ITU Telecommunication Standardization Sector
Study Group 15
Experts Group for Video Coding and Systems
in ATM and Other Network Environments

Document AVC-769
April 28, 1995

Source: Japan
Title: A case study for H.310 communication procedures
Purpose: Disucssion and proposal

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1. Introduction

This document endeavors to clarify the whole communication procedures from a call setup to the intended audiovisual communication by listing all the relevant events for an example case of audiovisual communication. It is submitted as a background material for the companion document AVC-767 addressing the protocol configuration to be defined in H.222.1, H.245 and H.310. *Mr. Dunstan's comments to the advance version are also included in italics.*

We focus on the mode switching for which two proposals have been made by Mr. Stuart Dunstan and Mr. Mike Nilsson, describing their information flow in the control and audiovisual channels. Various questions and observations are provided with # at the paragraph start. Some specific proposals are made with respect to the default mode and mode request.

{H.245 messages are yet to be carefully reviewed}

2. Case study

The following communication is taken up to study the communication procedures:

- CBR communication with a bitrate of 4992 kbit/s (=78*64 kbit/s)
- Transport Stream over AAL1
- Each elementary stream has the following characteristics:

Table 1

Medium	Bit rate(kbit/s)	Coding law	Note
Audio	64	G.722 mode 0	
Video	4832	H.262 | ISO/IEC 13818-2	
Data	64	T.120 JPEG high resolution still pictures	- Data channel is assumed to be always open
Control	16	H.245	- For in-channel negotiation, control, indication, mode change
Overhead	16	H.222.1	- TS packet header, PAT, PMT - Padded if the capacity is more than necessary

#1 Capacity of the control channel is to be fixed? Then what bit rate?

3. Communication procedures and their messages

[A] A call is set up by using the Q.2931 signaling. Here it is assumed that the called terminal has matched capabilities, thus the call is successful.

#2 The Q.2931 signalling is a one way indication or two way negotiation? For example, if the called side capability is up to 4 Mbit/s transfer rate and if the calling side set up a call of 5 Mbit/s, this call is rejected by the called side? Or, the called side returns its 4 Mbit/s capability and the called side changes its call set up parameters? The current Q.2931 specification does

not support this negotiation, but the negotiation is under consideration for Q.2962 where the called side can return smaller values than indicated by the caller in a CONNECT message in response to a SETUP message.

#3 If the communication cost is critical, we need a procedure to set up a call with a necessary minimum bit rate, then to expand the bit rate according to the inband negotiation.

#4 Use of B LLI and/or B HLI for terminal compatibility need be clarified and communicated with SG13.

[B] Just after the call setup, the call management (CM hereafter) sends out a Program Association Table (TS packet with PID=0000 h) with the following coding:

Table 2

Syntactic element	Code	Note
table_id	00 h	fixed for Program_association_section
program_number	0001 h	Number 1
program_map_PID	0010 h	

At this stage, only PAT is sent; the remaining capacity is filled with null packets (PID=1FFF h).

[C] The default communication mode

As soon as a sufficient number of PAT packets are repeated in an unacknowledged way {or at the same time with PAT?}, a Program Map Table is repeatedly sent which indicates the default communication mode; Audio (G.711) and Control (H.245). Some important parameters are as follows:

Table 3

Syntactic element	Code	Note
PID	0010 h	PMT
table_id	02 h	Program Map Table
program_number	0001 h	Number 1
PCR_PID	0020 h	Default audio
stream_type	09 h	H.222.1
elementary_PID	0020 h	Audio
descriptor_tag	66 d	ITU-T audio
coding_algorithm	02 h	G.711 u-law
stream_type	09 h	H.222.1
elementary_PID	0014 h	Control
descriptor_tag	67 d	ITU-T data
protocol	01 h	H.245

This message is not acknowledged. At this stage, the coded audio data and control messages are included in the bitstream; the remaining capacity is filled with null packets. As soon as the receiving side is initiated, audio is reproduced for the user and the control messages are digested.

We propose that H.310 defines PIDs for the default communication mode.

 # (S D) If acknowledged signalling procedures are being used then (if there are no default subchannels) the acknowledged signalling procedures should also be used here.

The example has highlighted an incompleteness in the current specification; a PAT should be also individually acknowledged. I would propose that a PAT should be sent only when all subchannels are in the IDLE state. No activity can occur until a PAT has been sent and acknowledged. I will include this as an amendment.

Figure 1 illustrates a mixed mode of H.222.1 subchannel signalling. It is probably preferable to use exclusively acknowledged or unacknowledged procedures in one call.

Note that when we talk about default modes it is also possible to have default subchannels for the default coding modes i.e. a default PAT and PMT table in the TS, or default PSM in the PS. I am not saying that this is necessary, only possible. This avoids the subchannel set up for these default coding modes.

#5 How many, or how long after the call setup, PAT packets should be repeated?

 # (S D) This is the problem with unacknowledged procedures; PAT tables should also be acknowledged as stated above.

#6 Transmission of the above PMT can be skipped for the default mode since it is known without explicit indication?

[D] Capability exchanges take place between the two terminals through the control channel.

For a symmetric terminal (H.310 Type A2), its capability message from the incoming side to the outgoing side is as follows:

Table 4

```
DeclaredTermCapSet          ::=SEQUENCE
{
    connectionless11        BOOLEAN,
    remoteControllability   BOOLEAN,    {yes}
    symmetricalCapSets      BOOLEAN,    {yes}
    yearOfRecommendation NumericString (SIZE(4..4)) (FROM ("0123456789")),
    independentTermCapSet [0]IMPLICIT SEQUENCE OF TermCapSet OPTIONAL,
    ...
}

TermCapSet                  ::=SEQUENCE
{
    receiveCapSet           [0]IMPLICIT CapSet OPTIONAL,
    ...
}

CapSet                          ::=SEQUENCE
{
    videoCap                [1]IMPLICIT SEQUENCESET OF VideoCap OPTIONAL,
    audioCap                [2]IMPLICIT SEQUENCESET OF AudioCap OPTIONAL,
    dataCap                 [3]IMPLICIT SEQUENCESET OF DataCap OPTIONAL,
    atmNetworkAdaptCap      [4]IMPLICIT ATMNetworkAdaptCap OPTIONAL,
    ...
}

VideoCap                    ::=CHOICE
{
    h261VideoCap            [1]IMPLICIT H261VideoCap, {#7 unnecessary if it is
not carried in H.222.1?}
    h262VideoCap            [2]IMPLICIT H262VideoCap,
    ...
}

H261VideoCap                ::=SEQUENCE
{
    qcifMPI                 [0]IMPLICIT INTEGER (1..4) OPTIONAL,
    cifMPI                  [1]IMPLICIT INTEGER (1..4) OPTIONAL,
    ...
}

H262VideoCap                ::=SEQUENCE
{
    profileAndLevel         BIT STRING
```

```
                        {
                            MP@ML    (2),
                        },
    videoBitRate        [0]IMPLICIT  INTEGER  OPTIONAL,
    vbvBufferSize       [1]IMPLICIT  INTEGER  OPTIONAL,
    samplesPerLine      [2]IMPLICIT  INTEGER  OPTIONAL,
    linesPerFrame       [3]IMPLICIT  INTEGER  OPTIONAL,
    framesPerSecond     [4]IMPLICIT  INTEGER  OPTIONAL,
    luminanceSampleRate [5]IMPLICIT  INTEGER  OPTIONAL,
    ...
}

AudioCap                ::=CHOICE
{
    itu-tAudio1         [1]IMPLICIT  BIT  STRING
                        {
                            g711Alaw     (0),
                            g711Ulaw     (1),
                            g722         (2),
                        },
    mpegAudio           [2]IMPLICIT  MpegAudio,
      ...
}

MpegAudio               ::=SEQUENCE
{
    audioLayer          BIT  STRINGENUMERATED
                        {
                            layers1&2    (1),
                        },
    audioSampling       BIT  STRING
                        {
                            32k          (0),
                            44k1         (1),
                            48k          (2),
                        },
    asynchronousCap     BOOLEAN,
    AudioCorrectionModes ENUMERATED
                        {
                            mode1        (0),
                            mode2        (1),
                            mode3        (2),
                            allThreeModes   (3),
                        },
    bitRate             INTEGER,
    ...
}

DataCap                 ::=BIT  STRING
{
    t120                (0),
}

ATMNetworkAdaptCap      ::=SEQUENCE      {#8 Is this useful in the H.245
message?  Should this be in the outband signalling?}
{
    aal                      BIT  STRING
                        {
                            Aal1         (0),
                            Aal5         (1),
                        },
    h222Multiplex       BIT  STRING
                        {
                            transportStream  (0),
                            programStream    (1),
                        },
    bitRate             INTEGER,
    numberOfVCs         INTEGER,
    ...
}
```

 # (S D) Comment relating to H.245: The ATM network adaptation capabilities have to be included as part of the capabilities set, but during the actual signalling some of the information is transmitted by Q.2931, while other information relates to H.222.1.

The outgoing side returns the following acknowledgment through the H.245 control channel:

Table 5

```
Acknowledgement          ::=SEQUENCE
{
   acknowledgementType   ENUMERATED
                            ackDeclaredTermCapSet        (0),
```

[E] After the capability exchange, the CM determines the sending mode in terms of audio, video and data elementary streams. The CM is aware of all the parameters such as coding algorithm, profile and level, bit rate.

As a result, the following mode switching takes place:

Audio:	switched from G.711 to G.722
Video:	newly opened
Data:	newly opened
Control:	unchanged

[F] For the procedures of the next phase "mode switching", there are two proposals:

Proposal 1: use of acknowledged procedures defined in Annex A to H.222.1
Proposal 2: use of (H.222.1 multiplex and) H.245 acknowledgment procedures

Proposal 1 (Figure 1)

1) The CM decides the number for each logical channel and its parameters:

#9 The CM decides the coding parameters?

 # (S D) Yes, if "coding parameters" means characteristics of the information to be carried on the logical channel. Remember that it is not the receive H.222.1 which reads these parameters, but the receive CM.

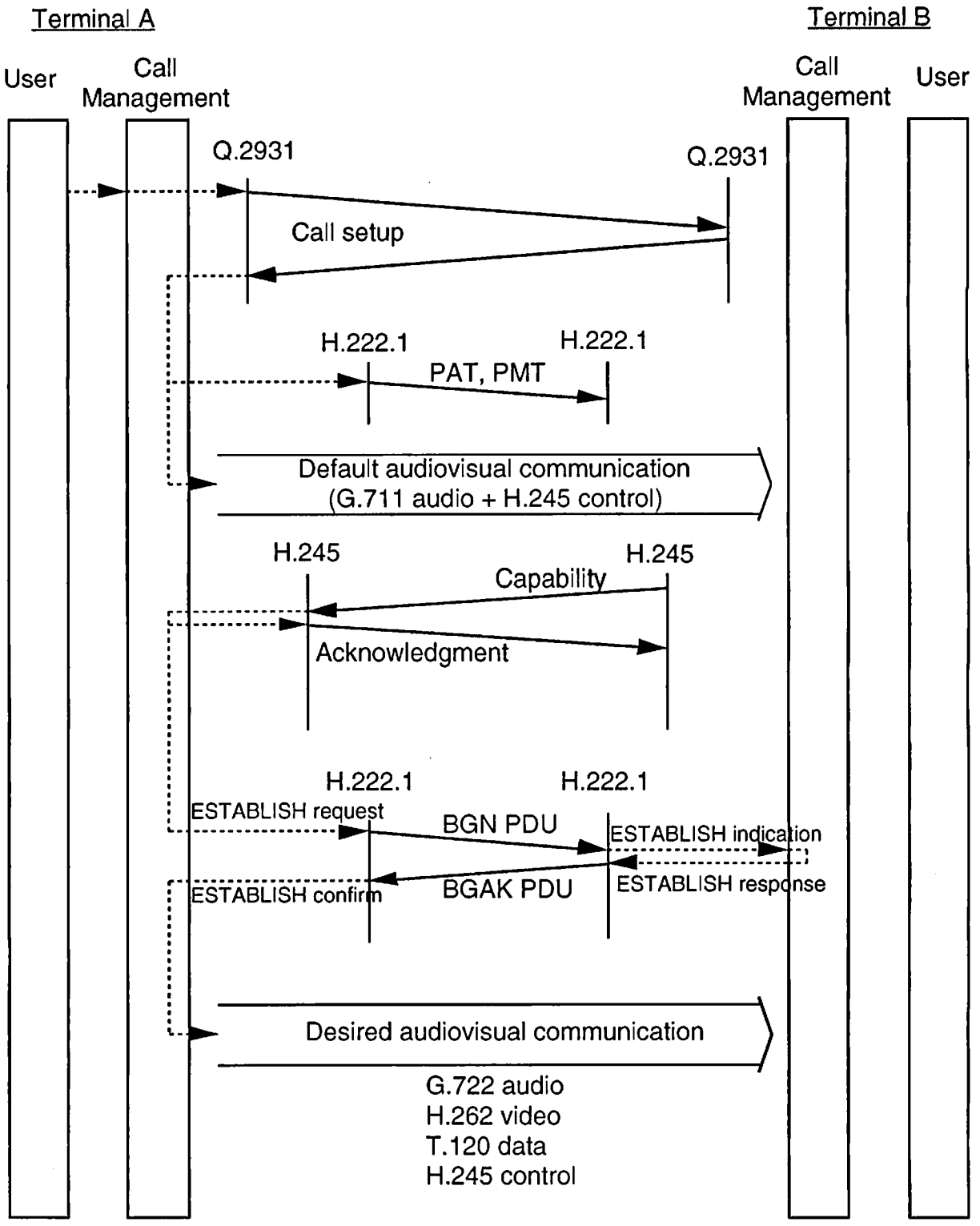
Table 6

Elementary Stream	LC number	Note
Video	50	
Audio	51	
Data	52	
Control	53	

then requests establishment of the logical channels to the H.222.1 SCSE by conveying this mapping.

#10 How the default audio is handled?

 # (S D) Assuming no default audio logical channel, the first H.222.1 signalling phase sets up such a logical channel. The logical channel can be released at this stage if it is no longer required.



Note - Communiction from Terminal B to A proceeds simultatneously, but not indicated here.

Figure 1 Mode switching according to Proposal 1

2) The H.222.1 SCSE maps these logical channels to PIDs:

Table 7

Logical channel	PID	Note
50 (Video)	0011 h	
51 (Audio)	0012 h	
52 (Data)	0013 h	
53 (Control)	0014 h	

#11 Control channel is also to be included even if it has already been established with the unacknowledged procedure?

 # (S D) If the control channel is already established then it is not included here.

3) H.222.1 outgoing SE sends a PMT containing BGN PDU type. This PMT also contains elementary stream descriptors, thus the incoming side SCSE can identify whether it has necessary decoding resources.

 # (S D) This is not quite right. It is not the receive side SCSE which knows about decoding resources, but the receive side CM above it. Remember that the receive side CM decides whether or not to accept the set up request, based upon its knowledge of the terminal resources. H.222.1 only has knowledge of which logical channels are in use.

Some important parameters in a PMT for BGN PDU are as follows

Table 8

Syntactic element	Code	Note
PID	0010 h	PMT
table_id	02 h	Program Map Table
program_number	0001 h	Number 1
PCR_PID	0011 h	Video
descriptor_tag	**69 d**	**scse_pdu_type_descriptor**
pdu_type	**00 h**	**BGN**
parameter	**??**	**N(SQ)**
stream_type	02 h	H.262
elementary_PID	0011 h	Video
descriptor_tag	2 d	
frame_rate_code	0100	29.97
profile_and_level indication	1001000 b	MP@ML
stream_type	09 h	H.222.1
elementary_PID	0012 h	Audio
descriptor_tag	66 d	ITU-T audio
coding_algorithm	04 h	G.722 mode 1
stream_type	09 h	H.222.1
elementary_PID	0013 h	Data
descriptor_tag	67 d	ITU-T data
protocol	??	T.120
stream_type	09 h	H.222.1
elementary_PID	0014 h	Control
descriptor_tag	67	ITU-T data
protocol	01 h	H.245

Descriptors in the PMT (Program Map Table) become effective just after the TS_program_map_section containing the program map table has been transmitted. Being effective means that a packet with a certain PID is delivered to an appropriate decoder (appropriate elementary stream decoder with an appropriate algorithm). This is analogous to

the H.221 specification that the command contained in the BAS channel becomes effective from the start of the next sub-multiframe.

 # (S D) In the above I am not sure what a "descriptor becoming effective" means.

#12 At this point, no video (PID=0011 h), G.722 audio (PID=0012 h) nor data (PID=0013 h) packets are in the H.222.1 bitstream? Only G.711 audio (PID=0020 h) and Control (PID=0014 h) are in the bitstream?

 # (S D) Correct.

#13 PCR_PID has been changed from G.711 Audio to Video PID. Do we need some provisions for this change?

4) H.222.1 incoming SE receives this BGN PDU and conveys the establish indication to the CM by mapping the PID and the logical channel.

Table 9

PID	Logical channel	Note
0011 h	100 (Video)	
0012 h	101 (Audio)	
0013 h	102 (Data)	
0014 h	103 (Control)	

#14 Descriptor information is also conveyed to the CM?

 # (S D) Yes, since it needs to know whether it can accept the information on this new logical channel.

5) The incoming side CM judges whether these logical channels be acceptable comparing to its available decoding resources. If so, the CM conveys "ESTABLISH response" to the SCSE which then returns a BGAK PDU without containing any elementary stream descriptors (?).

 # (S D) Correct. Only the SCSE PDU type descriptor is required to be included, at either the program level or the elementary stream level.

Some important parameters in a PMT for BGAK PDU

Table 10

Syntactic element	Code	Note
PID	0010 h	PMT
table_id	02 h	Program Map Table
program_number	0001 h	Number 1
PCR_PID	0011 h	Video
descriptor_tag	**69 d**	**scse_pdu_type_descriptor**
pdu_type	**01 h**	**BGAK**
stream_type	02 h	H.262
elementary_PID	0011 h	Video
stream_type	09 h	H.222.1
elementary_PID	0012 h	Audio
stream_type	09 h	H.222.1
elementary_PID	0013 h	Data
stream_type	09 h	H.222.1
elementary_PID	0014 h	Control

#15 The above coding without descriptors is correct?

 # (S D) Yes.

#16 This response can indicate that some logical channels are acceptable but some others not. For an unacceptable logical channel, BGREJ PDU is returned with an indication of cause in each elementary stream.

 # (S D) Correct. The actual types of causes have not yet been written into Annex A.

6) The outgoing side SCSE receives the BGAK PDU and conveys "ESTABLISH confirm" to the CM.

7) The CM now sends elementary streams with coded data. At this point, the incoming side user perceives video, new audio (switched from G.711 to G.722) and data. In the logical channel establishment period, both of G.711 and G.722 logical channels are established, but only G.711 appears in the bitstream. After the time the new logical channel configuration is established, no G.711 packets are sent through its logical channel (PID=0020 h) which is still open.

#17 When should the receiving terminal switch the input to the loudspeaker (or handset) from the output of G.711 decoder to G.722 decoder? If it is known that there is a single audio channel, both outputs can be connected to the loudspeaker? So, the receiver terminal need not worry about the mode switching; whatever decoded is passed to the loudspeaker; the sending side uses one encoder at a time?

 # (S D) Which coding mode to use could be indicated by which logical channel is in use. It may be that a synchronous signal is required, but hopefully not.

#18 What about if more than one audio (or video) signals are simultaneously used in such a multi-lingual case? Do we need signalling for relating the PID and the I/O port number?

 # (S D) But isn't that association done when the logical channel is established?

#19 Should the G.711 audio be closed? If so, an END PDU specifying it (PID=0020 h) is sent and acknowledged. This logical channel is opened with the H.222.1 unacknowledged procedure and closed with the H.222.1 acknowledged procedure?

 # (S D) for the first first question Maybe that is how the signalling is performed.

 # (S D) for the second question This is maybe possible. The presence of the SCSE PDU type descriptor says whether an acknowledgement is required or not. This may not be robust enough however.

#20 Unacknowledged procedures (for PAT, initial PMT and default Audio and Control) and acknowledged procedures (for Video, Audio, Data and Control) are mixed in a communication session. This may complicate the communication procedures?

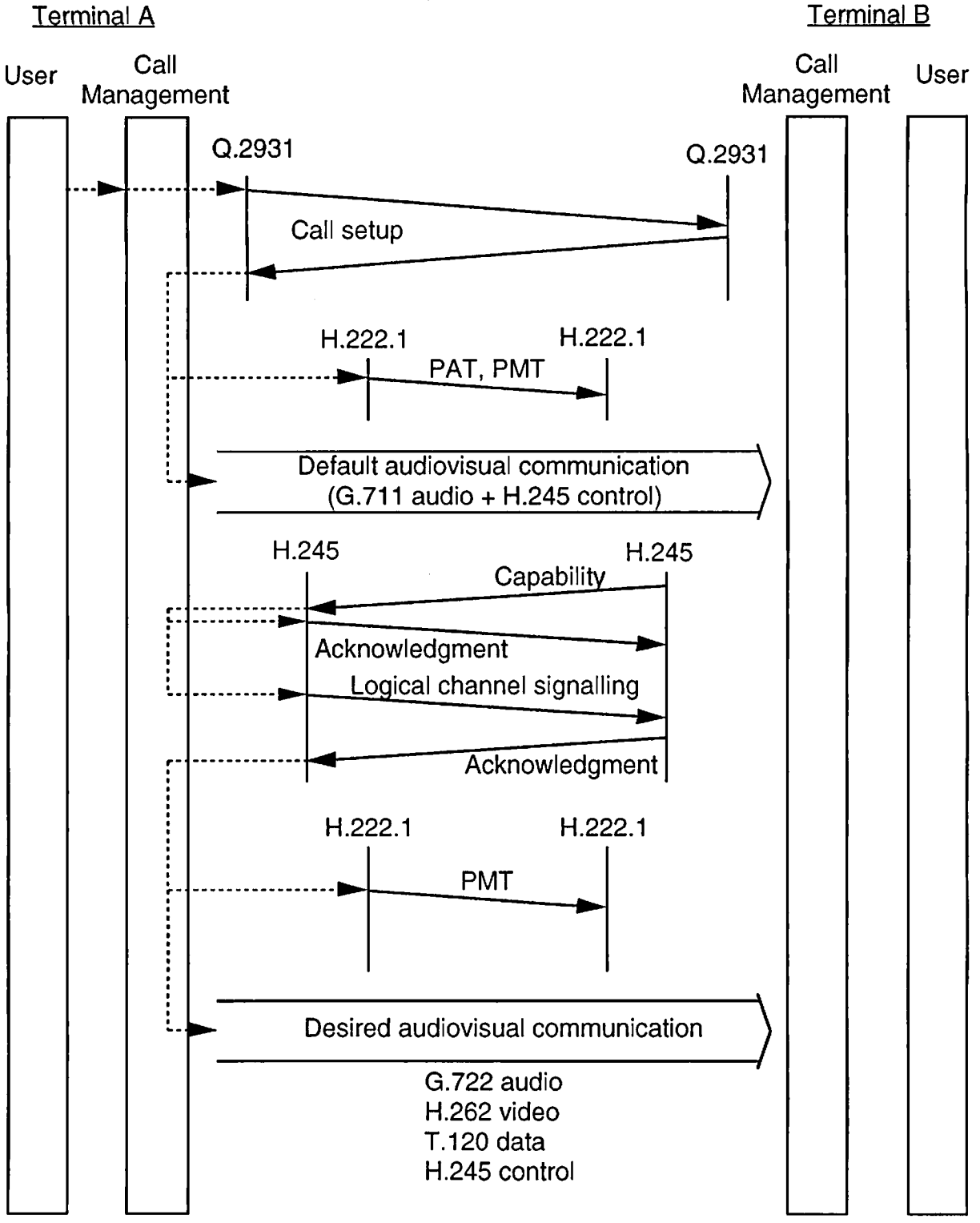
 # (S D) As stated above the first signalling phase should also be acknowledged.

#21 Separation of Logical Channel number and PID is necessary? What would be the relationship between the CM and the SCSE, they may be a single entity in a terminal?

 # (S D) I believe that PID number cannot be used to indicate the logical channel for the following reasons;

- *if there are multiple VCs the same PID number can be used in each of the VCs. Hence a PID number does not exclusively identify a logical channel.*
- *protocol layer independence between H.222.1 and the higher layers is a desirable property. For example which PIDs are reserved in H.222.0/1 should not be known outside of H.222.0/1.*

Proposal 2 (Figure 2)



Note - Communiction from Terminal B to A proceeds simultatneously, but not indicated here.

Figure 2 Mode switching according to Proposal 2

 # (S D) Proposal 2 appears to be using both H.245 and H.222.1 for logical channel signalling.

For reliable operation Proposal 2 still requires acknowledgement for the PAT and PMT tables. Nothing appears to have been gained by moving some of the signalling to H.245.

1) The CM decides the logical channels involved and their coding parameters based on the received capability set and its own transmitting capabilities. It also decides a PID number for each logical channel:

 # (S D) I don't agree with this last sentence for the previously stated reasons.

Table 11

Logical channel	PID	Note
Video	0011 h	17 d
Audio	0012 h	18 d
Data	0013 h	19 d
Control	0014 h	20 d

2) The CM sends the following messages of logical channel signalling through the H.245 Control channel:

Table 12

```
logicalChannelSignalling        [APPLICATION 8]IMPLICIT LogicalChannelSignalling,
        messageType             channelSetUp            (0)
        logicalChannelNumber    17 d
        channelUse              videoCap                [0]IMPLICIT VideoCap,
        messageType             channelSetUp            (0)
        logicalChannelNumber    18 d
        channelUse              audioCap                [0]IMPLICIT AudioCap,
        messageType             channelSetUp            (0)
        logicalChannelNumber    19 d
        channelUse              dataCap                 [0]IMPLICIT DataCap,

        atmSpecifics            ????
```

videoCap, audioCap and dataCap include coding algorithm and parameter values as used in the capability exchange. At this point, the H.222.1 multiplexed stream contains only G.711 audio and H.245 control packets.

#22 Is this nesting correct? Or the nesting be under messageType?

#23 For Audio (logicalChannelNumber = 18 d), meesageType should be channelSetUp (PID) or chanelRedefinition? channleRedefinition is used for the same logicalChannelNumber whose content is switched from one audio to another or from audio to video?

#24 For the default Audio and Control logical channels, no such logical channel signalling messages are sent?

3) The incoming side CM compares the requested logical channel configuration to its available decoding resources and returns acknowledgment with the following message:

Table 13

```
Acknowledgement             ::=SEQUENCE
{
    acknowledgementType     ENUMERATED
                                ackLogicalChannelModeIndication     (4),
```

This acknowledgment is for the combination of logical channels as listed in the logicalChannelSignalling message.

4) The outgoing side CM receives the acknowledgment message for the logical channel configuration.

5) The CM now sends out the following program map table:

Table 14

Syntactic element	Code	Note
PID	0010 h	PMT
table_id	02 h	Program Map Table
program_number	0001 h	Number 1
PCR_PID	0011 h	Video
stream_type	02 h	H.262
elementary_PID	0011 h	Video
descriptor_tag	2 d	
frame_rate_code	0100	29.97
profile_and_level indication	1001000 b	MP@ML
stream_type	09 h	H.222.1
elementary_PID	0012 h	Audio
descriptor_tag	66 d	ITU-T audio
coding_algorithm	04 h	G.722 mode 1
stream_type	09 h	H.222.1
elementary_PID	0013 h	Data
descriptor_tag	67 d	ITU-T data
protocol	??	T.120
stream_type	09 h	H.222.1
elementary_PID	0014 h	Control
descriptor_tag	67 d	ITU-T data
protocol	01 h	H.245

Following this PMT, packets for elementary streams start to be sent with coded data. At this point, the incoming side user perceives video, new audio (switched from G.711 to G.722) and data. Hereafter no G.711 packets are sent through its logical channel (PID=0020 h) which is still open. This is closed by sending a channelClose message in the LogicalChannelSignalling and receiving its corresponding acknowledgment.

#25 The information contained in this program map table is duplicated with the information in the H.245 logical channel signalling message (PID and coding parameters in form of logicalChannelNumber and capabilities).

 # (S D) Again logicalChannelNumber should not be the PID number.

[G] Mode request from the receiving side

This procedure is independent of the capability procedure. If the sending side agrees to the requested mode, it acknowledges the mode through H.245 messages and makes a mode switching as described in E) above. We need a procedure for resolving conflicts between mode switching and mode request so that the state transition in the sending terminal is clearly defined; e.g. a mode request may be received while awaiting acknowledgment for a mode switching. We propose to define such a conflict resolving procedure in H.245 by giving priority (e.g.) to the mode switching.

4. Observations

In addition to the remarks with # above, there is a general question how the default mode setting be understood. It can be a degenerate case of the general procedures consisting of

capability exchange, logical channel signalling, acknowledgment and the corresponding audiovisual signal transmission. For the default mode setting, the first three procedures are assumed to have been completed and only the final audiovisual transmission is actually seen on the channel.

Another general observation is that in the proposal 2, information in the H.245 message for logical channel signalling and the PMT is duplicated. To utilize widely available H.222.0 devices (or software?), this duplication is necessary?

We should also pay attention to the relationship between H.222.1/H.245 messages and DSM-CC messages. Though the discussion in Kamifukuoka concluded that they are "somewhat different" the relevance should be clarified in the light of the communication procedures addressed in this document.

5. Conclusion

This document has provided a discussion material to clarify the communication procedures which are to be defined in H.222.1, H.245 and H.310. Two specific proposals are made on the definition of default mode PIDs and conflict resolving between mode switch and mode request. It is also pointed out that the relationship between H.222.1/H.245 messages and DSM-CC messages be clarified.

References

[1] AVC-744 Draft H.222.1, February 1995 (input to SG15)
[2] AVC-745 Draft H.245, April 7 , 1995
[3] Correspondence between M Nilsson and S Dunstan on the mode switching, February 1995
[4] AVC-695 Consideration of H.222.0 Transport Stream as multimedia multiplexing for audiovisual communications (Japan), November 1995
[5] AVC-767 Logical channel set-up procedure (Japan), April 1995.