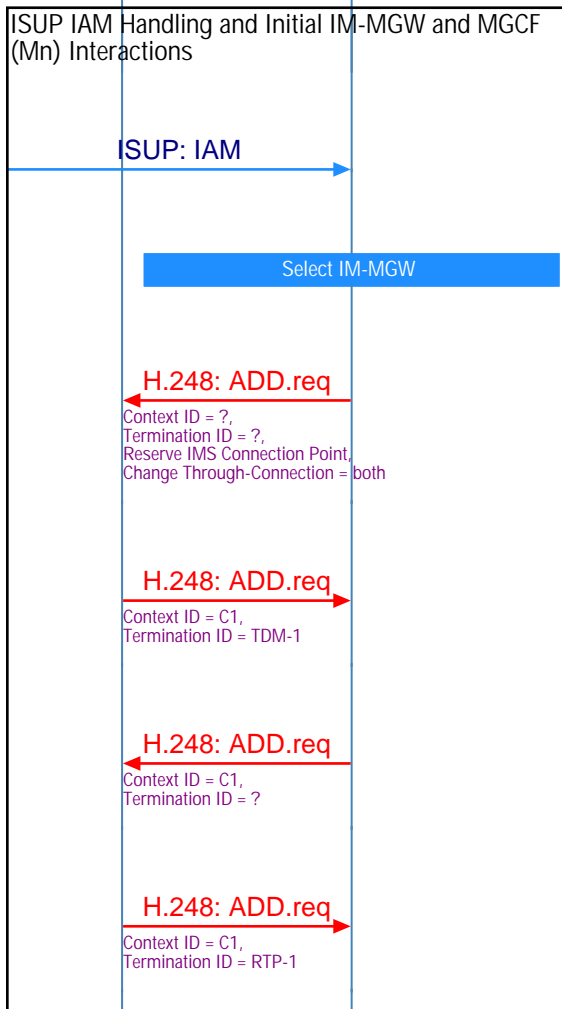| PSTN Subscriber to IMS Subscriber Call (PSTN-ISUP Originated Call; IM-MGW Megaco/H.248 Signaling; PSTN Initiated Release)						
PSTN		IMS Core Network			Called UE	Copyright © 2013 EventHelix.com
PSTN Equipment	PSTN Interface	CSCF Servers			Called User Equipment	
IM-MGW	MGCF	I-CSCF	Term S-CSCF	Term P-CSCF	Called	10-Jan-13 16:37 (Page 1)

This call flow covers the handling of a CS network originated call with ISUP. In the diagram the MGCF requests seizure of the IM CN subsystem side termination and CS network side bearer termination. When the MGCF receives an answer indication, it requests the IM-MGW to both-way through-connect the terminations.

This sequence diagram was generated with EventStudio System Designer (http://www.EventHelix.com/EventStudio).

ISUP IAM Handling and Initial IM-MGW and MGCF (Mn) Interactions

ISUP: IAM

The CS Network establishes a bearer path to the IM-MGW, and signals to the MGCF with a IAM message, giving the trunk identity, destination information and optionally the continuity indication. The message is routed to MGCF via the Signaling Gateway (SGW).
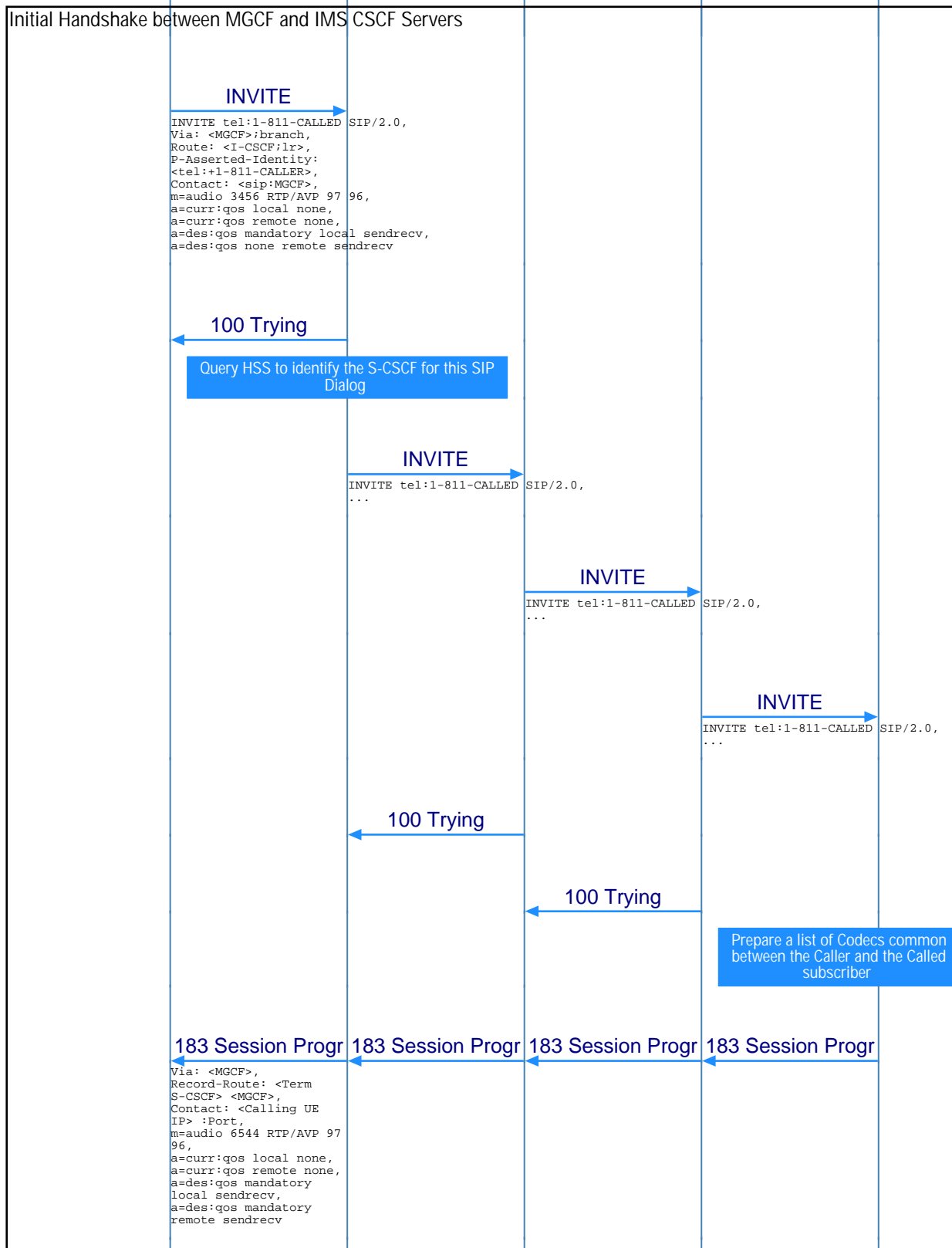
Select IM-MGW

The MGCF selects the IM-MGW based on the received circuit identity in the IAM.

H.248: ADD.req
Context ID = ?,
Termination ID = ?,
Reserve IMS Connection Point,
Change Through-Connection = both

Request addition of a new context and termination. The MGCF uses the Reserve IMS Connection Point procedure. Within this procedure, the MGCF indicates the local codecs and requests a local IP address and UDP port from the IM-MGW. The local IP address and UDP port are used by the IM-MGW to receive user plane data from the IM CN subsystem.

H.248: ADD.req
Context ID = C1,
Termination ID = TDM-1

The IM-CN responds back with Context "C1" and a TDM side termination "TDM-1".

H.248: ADD.req
Context ID = C1,
Termination ID = ?

Request addition of an RTP termination to the "C1" context. Change IMS Through Connection = backward.

H.248: ADD.req
Context ID = C1,
Termination ID = RTP-1

The IM-MGW adds the "RTP-1" termination to the "C1" context. At this point "TDM-1" is a circuit switched termination and "RTP-1" is a RTP based IP termination for communicating with the terminating IMS subscriber.

Initial Handshake between MGCF and IMS CSCF Servers

INVITE
```
INVITE tel:1-811-CALLED SIP/2.0,
Via: <MGCF>;branch,
Route: <I-CSCF;lr>,
P-Asserted-Identity:
<tel:+1-811-CALLER>,
Contact: <sip:MGCF>,
m=audio 3456 RTP/AVP 97 96,
a=curr:qos local none,
a=curr:qos remote none,
a=des:qos mandatory local sendrecv,
a=des:qos none remote sendrecv
```

The MGCF initiates an INVITE request, containing an initial SDP, as per the proper S-CSCF to S-CSCF procedure. The INVITE is first sent to the I-CSCF to identify the S-CSCF serving the called user.

100 Trying

The I-CSCF acknowledges the INVITE that was received from P-CSCF.

Query HSS to identify the S-CSCF for this SIP Dialog

Query the HSS to obtain the S-CSCF for the user.

INVITE
```
INVITE tel:1-811-CALLED SIP/2.0,
...
```

INVITE
```
INVITE tel:1-811-CALLED SIP/2.0,
...
```

The public URI in the SIP INVITE is replaced with the called subscriber's registered IP address and port number. The message is routed to the P-CSCF IP address that was recorded at the time of registration. The Via and Record-Route headers are updated.

INVITE
```
INVITE tel:1-811-CALLED SIP/2.0,
...
```
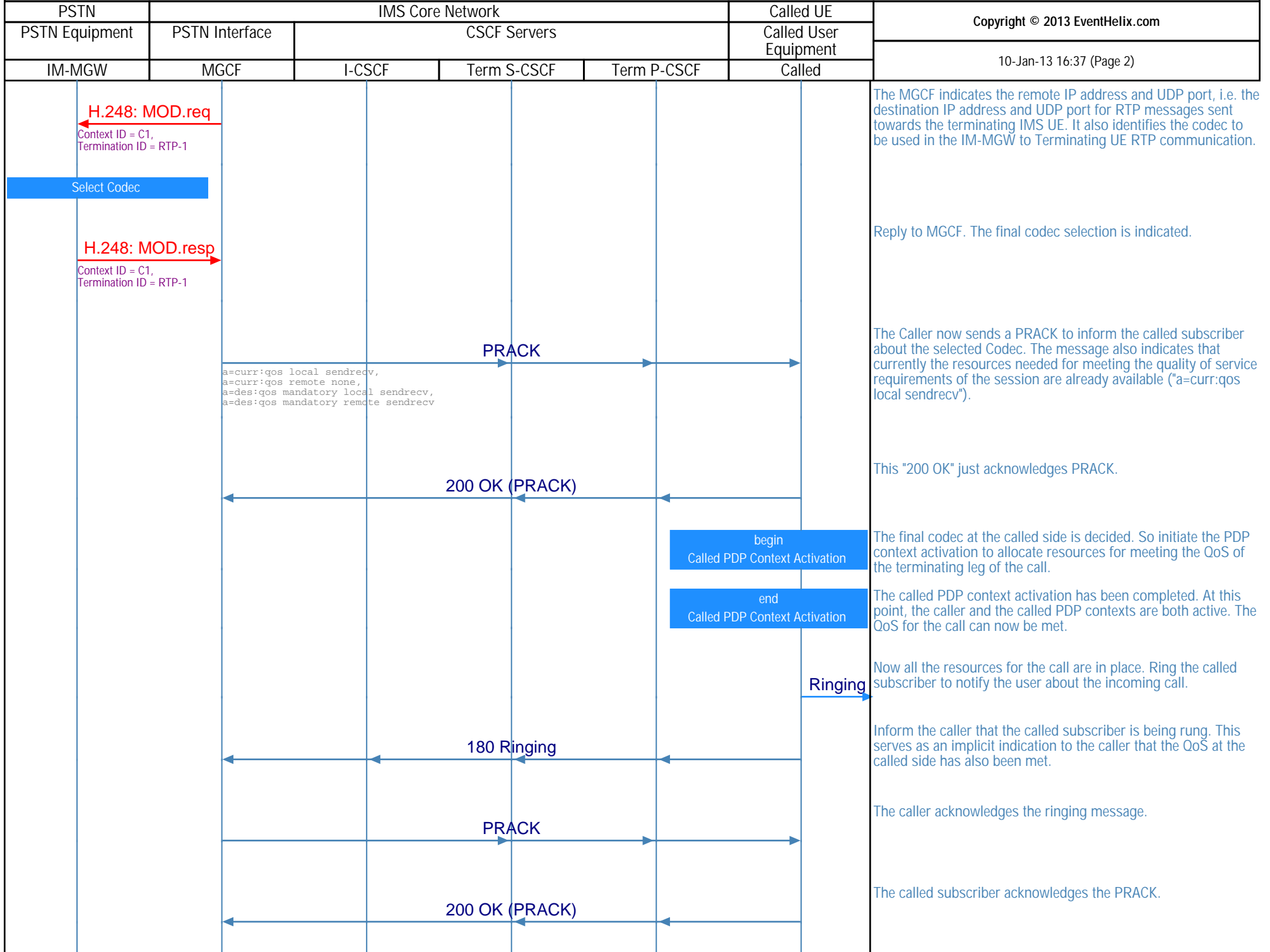
The P-CSCF updates the Via and Route-Record headers and forwards the request to the Called UE. Note that the secure port is included in the Via address specification.

100 Trying

100 Trying

Prepare a list of Codecs common between the Caller and the Called subscriber

The Caller examines the SDP list of available codec. It prunes the list by excluding codecs that are not supported by the called subscriber. This list will be included in the 183 message sent to the caller.

183 Session Progr   183 Session Progr   183 Session Progr   183 Session Progr
```
Via: <MGCF>,
Record-Route: <Term
S-CSCF> <MGCF>,
Contact: <Calling UE
IP> :Port,
m=audio 6544 RTP/AVP 97
96,
a=curr:qos local none,
a=curr:qos remote none,
a=des:qos mandatory
local sendrecv,
a=des:qos mandatory
remote sendrecv
```
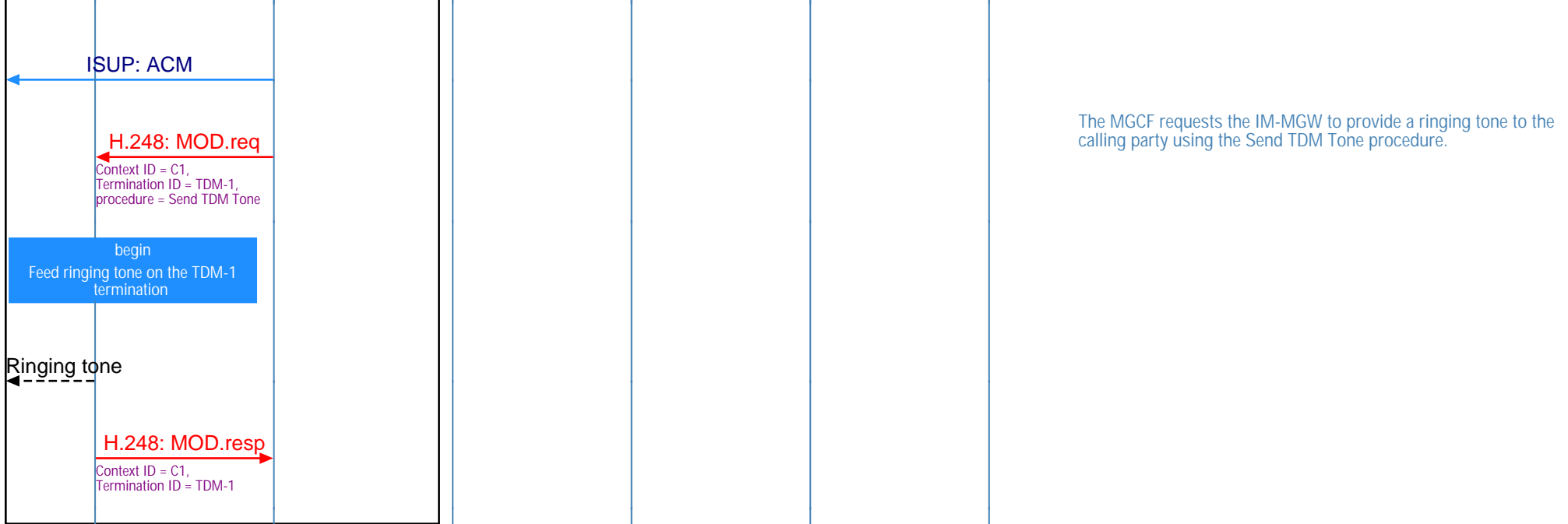
The UE replies indicating that the session is in progress. The contact address is set its own IP address. The Via and the Record-Route headers are copied from the received INVITE.

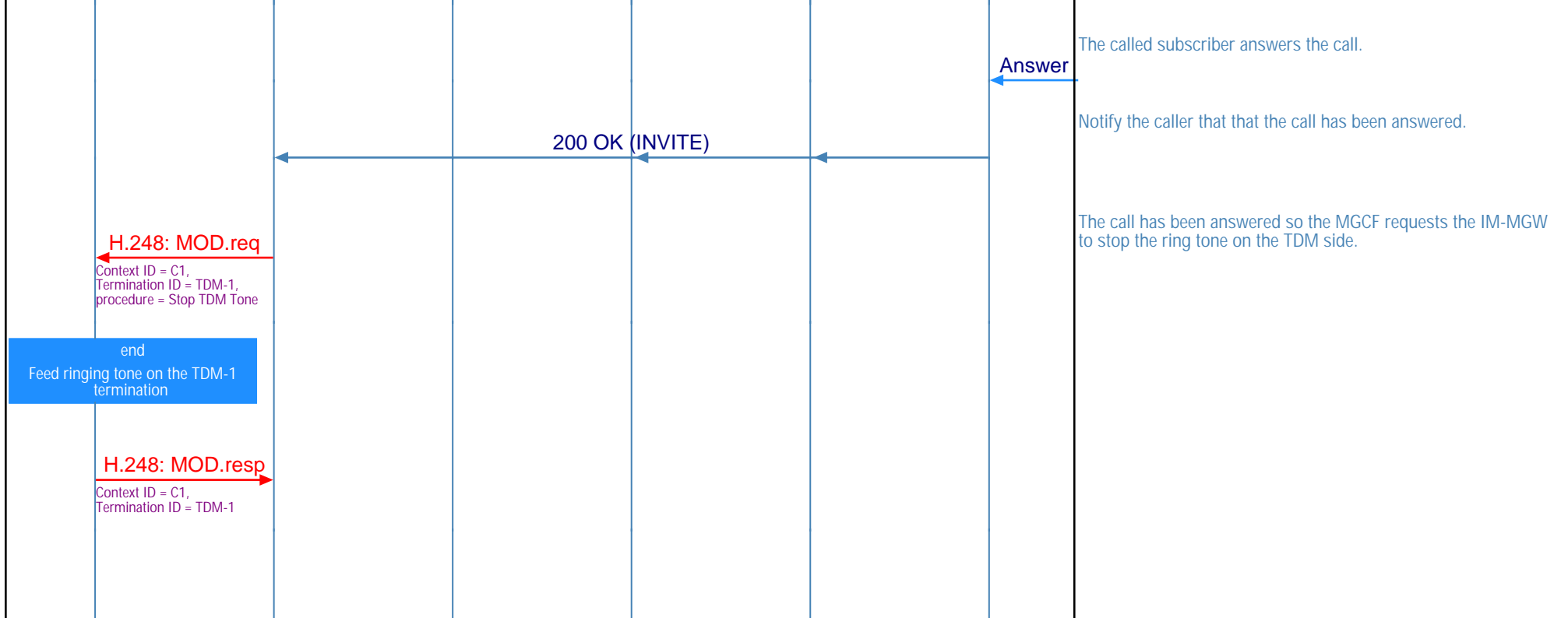## Mn Interactions for Codec selection

PSTN		IMS Core Network			Called UE	Copyright © 2013 EventHelix.com
PSTN Equipment	PSTN Interface	CSCF Servers			Called User Equipment	10-Jan-13 16:37 (Page 2)
IM-MGW	MGCF	I-CSCF	Term S-CSCF	Term P-CSCF	Called	

H.248: MOD.req
Context ID = C1,
Termination ID = RTP-1

The MGCF indicates the remote IP address and UDP port, i.e. the destination IP address and UDP port for RTP messages sent towards the terminating IMS UE. It also identifies the codec to be used in the IM-MGW to Terminating UE RTP communication.

Select Codec

H.248: MOD.resp
Context ID = C1,
Termination ID = RTP-1

Reply to MGCF. The final codec selection is indicated.

PRACK

```
a=curr:qos local sendrecv,
a=curr:qos remote none,
a=des:qos mandatory local sendrecv,
a=des:qos mandatory remote sendrecv
```

The Caller now sends a PRACK to inform the called subscriber about the selected Codec. The message also indicates that currently the resources needed for meeting the quality of service requirements of the session are already available ("a=curr:qos local sendrecv").

200 OK (PRACK)

This "200 OK" just acknowledges PRACK.

begin
Called PDP Context Activation

The final codec at the called side is decided. So initiate the PDP context activation to allocate resources for meeting the QoS of the terminating leg of the call.

end
Called PDP Context Activation

The called PDP context activation has been completed. At this point, the caller and the called PDP contexts are both active. The QoS for the call can now be met.

Ringing

Now all the resources for the call are in place. Ring the called subscriber to notify the user about the incoming call.

180 Ringing

Inform the caller that the called subscriber is being rung. This serves as an implicit indication to the caller that the QoS at the called side has also been met.

PRACK

The caller acknowledges the ringing message.

200 OK (PRACK)

The called subscriber acknowledges the PRACK.

ISUP ACM related interactions on Mn interface.

ISUP: ACM

H.248: MOD.req
Context ID = C1,
Termination ID = TDM-1,
procedure = Send TDM Tone

The MGCF requests the IM-MGW to provide a ringing tone to the calling party using the Send TDM Tone procedure.

begin
Feed ringing tone on the TDM-1 termination

Ringing tone

H.248: MOD.resp
Context ID = C1,
Termination ID = TDM-1

IMS Answer to ISUP ANM Handling

Answer

The called subscriber answers the call.

200 OK (INVITE)

Notify the caller that that the call has been answered.

H.248: MOD.req
Context ID = C1,
Termination ID = TDM-1,
procedure = Stop TDM Tone

The call has been answered so the MGCF requests the IM-MGW to stop the ring tone on the TDM side.

end
Feed ringing tone on the TDM-1 termination

H.248: MOD.resp
Context ID = C1,
Termination ID = TDM-1

PSTN		IMS Core Network			Called UE	Copyright © 2013 EventHelix.com
PSTN Equipment	PSTN Interface	CSCF Servers			Called User Equipment	10-Jan-13 16:37 (Page 3)
IM-MGW	MGCF	I-CSCF	Term S-CSCF	Term P-CSCF	Called	

**H.248: MOD.req**
Context ID = C1,
Termination ID = RTP-1

Request the IM-MGW to both-way through-connect the terminations using the Change IMS Through-Connection or Change TDM Through-Connection procedure.

H.248: MOD.resp
Context ID = C1,
Termination ID = RTP-1

ISUP: ANM

ACK

The caller acknowledges the "200 OK" message. The call is now ready to enter conversation mode.

Conversation Mode

Voice   **RTP voice packets**
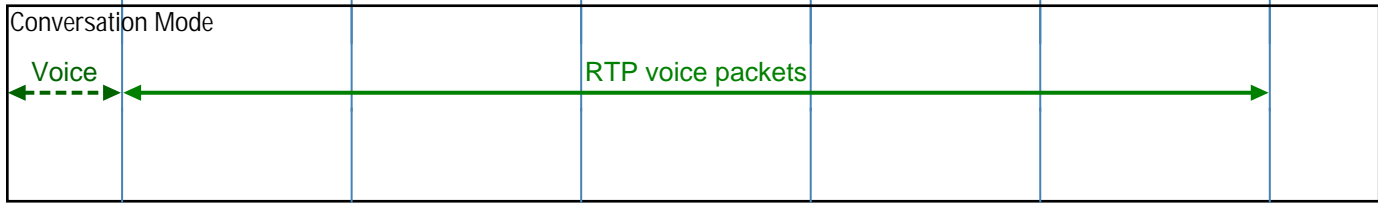
Conversation is now in progress. The voice is carried as PCM between the PSTN and IM-MGW. The IM-MGW converts the speech into RTP packets and back. The RTP communication takes place directly between the IM-MGW and Called IMS subscriber.

PSTN Initiated Call Release

ISUP REL
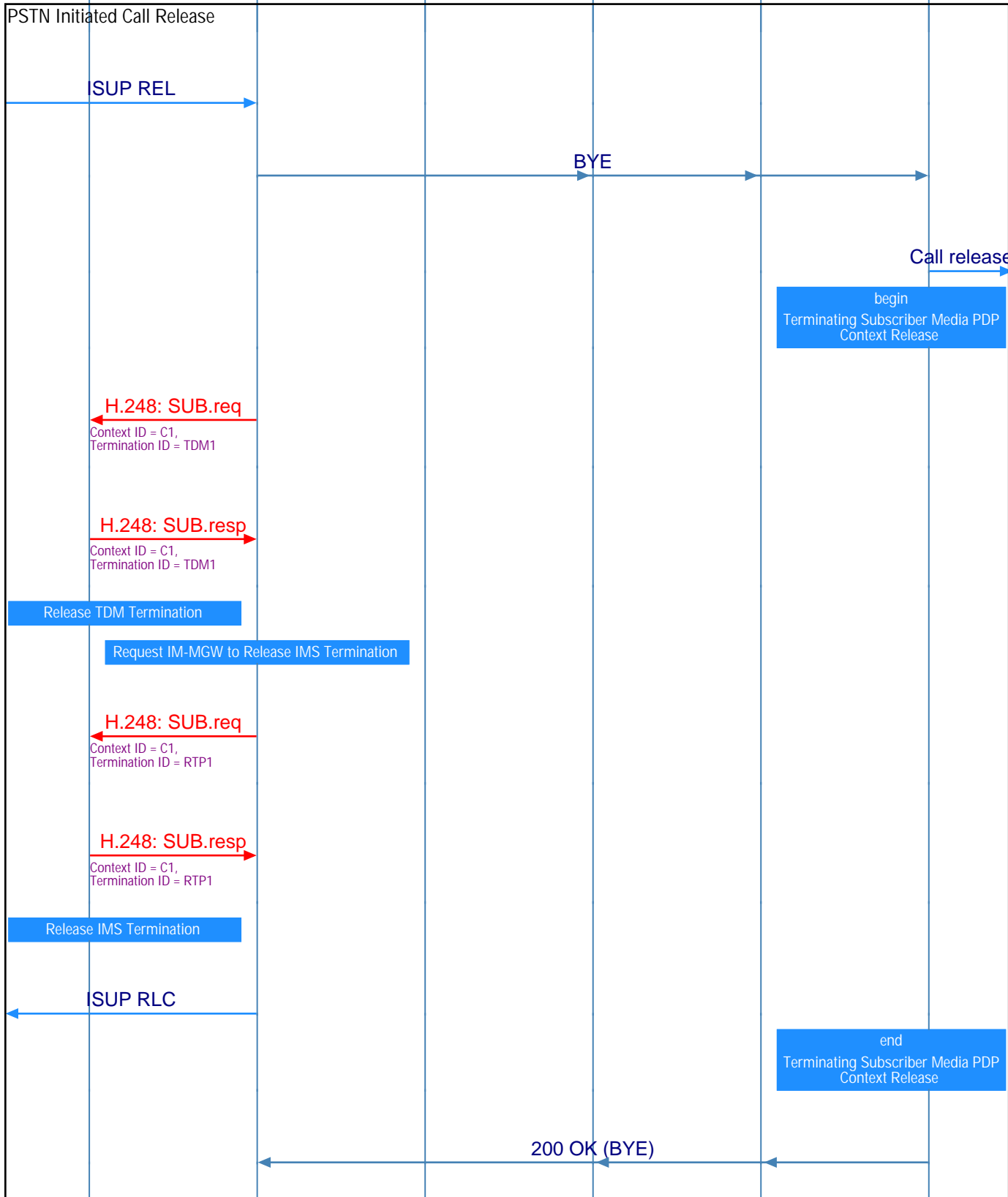
A call release has been received from the PSTN side.

BYE

MGCF initiates IMS side call release by sending BYE.

The called subscriber is notified that the call has been released.

Call release

begin
Terminating Subscriber Media PDP Context Release

Initiate the release of the terminating media PDP context.

H.248: SUB.req
Context ID = C1,
Termination ID = TDM1

Request IM-MGW to Release TDM Termination. A Megaco SUBtract request is sent to release the PSTN side TDM circuit.

H.248: SUB.resp
Context ID = C1,
Termination ID = TDM1

IM-MGW acknowledges.

Release TDM Termination

Request IM-MGW to Release IMS Termination

H.248: SUB.req
Context ID = C1,
Termination ID = RTP1

Request IM-MGW to Release RTP Termination. A Megaco SUBtract request is sent to release the IMS side RTP termination.

H.248: SUB.resp
Context ID = C1,
Termination ID = RTP1

IM-MGW acknowledges.

Release IMS Termination

ISUP RLC

MGCF signals ISUP Release Complete to the PSTN network.

end
Terminating Subscriber Media PDP Context Release

The release of the terminating media PDP context has been completed.

200 OK (BYE)

Acknowledge the BYE that was received from the IMS network.

PSTN Subscriber to IMS Subscriber Call (Alternate Scenario: Called IMS Subscriber Initiated Call Release)

PSTN		IMS Core Network				Called UE	
PSTN Equipment	PSTN Interface	CSCF Servers				Called User Equipment	Copyright © 2013 EventHelix.com
IM-MGW	MGCF	I-CSCF	Term S-CSCF	Term P-CSCF		Called	10-Jan-13 16:37 (Page 4)

This call flow covers the handling of a CS network originated call with ISUP. In the diagram the MGCF requests seizure of the IM CN subsystem side termination and CS network side bearer termination. When the MGCF receives an answer indication, it requests the IM-MGW to both-way through-connect the terminations.

This sequence diagram was generated with EventStudio System Designer (http://www.EventHelix.com/EventStudio).

ISUP IAM Handling and Initial IM-MGW and MGCF (Mn) Interactions
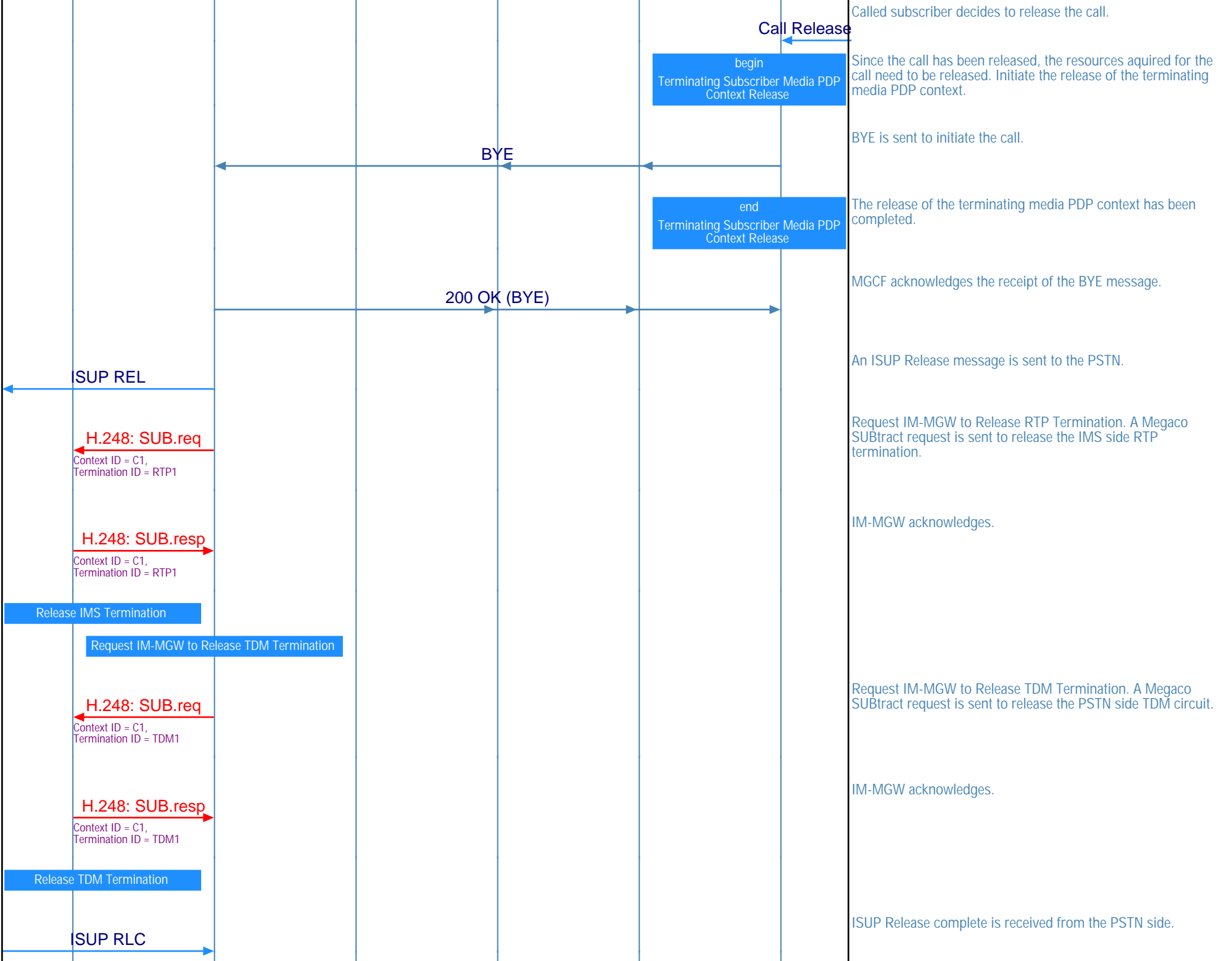
Initial Handshake between MGCF and IMS CSCF Servers

Mn Interactions for Codec selection

ISUP ACM related interactions on Mn interface.

IMS Answer to ISUP ANM Handling

Conversation Mode

Called Subsciber Initiates Call Release

Call Release
Called subscriber decides to release the call.

begin
Terminating Subscriber Media PDP Context Release
Since the call has been released, the resources aquired for the call need to be released. Initiate the release of the terminating media PDP context.

BYE
BYE is sent to initiate the call.

end
Terminating Subscriber Media PDP Context Release
The release of the terminating media PDP context has been completed.

200 OK (BYE)
MGCF acknowledges the receipt of the BYE message.

ISUP REL
An ISUP Release message is sent to the PSTN.

H.248: SUB.req
Context ID = C1, Termination ID = RTP1
Request IM-MGW to Release RTP Termination. A Megaco SUBtract request is sent to release the IMS side RTP termination.

H.248: SUB.resp
Context ID = C1, Termination ID = RTP1
IM-MGW acknowledges.

Release IMS Termination

Request IM-MGW to Release TDM Termination

H.248: SUB.req
Context ID = C1, Termination ID = TDM1
Request IM-MGW to Release TDM Termination. A Megaco SUBtract request is sent to release the PSTN side TDM circuit.

H.248: SUB.resp
Context ID = C1, Termination ID = TDM1
IM-MGW acknowledges.

Release TDM Termination

ISUP RLC
ISUP Release complete is received from the PSTN side.

This sequence diagram was generated with EventStudio System Designer (http://www.EventHelix.com/EventStudio).