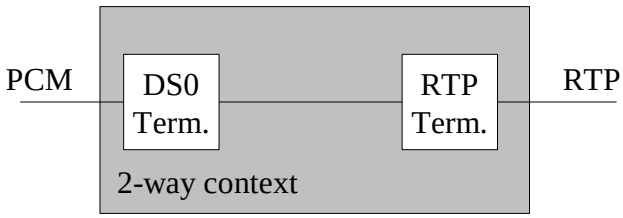
MULTIMEDIA EXTENSIONS TO H.GCP

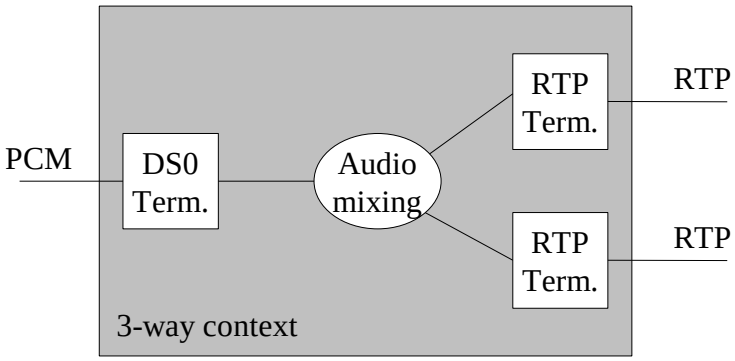
Introduction

In this document we analyze additions to the H.gcp connection model that will allow H.gcp to be used for controlling multimedia gateways. Multimedia gateways include gateways for interworking between H.320 and H.323 networks, as well as gateways for interworking between H.324 and H.323 networks. The discussion of H.320 includes bandwidth aggregation based on the work done by the BONDING consortium back in 1992. BONDING has become the predominate method used by H.320 endpoints to aggregate ISDN B channels for calls with a bandwidth 128kbit/s.

H.gcp connection model

The connection model used currently in H.gcp is based on two concepts, viz. Terminations and Contexts. Terminations sink and/or source media and/or signalling streams. For a point-to-point voice call, the connection model consists of two Terminations in one Context. The Context groups the Terminations belonging to the call. In the case of a multipoint voice call, each person in the call has a Termination. Besides grouping the Terminations, the Context then also describes the audio mixing properties. The diagrams below illustrate the connection model for two-way and three-way calls.





The oval labelled "Audio mixing" is not present in the three-way Context as a separate entity. The mixing properties are described as properties of the Context. If there are more than two Terminations in a Context, these are assumed to be connected in a star configuration.

The Terminations in a Context all carry the same type of media, audio in this case. Any parameters of the audio streams are described by the terminations.

Multimedia gateways

In order to be able to model multimedia sessions, the connection model has to be changed. In order to see which changes are needed, we investigate an H.320 gateway. In an H.320 call, multiple 64 kbit/s channels

are used to transport audio, video,T.120 data and an inband signaling channel (FAS, BAS). The H.221 recommendation describes the frame structure imposed on the channels.

Typical H.320 calls contain audio, video, T.120 and FAS/BAS signaling in a single B channel and the entire video bandwidth generally spans all B channels. A common mode for H.320 systems is to increase the allotment to T.120 dynamically. In this scenario the allotment for T.120 data bandwidth may be increase to include the entire 64 kbit/s of the second B channel, thereby reducing the amount of video in the call by 64 kbit/s. In general, for a decomposed H.320 gateway, there must be a way to describe how *n* bearer channels carry *m* streams in H.gcp. Therefore, the idea that there is a one-to-one correspondence between bearer channels (Terminations) and media streams must be relinquished. A solution is to have a Termination reference a number of bearer channels that together carry a number of media streams.

Bandwidth aggregation of 64kbit/s bearer channels in an H.320 call must also be considered. H.320 calls at 2x64kbit/s use bandwidth aggregation using methods in H.221. These calls will require no additional consideration in the decomposed gateway model. H.320 calls of 192kbit/s up to 2048kbit/s generally use bandwidth aggregation defined by the Bonding consortium. The Bonding method is a sequence of messages that are exchanged within the first B channel that define the rate of the call, assigns an identifier for a call and allows the answering side to select the remaining phone numbers for the call.

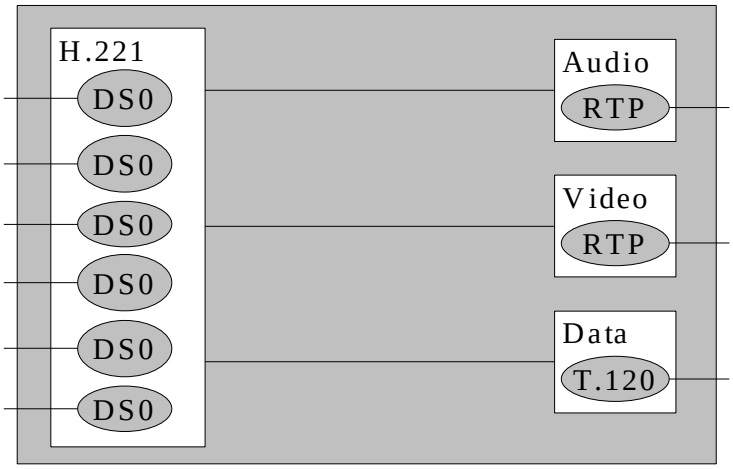
DS0 Terminations capable of H.320 calling must be capable of detecting H.221 and Bonding protocol inband when a B channel connects to the gateway. The MG can send this information to the MGC as an event causing the MGC to then move the termination to the proper context for the incoming H.320 call. A gateway with H.320 capabilities uses the Q.931 call type (Voice or Data) to differentiate incoming voice calls from other calls (i.e. data) that may be H.320. The GW must detect the H.221 or Bonding framing to be able to detect the signalling in the media stream, and then go into H.320 mode.

A question to be resolved is how to distinguish that a new call is a B channel to be added to an existing H.320 call or whether it is a new call. The Bonding method takes care of this by means of inband signaling as explained above. In the case of the 2B method, the MGC may assume that the same called party number is used to associate all B channels in a call.

Below we outline an approach that gives us a connection model that has the required functionality, and is simple for the two-party voice call scenario.

Multimedia connection model proposal

We start by providing some examples of multimedia Contexts. First we look at a point-to-point call between an H.320 and H.323 user involving audio, video and T.120 data. The Context for such a call contains four Terminations. It contains an H.221 Termination that sources and sinks the H.221 frames on DS0s. The Termination references a number of DS0s, six in the example for a call with a total bandwith of 384 kbit/s. The H.221 termination described how the audio, video and data streams are transported over the six 64 kbit/s bearer channels. Having this description available, it is possible to associate the three media streams to the three RTP flows for receipt/transmission of the media streams on the packet network.



Let's investigate how a point-to-point call such as the one above can be set up using the Bonding method.

1. MGC gets an incoming call with (Q.931) call type of data and sends an Add command to MG, to create a Context with an H.221 Termination, indicating in the parameter for the H.221 termination that Bonding will be used.

```
Transaction TR1(
      ContextID=ANY:
      Add (TermID=ANY, Media=H.221, Bearer= { DS0/x1/y1 },
      LocalState (mode=RecvOnly), Package=Bonding )
)
```

   The `Bearer` field contains an ordered list of bearer channels used in the call (here the length is one).
2. The MG acknowledges the Context creation, informing the MGC of the ContextID *C1* and TerminationID *T1* it assigned.

```
Accept TR1 (
      ContextID=C1: Add (TermID=T1)
)
```

3. When B channel connects to the MG, it starts looking for Bonding and H.221 in band framing.
4. When the termination finds Bonding, it assigns a Bonding call ID *x* and accepts the proposed call transfer rate requested by the calling H.320 endpoint. The termination then allocates additional phone numbers for the call and sends these back to the calling side via Bonding.
5. A Notify is sent to the MGC indicating a new Bonding call with identifier 'x' and the additional phone numbers for the call.

```
Transaction TR2 (
      ContextID=C1:
      Notify (TermID=T1, BondingID=x, AddPhoneNumbers= { N1, N2,
      N3, N4, N5 } )
)
```

   The additional numbers are specified by the value of the `AddPhoneNumbers` field (an ordered list). The MGC acknowledges the Notify command.
6. When the SGW notifies the MGC of incoming calls for the phone numbers associated with Bonding call *x*, the MGC sends Modify commands to the MG to add the appropriate DS0 bearer channels to the H.221 termination created previously; the MG acknowledges these commands. For instance, for the first additional DS0 that is added:

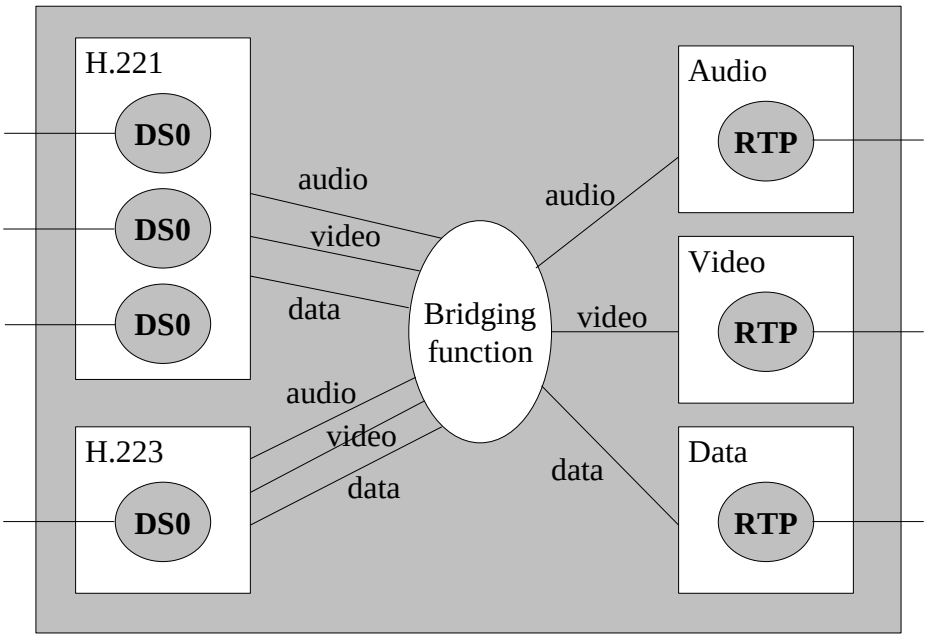
```
Transaction TR3 (
      ContextID=C1:
      Modify (TermID=T1, Bearer= { DS0/x1/y1, DS0/x1/y2 } )
)
```

   With the final `Modify` in which bearer channels are added, the MGC requests the MG to notify it when H.221 frames are detected.

7. After all five additional DS0s have been added, the H.221 termination can complete Bonding and start looking for H.221 framing.
8. Once H.221 framing is found a Notify is sent to the MGC.
9. The MGC instructs the H.221 termination to listen for DTMF tones in the audio stream, and possibly to play an announcement to the calling user.
10. The H.221 Termination will play the audio announcement and listen for DTMF tones in the audio portion of the mux and it commences a TCS4/IIS signaling exchange in the BAS channel. The information received is considered the destination *z* alias for this call.
11. The MG Notifies the MGC of at least three pieces of information: 1) frame alignment found, 2) H.320 capabilities, and 3) destination alias *z. [Question: should the RemoteTerminationDescriptor or LocalTerminationDescriptor be used for this? Should the TerminationDescriptors perhaps be organized into parts describing transport and media?]* The MGC sends ARQ to resolve IP address for alias *z*
12. Once the address is resolved, the MGC does H.225 call setup. . . gets caps from H.323 etc.
    Note that we assume that the MGC sets up the H.245 connection with the called party.
13. The MGC sends a Modify to the H.221 termination causing a new capability set to be sent from the GW to the H.320 terminal, based on the received capabilities the MGC got from the H.323 endpoint.
14. MGC may get an OLC from H.323 side for audio, the MGC will then Add an audio RTP termination to the Context.
15. The MGC will send a modify to the H.221 termination causing the H.221 mux to change and the selected audio channel (G.711, G.723 etc.) to be opened.
16. The H.320 side may do a mode switch to H.263 video for example. The H.221 termination will then send a event to the MGC requesting H.263 video.
17. The MGC must send and OLC to the H.323 side.
18. The MGC Adds a video RTP termination to the Context.
19. The MGC sends a modify to the H.320 termination to open the same H.263 channel on the H.320 side.
20. …

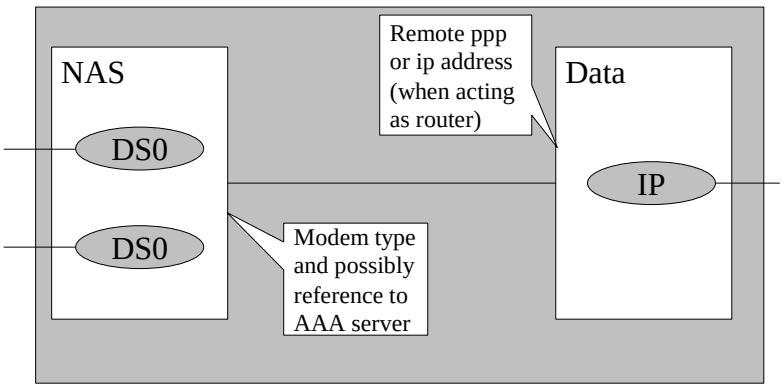
The call flow shows that either the H.323 or H.320 side can initiate opening (or closing) an audio or video channel through the gateway. In H.320, there is the requirement that such mode changes take at most 20 ms. In the call flow we see that messages are exchanged between MG and MGC to inform the MGC of a request for a mode change from the H.320 side, and have the MGC send an OLC to the H.323 terminal. The exchange is not likely to be completed within the 20 ms bound. Thus, there is an argument in favor of allowing the MG to do H.245 signaling, notifying the MGC of the channels opened/closed.

In the second example, we show a bridge with an H.320, an H.323 and an H.324 user. In the picture the types of media flowing over the links between the terminations are shown for clarity.

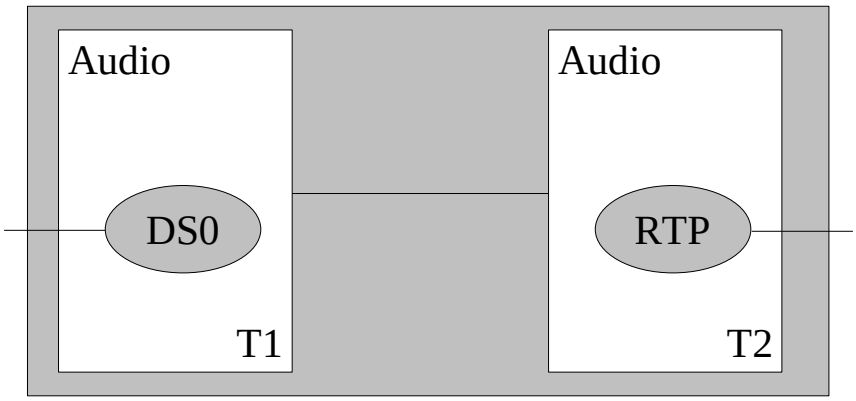


Again, we see in the diagram that the bridging functionality is a context property. There is no separate bridge entity in the connection model.

In the third example we show how this same model can be applied to channel bundling in NAS applications. In this example two DS0s may be attached to the NAS termination for channel bundling.



In our final example we show how a simple point-to-point voice call looks in our model to make sure that this has not become unnecessarily complex as a result of the multimedia extensions proposed.



The voice call still looks simple. There are two Terminations, one that uses a DS0 channel for transport, and one using an RTP flow. The two Terminations have the following properties. Here is how the call could be set up for a trunking GW:

1. The MGC creates a new Context with two Terminations:

```
Transaction TR1 (
      ContextID=ANY:
      Add (TermID=ANY, Media=audio, Bearer={ DS0/x1/y1 },
      TerminationState={ mode=RecvOnly } )
      Add (TermID=ANY, Media=audio, Bearer= { RTP/* } )
)
```

   The MG acknowledges the Context creation and informs MGC of names assigned and LocalTerminationDescriptor of the packet termination.

2. After receiving the parameters for the media stream from the called party, the MGC sets the RemoteTerminationDescriptor of the packet termination and applies ringback to the SCN side:

```
Transaction TR2 (
      ContextID=C1:
      Modify (TermID=T2, RemoteTerminationDescriptor = ... )
      Modify (TermID=T1, SignalDescriptor = { Ringback start } )
)
```

   The MG acknowledges these commands.

3. Upon receiving a Connect from the called party, another message exchange occurs between MGC and MG. In the transaction initiated by the MGC, ringback is canceled and the mode of the circuit termination is set to sendrecv:

```
Tranaction TR3 (
      ContextID=C1:
      Modify (TermID=T1, SignalDescriptor = { Ringback stop },
      TerminationState={ Mode=sendrecv } )
)
```

The only difference with the current H.gcp model is in the naming of Terminations. Names are assigned by the MG upon creation of Terminations. Since the description of the transport channel is not part of the name of the termination anymore, command messages are actually slightly shorter than they were before, when the complete hierarchical name of the old style Termination was included in every operation on a Termination.

Conclusion

We outlined how to change the connection model for H.gcp to give it the extra flexibility required to handle multimedia applications. In our approach, the Termination and Context concepts are extended. Terminations are not identified with bearer channels anymore, but they reference the bearer channels on

which media is sent and/or received. This is useful not only for H.320 functionality, but also allows support for layered video encoding where the different layers are sent to different UDP ports.

The current definition of Context as an implicit star connection may be just one of the several context types that eventually will be supported. Others may be required which are more suited for multimedia or conferencing. One can even envisage some low-level commands being specified to manipulate links between terminations in the small percentage of cases where the predefined contexts do not suffice. This could be necessary for instance should one want to use to protocol to control full-fledged MCUs.

Another extension we introduced is to allow the type of a Termination to change. This is necessary because it is not always possible to know that an incoming call is an H.320 call until the media starts streaming. Being able to transition from one Termination type to another is useful for fax and NAS as well. A high percentage of calls being simple voice calls, any incoming call from a PSTN network can be set up as if it is a voice call. If it turns out to be something else (NAS, fax, H.320, H.324), the transition to the appropriate Termination type can be made.

Further work required on this paper [ed]

Add an example for fax

Add an example on media multiplexing.

Describe properties/packages of H.221 termination:l

- *detect H.221 framing, send event to MGC*
- *generate an initial cap set*
- *listen for DTMF tones in the audio channel*
- *initiate TCS4/IIS command exchange within the BAS channel*
- *report destination alias event (from TCS4 or DTMF) to MGC*
- *report audio, video or data channel establishment to MGC*
- *initiate audio, video or data channel establishment based on event from MGC*

Describe Bonding Package:

- *detect Bonding framing and send event to MGC*
- *after delay equalization completes send an event to MGC*