9 MODIFY (AGC-FE to AMG-FE)

H.248/1[192.100.101.210]:2944..Transaction=161545730{..Context=134217744{..Modify=C0/26{..Media{..Stream=1{..LocalControl{..Mode=SendReceive..}..}..},..Events=161545730{..al/on,al/fl..},..Signals{....}..},..Modify= Eph100015{..Media{..Stream=1{..LocalControl{..Mode=SendReceive..},.. Remote{..v=0..o=as-vendor 1079426802 1 IN IP4 192.100.100.200..s=media-server..c=IN IP4 192.100.100.200..t=0 0..m=audio 49302 RTP/AVP 8....}..}..}..}..}..}

M10 MODIFY _REPLY (AMG-FE to AGC-FE)

H.248/1[192.100.101.220]:2944.Reply=161545730{..Context=134217744{.Modify= C0/26,.Modify = Eph100015..}..}

M11 MODIFY (AGC-FE to AMG-FE)

H.248/1[192.100.101.210]:2944..Transaction=163642882{..Context=134217744{..Modify=C0/26{..Media{..Stream=1{..LocalControl{..Mode=SendReceive..}..}..},..Events=163642882{..al/on,al/fl..},..Signals{....}..},..Modify= Eph100015{..Media{..Stream=1{..LocalControl{..Mode=SendReceive..},..Local{..v=0..c=IN IP4 $..m=audio $ RTP/AVP 8 0 4 18..}..}..}..}..}..}

M12 MODIFY _REPLY (AMG-FE to AGC-FE)

H.248/1 [192.100.101.220]:2944.Reply=163642882{..Context=134217744 ...Modify=C0/26, ..Modify= Eph100015{...Media{.. Local{..v=0..o=gw-vendor 1 208926965 1208926965 IN IP4 192.100.101.220..s=H.248 Call..c=IN IP4 192.100.101.220..t=0 0..m=audio 22008 RTP/AVP 8..a=ptime:10.. }..}..}..}

M13 MODIFY (AGC-FE to AMG-FE)

H.248/1[192.100.101.210]:2944..Transaction=161545730{..Context=134217744{..Modify=C0/26{..Media{..Stream=1{..LocalControl{..Mode=SendReceive..}..}..},..Events=161545730{..al/on,al/fl..},..Signals{....}..},..Modify=Eph100015{..Media{..Stream=1{..LocalControl{..Mode=SendReceive..},.. Remote{.v=0..o=samsung 1234 0 IN IP4 192.100.200.52..s=-..c=IN IP4 192.100.200.52..t=0 0.. m=audio 4150 RTP/AVP 8 0 4 4 18..a=ptime:10..}..}..}..}..}..}

M14 MODIFY _REPLY (AMG-FE to AGC-FE)

H.248/1[192.100.101.220]:2944..Reply=161545730{..Context=134217744{.Modify= C0/26,.Modify = Eph100015..}..}

I.7 Call server-based CRBT service by gateway model (Originating IMS-UE case)

Figure I.7 signalling flow shows a call server-based CRBT service by the gateway model scenario in the IMS-UE Originating case:

NOTE – This signalling flow shows the case of regular session establishment with re-INVITE.

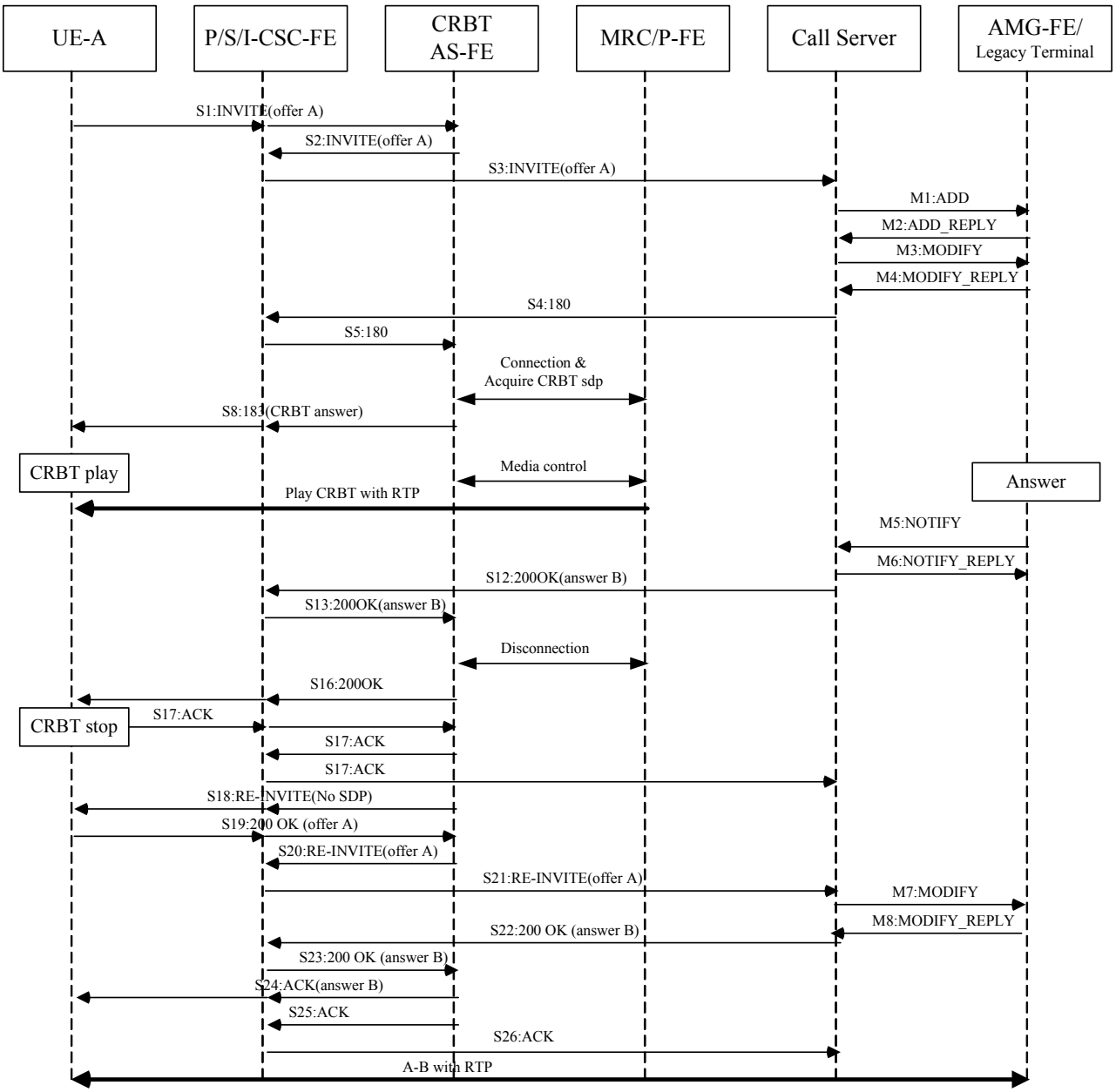


Figure I.7 – Call server-based CRBT service by gateway model (Originating IMS-UE case)

The procedure of the SIP signalling is the same as the IMS-based gateway model, and the procedure of H.248 signalling is as follows:

M1 ADD_REQUEST (AGC-FE to AMG-FE)

H.248/1[192.100.101.210]:2944..Transaction=79721793{..Context=${..Add=C0/17{..Media{..Stream=1{..LocalControl{..Mode=ReceiveOnly..}..}..},..Events=79721793{..al/of..}..},..Add=${..Media{..Stream=1{..LocalControl{.. Mode=ReceiveOnly..},..Local{..v=0..c=IN IP4 $..m=audio $ RTP/AVP 8 0 4 18..},..Remote{..v=0..o=LGE 1234 0 IN IP4 192.100.200.51..s=-..c=IN IP4 192.100.200.51..t=0 0..m=audio 23650 RTP/AVP 8 0 4 18..b=TIAS:64000..b=AS:96..a=fmtp: 4 annexa=no..a=fmtp:18 annexb=no....}..}..}..}..}..}

M2 ADD_REPLY (AMG-FE to AGC-FE)

H.248/1[192.100.101.220]:2944
..Reply=79721793{Context=240{Add=C0/17,Add=Eph179{Media{Stream=1{

Local{..v=0..o=LGE 1234 0 IN IP4 192.100.101.220 ..s=-..c=IN IP4 192.100.101.220 ..t=0 0..m=audio 23838 RTP/AVP 8..b=TIAS:64000.. b=AS:96..a=ptime:10..}}}}}}

M3 MODIFY_REQUEST (AGC-FE to AMG-FE)

H.248/1[192.100.101.210]:2944..Transaction=81818945{..Context=240{..Modify=C0/17{..Media{..Stream=1{..LocalControl{..Mode=ReceiveOnly..}..}..},..Events=81818945{..al/of..},..Signals{..al/ri..}..}..}..}

M4 MODIFY _REPLY (AMG-FE to AGC-FE)

H.248/1[192.100.101.220]:2944 ..Reply=81818945{Context=240{Modify=C0/17}}

M5 NOTIFY_REQUEST (AMG-FE to AGC-FE)

H.248/1[192.100.101.220]:2944
..Transaction=13662{Context=240{Notify=C0/17{ObservedEvents=81818945{al/of}}}}

M6 NOTIFY_REPLY (AGC-FE to AMG-FE)

H.248/1[192.100.101.210]:2944..Reply=13662{..Context=240{..Notify =C0/17..}..}

M7 MODIFY_REQUEST (AGC-FE to AMG-FE)

H.248/1[192.100.101.210]:2944..Transaction=163642882{..Context=240{..Modify= C0/17{..Media{..Stream=1{..LocalControl{..Mode=SendReceive..}..}..},..Events=163642882 {..al/on,al/fl..},..Signals{....}..},..Modify=Eph179{..Media{..Stream=1{..LocalControl{..Mode =SendReceive..},.. Local{..v=0..c=IN IP4 $ ..m=audio $ RTP/AVP 8 0 4 18..},.. Remote{..v=0..o=LGE 1234 0 IN IP4 192.100.200.51..s =-..c=IN IP4 192.100.200.51..t=0 0..m=audio 23650 RTP/AVP 8 0 4 18..b=TIAS:64000..b=AS:96..a=fmtp:4 annexa=no..a=fmtp:18 annexb=no....}..}..}..}..}..}

M8 MODIFY _REPLY (AMG-FE to AGC-FE)

H.248/1[192.100.101.220]:2944 ..Reply=163642882{..Context=240 {...Modify= C0/17, ...Modify=Eph179{....Media{. Local{..v=0..o=LGE 1234 0 IN IP4 192.100.101.220..s=-..c=IN IP4 192.100.101.220..t=0 0..m=audio 23838 RTP/AVP 8..b=TIAS:64000..b=AS:96..a=ptime:10..}....}...}..}.}.

I.8 Originating CRBT service interacts with terminating CRBT service by AS model

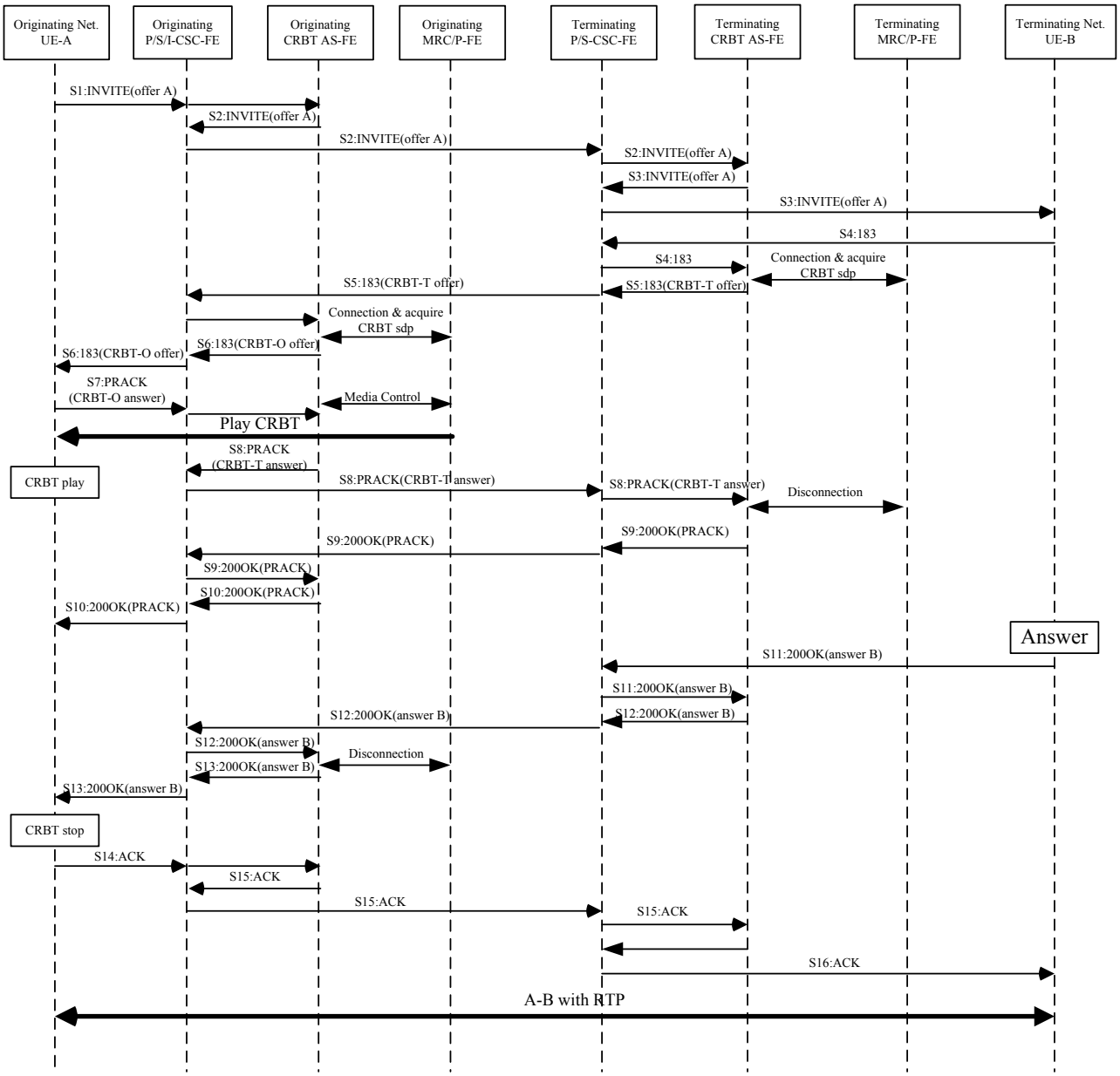


Figure I.8 – Originating CRBT service interacts with terminating CRBT service by AS model

The procedures of SIP signalling are as follows:

S1-3 INVITE (UE-A toward Originating S-CSC-FE)

The INVITE request is sent from the UE-A to the S-CSC-FE of the originating side. The originating S-CSC-FE evaluates the initial filter criteria and forwards the INVITE to the originating CRBT AS-FE, the originating CRBT AS-FE checks the CRBT priority setting, then the originating CRBT AS-FE forwards the INVITE to the terminating S-CSC-FE, and the terminating S-CSC-FE evaluates the initial filter criteria and forwards the INVITE to the terminating CRBT AS-FE. Finally, the INVITE is forwarded to the UE-B. The contact value includes UE-A's SIP URI that contains the IP address.

```
INVITE sip:ue-b@term_ngn.net SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
P-Preferred-Identity: <sip:ue-a@orig_ngn.net>, <tel:+1-222-555-3333>
Privacy: none
Contact: <sip:192.100.200.51:5090>
Supported: timer, early-session, 100rel
Accept: application/sdp
Session-Expires: 3600;refresher=uac
Content-Type: application/sdp
...
```

S4 183 (UE-B toward terminating CRBT AS-FE)

The UE-B responds with "183 Session Process" towards the terminating CRBT AS-FE.

```
SIP/2.0 183 Session Process
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Contact: <sip:192.100.200.52:5080>
...
```

S5 183 (terminating CRBT AS-FE toward originating CRBT AS-FE)

The terminating CRBT AS-FE adds CRBT-T offer SDP to an 183 response and forwards the 183 response to the originating CRBT AS-FE.

```
SIP/2.0 183 Session Process
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Require :100rel
Contact: <sip:192.100.200.52:5080>
Content-Type: application/sdp
Content-Disposition: early-session
Content-Length: (...)

v=0
o=- 2987933616 2987933616 IN IP4 eee:fff:aaa:bbb
s=-
c=IN IP4 ccc:aaa:bbb:acc
t=0 0
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes
m=video 3400 RTP/AVP 98
b=AS:75
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:98 H263
```

S6 183 (originating CRBT AS-FE toward UE-A)

Due to the fact that the originating CRBT has priority according to the priority setting, the originating CRBT AS-FE adds CRBT-O offer SDP, instead of CRBT-T offer, in a 183 response and forwards the 183 to the UE-A. The originating CRBT AS-FE plays the originating CRBT to UE-A.

```
SIP/2.0 183 Session Process
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Require :100rel
Contact: <sip:192.100.200.52:5080>
Content-Type: application/sdp
Content-Disposition: early-session
Content-Length: (...)

v=0
o=- 2987933616 2987933616 IN IP4 aaa:bbb:eee:fff
s=-
c=IN IP4 ccc:aaa:bbb:acc
t=0 0
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes
m=video 3400 RTP/AVP 98
b=AS:75
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:98 H263
```

S7 PRACK (UE-A toward originating CRBT AS-FE)

The UE-A completes the originating CRBT media negotiation and sends PRACK with CRBT-O answer SDP to the originating CRBT AS-FE.

```
PRACK sip:ue-b@term_ngn.net SIP/2.0
From: <sip:crbt@as-fe.term_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>; tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 PRACK
Contact: <sip: 192.100.200.51:5090>
Content-Type: application/sdp
Content-Disposition: early-session
Content-Length: (...)

v=0
o=- 2987933616 2987933616 IN IP4 aaa:bbb:ccc:ddd
s=-
c=IN IP4 aaa:bbb:ccc:ddd
t=0 0
m=audio 3466 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote sendrecv
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes...
m=video 3400 RTP/AVP 98
b=AS:75
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:98 H263
```

S8 PRACK (originating CRBT AS-FE toward terminating CRBT AS-FE)

The originating CRBT AS-FE sends PRACK to the terminating CRBT AS-FE, which contains CRBT-T answer SDP setting port to 0 to refuse the terminating CRBT media negotiation.

```
PRACK sip:ue-b@term_ngn.net SIP/2.0
From: <sip:crbt@as-fe.term_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>; tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 PRACK
Contact: <sip: 192.100.200.51:5090>
Content-Type: application/sdp
Content-Disposition: early-session
v=0
o=- 2987933616 2987933616 IN IP4 aaa:bbb:ccc:ddd
s=-
c=IN IP4 aaa:bbb:ccc:ddd
t=0 0
m=audio 0 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote sendrecv
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes...
m=video 0 RTP/AVP 98
b=AS:75
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=inactive
a=rtpmap:98 H263
...
```

S9 200 (terminating CRBT AS-FE toward originating CRBT AS-FE)

200 (OK) is sent toward the originating CRBT AS-FE through network elements. The contact value includes UE-B's SIP URI.

```
SIP/2.0 200 OK
From: <sip:crbt@as-fe.term_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>; tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 PRACK
Contact: <sip: 192.100.200.52:5080>
Content-Length: 0
```

S10 200 (originating CRBT AS-FE toward UE-A)

200 (OK) is sent toward the UE-A through network elements. The contact value includes the UE-B's SIP URI.

```
SIP/2.0 200 OK
From: <sip:crbt@as-fe.term_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>; tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 PRACK
Contact: <sip: 192.100.200.52:5080>
Content-Length: 0
```

S11-13 200 (UE-B toward UE-A)

200 (OK) is sent toward the UE-A through network elements. The contact value includes UE-B's SIP URI.

```
SIP/2.0 200 OK
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Contact: <sip:192.100.200.52:5080>
Content-Type: application/sdp
Content-Disposition: session
...
```

S14-16 ACK (UE-A toward UE-B)

The UE-A responds to the 200 OK with an ACK request to the UE-B.

```
ACK sip:192.100.200.52:5080 SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Content-Length: 0
```

I.9 Providing circuit switched network CRBT to the originating UE in IMS domain

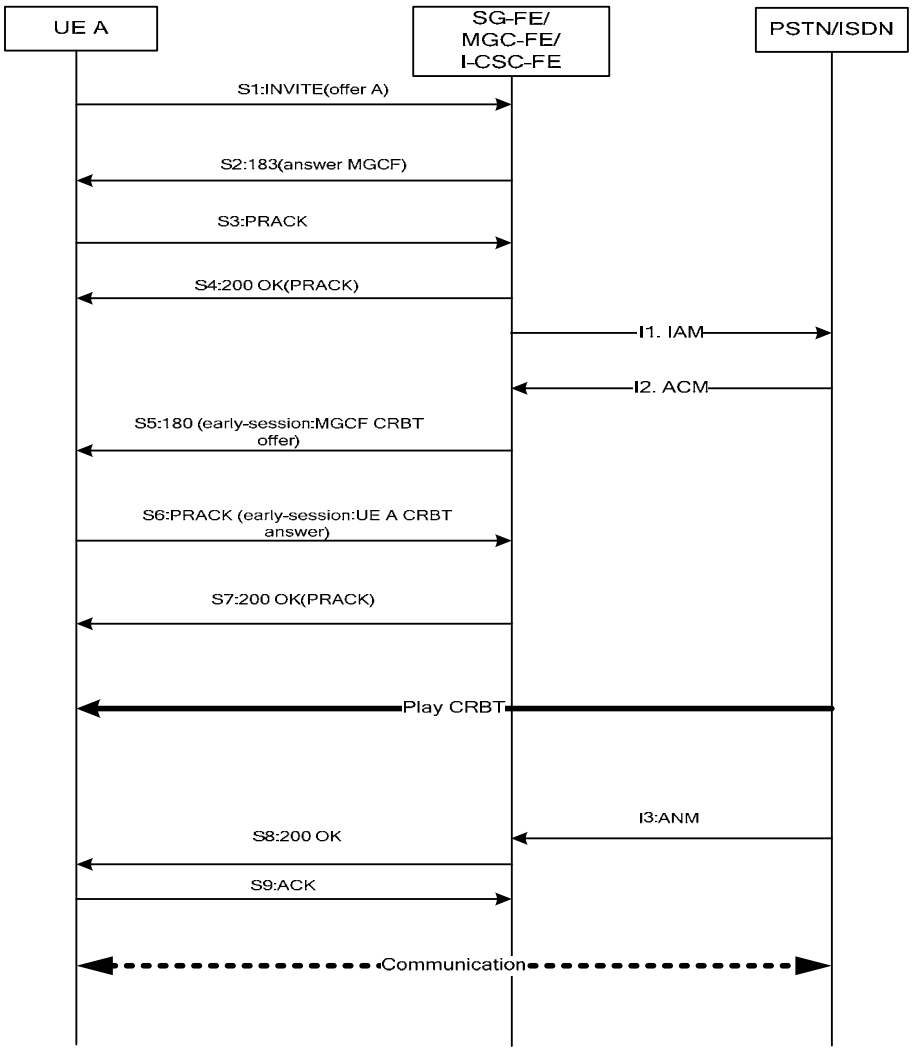


Figure I.9 – Providing circuit switched network CRBT to the originating UE in IMS domain

The procedures of SIP signalling and the significant messages of ISUP and H.248 signalling are shown as follows:

S1 INVITE (UE-A toward MGC-FE)

The UE-A sends "INVITE" to the MGC-FE. The INVITE includes the UE-A's SDP offer and early session supported indication.

```
INVITE tel:+1-222-333-4444 SIP/2.0
From: <sip:ue-a@orig_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
P-Preferred-Identity: <sip:ue-a@orig_ngn.net>, <tel:+1-222-555-3333>
Privacy: none
Contact: <sip:192.100.200.51:5090>
Supported: timer, early-session, 100rel
Accept: application/sdp
Session-Expires: 3600;refresher=uac
Content-Type: application/sdp
...
```

S2 183 (MGC-FE toward UE-A)

The MGC-FE sends "183 session progress" to the UE-A with a MGC-FE SDP answer.

```
SIP/2.0 183 session progress
From: < sip:ue-a@orig_ngn.net >;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Require :100 rel
Contact: <sip:192.100.200.52:5080>
Content-Type: application/sdp
...
```

S3 PRACK (UE-A toward MGC-FE)

The UE-A sends PRACK to the MGC-FE.

```
PRACK sip:ue-b@term_ngn.net SIP/2.0
From: <sip:crbt@as-fe.term_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>; tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 PRACK
Contact: <sip: 192.100.200.51:5090>
```

S4 200 (MGC-FE toward UE-A)

200 (OK) is sent toward the UE-A through network elements.

```
SIP/2.0 200 OK
From: <sip:crbt@as-fe.term_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>; tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 PRACK
Contact: <sip: 192.100.200.52:5080>
Content-Length: 0
```

I1 IAM (MGC-FE to PSTN/ISDN)

Called Party Number = 02223334444

Calling Party's Category

Nature of Connection Indicators

Forward Call Indicators

Transmission Medium Requirement

Calling Party Number = 2225553333

...

I2 ACM (PSTN/ISDN to MGC-FE) with in-band information indicator

Called Party Number = 02223334444

Calling Party's Category

Nature of Connection Indicators

Forward Call Indicators

In-band information Indicator = 1

Transmission Medium Requirement

Calling Party Number = 2225553333

S5 180 (MGC-FE toward UE-A)

The MGC-FE checks that the UE-A supports early session, and sends "180 Ringing" to the UE-A, which includes the MGC-FE CRBT early session offer.

```
SIP/2.0 180 Ringing
From: < sip:ue-a@orig_ngn.net >;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Require :100 rel
Contact: <sip:192.100.200.52:5080>
Content-Type: application/sdp
Content-Disposition: early-session
Content-Length: (...)

v=0
o=- 2987933616 2987933616 IN IP4 :aaa:bbb:eee:fff
s=-
c=IN IP4 ccc:aaa:bbb:acc
t=0 0
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes
m=video 3400 RTP/AVP 98
b=AS:75
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:98 H263
```

S6 PRACK (UE-A toward MGC-FE)

The UE-A sends PRACK to the MGC-FE with a UE-A CRBT early session answer.

```
PRACK sip:ue-b@term_ngn.net SIP/2.0
From: <sip:crbt@as-fe.term_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>; tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 PRACK
Contact: <sip: 192.100.200.51:5090>
Content-Type: application/sdp
Content-Disposition: early-session
Content-Length: (...)

v=0
o=- 2987933616 2987933616 IN IP4 aaa:bbb:ccc:ddd
s=-
c=IN IP4 aaa:bbb:ccc:ddd
t=0 0
m=audio 3466 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote sendrecv
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes...
m=video 3400 RTP/AVP 98
b=AS:75
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:98 H263
```

S7 200 (MGC-FE toward UE-A)

200 (OK) is sent toward the UE-A through network elements.

```
SIP/2.0 200 OK
From: <sip:crbt@as-fe.term_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>; tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 PRACK
Contact: <sip: 192.100.200.52:5080>
Content-Length: 0
```

I3 ANM (PSTN/ISDN to MGC-FE)

Called Party Number = 02223334444

Calling Party's Category

Nature of Connection Indicators

Forward Call Indicators

Transmission Medium Requirement

Calling Party Number = 2225553333

S8 200 (MGC-FE toward UE-A)

200 (OK) is sent toward the UE-A through network elements.

```
SIP/2.0 200 OK
From: < sip:ue-a@orig_ngn.net >;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Contact: <sip:192.100.200.52:5080>
...
```

S9 ACK (UE-A toward MGC-FE)

200 (OK) is sent toward the MGC-FE through network elements.

```
ACK sip:192.100.200.52:5080 SIP/2.0
From: < sip:ue-a@orig_ngn.net >;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Content-Length: 0
```

I.10 Providing IMS CRBT to the originating UE in circuit switched network domain

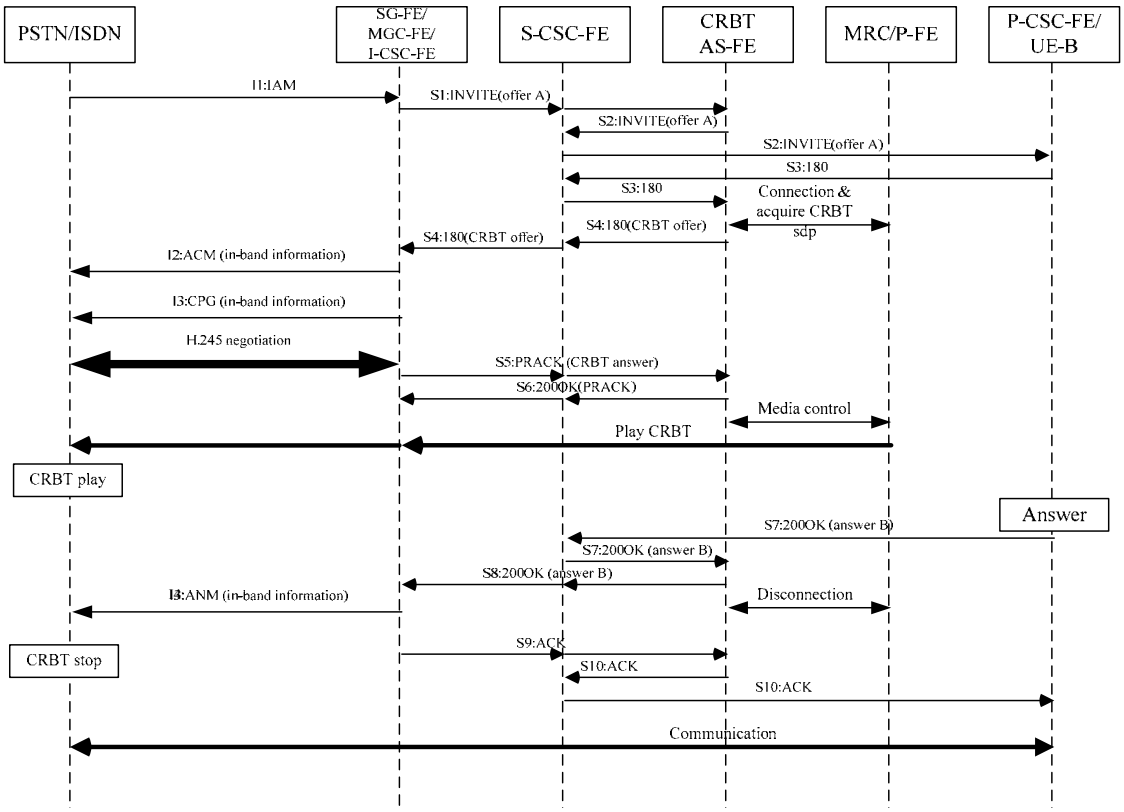


Figure I.10 – Providing IMS CRBT to the originating UE in circuit switched network domain

The procedure of the SIP signalling and the significant messages of ISUP and H.248 signalling are shown as follows:

I1 IAM (PSTN/ISDN to SG-FE/MGC-FE)

Called Party Number = 02223334444

Calling Party's Category

Nature of Connection Indicators

Forward Call Indicators

Transmission Medium Requirement

Calling Party Number = 2225553333

...

S1-2 INVITE (MGC-FE toward UE-B)

The INVITE request is sent from the MGC-FE to S-CSC-FE of the terminating side, the terminating S-CSC-FE evaluates the initial filter criteria and forwards the INVITE to the terminating CRBT AS-FE. Finally, the INVITE is forwarded to the UE-B. The contact value includes MGC-FE's IP address.

```
INVITE sip:ue-b@term_ngn.net SIP/2.0
From: < tel:+1-222-555-3333>;tag=171828
To: <tel:+1-222-333-4444>
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
P-Preferred-Identity: <sip:ue-a@orig_ngn.net>
Privacy: none
Contact: <sip:192.100.200.51:5090>
Supported: timer, early-session, 100rel
Accept: application/sdp
Session-Expires: 3600;refresher=uac
Content-Type: application/sdp
...
```

S3 180 (UE-B toward terminating CRBT AS-FE)

The UE-B responds with "180 Ringing" towards the terminating CRBT AS-FE.

```
SIP/2.0 180 Ringing
From: < tel:+1-222-555-3333>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Contact: <sip:192.100.200.52:5080>
...
```

S4 180 (terminating CRBT AS-FE toward MGC-FE)

The terminating CRBT AS-FE adds CRBT-T offer SDP to the 180 response and forwards the 180 response to the MGC-FE.

```
SIP/2.0 180 Ringing
From: < tel:+1-222-555-3333>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Require :100rel
Contact: <sip:192.100.200.52:5080>
Content-Type: application/sdp
Content-Disposition: early-session
Content-Length: (...)

v=0
o=- 2987933616 2987933616 IN IP4 eee:fff:aaa:bbb
s=-
c=IN IP4 ccc:aaa:bbb:acc
t=0 0
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes
m=video 3400 RTP/AVP 98
b=AS:75
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:98 H263
```

I2 The MGC-FE checks if the CRBT contains video according to the message from CRBT AS-FE; if yes, then, it asks the MSC to connect the calling party using an ACM message with in-band information indicator and holds an H.245 negotiation with the calling party.

ACM (SG-FE/MGC-FE to PSTN/ISDN)

Called Party Number = 02223334444

Calling Party's Category

Nature of Connection Indicators

Forward Call Indicators

In-band information Indicator = 1

Transmission Medium Requirement

Calling Party Number = 2225553333

I3 If the ACM has already been sent, the MGC-FE sends CPG.

CPG (SG-FE/MGC-FE to PSTN/ISDN)

Called Party Number = 02223334444

Calling Party's Category

Nature of Connection Indicators

Forward Call Indicators

In-band information Indicator = 1

Transmission Medium Requirement

Calling Party Number = 2225553333

S5 PRACK (MGC-FE toward CRBT AS-FE)

The MGC-FE completes the terminating CRBT media negotiation and sends PRACK with CRBT answer SDP to the originating CRBT AS-FE.

```
PRACK sip:ue-b@term_ngn.net SIP/2.0
From: <sip:crbt@as-fe.term_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>; tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 PRACK
Contact: <sip: 192.100.200.51:5090>
Content-Type: application/sdp
Content-Disposition: early-session
Content-Length: (...)

v=0
o=- 2987933616 2987933616 IN IP4 aaa:bbb:ccc:ddd
s=-
c=IN IP4 aaa:bbb:ccc:ddd
t=0 0
m=audio 3466 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote sendrecv
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes...
m=video 3400 RTP/AVP 98
b=AS:75
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:98 H263
```

S6 200 (CRBT AS-FE toward MGC-FE)

200 (OK) is sent toward the MGC-FE through network elements. The contact value includes UE-B's SIP URI.

```
SIP/2.0 200 OK
From: <sip:crbt@as-fe.term_ngn.net>;tag=171828
To: <tel:+1-222-333-4444>; tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 PRACK
Contact: <sip: 192.100.200.52:5080>
Content-Length: 0
```

S7-8 200 (UE-B toward MGC-FE)

200 (OK) is sent toward the MGC-FE through network elements. The contact value includes UE-B's SIP URI.

```
SIP/2.0 200 OK
From: < tel:+1-222-555-3333>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Contact: <sip:192.100.200.52:5080>
Content-Type: application/sdp
Content-Disposition: session
...
```

I4 ANM (SG-FE/MGC-FE to PSTN/ISDN)

Called Party Number = 02223334444

Calling Party's Category

Nature of Connection Indicators

Forward Call Indicators

Transmission Medium Requirement

Calling Party Number = 2225553333

S9-10 ACK (MGC-FE toward UE-B)

The UE-A responds to the 200 OK with an ACK request to the UE-B.

```
ACK sip:192.100.200.52:5080 SIP/2.0
From: < tel:+1-222-555-3333>;tag=171828
To: <tel:+1-222-333-4444>;tag=22222122
Call-ID : ueacb03a0suea00234123
CSeq: 1 INVITE
Content-Length: 0
```

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