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TITLE: DRAFT RECOMMENDATION H.310 REVISED BY WP1/15

This contribution provides a text for Draft Recommendation H.310 "Broadband audiovisual communication systems and terminals" which has been revised following the discussion in WP1/15.

~~{from S. Okubo to AVC Experts Group members: this is a sligtly different from TD46 (PLE/15) which was determined by SG15 in that changes are indicated to TD-33 (1/15) which is identical to Mr. Radha's h310_nov.doc dated November 11 and that the following Editor's notes were intentionally hidden in TD46 (PLE/15), but reverted back to unhidden in this version to facilitate our work; at the start of Section 5.5, Footnotes 7, 9, 13, 14, 18, 21, 23, 24, 38, 39, 40, 42.}~~

Summary

This Draft Recommendation covers the technical requirements for the systems and terminals of broadband audiovisual communication services defined in H.200/AV.100-Series Recommendations. Both H.310 *unidirectional* and *bidirectional* broadband audiovisual terminals are defined. The classification of H.310 terminals into different terminal types is based on a set of audiovisual, network adaptation, and signaling capabilities. With these capabilities, H.310 terminals support a wide range of conversational and distributive applications and services.

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INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

DRAFT H.310

(21~~70~~ December~~November~~, 1995)

LINE TRANSMISSION OF NON-TELEPHONE SIGNALS

BROADBAND AUDIOVISUAL COMMUNICATION SYSTEMS AND TERMINALS

DRAFT ITU-T Recommendation H.310

FOREWORD

The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the International Telecommunication Union. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, established the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

ITU-T Recommendation H.310 was prepared by the ITU-T Study Group 15 (199x-199x) and was approved by the WTSC (Place, Month xx-xx, 199x).

NOTES

1 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

CONTENTS

Draft Recommendation H.310

BROADBAND AUDIOVISUAL COMMUNICATION SYSTEMS AND TERMINALS

(Place, 199x)

1. Scope

This Draft Recommendation covers the technical requirements for the systems and terminals of broadband audiovisual communication services defined in H.200/AV.100-Series Recommendations.

Recommendation H.310 defines both *unidirectional* and *bidirectional* broadband audiovisual terminals. The classification of H.310 terminals into different terminal types is based on a set of audiovisual, network adaptation, and signaling capabilities which are defined in Section 5.25.25.2. Two classes of unidirectional terminals are covered by this recommendation: Receive-Only-Terminal (ROT) and Send-Only-Terminal (SOT) classes[1]. See Section 5.45.45.4 for more details regarding the unidirectional terminal types and their capabilities.

In this recommendation, bidirectional terminal types are referred to as Receive-and-Send Terminal (RAST) types. The definition of H.310 RAST terminals is based on the following interoperability principles:

1) Interworking between H.310 RAST terminal types and other N-ISDN/B-ISDN (H.320/H.321) audiovisual terminals is mandatory.

2) Interworking among the *different* H.310 RAST terminal types is also mandatory.

Two classes of RAST terminal types are defined: H.310 RAST terminal type for (Public) B-ISDN (RAST-P), and H.310 Terminals for customer premises ATM network (RAST-C). For interworking with H.320/H.321 terminals, both H.310 RAST-P and RAST-C terminal types support common H.320 audiovisual modes as explained in Section 999. For interworking between H.310 RAST-P and H.310 RAST-C terminals, a gateway (not inside the public network but in the customer premises) between a B-ISDN and a customer-premises ATM network might be needed to provide interoperability functions (in certain modes of operation). See Section 999 for more details. Similarly, a gateway between a N-ISDN and a customer premises ATM network is needed to provide interworking functions between RAST-C and H.320 terminals.

{Add description regarding the relationship between H.310 ROT and VoD settop unit without mentioning a particular forum name using the material in §7.3.6/TD-37 (1/15).}

In addition to supporting VoD services, H.310 unidirectional (ROT and SOT) terminals also support simple audiovisual signal transmission, surveillance, and other services. Therefore, all H.310 terminals (unidirectional and bidirectional) are required to support H.245 as their communication

[1] Throughout this recommendation, the term *receive-only* (or *transmit-only*) refers to a unidirectional transmission of the audio and video signals. The term is not necessarily applicable, however, to other data types such as in-band signaling, out-of-band signaling, or other control data which can be received *and* transmitted by a unidirectional terminal.

control protocol so that they can support their intended services and interoperate among each other[2]. Accordingly, H.310 terminals must employ the H.222.1 acknowledged procedures for the subchannel signalling.

~~ROT and SOT are not only for VoD services, but they are also for simple audiovisual signal transmission, surveillance, and other services.~~

~~• All H.310 terminals are required to support H.245 as their communication control protocol so that they interoperate each other. Accordingly, H.310 specifies that the H.222.1 acknowledged procedures are used for the subchannel signalling.~~

~~• The dedicated VoD terminal does not require H.245; such type of terminal is to be defined not as part of H.310 but as part of a separate Recommendation (see the diagram below). This is in line with the practice of N-ISDN audiovisual terminals, namely H.320 with H.242 and H.331 without H.242.~~

The video and audio coding and other technical aspects that are applicable to more than one distinct services are covered in H.200/AV.200-Series Recommendations.

2. References

The following ITU-T Recommendations, and other references, contain provisions which, through reference in this text, constitute the provisions of the Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all 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.

[1~~1~~] ITU-T Recommendation G.711 (1988) - Pulse code modulation (PCM) of voice frequencies
[2~~2~~] ITU-T Recommendation G.722 (1988) - 7 kHz audio-coding within 64 kbit/s
[3~~3~~] ITU-T Recommendation G.723 (1995) - Dual rate speech coder for multimedia communication transmitting at 5.3 & 6.3 kbit/s
[4~~4~~] ITU-T Recommendation G.728 (1992) - Coding of speech at 16 kbit/s using low-delay code excited linear prediction

[5~~5~~] ITU-T Recommendation H.221 (1993) - Frame structure for a 64 to 1920 kbit/s channel in audiovisual teleservices
[6~~6~~] ITU-T Recommendation H.222.0 (1995) - Coding of Moving Pictures and Associated Audio: Systems - ISO/IEC 13818-1
[7~~7~~] ITU-T Recommendation H.222.1 (1995) - Multimedia multiplex and synchronization for audiovisual communication in ATM environments
[8~~8~~] ITU-T Recommendation H.224 (1995) - A real time control protocol for simplex applications using the H.221 LSD/HSD/MLP channels
[9~~9~~] ITU-T Recommendation H.230 (1993) - Frame-synchronous control and indication signals for audiovisual systems
[10~~10~~] ITU-T Recommendation H.233 (1993) - Confidentiality system for audiovisual services
[11~~11~~] ITU-T Recommendation H.234 (1993) - Authentication and key management
[12~~12~~] ITU-T Recommendation H.242 (1993) - System for establishing communication between audiovisual terminals using digital channels up to 2 Mbit/s

[13~~13~~] ITU-T Recommendation H.261 (1993) - Video Codec for audiovisual services at px64 kbit/s

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[2] Please note that a dedicated VoD terminal does not require H.245. Therefore, such a terminal type (i.e., dedicated for VoD) is to be defined not as part of H.310 but as part of a separate Recommendation. This is in line with the practice of N-ISDN audiovisual terminals, namely H.320 with H.242 and H.331 without H.242.

[14~~14~~] ITU-T Recommendation H.262 (1995) - Generic Coding of Moving Pictures and Associated Audio: Video - ISO/IEC 13818-2

[15~~15~~] ITU-T Recommendation H.263 (1995) - Video coding for low bitrate communication

[16~~16~~] ITU-T Recommendation H.281 (1995) - A far end camera control protocol for videoconferences using H.224

[17~~17~~] ITU-T Recommendation H.320 (1993) - Narrow-band ISDN visual telephone systems and terminal equipment

[18~~18~~] ITU-T Recommendation H.321 (1995) - Adaptation of H.320 visual telephone terminals equipment to B-ISDN environments

[19~~19~~] ITU-T Recommendation I.311 (1993) - B-ISDN general network aspects

[20~~20~~] ITU-T Recommendation I.361 (1993) - B-ISDN ATM layer specification

[21~~21~~] ITU-T Recommendation I.362 (1993) - B-ISDN ATM adaptation layer (AAL) functional description

[22~~22~~] ITU-T Recommendation I.363 (1993) - B-ISDN ATM adaptation layer (AAL) specification

[23~~23~~] ITU-T Recommendation Q.2931 (1995) - Broadband integrated services digital network (B-ISDN) - Digital subscriber signaling No. 2 (DSS 2) - User network interface layer 3 specification for basic call/connection control

[24~~24~~] Draft ITU-T T.84 | ISO/IEC 10918-3 (199x): "Digital Compression and Coding of Continuous Tone Still Images - Extensions"

[25~~25~~] ITU-T Recommendation T.120 (199x) - Data protocols for multimedia conferencing - under development

[26~~26~~] ITU-T Recommendation T.434 (1992) - Binary File Transfer Format for the Telematic Services

[27~~27~~] ISO/IEC 11172-3 (1993): Information Technology - Coding of Moving Pictures and Associated Audio for digital storage media at up to about 1,5 Mbit/s - Part 3: Audio

[28~~28~~] ISO/IEC 13818-3 (1995): Information Technology - Generic Coding of Moving Pictures and Associated Audio - Part 3: Audio

[29~~29~~] ISO/IEC 13818-6 (1996): Information Technology - Generic Coding of Moving Pictures and Associated Audio - Part 6: Digital Storage Media Command and Control

3. Definitions

{Add Convention section for the use of "shall", "should", etc. according to §5/H.324.}

The word "shall" is used in this Recommendation to specify a mandatory requirement.

The work "should" is used in this Recommendation to specify a suggested, but not required, course of action.

The work "may" is used in this Recommendation to specify an optional course of action, without expressing a preference.}

4. Applications

The definition of bidirectional (RAST-P and RAST-C) and unidirectional (ROT and SOT) H.310 terminal types is intended for the support of the following applications:

⇒ Conversational services (e.g., videoconferencing and videotelephony services).

⇒ Retrieval services.

⇒ Messaging services.

⇒ Distribution services with individual presentation by the recipient (e.g., video-on-demand services[3] with VCR-like functionalities).

⇒ Distribution services without individual presentation by the recipient (e.g., broadcast TV services[4]).

⇒ Video transmission.

⇒ Surveillance.

5. System Description

5.1 System Configuration

Figure 1/H.310 shows a generic broadband audiovisual communication system. It consists of terminal equipment, network, multipoint control unit (MCU) and the constituent elements of the terminal equipment. The corresponding Recommendations/Draft Recommendations are also identified.

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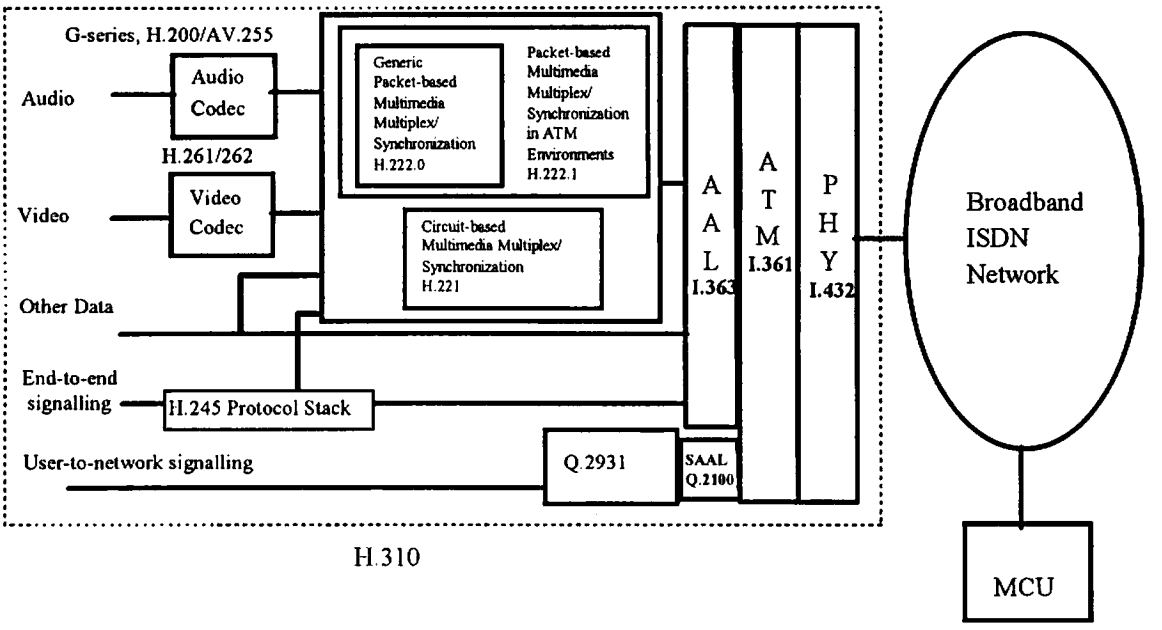
[3] The definition of the required H.310 functions for the support of video-on-demand services is based on close collaboration and formal ITU-T SG-15 ~~informational~~ communication with the ATM Forum Audiovisual Multimedia Services (AMS): Video-On-Demand (VOD) Implementation Agreement.

[4] The definition of the required H.310 functions for the support of broadcast TV services is based on close collaboration with ITU-T SG9 Recommendation J.82 effort.

Figure 111/H.310: Broadband audiovisual communication system and terminal configuration

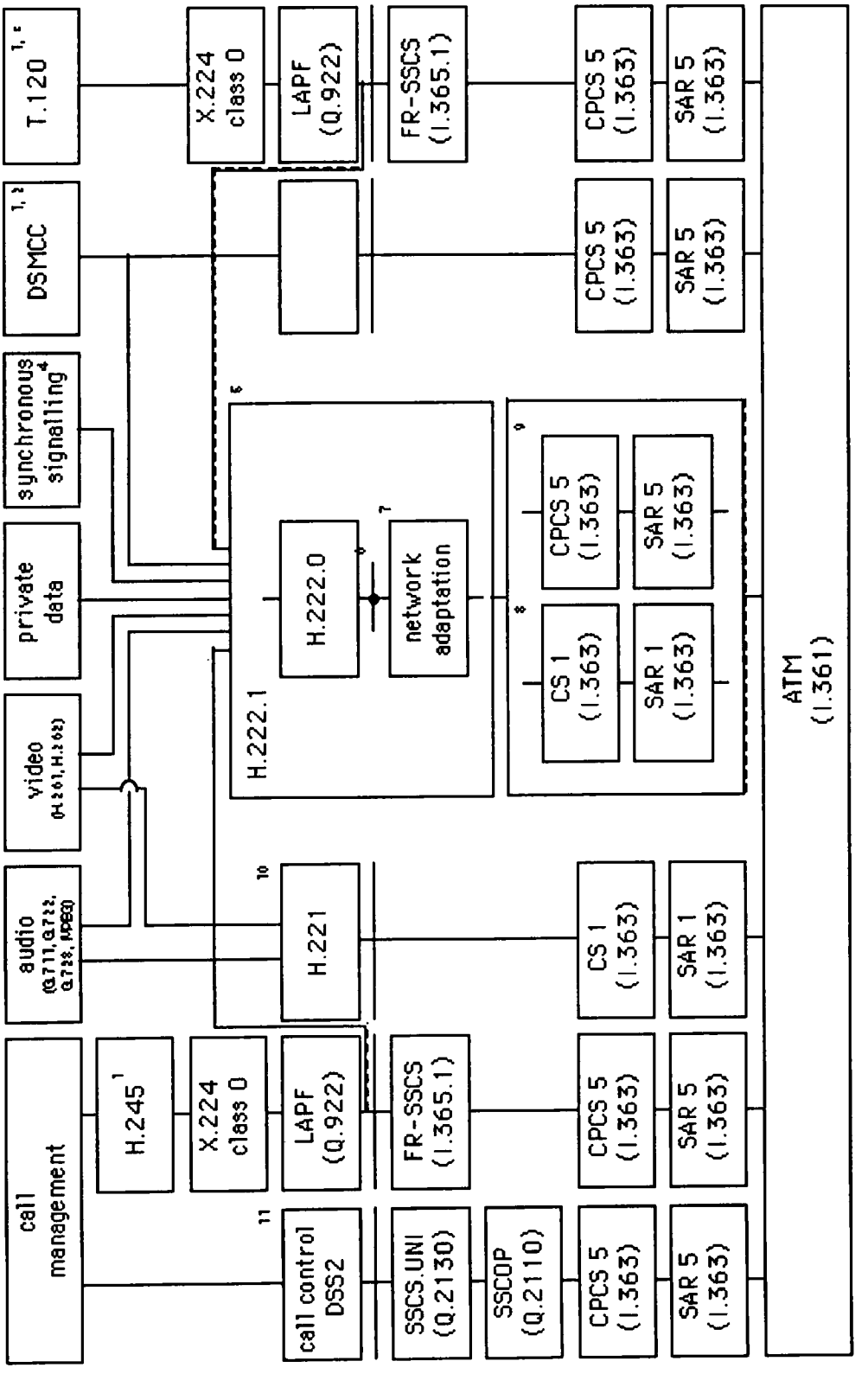


H.310

It is important to note that the generic H.310 terminal shown in Figure 111Figure 11Figure 1 can represent any of the unidirectional or bidirectional terminal types defined in this recommendation.

The interaction among the H.310 terminal capabilities is based on the Protocol Reference Model shown in Figure 222Figure 22Figure 2. This H.310 Reference Model illustrates the protocol stacks for the audiovisual, data, call management (Q.2931 and H.245), DSM-CC, and other control and indication signals that can be supported by the different terminal types of H.310.

Figure 222/H.310: H.310 Protocol Reference Model



{Notes are to be reproduced from Annex 3 to TD-37(1/15).}

Notes to Figure 222~~Figure 22~~:

1) DSM-CC (ISO/IEC 13818-6), and the T.120 protocol stacks may be carried in,

- independent ATM Virtual Channels, or
- H.222.1

In the later case, the anticipated points of connection are shown.

2) Clause 1.3 of ISO/IEC 13818-6 states that AAL5 is suitable for the transport of DSM-CC messages on ATM. The figure indicates this, but leaves unspecified as to whether additional protocol beyond AAL type 5 CPCS is required.

3) Study Group 8 have agreed to use the FR-SSCS (I.365.1) for support of T.120 series protocols in a separate VC (AVC-808). AVC-808 recommends use of FR-SSCS also in case of one VC, which differs from the AVC Experts Group view. The point of connection recommended by the AVC Experts Group for T.120 series in case of one VC is shown in the figure.

4) Video frame synchronous signals are described in H.310.

5) H.222.1/H.222.0 functions:

- multiplexing
- timebase recovery
- media synchronization
- jitter removal
- buffer management
- security and access control
- in-band signalling
- trick modes

H.222.1 chooses elements and procedures from the generic H.222.0, and specifies their use in ATM environments. H.222.1 also specifies code points and procedures for ITU-T defined elementary streams.

6) This point represents the point at which the H.222.2 | ISO/IEC 13818-9: Real Time Interface applies, if it is applicable. This point may not always be physically realised.

7) H.222.1 network adaptation functions:
- jitter removal

8) Although AAL type 1 currently addresses constant bit rate operation, it is anticipated that the AAL type 1 SAR sublayer, and perhaps some of the AAL type 1 CS toolkit, will be used for variable bit rate operation. In the case of variable bit rate operation not all of the following AAL type 1 CS sublayer functions are applicable.

AAL type 1 CS functions:

- transmission clock recovery
- jitter removal
- bit error correction
- cell loss correction
- data structure preservation

9) AAL type 5 (CPCS) functions:

- bit error detection
- cell loss detection
- data structure preservation

9) H.221 is required in the H.310 RAST-P terminals for interworking with H.320 terminals.

10) B-ISDN signalling is referred to as Digital Subscriber Signalling System No. 2 (DSS2). DSS2 is composed of the suite of protocols shown in Table 1.

Table 1 Summary of DSS2 protocols

ITU-T Rec.	Title
Q.2931	User Network Interface Layer 3 specification for basic call/connection control
Q.2961.1	Additional traffic and QOS parameter indications
Q.2962	Negotiation of traffic and QOS parameters (during call/connection establishment)
Q.2963	Renegotiation/modification of traffic and QOS parameters (for already established calls/connections)
Q.2964	B-ISDN look-ahead
Q.2971	Point-multipoint call/connection control
Q.298x	Multiconnection calls

~~1~~

5.2 Terminal Capabilities

As explained above, bidirectional and unidirectional (receive-only and transmit-only) audiovisual terminals are defined by this Recommendation. The definition and classification of H.310 terminal types and their communication modes are based on the following capabilities:

- Audiovisual and Data.
- Network Adaptation.
- Signaling (both user-to-user and user-to-network).

A *communication mode* is defined as a combination of certain parameters of the above capabilities. Based on the different capabilities of H.310 terminals (described below), two classes of communication modes are outlined in Section 5.~~3~~5.~~3~~5.3:

- H.320/H.321 communication modes.
- Native H.310 communication modes.

Before proceeding, it is important to note the following points:

I. For unidirectional H.310 terminals, only native H.310 communication modes of operation are supported. In other words, unidirectional terminals do not support any of the H.320/H.321 communication modes.

II. During the start of the call procedures, H.310 terminals will be able to identify (or infer) the remote terminal type (H.320/H.321, H.310 bidirectional, etc.) via Q.2931 high-level information messages[5], and use a default H.245 (logical) channel or an H.242 channel to perform capability exchange procedures. (See Section 5.~~5~~5.~~5~~5.5 for more details.)

III. If a capability (audiovisual or another) has to be supported by a certain H.310 terminal type (i.e., it is a mandatory capability for that terminal), then this capability may or may not be supported by that terminal type *during a given communication session*, depending on the particular communication mode of operation. For example, and as

[5] This procedure and the related Q.2931 messages are still under study.

explained below, H.310 RAST terminals has to support H.261 video capabilities for interworking with H.320/H.321 terminals. However, the support of H.261 video in H.310 RAST terminals is only mandatory in the H.320/H.321 mode of operation(s), and not in the native H.310 communication mode(s)[6].

5.2.1 Audiovisual and Data Capabilities

5.2.1.1 Video Capabilities

Video capabilities according to ITU-T Recommendations H.261, H.262, and H.263 are considered in this Recommendation.

Unidirectional Terminals
~~Unidirectional H.310 terminals are not required to support any of the H.261 video coding modes.~~

All H.310 unidirectional (SOT and ROT) terminals must support Recommendation H.262 Main Profile (MP) at Mail Level (ML), i.e. H.262 MP@ML conformance point.

The support of the following H.262 profiles and levels is *optional* in unidirectional H.310 terminals:

- H.262 Main Profile at High-14 Level (MP@H14L).
- H.262 Main Profile at High Level (MP@HL).
- H.262 SNR scalability profile at Low Level (SNR@LL).
- H.262 SNR scalability profile at Main Level (SNR@ML).
- H.262 Spatial scalability profile at High-14 Level (Spatial@H14L).
- H.262 High Profile at Main Level (HP@ML).
- H.262 High Profile at High-14 Level (HP@H14L).
- H.262 High Profile at HighMain Level (HP@HML).

H.310 unidirectional terminals must adhere to the hierarchical relationship (as defined in Section 8 of Recommendation H.262) among the different H.262 profiles and levels. Therefore, and based on this hierarchical relationship, it is important to note that H.262 Simple Profile at Mail Level (SP@ML) and Main Profile at Low Level (MP@LL) must be supported by all H.310 terminals.

Moreover, when a given H.262 conformance point (i.e., a given profile at a given level) is supported, H.310 terminals must adhere to the video parameters' constraints[7] outlined in Section 8 of Recommendation H.262 for that conformance point.

Unidirectional H.310 terminals are not required to support any of the H.261 or H.263 video coding modes.

Bidirectional Terminals
All H.310 *bidirectional* terminals must support ITU-T Recommendation H.261 with both the Common Intermediate Format (CIF) and Quarter CIF (QCIF) picture resolutions. This enables the interworking between H.310 and a wide range of existing and future H.320/H.321 terminals.

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[6] It is important to note that when two H.310 RAST terminals communicate, they are not required to operate in an H.320/H.321 mode. However, they have to use that mode when communicating with H.320 or H.321 terminals.

[7] Picture formats, maximum video bitrate, minimum VBV buffer size, and range of motion vectors are examples of H.262 video parameters.

All H.310 bidirectional (RAST-P and RAST-C) terminals must support Recommendation H.262 Main Profile (MP) at Mail Level (ML), i.e. H.262 MP@ML conformance point.

The support of the following H.262 profiles and levels is *optional* in bidirectional H.310 terminals:

- H.262 Main Profile at High-14 Level (MP@H14L).
- H.262 Main Profile at High Level (MP@HL).
- H.262 SNR scalability profile at Low Level (SNR@LL).
- H.262 SNR scalability profile at Main Level (SNR@ML).
- H.262 Spatial scalability profile at High-14 Level (Spatial@H14L).
- H.262 High Profile at Main Level (HP@ML).
- H.262 High Profile at High-14 Level (HP@H14L).
- H.262 High Profile at ~~High~~Main Level (HP@HML).

H.310 bidirectional terminals must adhere to the hierarchical relationship (as defined in Section 8 of Recommendation H.262) among the different H.262 profiles and levels. Therefore, and based on this hierarchical relationship, it is important to note that H.262 Simple Profile at Mail Level (SP@ML) and Main Profile at Low Level (MP@LL) must be supported by all H.310 terminals.

Moreover, and similar to the H.310 unidirectional terminal types, when a given H.262 conformance point (i.e., a given profile at a given level) is supported, H.310 terminals must adhere to the video parameters' constraints outlined in Section 8 of Recommendation H.262 for that conformance point.

In addition to supporting the above optional H.262 video modes, bidirectional H.310 terminals have the *option* of supporting the following H.263 picture format modes:

- H.263 Sub QCIF (SQCIF).
- H.263 QCIF.
- H.263 CIF.
- H.263 four CIF (4CIF).
- H.263 16 CIF (16CIF)

For each of the above H.263 picture formats, H.310 can support the unrestricted vector, arithmetic coding, advanced prediction, and/or PB-frame H.263 optional video modes.

5.2.1.2 Audio Capabilities

Three audio coding standards are considered here: ITU-T G-series (G.711, G.722, G.728, etc.), ISO/IEC 11172-3 (MPEG-1 audio), and ISO/IEC 13818-3 (MPEG-2 audio).

Unidirectional Terminals
Unidirectional H.310 terminals must support Layer 21 of ISO/IEC 11172-3 (MPEG-1) audio. The support of ~~Layer-2 MPEG-1,~~ Layer 3 MPEG-1, and ISO/IEC 13818-3 audio (MPEG-2 audio) standards is optional for unidirectional H.310 terminals.

Unidirectional H.310 terminals can support any of the G-series audio standards as an option[8].

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[8] {Editor: When supporting a G.series audio mode, should H.310 unidirectional terminals support that mode for unidirectional or bidirectional (i.e., audio-only telephony) application?}

Bidirectional Terminals
All *bidirectional* H.310 terminals must support ITU-T Recommendations G.711. This enables existing and future H.320/H.321 terminals to interwork with H.310 terminals. In addition, bidirectional terminals can support one or more of the following ITU-T audio standard (optional):

- G.722 at 64 kbit/s.
- G.722 at 56 kbit/s.
- G.722 at 48 kbit/s.
- G.723 at either 5.3 or 6.3kbit/s.
- G.728 (16 kbit/s).
- G.729 (8 kbit/s).
- G.DSVD (under development).

The support of any of the MPEG-1 and MPEG-2 audio modes by H.310 bidirectional terminals is optional.

5.2.1.3 Data Capabilities

The support of the following data protocols[9] is optional in H.310 terminals:

- T.120 data protocol.
- T.84 image data protocol (e.g., JPEG and JBIG).
- T.434 binary files protocol.
- H.224 simplex device control protocol.
- NLPID network layer protocol as defined in ISO/IEC TR9577[10].
- User-defined data.

These data can be multiplexed with other audiovisual information by using either the H.222.1 or ATM layer multiplexing functions.

T.120 is the default basis of data interoperability between an H.310 terminal and other H.310, H.320, H.321, H.323 or H.324 terminals. When any optional data application is implemented using one or more of the ITU-T Recommendations which can be negotiated via H.245, the equivalent T.120 applications shall be one of those provided (if such applications have been recommended by the ITU-T). A terminal that provides far-end camera control using H.281 and H.224 is not required to also support a T.120 far end camera control protocol. Another ~~The sole~~ exception is Transparent User Data.

5.2.2 Network Adaptation Capabilities (NAC)

The NAC capabilities of H.310 terminals include the multimedia multiplex and synchronization mechanism, ATM Adaptation Layer, transfer rate, and ATM Virtual Connection (VC) capabilities.

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[9] Please note that the support of ITU-T H.245 and ISO DSM-CC messages is covered under the signaling capabilities of H.310 terminals.

[10] {Editor: Is NLPID protocol applicable to or useful for H.310 terminals?}

5.2.2.1 Multimedia Multiplex and Synchronization

Multiplexing of audio, video, data, and control signals in H.310 terminals is accomplished using the multimedia multiplex protocols and procedures defined in Recommendations H.221 and H.222.1. ITU-T Recommendation H.222.1 specifies both H.222.0 (MPEG-2 system) and H.222.1 specific functions (e.g., error protection, jitter removal, ITU-T defined stream_id and descriptors, etc.) not defined by H.222.0. Before proceeding, it is important to note that the multiplexing of H.245, DSM-CC and other control signals and data (e.g., T.120) with the audiovisual information may be accomplished at the ATM Service Access Point (SAP), i.e. through a separate ATM virtual channel.

Unidirectional Terminals
All H.310 unidirectional terminals must support ITU-T Recommendations H.222.0/H.222.1 for the multiplexing and synchronization of video, audio, data, and other control (e.g., H.245 and DSM-CC messages[11]) signals. The support of H.222.10 Transport Stream ~~based~~ multiplexing is *mandatory* for all H.310 unidirectional terminals. The support of H.222.10 Program Stream multiplexing is optional in H.310 unidirectional terminals. ~~In addition to supporting H.222.10 multiplexing and synchronization capabilities, H.310 unidirectional terminals support H.222.1 specific functions.~~

Unidirectional H.310 terminals are *not* required to support the H.221 multiplexing capability.

Bidirectional Terminals
All *bidirectional* H.310 terminals (RAST-P and RAST-C) must support ITU-T Recommendation H.221 for interworking with H.320 and H.321 terminals. For RAST-C terminals, the support of H.221 can be achieved either in the terminal or in a gateway (at the customer premises side) between the (public) ISDN and (private) customer premises networks.

All bidirectional H.310 terminals (RAST-P and RAST-C) must support ITU-T Recommendations H.222.0/H.222.1 for the multiplexing and synchronization of video, audio, data, and other control signals. The support of H.222.10 Transport Stream ~~based~~ multiplexing is *mandatory* for all H.310 bidirectional terminals. The support of H.222.10 Program Stream multiplexing is optional in H.310 bidirectional terminals. ~~In addition to supporting H.222.10 multiplexing and synchronization capabilities, H.310 bidirectional terminals also support H.222.1 specific functions.~~

5.2.2.2 ATM Adaptation Layer

The different types of signals supported by H.310 terminals require different ATM adaptation layer functions. Below, the H.310 AAL capabilities for the multimedia multiplexed (i.e., H.221 and H.222.1), in-band signaling (e.g., H.245), out-band signaling (e.g., Q.2931), and data signals are outlined.

5.2.2.2.1 AAL for H.221/H.222.1 Multiplexed Audiovisual Signals
AAL Segmentation-And-Reassembly (SAR) and Convergence Sublayer (CS) functions are supported by H.310 terminals. Both AAL types 1 and 5 are used for the transfer of the multiplexed Constant Bitrate (CBR) signals over ATM networks.

The definition of AAL functions and capabilities for the adaptation of Variable Bitrate (VBR) audiovisual signals is under study.

Unidirectional Terminals
AAL-1 and AAL-5 based unidirectional H.310 terminal types[12] are defined in this recommendation[13].

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[11] The DSM-CC protocol stacks for H.310 unidirectional terminals is under study.

[12] An AAL-1 based unidirectional terminal is not required to support AAL-5 functions. Similarly, an AAL-5 based unidirectional terminal is not required to support AAL-1 functions.

For the AAL-5 unidirectional terminal type, only SAR and Common Part CS (CPCS) functions are supported as defined in Recommendation I.363. Therefore, Service Specific Convergence Sublayer (SSCS) functions are neither defined nor supported by H.310 AAL-5 unidirectional terminals.

The rules and protocols used for the mapping of H.222.1 Program Stream and Transport Stream packets into the AAL-5 Protocol Data Unit (PDU) is specified in Recommendation H.222.1.

When detecting an errored cell (using the CRC function of the AAL-5 CPCS sublayer), the AAL-5 PDU may be passed to the user according to the corrupted-data delivery option specified in ITU-T Recommendation I.363.5. In addition, the AAL-5 CPCS sublayer must use the length field to detect that the right number of bytes have been received. In this case, the AAL-5 CPCS must report the lost or gained data event, and pass the corrupted (shortened or lengthened) CPCS-PDU to the higher layer. These error event detection capabilities might be used by H.310 terminals for error concealment. This recommendation, however, does not specify a particular method for error concealment.

The usage of the AAL-5 CPCS User-to-User (CPCS-UU) indication field[14] is not specified in this recommendation. Moreover, in H.310 SOT terminals, the Common Part Indicator (CPI) field[15] must always be set to zero (i.e., only the 64-bit alignment function is used).

For the AAL-1 unidirectional terminal scenario, the support of AAL-1 functions is under study[16].

Bidirectional Terminals

Bidirectional H.310 terminals must support the adaptation of H.221 multiplexed audiovisual data using the AAL-1 SAR and CS[17] functions supported in H.321 terminals. This will enable the interworking between H.310 and H.321 terminals. In addition, all bidirectional *RAST-P* H.310 terminals must support the adaptation of H.222.1[18] multiplexed bitstreams into ATM using AAL type 1.

H.310 RAST-P terminals have the *option* of using the (128, 124) Reed-Solomon Forward Error Correction (FEC) code *without* interleaving as part of the AAL type 1 Convergence Sublayer functions.

Neither the Structure Data Transfer (SDT) mode nor the Synchronous Residual Time Stamp (SRTS) of AAL type 1 is supported by H.310 RAST terminals for the transfer of H.222.1 multiplexed data. It is important to note, however, that H.310 terminals must support the AAL type-1 SDT functions when operating in the H.320/H.321 communication mode (as explained above).

The support of AAL type 5 for the adaptation of H.222.1 multiplexed bitstreams is optional for all H.310 RAST terminals (i.e., RAST-P and RAST-C). H.310 RAST-C terminals, however, must

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[13] Note that the current definition of unidirectional terminals implies that an AAL-1 based transmit-only terminal can not communicate with an AAL-5 based receive terminal, and vice versa. Some of this interworking issues are resolved by allowing for the support of the other AAL as an option for a given type of terminal.

[14] {Editor: Do we need to specify the usage of the CPCS-UU field in AAL-5? Can we use it for anything useful in H.310 terminals.}

[15] {Editor: After reading I.363, I am assuming that zero is the only value that should be used for the CPI field in the CPCS sublayer of AAL-5. Is this assumption correct?}

[16] The definition of AAL-1 functions for unidirectional (AAL-1 based) H.310 terminals shouldmay follow the development of proposed Recommendation J.82 which is under study by ITU-T SG-9.

[17] In H.321 terminals, only the Structure Data Transfer (SDT) mode function of the AAL-1 CS is supported. Therefore, and similar to H.321, H.310 terminals are *not* required to support other AAL-1 CS functions such as the Synchronous Residual Time Stamp (SRTS) or any of the cell-loss recovery interleaving methods.

[18] Similar to the unidirectional terminal case, the rules and protocols used for the mapping of H.222.1 Program Stream and Transport Stream packets into the AAL-5 Protocol Data Unit (PDU) and AAL-1 SAR payload is specified in Recommendation H.222.1.

support either AAL type 1 or AAL type 5. An AAL-5 based RAST-C terminal requires a gateway (at the customer premises side of B-ISDN/customer premises ATM network boundary) to provide the AAL-1 adaptation function supported by RAST-P terminals. By supporting these requirements, all bidirectional H.310 terminals will be capable of interworking using the H.222.1 multiplexing scheme.

The rules and protocols used for the mapping of H.222.1 Program Stream and Transport Stream packets into the AAL-5 Protocol Data Unit (PDU) is specified in Recommendation H.222.1.

Similar to the H.310 unidirectional terminals, when detecting an errored cell (using the CRC function of the AAL-5 CPCS sublayer), the AAL-5 PDU may be passed to the user according to the corrupted-data delivery option specified in ITU-T Recommendation I.363.5. Also, the AAL-5 CPCS sublayer must use the length field to detect that the right number of bytes that have been received. The AAL-5 CPCS must report the lost or gained data event, and pass the corrupted (shortened or lengthened) CPCS-PDU to the higher layer. These error event detection capabilities might be used by H.310 terminals for error concealment. This recommendation, however, does not specify a particular method for error concealment.

Also similar to the H.310 unidirectional terminals, the usage of the AAL-5 CPCS User-to-User (CPCS-UU) indication field in RAST terminals is not specified in this recommendation. Moreover, in the transmitter side of H.310 RAST terminals, the Common Part Indicator (CPI) field must always be set to zero. (See footnotes 14~~13~~ and 15~~14~~ above.)

5.2.2.2.2 AAL for Data

Data signals can be multiplexed with other audiovisual elementary streams using either the H.222.1 multiplex layer or the ATM layer. The mapping of data (e.g., T.120) over ATM in H.310 terminals is accomplished through a protocol stack in which the AAL-5 CPCS and SAR sublayers occupy the corresponding ATM adaptation layers (see the H.310 reference model in Section 5.15.~~1~~5.~~1~~).

5.2.2.2.3 AAL for H.245

Capability exchange, mode request and switching, and other H.245 messages can be multiplexed with other audiovisual elementary streams using either the H.222.1 multiplex layer or an AAL/ATM based protocol layer. The mapping of H.245 messages over ATM is accomplished through a protocol stack the complete definition in which the AAL-5 CPCS[19] and SAR sublayers occupy the corresponding ATM adaptation layers (see the H.310 reference model in Section 5.15.~~1~~5.~~1~~).

5.2.2.2.4 AAL for Q.2931

H.310 terminals support the Q.2931 protocol stack for performing out-of-band call management and

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[19] {Editor: We need to specify the AAL-5 PDU size(s) and other AAL rules for the H.245 messages. The H.245 maximum message size in H.310 terminals will follow the maximum size (2048 bytes?) specified for H.324 terminals.}

signaling functions. In addition to the Q.2130 (SSCS.UNI) and Q.2110 (SSCOP) layers, the AAL-5 CPCS and SAR sublayers represent an integrated part of the Q.2932 protocol stack.

5.2.2.2.5 ATM Virtual Connection(s)

H.310 terminals may support single or multiple ATM VC's for the transfer of H.221 (in the H.320/H.321 mode) or H.222.1[20] multiplexed audiovisual signals. Additional VC's might be required

[20] The support of only a single VC is possible when the multiplexing of all audiovisual elementary streams, user data, and control (e.g., H.245 messages) is accomplished using the H.222.1 multiplexing and synchronization functions. This capability, however, is under study.

for the transfer of H.245 messages or other data (e.g., T.120). The minimum number of VC's that the different types of H.310 terminals will support is under study[21].

5.2.2.3 Transfer Rate

H.310 terminals are capable of supporting a wide range of possible transfer rates. The transfer rate capabilities of H.310 terminals are defined at the different service access points within the terminal protocol reference models as explained below.

5.2.2.3.1 Multimedia Multiplex H.221/H.222.1 Transfer Rates

Bidirectional H.310 terminals must support the B, 2B, and H0 narrow-band ISDN transfer rates of H.320/H.321 terminals. Other H.320/H.321 rates (e.g., H11 and H12) are optional. This will enable the interworking of H.310 terminals with a wide range of H.320/H.321 terminals.

Both unidirectional and bidirectional H.310 terminals will support Constant Bitrate (CBR) transfer rates of n x 64 kbit/s, where n ranges from 1 to 65535, for the transmission and reception of H.222.1 multiplexed audiovisual signals.

Mandatory transfer rates are P=6.abc Mbit/s (for MP@ML medium quality services) and Q=9.xyz Mbit/s (for MP@ML high quality services) where P/Q is a simple rational number. The specific values for P and Q are under study. Other optional rates can be negotiated through H.245 capability messages and related procedures.

{Editor: The specification of other CBR and VBR transfer rates is under study.}

5.2.2.3.2 ATM Cell Rate

{Editor: The ATM cell rates described in Japan contribution AVC-723, January 1995 will be outlined here.}

5.2.3 Signaling Capabilities

{Editor: This section discusses the different user-to-user and user-to-network signaling capabilities that H.310 terminals must support. There are many issues regarding the different signaling entities (H.245 messages and procedures, DSM-CC, H.222.1 subchannels, Q.2931, etc.) and the interaction among them that need to be resolved or better understood before completing this section. Therefore, modifications to this section are expected in future versions of the Recommendation. The editor needs a lot of help here!}

5.2.3.1 User-to-Network Signaling

All H.310 terminals (unidirectional and bidirectional) must support Recommendation Q.2931 for user-to-network signaling.

The support of user-to-network DSM-CC messages and procedures by H.310 terminals is under study.

5.2.3.2 User-to-User Signaling

5.2.3.2.1 H.245/H.242-H.230

All H.310 terminals (unidirectional and bidirectional) must support Recommendation H.245 messages and procedures for user-to-user (e.g., capability exchange, mode switching, etc.) signaling. The exact set of H.245 messages and procedures to be supported by H.310 terminals is under study and will be outlined in the next version of this Recommendation. H.245 signaling is only supported in the native H.310 communication mode.

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[21] {Editor: It is important to note that bidirectional H.310 terminals have to support, at minimum, two VC's for the transfer of 2B channels in the H.320/H.321 mode. This transfer mode is required for interworking with current and future H.320/H.321 terminals.}

All *bidirectional* H.310 terminals (RAST-P and RAST-C) must support ITU-T Recommendations H.242 and H.230 for interworking with H.320 and H.321 terminals. For RAST-C terminals, the support of H.242 and H.230 can be achieved either in the terminal or in a gateway (at the customer premises side) between the (public) ISDN and (private) customer premises networks. H.242/H.230 based signaling is only required in the H.320/H.321 communication mode of H.310 terminals.

5.2.3.2.2 DSM-CC

The support of user-to-user DSM-CC messages and procedures by H.310 terminals is under study.

5.2.3.2.3 Video-Frame-Synchronous (VFS) Control and Indication (C&I) Signaling

The following VFS C&I signals must be supported by all H.310 bidirectional terminals[22]:

- ◊ Video-freeze-picture-release control
- ◊ Split-screen indication
- ◊ Document-camera indication
- ◊ Closed caption

The syntax for VFS C&I signals is shown Table 111~~Table 11~~~~Table 1~~. Details of other aspects of H.310 VFS C&I signals (e.g., their multiplexing with the audiovisual information) are under study.

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[22] {Editor: Do we need to include VFS C&I signals in unidirectional terminals also?}

Table 111: Syntax for H.310 Video-Frame-Synchronous Control and Indication Signals

```
VideoFrameSynchronousCandIPDU          ::=SEQUENCE SIZE (1.. 65535) OF
{
□ elementaryStream                     CHOICE
  {
      ts-PID   INTEGER (0..8191),
      ps-StreamID                      SEQUENCE
          {
              streamID                 INTEGER (0..255),
              streamIDExtension        INTEGER (0..255)
          }
      },
  resourceID   INTEGER (0..65535) OPTIONAL,
□ videoFrameSynchronousCommand         VideoFrameSynchronousCommand OPTIONAL,
  videoFrameSynchronousIndication      VideoFrameSynchronousIndication OPTIONAL,
  ...
}

VideoFrameSynchronousCommand           ::=SET
{
  nonStandard NonStandardParameter OPTIONAL,
  videoFreezePictureReleaseControl     NULL OPTIONAL,     -- not used for H.261 or H.263
streams
  closedCaption                        OCTET STRING OPTIONAL,
  ...
}

VideoFrameSynchronousIndication        ::=SET
{
  nonStandard NonStandardParameter OPTIONAL,
  splitScreenIndication                NULL OPTIONAL,     -- not used for H.261 or H.263
streams
  documentCameraIndication             NULL OPTIONAL,     -- not used for H.261 or H.263
streams
  ...
}

-- The following lines are quoted from draft H.245

NonStandardParameter                   ::=SEQUENCE
{
  nonStandardIdentifier                NonStandardIdentifier,
  data          OCTET STRING
}

NonStandardIdentifier                  ::=CHOICE
{
  object                               OBJECT IDENTIFIER,
  h221NonStandard                      SEQUENCE
  {
      t35CountryCode                   INTEGER (0..255),
      t35Extension                     INTEGER (0..255),
      manufacturerCode                 INTEGER (0..65535)
  }
}
```

5.3 Communication Modes

Two basic modes of communication are defined for H.310 terminals:

⇒ Native H.310 communication modes
⇒ H.320/H.321 communication modes

The native H.310 communication modes are characterized by the usage of the H.222.1 multimedia multiplexing layer for the synchronization and other multiplexing functions of audiovisual, data, control, and indication signals. These communication modes are also characterized by using H.245[23] for capability exchange and other user-to-user signaling functions. It is important to note, however, that H.245 and DSM-CC messages might be carried in a totally separate ATM channel than the ATM VC used for the audiovisual information. Moreover, ATM Adaptation Layer (AAL) types 1 or 5 can be used in the native H.310 communication modes for the transfer of the audiovisual (H.222.1-multiplexed) data. (See Section 5.~~4~~5.~~4~~5.~~4~~ for more details.)

The H.320/H.321 communication modes are characterized by the usage of the H.221 multiplexing scheme employed in N-ISDN H.320 and B-ISDN H.321 audiovisual terminals. In these modes, capability exchange and other user-to-user signaling is carried out using the H.242 and H.230 messages and procedures employed in H.320 and H.321 terminals. Therefore, in the H.320/H.321 modes of operation, there is no support for H.245 and DSM-CC signaling. Currently, only AAL type-1 based transfer of audiovisual (H.221-multiplexed) data is defined for the H.320/H.321 modes of communication.

H.310 unidirectional (SOT and ROT) terminals only support the native H.310 communication modes.

H.310 bidirectional terminals (RAST-P and RAST-C) support both the H.310 native and H.320/H.321 communication modes.

5.4 H.310 Terminal Types

H.310 Unidirectional Terminals

As explained earlier, this recommendation defines both unidirectional and bidirectional terminals. Two classes of unidirectional terminals are defined: Send-Only-Terminal (SOT) and Receive-Only-Terminal (ROT). Under each unidirectional class, two terminal types are defined depending on the ATM Adaptation Layer (AAL) type supported by the terminals. AAL type 1 based SOT and ROT terminals are defined. Similarly, AAL type 5 based SOT and ROT terminals are defined. Therefore, this recommendation defines two pairs of unidirectional terminals. The two terminals of a given unidirectional pair are interoperable. However, the different pairs of unidirectional terminals may not interwork with each other.

H.310 Bidirectional Terminals

Two classes of bidirectional Receive-and-Send Terminal (RAST) types are defined: H.310 RAST terminal type for (Public) B-ISDN (RAST-P), and H.310 Terminals for customer premises ATM networks (RAST-C). For interworking with H.320/H.321 terminals, both H.310 RAST-P and RAST-C terminal types should support the H.320 audiovisual modes shown in Table 22~~Table 22~~Table 2. (See Section 9~~9~~9.) For interworking between H.310 RAST-P and H.310 RAST-C terminals, a gateway (not inside the public network but in the customer premises) between a B-ISDN and a customer premises ATM network is needed to provide interoperability functions (in certain modes of operation). See Section 9~~9~~9 for more details. Similarly, a gateway between a N-ISDN and a customer premises ATM network is needed to provide interworking functions between RAST-C and H.320 terminals.

[23] Note that the support of H.245 is mandatory for all H.310 terminals. The support of DSM-CC is optional for all (unidirectional and bidirectional) terminals.

Each of the above unidirectional and bidirectional terminal types support different mandatory and optional H.310 capabilities outlined above. These Mandatory (M) and Optional (O) capabilities are shown in the tables below for the different types of H.310 terminals.

Table 222/H.310: Audiovisual and Data Capabilities of Unidirectional H.310 Terminals

Terminal Type	Audiovisual and Data Capabilities					
	Video		Audio[24]		Data[25]	
	M	O	M	O	M	O
ROT/SOT (AAL-1)	H.262 MP@ML[26]	H.262 MP@H14L H.262 MP@HL H.262 SNR@LL H.262 SNR@ML H.262 Spatial@H14L H.262 HP@ML H.262 HP@H14L H.262 HP@HML	MPEG1 Layer21	MPEG1 L2 MPEG1 L3 MPEG2 L1 MPEG2 L2 MPEG2 L3 G.711 G.722 G.728 G.723 G.729 G.DSDV	US	US
ROT/SOT (AAL-5)	H.262 MP@ML[26][25]	H.262 MP@H14L H.262 MP@HL H.262 SNR@LL H.262 SNR@ML H.262 Spatial@H14L H.262 HP@ML H.262 HP@H14L H.262 HP@HML	MPEG1 Layer21	MPEG1 L2 MPEG1 L3 MPEG2 L1 MPEG2 L2 MPEG2 L3 G.711 G.722 G.728 G.723 G.729 G.DSDV	US	US

[24] {Editor: The support of MPEG-1, MPEG-2, and G-series audio by the different types of H.310 terminals require further study. Therefore, it is quite possible that the entries in both the mandatory and optional columns may change.}

[25] {Editor: It is not clear if ROT and SOT terminal types would need the functions provided by a standard data protocol such as T.120. Should we consider other data types that might be suitable for these types of terminals?} {T.120 is useful, e.g. in data conferencing. Other data are also useful particularly in the distribution service environments. In any case, support of data is optional in H.310 terminals.}

[26] Note that the support of H.262 Main Profile (MP) at Main Level (ML) also implies the support of H.262 Simple Profile (SP) at Main Level (ML) and Main Profile at Low Level.

Table 333/H.310: Audiovisual and Data Capabilities of Bidirectional H.310 Terminals in The Native H.310 Communication Mode

Terminal Type	Audiovisual and Data Capabilities					
	Video		Audio[27]		Data	
	M	O	M	O	M	O
RAST-P	H.262 MP@ML[26263]	H.261 QCIF H.261 CIF H.262 MP@H14L H.262 MP@HL H.262 SNR@LL H.262 SNR@ML H.262 Spatial@H14L H.262 HP@ML H.262 HP@H14L H.262 HP@ML H.263 SQCIF H.263 QCIF H.263 CIF H.263 4CIF H.263 16CIF	G.711	G.722 G.728 G.723 G.729 G.DSDV MPEG1 L1 MPEG1 L2 MPEG1 L3 MPEG2 L1 MPEG2 L2 MPEG2 L3	US	T.120 T.84 T.434 H.224 NLPID UserData
RAST-C	H.262 MP@ML[26263]	H.261 QCIF H.261 CIF H.262 MP@H14L H.262 MP@HL H.262 SNR@LL H.262 SNR@ML H.262 Spatial@H14L H.262 HP@ML H.262 HP@H14L H.262 HP@ML H.263 SQCIF H.263 QCIF H.263 CIF H.263 4CIF H.263 16CIF	G.711	G.722 G.728 G.723 G.729 G.DSDV MPEG1 L1 MPEG1 L2 MPEG1 L3 MPEG2 L1 MPEG2 L2 MPEG2 L3	US	T.120 T.84 T.434 H.224 NLPID UserData

[27] {Editor: The support of MPEG-1, MPEG-2, and G-series audio by the different types of H.310 terminals may require further study.}

Table 444/H.310: Audiovisual and Data Capabilities of Bidirectional H.310 Terminals in The H.320/H.321 Communication Mode

Terminal Type	Audiovisual and Data Capabilities					
	Video		Audio		Data	
	M	O[28]	M	O[29]	M	O[30]
RAST-P	H.261 QCIF H.261 CIF	H.262 MP@ML H.263 SQCIF H.263 QCIF H.263 CIF H.263 4CIF H.263 16CIF	G.711	G.722 G.728 G.723?? G.729?? G.DSDV? MPEG1?? MPEG2??	US	T.120 T.84 T.434 H.224 NLPID UserData
RAST-C	H.261 QCIF H.261 CIF	H.262 MP@ML H.263 SQCIF H.263 QCIF H.263 CIF H.263 4CIF H.263 16CIF	G.711	G.722 G.728 G.723?? G.729?? G.DSDV? MPEG1?? MPEG2??	US	T.120 T.84 T.434 H.224 NLPID UserData

[28] The particular H.262 and H.263 optional video modes to be supported by H.320/H.321 is under study.

[29] The support of some of the optional audio modes shown in the table is under study.

[30] The support of some of the optional data modes shown in the table may require further study.

Table 555/H310: Network Adaptation Capabilities of H.310 Terminals

Terminal Type	Network Adaptation Capabilities							
	Multimedia Multiplex[31]		AAL for Audiovisual Data		Number of ATM VCs[32]		Transfer Rate	
	M	O	M	O	M	O	M	O
ROT (AAL-1)	H.222.1~~H.2 22~~ TS	H.222.1~~H.2 22~~ PS	AAL-1	AAL-5	one	> one	US	US
ROT (AAL-5)	H.222.1~~H.2 22~~ TS	H.222.1~~H.2 22~~ PS	AAL-5	AAL-1	one	> one	US	US
SOT (AAL-1)	H.222.1~~H.2 22~~ TS	H.222.1~~H.2 22~~ PS	AAL-1	AAL-5	one	> one	US	US
SOT (AAL-5)	H.222.1~~H.2 22~~ TS	H.222.1~~H.2 22~~ PS	AAL-5	AAL-1	one	> one	US	US
RAST-P (Native H.310 Comm. Mode)	H.222.1~~H.2 22~~ TS	H.222.1~~H.2 22~~ PS	AAL-1	AAL-5	one	> one	US	US
RAST-C (Native H.310 Comm. Mode)	H.222.1~~H.2 22~~ TS	H.222.1~~H.2 22~~ PS	AAL-1 or AAL-5	AAL-5 or AAL-1	one	> one	US	US
RAST-P (H.320/H.321 Comm. Mode)	H.221	None	AAL-1	None	two	> two	B 2B H0	nxB nxH0 H11 H12
RAST-C (H.320/H.321 Comm. Mode)	H.221[33~~33~~]	US	AAL-1[33]	None	two	> two	B 2B H0[33~~33~~]	nxB nxH0 H11 H12

[31] Other H.222.1 functions that are currently under study might be added to this column.

[32] This capability represents the minimum number of VCs required for the transfer of audiovisual (H.222.1 or H.221 multiplexed) data. supported by H.310 terminals. Other VCs might be required to support the transfer of other data types (e.g., Q.2931 signaling, H.245 messages, or T.120 data).

[33] The support of multiplexing, control protocol, bitrate, and AAL-1 functions in the RAST-C terminal case might be provided by a gateway (at the premises side of the boarder) between the (public) B-ISDN and (private) customer premises ATM networks.

Table 666/H.310: Signaling Capabilities of H.310 Terminals

Terminal Type	Signaling Capabilities			
	User-to-User Signaling (H.245/DSM-CC UU)		User-to-Network Signaling (Q.2931/DSM-CC UN)	
	M	O	M	O
ROT/SOT (AAL-1)	H.245	DSM-CC UU	Q.2931	DSM-CC UN
ROT/SOT (AAL-5)	H.245	DSM-CC UU	Q.2931	DSM-CC UN
RAST-P (Native H.310 Comm. Mode)	H.245	DSM-CC UU	Q.2931	DSM-CC UN
RAST-C (Native H.310 Comm. Mode)	H.245	DSM-CC UU	Q.2931	DSM-CC UN
RAST-P (H.320/H.321 Comm. Mode)	H.242/H.230	US	Q.2931	US
RAST-C (H.320/H.321 Comm. Mode)	H.242/H.230	US	Q.2931	US

5.5 H.310 Call Phases

{Editor: Major modifications are expected here to reflect the group's latest understanding of the different in-band and out-of-band signaling scenarios, and the interaction of the Q.2931, H.245, and DSM-CC signaling entities and functions. This version includes some of the ideas outlined in Mr. Okubo's recent contribution (AVC-841) for the H.310 start up procedures. Also, the editor used his cosmic editorial power and took the initiative to describe his latest understanding of the issues!!}

The call and signaling procedures (between two H.310 terminals or between an H.310 terminal and an H.320/H.321 terminal) described in this section are based on the following principles:

1. An H.310 terminal (initiating or receiving a call) will be able to identify the remote terminal type (H.320/H.321, H.310 RAST, etc.) via Q.2931 signaling at the beginning of the call (i.e., prior to audiovisual communications)[34].

2. When two H.310 terminals are communicating, a default H.245 (logical) channel is established over the initial ATM VC at the beginning of the call.

3. When two H.310 terminals communicate, each terminal can indicate its capabilities (outlined in Section 5.~~25.25.2~~) to the remote terminal using the capability-exchange messages and procedures[35] described in ITU-T Recommendation H.245.

4. When an H.310 terminal communicates with an H.320/H.321 terminal, the two terminals use the H.242 and H.230 messages and procedures for capability exchanges and other in-band signaling needs as done in H.320/H.321 terminals.

5. For the different types of native H.310 communication modes, in-band signaling during the call will be based on H.245 messages and procedures. After using H.245 capability exchanges and call procedures, some H.310 terminals may invoke a DSM-CC channel depending on the particular mode of operation and the intended application (e.g., VOD).

Depending on the type of the two communicating terminals, an H.310 terminal will employ one of the following three call procedures:

I. **Receive-And-Send-Terminal/Receive-And-Send-Terminal (RAST/RAST)**

The *RAST/RAST* call procedures have to be supported by all bidirectional (RAST-P and RAST-C) H.310 terminals.

II. **Send-Only-Terminal/Receive-Only-Terminal (SOT/ROT)**

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[34] The details of this procedure and the related Q.2931 messages are under study.

[35] {Editor: We need to address the following questions regarding the usage of DSM-CC in conjunction with Q.2931 and H.245:

- It has been agreed that unidirectional H.310 terminals can support DSM-CC functions as an option. Do we need to identify *what* DSM-CC user-to-user, user-to-network, software-download, and other functions that should be mandatory and/or optional in H.310 unidirectional terminals? Or, it is good enough to point to the DSM-CC specification only without further clarifying what is the minimum set of functions that must be supported?
- It has been agreed that bidirectional H.310 terminals can support DSM-CC functions as an option. Do we need to be more specific about what DSM-CC functions that should be considered?}

The *SOT/ROT* call procedures have to be supported by all H.310 unidirectional (SOT and ROT) terminals. The support of these procedures by bidirectional H.310 terminals is optional.

III. **Receive-And-Send-Terminal/H.321 terminals (RAST/H.321)**

The RAST/H.321 call procedures, which are used for communications between H.310 bidirectional and H.320/H.321 terminals, has to be supported by all RAST H.310 terminals.

It is important to note that the three above procedures share common phases as explained below. In particular, common start-up procedures will be supported by all H.310 terminals. This will ensure maximum interoperability among the different types of H.310 terminals.

Figure 333~~Figure 33~~~~Figure 3~~ shows the H.310 call phases for the RAST/RAST and SOT/ROT call procedures.

5.5.1 H.310 RAST/RAST Call Procedures

The RAST/RAST call procedure is divided into the following call phases:

I. **Phase A (Call-Setup)**

Phase A is a call set-up procedure phase which is divided into the following subphases:

- **Phase A1 (Initial VC-Setup)**
  In this phase, the *initial* ATM virtual channel (VC) using a Q.2931 SETUP message is established. The exact parameters and Q.2931 Information Elements (IEs) used for this phase is under study. It is important to note that all H.310 terminals has to perform this phase using Q.2931. Therefore, Phase A1 is the same (except for one or two Q.2931 SETUP message parameters) for all of the three call procedure types listed above (i.e., SOT/ROT, RAST/RAST, and RAST/H.321).

  One of the key features of this phase is that it enables an H.310 terminal (initiating or receiving a call) to either identify the type of H.310 remote terminal or infer that the remote terminal is not an H.310 terminal type (i.e., by default the remote is an H.320/H.321 terminal). This is done by using the Broadband-High Layer Information (B-HLI) IE of the Q.2931 SETUP message. An H.310 terminal has to set the Terminal Protocol Identification field of the B-HLI information element to the appropriate parameter which indicates the H.310 terminal type[36] . If an H.310

[36] {Editor: the AVC group has agreed that there is an advantage in identifying an H.310 terminal type and *possibly* its AAL capabilities. The Editor proposes that the group consider allocating the following codes for identifying H.310 terminal types:

- H.310 SOT/AAL-1
- H.310 SOT/AAL-5
- H.310 SOT/AAL-1 & AAL-5
- H.310 ROT/AAL-1
- H.310 ROT/AAL-5
- H.310 ROT/AAL-1 & AAL-5
- RAST-P
- RAST-P/AAL-5
- RAST-C/AAL-1

terminal does not receive the B-HLI information element from the remote terminal, then the H.310 terminal has to assume that it is communicating with an H.320/H.321 terminal[37].
The initial VC should have a bitrate of 64 kbit/s (with AAL-5) for the transfer of H.245 capability exchange messages as explained below[38].

- **Phase A2 (Capability Exchange)**
  In this phase, it is assumed that each H.310 terminal has already identified that the remote terminal is an H.310 terminal type. Therefore, at this stage the two terminals can (and should) exchange their capability information using the appropriate H.245 messages and procedures over the initial VC that was established in Phase A1. Based on the capabilities of the two terminals, the highest common mode of communication should be determined[39] .

- **Phase A3 (Additional VC Setup)**
  In this phase, and based on the highest communication mode determined above, the calling[40] terminal (i.e., the one who initiated the first VC SETUP message) should

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- RAST-C/AAL-5
- RAST-C/AAL-1 & AAL-5

}

[37] {Editor: These procedures need the following clarifications:

- First, can we rely 100% on the delivery of B-HLI information elements to terminals?. If the answer is yes, then this approach might work. If the answer is no, then what is the alternative for (a) distinguishing between H.320/H321 and H310 terminals, and (b) identifying H.310 terminal types? When a RAST H.310 terminal can't verify that the remote terminal is another H.310, it seems that the safe thing to do is to use the initial VC to transmit H.221 framed signal with G.711 and H.242 messages in BAS just as done in H.320/H.321 terminals.
- Second, if we assume that the above scenario occurs (i.e., the two terminals can not identify themselves to each other and an H.320/H.321 mode of communication is established over the initial VC) while the two terminals are actually H.310 RAST terminals, is it possible to use some kind of an escape mechanism (e.g., a new H.245 escape code in H.242 which is only recognizable by H.310 terminals) to start an H.245 session between the two H.310 terminals. This may require allocating a new BAS code for an H.245 capability which would be ignored by H.320/H.321 terminals but recognized by H.310 terminals.
- Third, there is still the AAL type issue. In other words, when an H.310 RAST terminal selects AAL-5 in the Q.2931 SETUP message with the intention of using the VC for transmitting H.245 messages (over AAL-5), then what would be the solution if that terminal finds-out (or infer by not receiving the desired B-HLI information element) that the remote terminal is an H.320/H.321 terminal? In fact, if the remote terminal is an H.320/H.321 terminal type, most likely the call will be rejected (either by a N-ISDN/B-ISDN I.580 Interworking Unit or by an H.321 terminal) if the calling terminal requests an AAL-5 based VC.
- Forth, if the call is rejected as in the last example, can this rejection be used as an indication that the remote terminal is an H.320/H.321 one, and then the calling H.310 terminal can use that to retry the Q.2931 call set-up procedure with selecting AAL-1 with the intention of transmitting H.221 framed signal over the initial VC.}

[38] The call procedure explained above are based on establishing two VCs: one for H.245 messages, and the other for the transfer of audiovisual (and possibly other) data. A ***single***-VC call procedure is currently under study as an alternative to the two-VC based solution.

[39] {Editor: Do we need to be more specific in here? Do we need to outline some rules on how to identify the highest mode of communications?}

[40] {Editor: Do we need, at this stage of the call, to identify which terminal is the H.245 Master and which one is the Slave? If we do, can we always assume that the calling and called terminals are the H.245 Master and Slave, respectively, for the default H.245 channel over the initial VC? Or, do we need to use the H.245 Master/Slave determination procedure to identify who is the master and who is the slave? And, if we decide that a particular terminal is the Master, does this terminal stays the Master of all logical channels established over a given VC and during the remaining of the call (over that VC)? Also, should the Master (or calling) terminal be responsible

setup an additional VC[41] with the appropriate parameters (e.g., bitrate, AAL type, etc.) for the transfer of the audiovisual and other data between the two H.310 terminals.

- **Phase A4 (Logical Channels Setup)**
  The Master[42] H.310 terminal should open the desired video, audio, data, and/or control logical channels using the appropriate H.245 logical channel setup messages and procedures.

II. **Phase B (Audiovisual Communication)**

In addition to the transfer of audiovisual and other data during Phase B of the call, one or more of the following procedures may also take place:

- **Mode Request and Switching**
  H.310 RAST terminals can request and switch to a new mode of audiovisual communication over the different logical channels (established over a given VC) using the mode request and switching messages and procedures outlined in H.245.

- **Control & Indication (C&I) Signaling**
  H.310 RAST terminals can use H.230-like video-synchronous C&I signals. The complete definition of these signals is still under study.

- **Maintenance and Roundtrip Delay Signaling**
  H.310 RAST terminals can use the H.230-like maintenance (loopback) and roundtrip delay messages described in H.245.

III. **Phase C (Call Release)**

In this phase, all H.245 logical channels and ATM VCs are released using the procedures outlined in H.245 and Q.2931, respectively.

5.5.2 H.310 SOT/ROT Call Procedures

Under study (See Figure 333~~Figure 33~~Figure 3.)

5.5.3 RAST/H.321 Call Procedures

After determining that the remote terminal is an H.320/H.321 terminal type, a RAST H.310 terminal must follow the call procedures described in ITU-T Recommendations H.320 and H.321.

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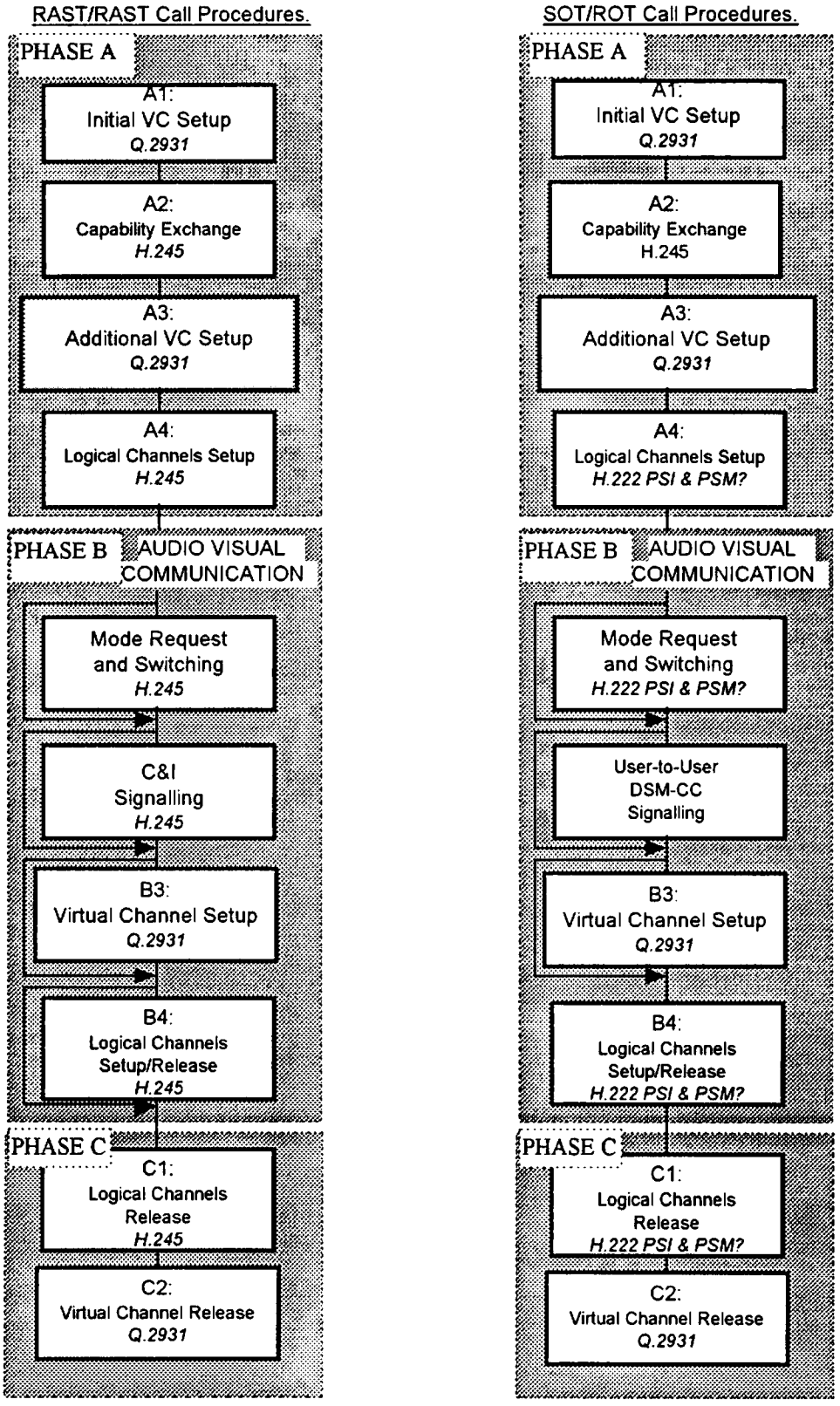
for identifying the communication mode(s) for the audiovisual channel (e.g., video and audio modes, bitrates, etc.)?}

[41] {Editor: After both terminals exchange capabilities, and after *determining* the appropriate parameters for the additional VC and the desired audiovisual logical channels and their modes of communication (for the other VC), can the terminals drop the first (initial) VC and establish a new one with the desired Q.2931 parameters and a *predetermined* set of audiovisual logical channels? It seems that this may work if (a) all of the predetermined logical channels use the same AAL type, (b) all of the logical channels get multiplexed prior to the AAL SAP, and (c) one of the (predetermined) logical channels should be for communicating H.245 messages over the new (and only) VC. Or, the establishment of an additional VC is always the only way to get around this issue? For RAST terminals we know that they have to support at least two VCs for audiovisual communication (for interworking with H.320/H.321 terminals). Therefore, this may not be a major issue for RAST terminals. what's about unidirectional terminals?}

[42] As determined by the H.245 Master/Slave determination procedure used over the initial VC channel.

Figure 333/H.310: H.310 Call Phases for RAST/RAST and SOT/ROT Call Procedures



5.6 Communication Protocol
Under study.

6. Multipoint Communication

{Necessary minimum support of multipoint related H.245 messages are to be specified here, leaving other enhancements to the future revision. Study in H.323, H.324 can be reflected.} {Editor: Help is needed here!}

7. Equipment Requirements
For further study.
{Editor: this section will contain information related to the equipment requirements for interworking, such as audio level setting, including MPEG audio.}

8. Error Resilience
For further study.

{Editor: this section will contain information related to the error resilience of the system. Contributions are welcome.}

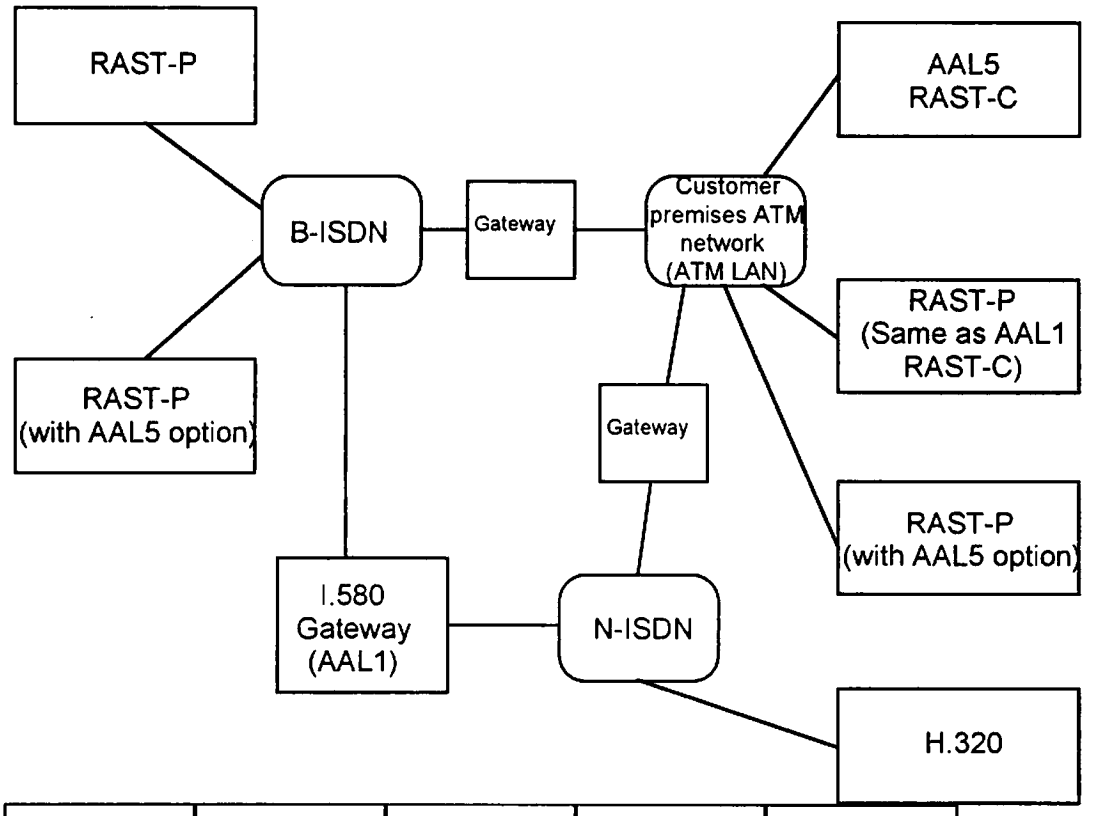
8.1 Video Layer
For further study.

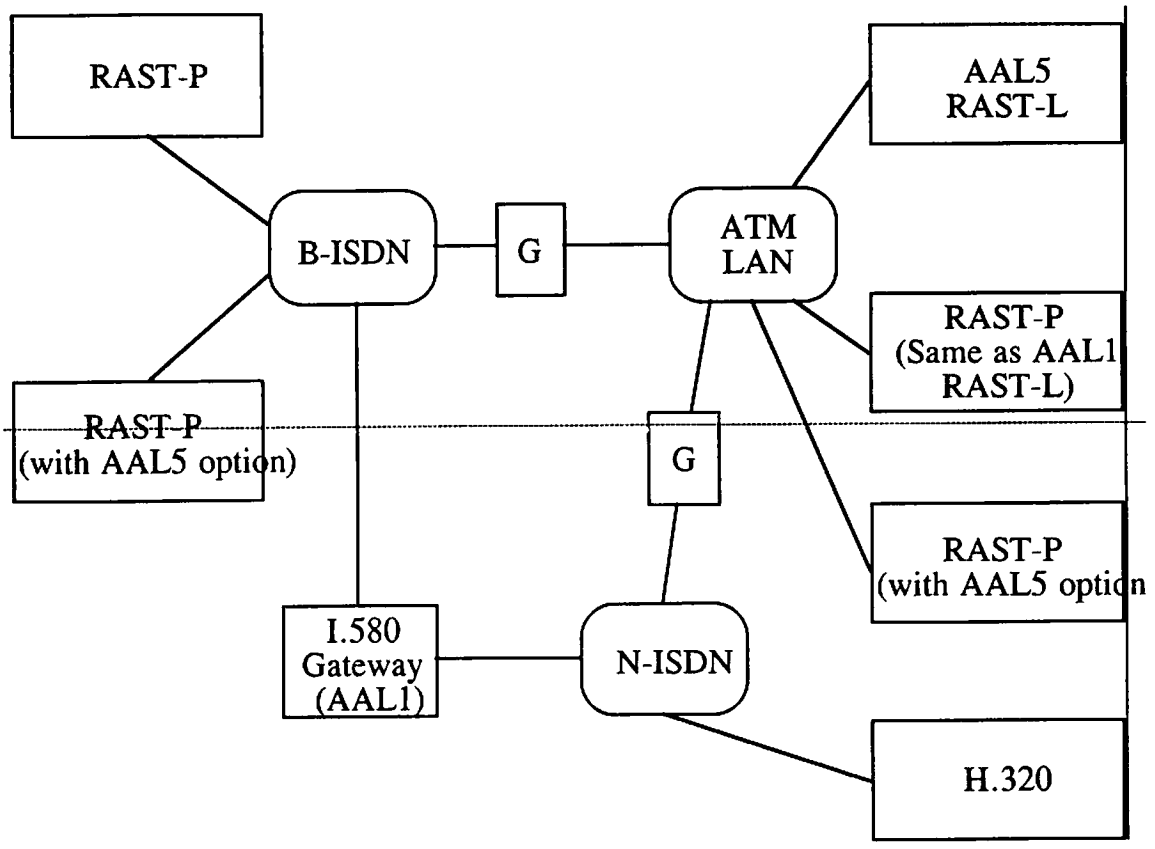
8.2 Multimedia Multiplex Layer
For further study.

9. Intercommunications

As mentioned earlier interworking between bidirectional (RAST) H.310 terminals and H.320/H.321 is mandatory. In addition, interworking among the different types of bidirectional H.310 terminals is also mandatory. Figure 444~~Figure 44~~~~Figure 4~~/H.310 illustrates the interworking scenarios for H.310 terminals.

Figure 44/H.310: Interworking of H.310 Terminals





{Replace with the figure in TD-37(1/15) and add definition of "G".}

9.1 Intercommunication Between Different Terminal Types

Since the support of AAL type 1 (for the transfer of H.222.1 and H.221 audiovisual signals over B-ISDN) is mandatory for all H.310 RAST-P terminals, therefore these terminals (i.e., RAST-P) can interwork with each other and with H.321 without a gateway function. (The support of audiovisual data over AAL5 by H.310 RAST-P terminals is optional.)

However, since the support of AAL type 1 by H.310 RAST-C is optional, a gateway (not inside the network but in the customer premises) between a B-ISDN and a customer premises ATM network is needed to provide interworking functions between:

(a) AAL5 only RAST-C and RAST-P (which do not support the optional AAL5 mode) terminals,
(b) AAL5 only RAST-C and AAL1 only RAST-C terminals, and
(c) AAL5 only RAST-C and H.321 terminals.

Similarly, a gateway between an N-ISDN and a customer premises ATM network is needed to provide interworking functions between RAST-C and H.320 terminals.

It is important to note that H.310 RAST-P terminals (with and without the optional AAL5 support) can be deployed on (or interface with) both B-ISDN and customer premises ATM networks. However, H.310 RAST-C terminals can only interface with customer premises networks.

9.2 Intercommunication With N-ISDN Terminals

For interworking with H.320/H.321 terminals, both H.310 RAST-P and RAST-C terminal types will support the following modes (mandatory):

(a) H.261 CIF/QCIF

(b) G.711 (G722 and G728 optional)

(c) H.221/H.242-H.230[43]

(d) 1B, 2B and H0 transfer modes

(e) Two ATM VCs (for supporting the 2B communication mode with H.320)

9.3 Intercommunication With Telephony

For further study.

9.4 Intercommunication With Audiovisual Terminals Connected To Other Networks

For further study.

END

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[43] The H.221 multimedia multiplexing scheme in RAST-C terminals can be supported in a gateway between the (public) B-ISDN and (private) customer premises ATM networks (at the customer premises side).