Telecommunication Standardization Sector **AVC-856**

Study Group 15, Working Party 1

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This document contains revision marks indicating changes from TD71(1/15). In addition to the changes shown, the editor should undertake the following tasks:

1. change broadcast to multicast everywhere appropriate.

2. change WAN to SCN(Switched Circuit Network) as appropriate.

3. review all usage of MC, and substitute MCU where appropriate (much of this has been done).

INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

DRAFT H.323

TELECOMMUNICATION
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LINE TRANSMISSION OF NON-TELEPHONE SIGNALS

VISUAL TELEPHONE SYSTEMS AND EQUIPMENT FOR LOCAL AREA NETWORKS WHICH PROVIDE A NON-GUARANTEED QUALITY OF SERVICE

DRAFT ITU-T Recommendation H.323

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

SUMMARY

Recommendation H.323 describes terminals, equipment, and services for multimedia communication over Local Area Networks (LAN) which do not provide a guaranteed Quality of Service. H.323 terminals and equipment may carry real-time voice, data, and video, or any combination, including videotelephony.

The LAN over which H.323 terminals communicate, may be a single segment or ring, or it may be multiple segments with complex topologies. It should be noted that operation of H.323 terminals over the multiple LAN segments (including the Internet) may result in poor performance. The possible means by which quality of service might be assured on this LAN is beyond the scope of this recommendation.

H.323 terminals may be integrated into personal computers or implemented in stand-alone devices such as videotelephones. Support for voice is mandatory, while data and video are optional, but if supported, the ability to use a specified common mode of operation is required, so that all terminals supporting that media type can interwork. H.323 allows more than one channel of each type to be in use. Other Recommendations in the H.323 series include the H.225.0 packet and synchronization, H.245 control, H.261 and H.263 video codecs, and G.711, G.722, G.728, and G.723 audio codecs.

H.323 makes use of the logical channel signaling procedures of Recommendation H.245, in which the content of each logical channel is described when the channel is opened. Procedures are provided for expression of receiver and transmitter capabilities, so transmissions are limited to what receivers can decode, and so that receivers may request a particular desired mode from transmitters. Since the procedures of H.245 are also planned for use by Recommendation H.310 for ATM networks, and Recommendation H.324 for GSTN, interworking with these systems should be straightforward.

H.323 terminals may be used in multipoint configurations, and may interwork with H.310 terminals on B-ISDN, H.320 terminals on N-ISDN, H.321 terminals on B-ISDN, H.322 terminals on Guaranteed Quality of Service LANs, and H.324 terminals on GSTN and wireless networks.

Table of contents to be Added

1 Scope

This Recommendation, H.323, covers the technical requirements for narrow-band visual telephone services defined in H.200/AV.120-Series Recommendations, in those situations where the transmission path includes one or more Local Area Networks (LAN), which may not provide a guaranteed Quality of Service (QoS) equivalent to that of N-ISDN. Examples of this type of LAN are:

-Ethernet (IEEE 802.3)

-Fast Ethernet (IEEE 802.10)

-FDDI (non-guaranteed quality of service mode)

-Token Ring (IEEE 802.5)

Recommendation H.322 covers the case of visual telephone services in those situations where the transmission path includes one or more Local Area Networks (LAN), which are configured and managed to provide a guaranteed Quality of Service (QoS) equivalent to that of N-ISDN such that no additional protection or recovery mechanisms beyond those mandated by Rec. H.320 need be provided in the terminals. Pertinent parameters are the data error and loss properties and variation of transit delay. An example of a suitable LAN is: Integrated Services (IS) LAN: IEEE 802.9A Isochronous services with Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Media access control (MAC) service.

H.323 terminals may be used in multipoint configurations, and may interwork with H.310 terminals on B-ISDN, H.320 terminals on N-ISDN, H.321 terminals on B-ISDN, H.322 terminals on Guaranteed Quality of Service LANs, and H.324 terminals on GSTN and wireless networks. See Figure 1/H.323.

Figure 1/H.323 Interoperability of H.323 Terminals

1.1 H.323 Components

This Recommendation describes the components of an H.323 system. This includes Terminals, Gateway Units, Gatekeepers, Multipoint Controllers, and Multipoint Control Units. Control messages and procedures within this Recommendation define how these components communicate. Detailed descriptions of these components are contained in Section 5

1.1.1 Terminals

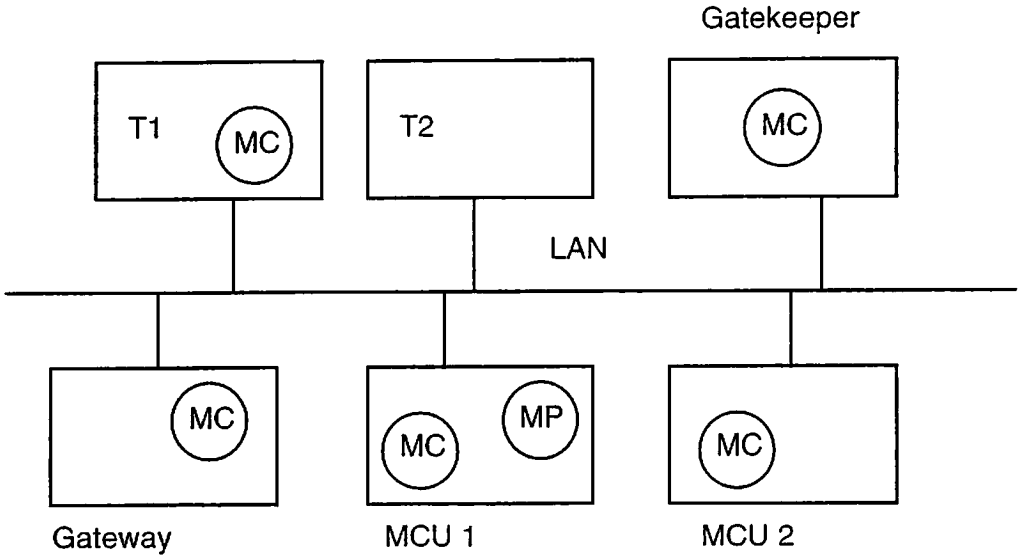
An H.323 Terminal is an endpoint on the local area network which provides for real-time, two-way communications with another H.323 terminal, Gateway Unit, or Multipoint Control Unit. This communications consists of control, indications, audio, moving color video pictures, and/or data between the two terminals. A terminal may provide speech only, speech and data, speech and voice, or speech, data, and voice.

1.1.2 Gateway ~~Unit~~

An H.323 Gateway Unit (GW) is an endpoint on the local area network which provides for real-time, two-way communications between H.323 Terminals on the LAN and other ITU Terminals on a wide area network, or to another H.323 gateway. Other ITU Terminals include those complying with Recommendations H.310 (H.320 on B-ISDN), H.320 (ISDN), H.321 (ATM), H.322 (GQOS-LAN), H.324 (GSTN), and H.324M (Mobile). The Gateway ~~Unit~~ has the characteristics of an H.323 Terminal or MCU on the LAN, and of the ITU terminal or MCU on the WAN. The Gateway Unit provides the necessary conversion between the different terminal types. Gateways should appear~~may appear~~ to the WAN as terminals or MCUs. Gateways should ~~may~~ also appear ~~to the LAN~~ as H.323 terminals or H.323 MCUs. ***{Editor's Note: The basis for this choice requires further discussion}.***

1.1.3 Multipoint Controller

The Multipoint Controller (MC) is a non-callable entity which provides for the control of two ~~three~~ or more terminals participating in a multipoint conference. The MC provides for capability negotiation with all terminals to achieve common levels of communications. It also may control conference resources such as who is multicasting video. The MC does not provide for mixing or switching of audio, video and data. The MC may be part of a gatekeeper, gateway, terminal, or MCU. Note that an MCU may consist only of a callable MC in the simplest~~simplist~~ case. See Figure 1A.



Note: Gateway, Gatekeeper, and MCU can be a single device

Figure 1A: Possible locations of MC in H.323 system (add MC-less GK/GWs)

Note: The MP function may reside in Terminals or Gateways that can accept multiple A/V streams and do their own switching and mixing.

1.1.4 Multipoint Processor

The Multipoint Processor (MP) is the part of an MCU which provides for the processing of audio, video, and/or data streams in a centralized or hybrid multipoint conference. The MP provides for the mixing, switching, or other processing of media streams under the control of the MC. The MC and MP together make up a Multipoint Control Unit (MCU), although the MP may be a null element. An MCS provider that is capable as acting as an MCS top provider and is part of the MCP~~, e.g., the data processor of H.243.~~

1.1.5 Gatekeeper

The Gatekeeper (GK) is a LAN addressable ~~software~~ entity that provides address translation and controls access to the local area network for H.323 terminals, Gateway Units, and MCUs. The gatekeeper may also provide other services to the terminals, gateway units, and MCUs such as bandwidth management and locating gateway units and multipoint controllers. A multipoint controller may optionally be part of the gatekeeper as well. ***{add GK cloud concept}***

1.1.6 MCU

The MCU (Multipoint Control Unit) for an H.323 ~~system~~ consists of an MC plus an MP, which may be null, that is callable and addressable using the means of H.323. Generally, the H.323 MCU operates in the fashion of an H.231 MCU. MCU functionality may be combined with a gateway or a gatekeeper as the discretion of the manufacturer.

1.2 Topology

The following logical topology elements are defined in order to explain the scope and intercommunications of H.323 components.

1.2.1 Zone

A Zone (Figure 2/H.323) is the collection of all terminals, Gateway Units, and Multipoint Controllers managed by a single Gatekeeper. A Zone may or may not include a Gateway Unit. A Zone has one and only one Gatekeeper. Multiple LAN segments may be connected using routers or other devices. ***{Note: Add MCU to picture, change domain to zone}***

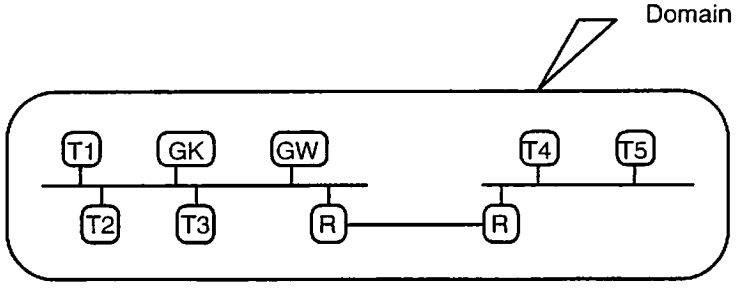
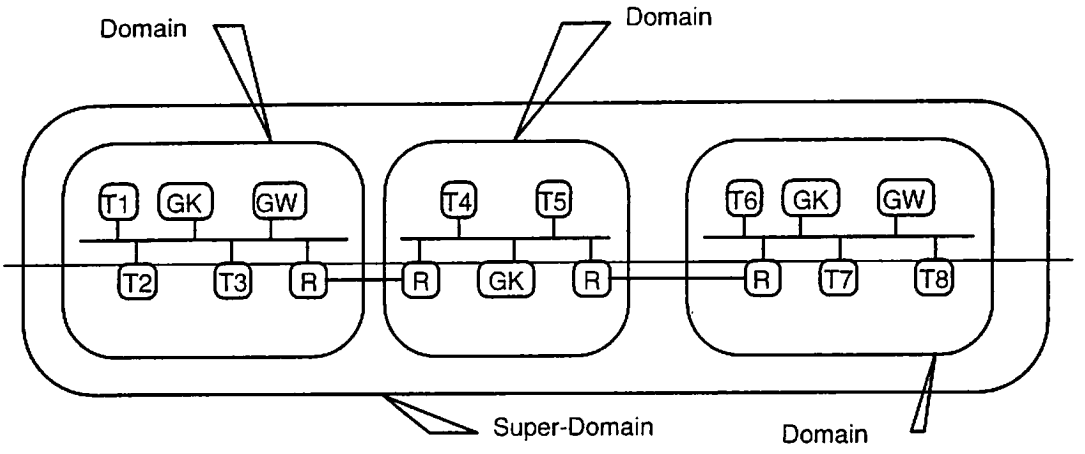


Figure 2/H.323 Zone

~~1.2.2 Super-Zone~~ No Need - never used in the text

~~A Super-Zone (Figure 3/H.323) is the collection of all Zones across which a call can be made without using a Gateway Unit. Multiple Zones may exist within a Super Zone. In a system with no Gatekeeper or only one Gatekeeper, the Zone and Super Zone are the same.. *{Note: Add MCU to picture, define router, change Domain to Zone} {Domain boundries are not always on routers!}(Add gatekeeper cloud???)*~~

The only use to the super zone is that everything beyond the super zone is not H.323 and needs a Gateway to access it.



~~Figure 3/H.323 Super-Zone~~

1.3 Conference Models

H.323 supports the conference types described in this section. ***{Editor's Note: these are examples}***

1.3.1 Point-to Point~~toPoint~~

Point-to-Point conferences are those conferences between two terminals. These terminals can both be on the LAN or one on the LAN and one on the WAN.

1.3.2 Multipoint

A Multipoint conference is a conference between two~~three~~ or more terminals. The terminals may be on the LAN or connected via gateways.~~on the WAN~~. The multipoint conference shall always be controlled by an MC. Various multipoint conference types are defined in this section and may

involve more than one MC and/or MP. They may also involve one or more H.3xx~~20~~ MCUs~~.~~ via gateways.~~on the WAN.~~

1.3.2.1 Centralised~~Centalized~~ Multipoint

A Centralized Multipoint conference is one in which all participating terminals~~teminals~~ transmit their audio and video to a single ~~n~~ MP which processes~~proeeses~~ them, and returns an audio and video stream to each terminal. ***{Editor: It seems dangerous to make this option part of "centralized" since multicast is not always possible. This idea should be moved elsewhere}.*** Data is centrally processed by an MCS top provider, and the MC centrally manages the conference.

1.3.2.2 Decentralised~~Decentralized~~ Multipoint

A Decentralized Multipoint conference is one in which all participating terminals multicast their audio and video to all other participating terminals. Every participating H.323 Terminal contains its own MP. Note~~No MP is required in this case. Note~~ that data and control are still centrally provided by the MC and MCS top provider. Decentralized control and data mixing are for further study.

1.3.2.3 Hybrid Multipoint

A Hybrid Multipoint conference is one in which terminals multicast their video to other participating terminals, and unicast their audio to the MP for mixing. The MP returns a mixed audio stream to each terminal. The reverse case is also allowed with audio multicast and video processed by the MP. Note that data and control are still centrally provided by the MC and MCS top provider. ~~{~~***add the reverse case}***

1.3.2.4 Mixed Multipoint

This is the situation where some terminals have the ability to participate in a decentralized conference, and other terminals can only conference using an MCU.

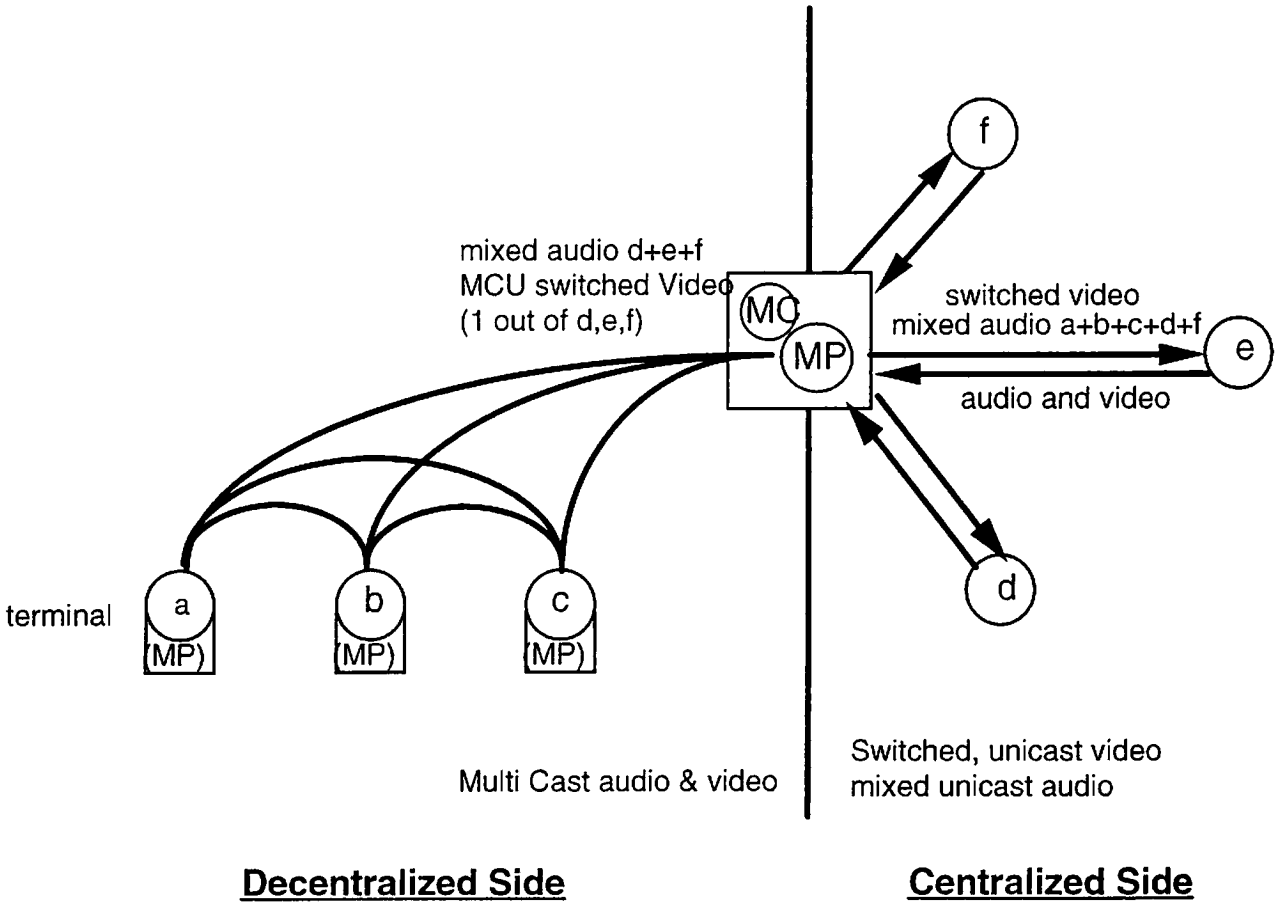


Fig 1.3.4.3-1 Mixed Multipoint Conference

1.3.3 Multipoint Ready Conference

A Multipoint-Ready conference is a point to point conference that can be expanded into a multipoint conference at some time during the call. This can be done if a one or more of the terminals in the initial point to point conference contains an MC, if the call is made using a gatekeeper that includes MC functionality, or if the initial call is made through an MCU as a multipoint call between only two terminals. Note: A "Multipoint ready conference" is actually a multipoint conference (MC involvement) with two terminals.

1.3.4 Broadcast

A Broadcast conference is one in which there is one transmitter of media streams and a group containing many receivers. ~~There is no bidirectional transmission of control or media streams.~~ Such conferences should be implemented using LAN transport multicast facilities, if available. Mechanisms for bi-directional control are defined in H.225.0 Annex (RTP).

1.3.5 Broadcast Panel

A Broadcast Panel conference is a combination of a Multipoint conference and a Broadcast conference. In this conference, several terminals are engaged in a multipoint conference while

many other terminals are only receiving the media streams. There is bi-directional~~bidirectional~~ transmission between the terminals in the multipoint portion of the conference and no bi-directional~~bidirectional~~ transmission between them and the listening terminals.

Comment - there should be a minimal level of control - the two talkers need to know who is actually listening.

1.3.6 Mixed multipoint conference

A conference may be "mixed" i.e. with one part centralized and the other decentralized as decided by the Gatekeeper~~the MC~~. A terminal is not aware of the mixed nature of the conference; only of the type of conference it is participating in.

2 Normative references

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; 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) ITU-T Recommendation H.225.0 (199X): " Media Stream Packetization and Synchronisation~~Synchronization~~ on Non-Guaranteed Quality of Service LANs ".

(2) ITU-T Recommendation H.245 (199X): "Control of communications between Visual Telephone Systems and Terminal Equipment on Non-Guaranteed Bandwidth LANs ".

(3) ITU-T Recommendation G.711 (1988): "Pulse Code Modulation (PCM) of Voice Frequencies".

(4) ITU-T Recommendation G.722 (1988): "7 kHz Audio-coding within 64 kbit/s".

(5) ITU-T Recommendation G.723 (1995): "Dual Rate Speech codec for multimedia telecommunications transmitting at 6.4 and 5.3 kbit/s".

(6) ITU-T Recommendation G.728 (1992): "Speech Coding at 16 kbit/s".

(7) ITU-T Recommendation G.xxx (1995): ((reserved for low complexity algorithm)) "Speech codec for multimedia telecommunications transmitting at *** kbit/s".

(8) ITU-T Recommendation H.261 (1993): "Video CODEC for audiovisual services at p X 64 kbit/s"

(9) ITU-T Recommendation H.263 (1993): "Video CODEC for narrow telecommunications channels at < 64 kbit/s"

(10) ITU-T Recommendation T.120 (1994): "Transmission protocols for multimedia data"

(11) ITU-T Recommendation H.320 (1993): "Narrow-band ISDN visual telephone systems and terminal equipment".

(12) ITU-T Recommendation H.321 (1993): "Adaptation of H.320 Visual Telephone Terminals to B-ISDN Environments".

(13) ITU-T Recommendation H.322 (1993): "Visual Telephone Systems and Terminal Equipment for Local Area Networks which Provide a Guaranteed Quality of Service".

(14) ITU-T Recommendation H.324 (1993): Terminal for Low Bitrate Multimedia Communications".

(15) ITU-T Recommendation H.310 (1993): "Narrow-band ISDN visual telephone systems and terminal equipment".

What about H.231 & H.243?

3 Definitions

For the purposes of this Recommendation the definitions given in Clause 3 of both H.225.0 (1) and H.245 (2) apply along with the following.

The following terms must be added and defined and used consistentlyeonsistantly:

connection

conference

session

call

Addressable: Having a transport address. Not the same as being callable. A gatekeeper is addressable but not callable. An MC is neither callable nor addressable.

Audio mute: muting the loudspeaker of a terminal. ***{proposal to split into send and receive mute}***

Callable: Capable of being called in the H.323 sense. Terminals, MCUs, and Gateways are callable, but gatekeepers are not. An MC is not neither callable nor addressable.

Channel: a unidirectional link between two users.

Connection: a bi-directional link between two users.

Control and Indication (C&I): end-to-end signaling between terminals, consisting of Control, which causes a state change in the receiver, and Indication which provides for information as to the state or functioning of the system (see also H.245 (2) for additional information and abbreviations).

Data: information other than audio/speech and video, carried in the logical data channel (see H.225.0 (1)).

Lip synchronization: operation to provide the feeling that speaking motion of the displayed person is synchronized with his speech.

Human-machine interface: interface between human user and terminal/system, consisting of a physical section (electro-acoustic, electro-optic transducer, keys, etc.) and a logical section dealing with functional operation states.

Videophone System: Two or more videophone units capable of interoperating with the LAN, and each other.

Videophone Unit: A unit of terminal equipment capable of sending and receiving speech and moving picture information simultaneously. Alternatively, a videophone equivalent may be implemented on a general purpose micro-computer equipped with application specific hardware and software capable of performing the functions of a videophone.

Well-known Port: Add definition

4 Symbols and abbreviations

For the purposes of this Recommendation , the following symbols and abbreviations apply.

ACE	Audio Command Equalize
AIA	Audio Indicate Active
AIM	Audio Indicate Mute
ANS	Answer Tone
B-ISDN	Broadband - Integrated Services Digital Network
CI	Call Indication Signal
C&I	Control and Indication
CIF	Common Intermediate Format
CR	Capabilities Request
DCE	Data Communication Equipment
DEMUX	Demultiplex
DTE	Data Terminal Equipment
GW	Gateway Unit
GK	Gatekeeper
GSTN	General Switched Telephone Network
ISDN	Integrated Services Digital Network
ITU-T	International Telecommunications - Telecommunications Standardization Sector
IWA	InterWorking Adaptor
LCA	Loopback Command Audio
LCD	Loopback Command Digital
LCO	Loopback Command OFF
LCV	Loopback Command Video
MC	Multipoint Controller
MCC	Multipoint Command Conference
MCU	Multipoint Control Unit
MIS	Multipoint Indicate Secondary-status
MIZ	Multipoint Indicate Zero-communication
MR	Mode Request
MSB	Most Significant Bit
N-ISDN	Narrow Band-Integrated Services Digital Network
QCIF	Quarter CIF

RTP	Real Time Protocol
RTCP	Real Time Control Protocol
SQCIF	Sub QCIF
TEA	Terminal Equipment Alarm
VCF	Video Command Freeze
VCU	Video Command Update
VIA	Video Indicate Active
VIR	Video Indicate Ready-to-activate
VIS	Video Indicate Suppressed

5 System description

This Recommendation describes the elements of the H.323-conference~~components~~. These elements include ~~are~~ Terminals, Gateway Units, Gatekeepers, MCs, and MCUs. These components communicate through the transmission of Information Streams. The characteristics of these components are described in this section.

5.1 Information Streams

Visual telephone components communicate through the transmission of Information Streams. These Information Streams are classified into video, audio, data, conference control, and call control as follows:

Audio signals are isochronous and contain digitized and coded speech. In order to reduce the average bitrate of audio signals, voice activation may be provided. The audio signal is accompanied by an audio control signal.

Video signals are also isochronous and contain digitized and coded motion video. Video is transmitted at a fixed bitrate selected as a result of the capability exchange. The video signal is accompanied by a video control signal.

Data signals include still pictures, facsimile, documents, computer files, and other data streams.

Conference Control signals pass control data between remote ~~like~~-functional elements and are used for capability exchange, opening and closing logical channels, mode control and other functions.

Call control signals are used for call establishment, disconnect, and other call control~~econtol~~ functions.

The information streams described above are packetized and sent to the network interface as described in H.225.0.

5.2 Terminal Characteristics

An example of an H.323 terminal is shown in Figure 4/H.323. The diagram shows the user equipment interfaces, video codec, audio codec, telematic equipment, packetizer/depacketizer, system control functions, and the interface to the LAN. All H.323 terminals shall have a System Control ~~Unit~~, Packetizer/Depacketizer ~~Unit~~, Network Interface, and an Audio Codec ~~Unit~~. The Video Codec ~~Unit~~

and User Data Applications are optional. ***{Editors Note- a definition of return path delay will be added}***

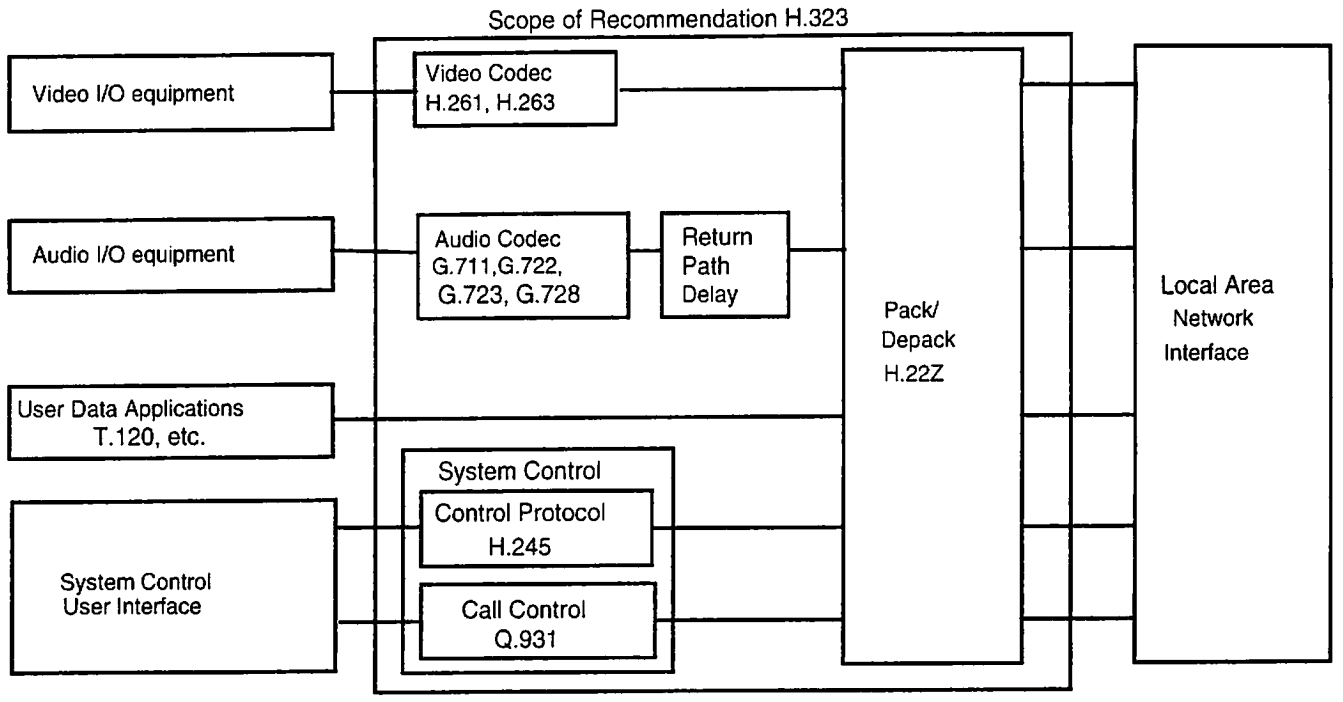


Figure 4/H.323 H.323 Terminal Equipment

{Editor's Note: a box will be added for terminal to gatekeeper signals that are not part of call control or H.245} {replace~~replease~~ Q.931 with H.225.0 call signaling}{there are those who don't like the term packetizer for H.225.0, suggestions? H.225 Transport Layer}

5.2.1 Terminal elements outside the scope of H.323

The following elements are not within the scope of H.323, and are therefore not defined within this Recommendation:

- Attached audio devices providing, voice activation sensing, microphone and loudspeaker, telephone instrument or equivalent, multiple microphones mixers, and acoustic echo cancellation.
- Attached video equipment providing cameras and monitors, and their control and selection, video processing to improve compression or provide split screen functions.
- Data applications and associated user interfaces which use T.120 or other data services over the data channel.
- Attached Network Interface, which provides the interface to the LAN, supporting appropriate signaling, and voltage levels, in accordance with national standards.
- Human user system control, user interface and operation.

5.2.2 Terminal elements within the scope of H.323

The following elements are within the scope of H.323, and are therefore subject to standardization and are defined within this Recommendation:

- The Video Codec (H.261, etc.) encodes the video from the video source (i.e.~~ie.~~ camera) for transmission and decodes the received video code which is output to a video display.

- The Audio Codec (G.711, etc.) encodes the audio signal from the microphone for transmission, and decodes the received audio code which is output to the loudspeaker.

- The Data Channel supports telematic applications such as electronic whiteboards, still image transfer, file exchange, database access, audiographics conferencing, etc. The standardized data application for real-time audiographics conferencing is T.120. Other applications and protocols may also be used via H.245 negotiation as specified in H.323, section XYZ***{This will refer to the section where H.323 data options are described}***

- The System Control ~~Unit~~ (H.245, H.225.0) provides signaling for proper operation of the H.323 terminal. It provides for call control, capability exchange, signaling of commands and indications, and messages to open and fully describe the content of logical channels.

- The Transport Layer~~Packetizer/Depacketizer~~ (H.225.0) formats the transmitted video, audio, data and control streams into PDUs for output to the network interface, and retrieves the received video, audio, data, and control streams from PDUs which have been input from the network interface. In addition, it performs logical framing, sequence numbering, error detection, and error correction by means of retransmission, as appropriate to each media type.

5.2.3 Network Interface

The network interface is implementation specific and is outside the scope of this recommendation. However, the network interface shall provide the services described in Recommendation H.225.0. This includes the following: Duplex reliable (e.g. TCP, SPX) end-to-end service is mandatory for the Control Channels and the Data Channels. Unreliable (e.g. UDP, IPX) end-to end service is mandatory for the audio and video channels depending on the application. These services may be duplex or simplex, unicast or multicast depending on the application and the capabilities of the terminals.

5.2.4 Video Codec

The video codec is optional. All H.323 terminals providing video communications shall be capable of encoding and decoding video according to H.261 QCIF. Optionally, a terminal may also be capable of encoding and decoding video according H.261 CIF or H.263 SQCIF, QCIF, CIF, 4CIF, and 16CIF. If a terminal supports H.263 with CIF or higher resolution, it shall also support H.261 CIF. The H.261 and H.263 codecs, on the LAN, shall be used without BCH error correction and without error correction framing.

Other video codecs, and other picture formats, may also be used via H.245 negotiation. More than one video channel may be transmitted, as negotiated via the H.245 control channel.

CIF and QCIF are defined in H.261. SQCIF, 4CIF and 16CIF are defined in H.263. For the H.261 algorithm, SQCIF is any active picture size less than QCIF, filled out by a black border, and coded in

the QCIF format. For all these formats, the pixel aspect ratio is the same as that of the CIF format. NOTE - The resulting picture aspect ratio for H.263 SQCIF is different from the other formats.

The video bitrate, picture format and algorithm options that can be accepted by the decoder are defined during the capability exchange using H.245. The encoder is free to transmit anything that is in line with the decoder capability. The decoder should have the possibility to generate requests via H.245 for a certain mode, but the encoder is allowed to simply ignore these requests if they are not required modes. Decoders which indicate capability for a particular algorithm option shall also be capable of accepting video bitstreams which do not make use of that option.

H.323 terminals shall be capable of operating in asymmetric video bit rates~~bitrates~~, frame rates, and picture resolutions. For example, this will allow a CIF capable terminal to transmit~~transmit~~ QCIF while receiving CIF pictures.

When each video logical channel is opened, the maximum operating mode to be used on that channel is signaled to the receiver. The header within the video logical channel indicates which mode is actually used for each picture, within the stated maximum.

The maximum mode signaled includes maximum picture format, algorithm options, etc. For example, a video logical channel opened for CIF format may transmit CIF, QCIF, or SQCIF pictures, but not 4CIF or 16CIF. A video logical channel opened with only the **unrestrictedVector** and **arithmeticCoding** options may use neither, either, or both options, but shall not use options which were not signaled.

The video stream is packetized as described in H.225.0. Each logical channel opened for video shall be accompanied by a logical channel opened for video control. The video control channel is described in H.225.0.

5.2.4.1 Continuous Presence

5.2.4.1.1 Terminal Based

H.323 terminals may receive more than one video channel, particularly for multipoint conferencing. In these cases, the H.323 terminal may need to perform a video mixing or switching function in order to present the video signal to the user. This function may include presenting the video from more than one video channel ~~terminal~~ to the user. The H.323 terminal shall use H.245 simultaneous capabilities to indicate how many video and/or audio streams it is capable of decoding. Gateways should not be required to participate as a continuous presence terminal.

5.2.4.1.2 MCU based

The MP (MCU resident) which is receiving video channels from each of the conference participants, performs the video mixing or switching function. The MP may mix the video from more than one terminal into a single video stream for output to the terminals.

5.2.5 Audio Codec

All H.323 terminals shall have an audio codec. All H.323 terminals shall be capable of encoding and decoding speech according to Recommendation G.711. All terminals shall be capable of transmitting and receiving A-law and μ-law. A terminal may optionally be capable of encoding and decoding speech using Recommendations G.722, G.728, G.729, MPEG1 audio, and G.723. When available, G.DSVD will be an option*(isn't G.729 the G.dvsd?)*. The audio algorithm used by the encoder shall be defined during the capability exchange using H.245. The H.323 terminal shall be

capable of asymmetric operation for all audio capabilities it has declared, e.g. it shall be able to send G.711 and receive G.728 if it is capable of both.

The audio stream is packetized as described in H.225.0. Each logical channel opened for audio shall be accompanied by a logical channel opened for audio control. The audio control channel is described in H.225.0.

The H.323 terminal may optionally send and receive more than one audio channel at the same time, for example, to allow two languages to be conveyed.

5.2.5.1 Delay compensation

The video codecs require some processing delay, while the audio codec involves much less delay. Lip synchronization shall not be mandatory, but if it is to be maintained, additional delay may need to be added in the receive path to compensate. Time tags in the audio and video streams may be used by the receiving terminal to determine this delay. An H.323 terminal shall not add delay for this purpose in its transmitting audio path.

Intermediate processing points such as MCUs or Gateways ~~Units~~ may alter the video/audio skew, and where possible should ~~shall~~ transmit appropriately modified time tags, reflecting their transmitted signals except in the following cases:

a). In hybrid~~hybid~~ multipoint conferences where video is multicast and audio is mixed in the MP. Note that Lip Sync and the ability to provide video selection by voice switching is lost.

b) Other cases may be added here.

5.2.5.2 Audio Mixing

H.323 terminals may receive more than one audio channel, particularly for multipoint conferencing. In these cases, the H.323 terminal may need to perform an audio mixing function in order to present a composite audio signal to the user.

5.2.6 Data Channel

One or more data channels are optional. If available, each data channel shall be capable of supporting standardized data applications such as Multipoint Audiographic Teleconferencing, as defined in the T.120 series of Recommendations. Other data channel services may also be used.

T.120 is the default basis of data interoperability between an H.323 terminal and other H.323, H.320, or H.310 terminals. Where 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 application, if any, shall be one of those provided. The sole exception is Transparent User Data***{Editors Note: some confusion exists about whether this is the correct way to refer to Transparent~~Transpartent~~ User Data; this will be corrected}*** A terminal that provides far-end camera control using H.281 and/or H.224 is not required to also support a T.120 far end camera control protocol. Note that non-standard data applications may be used whether the equivalent T.120 application is provided or not. Gateways should not be required to participate as a T.120 terminal, and should be transparent to data (except for T.123 functions which shall be supported).

The Data channel is packetized as described in H.225.0.

5.2.7 Conference Control Channel

The Conference control channel carries end-to-end control messages from H.245 governing operation of the H.323 system, including capabilities exchange, opening and closing of logical channels, mode preference requests, flow control messages, and general commands and indications.

~~In point-to-point connections,~~ H.245 signaling is established between the terminals or between the terminal and gatekeeper or MCU. ~~The above also applies to multipoint~~. There~~conferences.There~~ shall be exactly one bi-directional control channel per connection the terminal is participating in, which shall use the messages and procedures of Recommendation H.245. Note that an MCU, gatekeeper, or gateway may support many connections, and thus many H.245 control channels. The control channel shall be carried on H.245 logical channel 0. Logical channel 0 (?) shall be considered to be permanently open from the establishment of the H.245 control channel until the termination of this channel; the normal H.245 procedures for opening and closing logical channels shall not apply to the control channel.

General commands and indications shall be chosen from the message set contained in H.245. In addition, other command and indication signals may be sent which have been specifically defined to be transferred in-band within video, audio or data streams (see the appropriate Recommendation to determine if such signals have been defined).

H.245 messages fall into four categories: Request, Response, Command, and Indication. Request messages require a specific action by the receiver, including an immediate response. Response messages respond to a corresponding request. Command messages require a specific action, but do not require a response. Indication messages are informative only, and do not require any action or response. H.323 terminals shall respond to all H.245 commands and requests as specified in H.323, Table XXX***{Editors Note: A table of all required H.245 commands shall be added to H.323}***, and shall transmit indications reflecting the state of the terminal.

H.323 terminals shall be capable of parsing all H.245 **MultimediaSystemControlPDU** messages, and shall send and receive all messages needed to implement required functions and those optional functions which are supported by the terminal. All messages and procedures of Recommendation H.245 are required, except for those explicitly prohibited in this document and those defined as optional in H.245, or those which are related to defined optional capabilities that the terminal does not support. H.323 terminals shall send the **FunctionNotSupported** message in response to unrecognized request, response, or command messages

A control channel indication, **UserInputIndication**, is available for transport of user input alphanumeric characters from a keypad or keyboard, equivalent to the DTMF signals used in analog telephony. This may be used to manually operate remote equipment such as voice mail or video mail systems, menu-driven information services, etc. H.323 terminals shall support the transmission of user input characters 0-9, '*', and '#'. Transmission of other characters is optional. Terminals and gateways should ~~may~~ optionally support DTMF signaling as well.

NOTE - If the encryption procedures of this Recommendation are in use, the control channel will not be encrypted. Users are therefore cautioned regarding the carriage of user data in the control channel, the use of non-standard messages, and the confidentiality risk from traffic analysis of the control channel.

{Editors Note: A table indicating H.245 elements used will be added here. This list will be rationalized~~reationalized~~ with (1)the latest H.245, (2)new H.323 commands being added to H.245}

5.2.7.1 Capabilities exchange

Capabilities exchange shall follow the procedures of H.245, which provides for separate receive and transmit capabilities, as well as a system by which the terminal may describe its ability to operate in various combinations of modes simultaneously.

Receive capabilities describe the terminal's ability to receive and process incoming information streams. Transmitters shall limit the content of their transmitted information to that which the receiver has indicated it is capable of receiving. The absence of a receive capability indicates that the terminal cannot receive (is a transmitter only).

Transmit capabilities describe the terminal's ability to transmit information streams. Transmit capabilities serve to offer receivers a choice of possible modes of operation, so that the receiver may request the mode which it prefers to receive. The absence of a transmit capability indicates that the terminal is not offering a choice of preferred modes to the receiver (but it may still transmit anything within the capability of the receiver).

The transmitting terminal assigns each individual mode the terminal is capable of operating in a number in a **capabilityTable**. For example, G.723 audio, G.728 audio, and CIF H.263 video would each be assigned separate numbers.

These capability numbers are grouped into **AlternativeCapabilitySet** structures. Each **AlternativeCapabilitySet** indicates that the terminal is capable of operating in exactly one mode listed in the set. For example, an **AlternativeCapabilitySet** listing {G.711, G.723, G.728} means that the terminal can operate in any one of those audio modes, but not more than one.

These **AlternativeCapabilitySet** structures are grouped into **simultaneousCapabilities** structures. Each **simultaneousCapabilities** structure indicates a set of modes the terminal is capable of using simultaneously. For example, a **simultaneousCapabilities** structure containing the two **AlternativeCapabilitySet** structures {H.261, H.263} and {G.711, G.723, G.728} means that the terminal can operate either of the video codecs simultaneously with any one of the audio codecs. The **simultaneousCapabilities** set { {H.261}, {H.261, H.263}, {G.711, G.723, G.728} } means the terminal can operate two video channels and one audio channel simultaneously: One video channel per H.261, another video channel per either H.261 or H.263, and one audio channel per either G.711, G.723, or G.728.

NOTE - The actual capabilities stored in the **capabilityTable** are often more complex than presented here. For example, each H.263 capability indicates details including ability to support various picture formats at given minimum picture intervals, and ability to use optional coding modes. For a complete description, see Recommendation H.245.

The terminal's total capabilities are described by a set of **CapabilityDescriptor** structures, each of which is a single **simultaneousCapabilities** structure and a **capabilityDescriptorNumber**. By sending more than one **CapabilityDescriptor**, the terminal may signal dependencies between operating modes by describing different sets of modes which it can simultaneously use. For example, a terminal issuing two **CapabilityDescriptor** structures, one { {H.261, H.263}, {G.711, G.723, G.728} } as in the previous example, and the other { {H.262}, {G.711} }, means the terminal can also operate the H.262 video codec, but only with the low-complexity G.711 audio codec.

Terminals may dynamically add capabilities during a communication session by issuing additional **CapabilityDescriptor** structures, or remove capabilities by sending revised **CapabilityDescriptor** structures. All H.323 terminals shall transmit at least one **CapabilityDescriptor** structure.

Non-standard capabilities and control messages may be issued using the **NonStandardParameter** structure defined in H.245. Note that while the meaning of non-standard messages is defined by individual organizations, equipment built by any manufacturer may signal any non-standard message, if the meaning is known.

Terminals may reissue capability sets at any time, according to the procedures of H.245.

5.2.7.2 Logical channel signallingsignaling

Each logical channel carries information from a transmitter to a receiver, and is identified by a logical channel number unique for each direction of transmission.

Logical channels are opened and closed using the **OpenLogicalChannel** and **CloseLogicalChannel** messages and procedures of H.245. When a logical channel is opened, the **OpenLogicalChannel** message fully describes the content of the logical channel, including media type, algorithm in use, any options, and all other information needed for the receiver to interpret the content of the logical channel. Logical channels may be closed when no longer needed. Open logical channels may be inactive, if the information source has nothing to send.

Logical channels in H.323 are unidirectional, so asymmetrical operation, in which the number and type of information streams is different in each direction of transmission, is allowed. However, if a receiver is capable only of certain symmetrical modes of operation, it may send a receive capability set that reflects its limitations. Terminals may also be capable of using a particular mode in only one direction of transmission. Certaintransmission.Certain media types, including data protocols such as T.120, inherently require a bi-directional channel for their operation. In such cases a pair of unidirectional logical channels, one in each direction, may be opened and associated together to form a connection usingbi-directional channel using the bi-directional channel opening procedures of H.245. Such pairs of associated channels need not share the same logical channel number, since logical channel numbers are independent in each direction of transmission.

The **OpenLogicalChannelAck** shall be used to return the transport port number that the receiver has allocated for this logical channel. The transmitter shall transmit the information associated with the logical channel to the assigned port.

5.2.7.3 Mode preferences

Receivers may request transmitters to send a particular mode using the H.245 **RequestMode** message, which describes the desired mode. Transmitters should comply if possible.

A terminal receiving the **multipointModeCommand** from the MC shall assure that it is transmitting the same modes that it is receiving on the associated logical channel(s); this shall be done via H.245 logical channel signaling. . In addition, a transmitter shall comply with the **RequestMode** command if it is within its capability set, if the terminal is also in receipt of multipointModeIndicate

{Editors Note: some text on mode preferences in decentralized conferenceseenterenees may have to be added here}

5.2.8 Call Control Channel

The call control channel uses H.225.0 call control signalingsignalling to establish a conection between two H.323 endpoints.. The call control channel is independent from the H.245 channel and H.245 open logical channel procedures are not used for the the Call Control Procedure. The call control channel is opened prior to the establishment of any communications between H.323 end

points. In systems that do not have a Gatekeeper, the call control channel is opened between the two endpoints involved in the call. In systems which contain a Gatekeeper Unit, the call control channel is opened between the end point and the Gatekeeper, or between the terminals themselves as chosen by the gatekeeper. This channel is described in detail in Section 6 of this document.

5.2.9 H.225 Transport Layer ~~Packetizer/Depacketizer~~

Logical channels of video, audio, data and ~~or~~ control information are established according to the procedures of Recommendation H.245. Logical channels are unidirectional, and are independent in each direction of transmission. Any number of logical channels of each media type may be transmitted, except for the H.245 control channel of which there shall be one. The packetization used to transmit these logical channels shall conform to Recommendation H.225.0.

5.2.9.1 Logical channel numbers

Each logical channel is identified by a logical channel number (LCN), in the range 0 to 65535, which serves only to associate logical channels with the transport connection. Logical channel numbers are selected arbitrarily by the transmitter, except that logical channel 0 shall be permanently assigned to the H.245 control channel. The actual transport port number that the transmitter shall transmit to in the receiver shall be returned by the receiver in the **OpenLogicalChannelAck** message.

5.2.9.2 Flow control

H.323 terminals shall respond to the **FlowControlCommand** message of H.245, which commands a limit to the overall bit rate of a logical channel or of all logical channels.

The limit applies to the information streams which are the content of the logical channel, before the PDU header is applied. The flow control restrictions apply strictly on a per logical ~~channel~~ basis.

When the terminal has no information to send in a given channel, the terminal shall send no information. Fill data shall not be sent.

Flow control will be applied using H.245 messages only. Note that the following H.245 messages have an RTCP equivalent. Only H.245 messages shall apply (and not their RTCP equivalents:
End session - This command indicates the end of the H.245 session. (The equivalent to the RTCP "BYE" message);

~~**Miscellaneous Command** -~~ videoFreezePicture,

videoFastUpdatePicture, in coflict with RTP H.261 payload para. 6.1. Use of optional H.261-specific control packets

"Full INTRA-frame Request" and "Negative Acknowledgement",

videoFastUpdateGOB,

videoTemporalSpatialTradeOff,

videoSendSyncEveryGOB,

videoSendSyncEveryGOBCancel,.

equaliseDelay and zeroDelay,

cancelMultipointModeCommand

estimatedReceivedJitterMantissa,

estimatedReceivedJitterExponent,

RoundTripDelayRequest,

roundTripDelayResponse,

nonStandardData (conflicts with RTP 6.3.3 Extending the sender and receiver reports, NOTES and other RTCP defined extensions)

{Question - what is going to happen if a logical channel definiton conflicts wih the RTP header and RTP paylod that is actually being transmitted? E.g if the H.245 defines G711ulaw, and the RTP header announces RTPALaw?}

Similar issues (not clear where to to include them in the context of H.323) are reflected in RTP para. 6.2.1 - "Maintaining the number of session members" which contradicts the methods defined in call control for Gatekeeper to Terminal control.

{Editor's Note: a conflict may exist between RTP and H.245 flow control. Consideration will also be given to possible interactions with T.120 flow control. This requires investigation.} In case of conflicts, the following order of precedence shall apply:H.323, H.225.0, H.245, H.225 RTP Annex, T.120.

5.3 Gateway ~~Unit~~ Characteristics

The Gateway ~~Unit~~ provides the appropriate translation between transmission formats (for example H.225.0 to/from H.221) and between communications procedures (for example H.245 to/from H.242). The Gateway ~~Unit~~ must also perform call setup and clearing of ~~on~~ both the LAN side and the WAN side. Translation between video, audio, and data formats may also be performed in the Gateway Unit.

An H.323 terminal may communicate with another H.323 terminal on the same LAN directly and without involving the Gateway. The Gateway may be omitted if communication with external terminals (~~terminals not on the LAN~~ terminals not in the super-zone) is not required. It may also be possible for a terminal on one segment of the LAN to call out through one Gateway ~~Unit~~ and back onto the LAN through another Gateway ~~Unit~~ in order to bypass a router or a low bandwidth link.

An example of an H.323 Gateway ~~Unit~~ is shown in Figure 5/H.323. The diagram shows the H.323 terminal function, the WAN terminal interface~~terminal function~~, and the conversion function. The H.323 terminal interface ~~function~~ has the necessary characteristics described in 5.2. The Gateway ~~Unit~~ appears to the other H.323 terminals on the LAN as a Gateway. Note that if the WAN side connection is an MCU, the Gateway should appear on the LAN as an MCU. ~~as one or more H.323 terminals, or an H.323 MP.~~ It communicates with the other H.323 terminals using the procedures in this Recommendation. The WAN terminal function has the characteristics described in the appropriate Recommendation (H.310, H.320, H.321, H.322, H.324). The Gateway Unit appears to the terminals on the WAN as one or more of the same terminal types or MCUs. ~~It communicates to another terminal on the WAN using the procedures described in the appropriate Recommendation~~

~~for that terminal.~~ The conversion function provides the necessary conversion of transmission format, control, audio, video, and/or data streams between the different terminal recommendations.

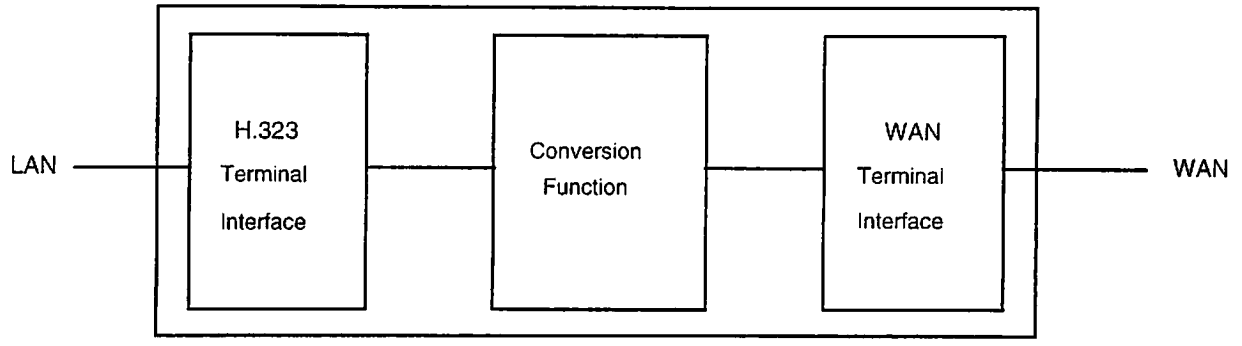


Figure 5/H.323 H.323 Gateway ~~Unit~~

A~~s~~t a minimum, the Gateway Unit shall provide a conversion function for the transmission format, call setup, and the control signals and procedures.

This recommendation describes the connection of one H.323 terminal on the LAN to one external terminal on the WAN through the Gateway Unit. The actual number of H.323 terminals that can communicate through the Gateway Unit is a logical extension of this connection and is not subject to standardization. Similarly, the number of WAN connections, number of simultaneous independent conferences, audio/video/data conversion functions, and inclusion of multipoint functions is left to the manufacturer.

The Gateway Unit may be connected via N-ISDN or B-ISDN (or another LAN) to other Gateway Units to provide H.320 communication between H.323 terminals which are not ~~on~~within the same super zone ~~the same LAN~~.

Equipment which provides transparent interconnection between LANs without using H.320 (such as routers and remote dial in units) are not Gateway Units and are not within the scope of this Recommendation.

Add text on scope of gateway, especially that WAN call signaling is beyond the scope H.323 (i.e. use of User-Network or Network-Network signaling.

Add text that states that the purpose of the gateway is to reflect the characteristics of the terminals or MCUs or Gateways attached to it.

Add text to clarify that the gateway may talk to another H.323 gateway as well as a terminal. This might be placed in a new recommendation, H.INTERWORKING, it is proposed by some. It also could be placed here; comments} Defer for further study.

5.4 Gatekeeper Characteristics

The Gatekeeper, which is optional in an H.323 system, provides call control services to the H.323 terminals and Gateway Units. When it is present in a system, the Gatekeeper shall provide the following services:

- Network~~Transport~~ Address Translation - The Gatekeeper shall~~may~~ perform E.164 or H.323 ID to network address~~transport address~~ translation. This may be done using a static

translation table which is maintained manually and/or it may use a dynamic translation table which is updated using the Registration Messages described in section 6. ***{Editor's Note: this usage of transport address may not be correct; this may apply elsewhere}***

- Admissions Control - The gatekeeper shall authorize LAN access using ARQ/ACF/ARJ H.225.0 messages. This may be a null function, or it may be based on bandwidth or call authorization management.

- Bandwidth Control - The gatekeeper shall support BRQ/BRJ/BCF messages. This may be a null function, or it may be based on bandwidth management.

- Zone Management - The Gatekeeper shall know all ~~of~~-terminals, MCUs, and Gateways which are bound to it within its Zone, and provide the above functions for those terminals.

The Gatekeeper may also perform other optional function such as:

- Call control signaling - The Gatekeeper may complete the H.225.0 call control signaling with the terminals, Gateway units, and MCUs. It acts as the *network* as defined in H.225.0. Note that by connecting terminals together directly, the gatekeeper can avoid handling H.225.0 call control signals

- Call Authorization - The Gatekeeper shall authorize a terminals access to the LAN. Through the use of the H.225.0 signaling, the Gatekeeper may reject calls from a terminal due to authorization failure. The reasons for rejection may include, but are not limited to, restricted access to/from particular terminals or Gateway units, and restricted access during certain periods of time. The criteria for determining if authorization failed is outside the scope of this Recommendation.

- Bandwidth Management - Control of the number of H.323 terminals permitted simultaneous access to the LAN. Through the use of the H.225.0 signaling, the Gatekeeper may reject calls from a terminal due to bandwidth limitations. This may occur if the Gatekeeper determines that there is not sufficient bandwidth available on the network to support the call. The criteria for determining if bandwidth is available is outside the scope of this Recommendation. Note that this may be a null function, i.e. all terminals are granted access. This function also operates during an active call when a terminal requests additional bandwidth. Any resource reservations made by the gatekeeper are beyond the scope of H.323.

- Super-Zone Management - The Gatekeeper may maintain a list of other Gatekeepers within a Super-Zone that it can communicate with. The Gatekeeper may communicate with the other Gatekeepers within the Super-Zone in order to identify all terminals within the Super-Zone. All such procedures are beyond the current scope of H.323.

- Call Management - For example, the Gatekeeper may maintain a list of ongoing H.323 calls. This information may be necessary to indicate that a called terminal is busy, and to provide information for the Bandwidth Management function.

- Network management information data structure - For further study.

- Bandwidth reservation for terminals not capable of this function. For further study. ***{Editor's Note: This may need to be coordinated with T.RES. Note that the H.323 terminal may be in~~bein~~ the ARQ message to indicate whether it desires a bandwidth reservation, or has already made a reservation itself; this issue must be dealt with. Alternatively, the gatekeeper may use ARC to tell the terminal to reserve bandwidth. We will deal with this at Ipswich}.***

- Directory services. For further study.

The Gatekeeper is logically separate from the terminal and the Gateway, however, its physical implementation may coexist with a terminal, gateway, server, or other network entity. The Gatekeeper may be a single entity or may be multiple entities that cooperate to provide the gatekeeper services.

5.5 Multipoint Controller (MC) Characteristics

The MC provides control functions to support conferences between three or more terminals (multipoint conferences).

The MC carries out the capabilities exchange with ~~each~~ terminals in a multipoint conference. The MC sends a capability set to the terminals in the conference indicating the operating modes in which they may transmit. The MC may revise the capability set that it sends to the terminals as a result of terminals joining or leaving the conference, or for other reasons. In this manner, the MC determines SCM (Selected Communication Mode (see H.243)) for the conference. The manner in which the MC determines a common operating mode is not within the scope of this recommendation. Note that a common SCM is not strictly required, e.g. some terminals may operate in different modes with the MCU providing transcoding using the MP.

As part of conference setup, the H.323 terminal will become connected to an MC on its H.245 control channel. This may either occur via explicit connection with an MCU, or via signaling to the gatekeeper or to another terminal to initiate a multipoint conference. The choice of conference mode (e.g. decentralized or centralized) may be done during call setup by the Gatekeeper or occurs after connection with the MC using H.245 signaling.

~~3n.~~ The MCU should use ~~uses~~ H.245 messages and methods to implement ~~the~~ features found in H.243. More information on H.245 MCU operation can be found in H.MCU245(proposed). This for further study.

{Editor's Note: Alternative ways of defining centralized/decentralized capabilities may be considered at Ipswich~~Ispswieh~~}

{Editor's Note: Add text indicating that the MC must have a way of knowing which terminals are gateways and which are terminals since the gateways behave differently from H.323 terminals~~termainls~~ since they represent H.320 terminals This is where the Gatekeeper comes in. The Gatekeeper should have all the relevant and pertinent information to make an intelligent decision..}

It is RADVision's position that call control essages (e.g. Setup, Connect,...) shall include a defintion of the device which is generating the call control message (Terminal, Gatekeeper, Gateway, MCU or "other"). In addition (see AVC 855 - comments on H.225.0), we find that the only workable mechanism that can handle the "20msec" problem in mode change requests when going through a

gateway, that a "request/acknowledge" mechanism, using H.245 signaling can help. See AVC855, para. 6.1 (denoted by (*)).

5.5.1 Centralised~~Centralized~~ Multipoint Capability

Alle terminals shall have centralized multipoint capability.; lin this mode of operation they communicate with the MC in a point-to-point manner on the control channel and with the MP on the audio, video, and data channels. In this mode, the MC performs H.245 multipoint control functions, while the MP performs video switching or mixing, audio mixing, and T.120 multipoint data distribution. The MP transmits the resulting video, audio, and data streams back to the terminals. The MP may have the capability to convert between different audio, video, and data formats and bitrates, allowing the terminals to participate in the conference using different communications modes. The MP should be able to provide lip synchronization between the selected video and the relevant audio stream.

{Editor's Note: this must be moved to another capability; mixing it with centralized is confusing}

5.5.2 Decentralised~~Decentralized~~ Multipoint Capability

If the terminals and MC have decentralized multipoint capability, the terminals communicate with the MC in a point-to-point mode on the control channel and data channels only. The MC directs a selected terminal or terminals to multicast its(their) video channel to the other terminals in the conference. All terminals in the conference multicast their audio channels.

The terminals receive multicast video channels and should select one or more of the available channels for display to the user. The terminals receive the multicast audio channels and should perform an audio mixing function in order to present a composite~~comporsit~~ audio signal to the user.

The MC may provide conference control functions such as chair control, video broadcast and video selection (except for Voice switched selection). This shall be done by receiving H.245 from a terminal and then sending the appropriate control to other terminals to enable or disable their video multicast. ~~T.120 commands may optionally provide the same functions.~~

5.5.3 Hybrid Multipoint Capability

If the terminals and MC have hybrid multipoint capability, the terminals communicate with the MC in a point-to-point mode on the control channel and data channels only. The MC directs a selected terminal or terminals to multicast its (their) video channel to the other terminals in the conference. The terminals receive multicast video channels and select one or more of the available channels for display to the user.

All of the terminals in the conference transmit their audio channels to the MP. The MP performs the audio mixing function and outputs the resulting audio streams to the terminals. Note that the MP should produces an exclusive audio sum for each terminal in the conference. The MP may also multicast a selected audio stream to the participating terminals(other than the source) in order to minimize the bandwidth used on the LAN***{Editors Note: Is it a mistake to link this option with the hybrid case?? Do we need another capability?}*** For this case terminals are incapable of voice actuated Video selection.

The reverse case may also exist: All terminals multicast their Audio, and mixing is local to each Terminal. Video is unicast to an MCU which may either select a videosStream for retransmission to

the participating terminals or send a composite (mixed) video stream to the terminals (continuous presence).

5.5.4 Establishment of common mode

The MC ~~shall~~ should (this is not a mandatory mode) coordinate a common communications mode between the terminals in the multipoint conference[1]. The MC may force terminals into a particular common mode of transmission (as allowed by their capability sets) by sending to the terminal a receive capability set listing only the desired mode of transmission, or the MC may rely on multipointModeCommand to enforce mode symmetry.

5.5.5 Multipoint rate matching

Since the terminals on each link in a multipoint configuration may be operating at different bit rates, MCs may choose to send H.245 **FlowControlCommand** messages to limit the transmitted bit rates to those which can be sent to receivers.

5.5.6 Multipoint lip synchronisation~~synchronization~~

An MP which provides centralized multipoint capability should maintain audio and video synchronization by modifying the time tags of the output audio and video streams to take into account any skew that it introduces. It should be noted that this service cannot be performed for the mixed audio hybrid conference. ***{Editor's Note: more work is needed to consider the various cases}***

5.5.7 Multipoint encryption

In a centralized multipoint configuration the MP is considered to be a trusted entity. Each port of the MP decrypts the information streams from each of the H.323 terminals and encrypts the information streams to each terminal in accordance with section 9.1. Operation of an untrusted MCU is for further study.

5.5.8 Cascading Multipoint Control Units

The multipoint control function may be distributed between several MCU entities. Such operations are for further study.

5.5.9 Mixed Multipoint Operation

There are cases where part of the terminals are able to switch their video and mix their audio (and hence participate in a decentralized conference); while other terminals will not be able to mix their audio, and can only participate in a centralized multipoint conference. In this case, the MCU shall connect as a single participant in the decentralized multipoint and shall provide the mixed audio and the selected video of its terminals.

6 Call Signaling

For terminals that are bound to gatekeepers, call signaling begins with an admissions message exchange using the gatekeeper's unreliable well known port. After this initial exchange, call signaling between terminals, Gateways, and Gatekeepers takes place between well known

[1]Note that although this is generally true, there are several exceptions, including "mixed" mode conferences and secondary terminals.

addresses (IPX Socket, IP port) and dynamic ports over a guaranteed transport using the procedures described in H.323. The H.225.0 call control messages are transmitted in Control PDUs as defined in H.225.0. In this section, a terminal is understood to be either a terminal, a gateway, or an MCU unless otherwise specified. ***{Editor's note: some controversy exists over whether the MC should be considered callable; discussion at Ispswich to follow}***

The calling and the called terminal shall be the User as far as call setup messages. Gateways and Gatekeepers shall be Network. MCUs shall be User.

Guaranteed and reliable are synonimous terms.

When the calling terminal is not bound to a ~~In networks that do not contain a~~ Gatekeeper, Call Signaling messages are passed directly between the calling and called terminals. In these networks, it is assumed that the calling terminal knows the reliable transport address of the called terminal and thus can communicate directly.

When the calling terminal is bound to a gatekeeper, ~~In networks that do contain a Gatekeeper,~~ Call Signaling messages are passed between the calling terminal and the Gatekeeper; and the Gatekeeper and the called terminal, or directly between the terminals as determined ~~chosen~~ by the gatekeeper The terminals communicate with the Gatekeeper as if the Gatekeeper were the *network* as defined in H.225.0 in the former case. It is assumed that calling terminal knows the unreliable transport address of the Gatekeeper in its Zone. The~~ZoneThe~~ Gateway performs the appropriate inter-exchange signaling procedures between the H.225.0Control PDUs and the WAN signaling system (Q.931, Q.2931, SS7?).

The following table indicates the roles(user or network, as used in H.225.0) played by terminals, gateways, gatekeepers, and MCUs as a function of call model on the LAN side of a gateway. This table does not address the role that a gateway might play on the WAN side using Q.931 or other call protocols.

Entity	***Case***	***Action***	***H.225.0 Role on LAN side***
Terminal/MCU~~/GW~~	Figure 6A	Calling	User
	Figure 6A	Called	User
	Figure 6B	Calling	User
	Figure 6B	Called	User~~Network~~
Gateway	Figure 6A	Calling	Network
	Figure 6A	Called	Network
	Figure 6B	Calling	Network
	Figure 6B	Called	Network
Gatekeeper	Figure 6A	Called/Calling	Network
	Figure 6B	Called/Calling	Not involved

The two basic models of gatekeeper permissioned connection setup are:

1)A model where call signaling after admission control is routed directly to the terminal(Figure 6B).

2)A model where call signaling after admission control is routed via the gatekeeper to the terminal(Figure 6A).

Both models use the same kinds of connections for the same purposes, and the same messages. There is no need to differentiate between bound and unbound terminals in either model.***{Add reference for bound and unbound}***

In both models, unreliable messages (e.g. UDP) shall be ~~are~~ used for admission interactions with the Gatekeeper, followed by an exchange of H.225.0 call signaling on a reliable (TCP) connection, followed by the setup of another reliable connection for H.245 messages. The~~messages.~~ Gatekeeper shall determine which Call Signaling model should be used.~~The actions of the gatekeeper in response to the admisssion messages determine which call model is used, this is not under the control of the terminal.~~

In both models two types of "well known" transport addresses exist: ***{A definition of a well known port will be added; we will try to rationalize the terminology~~terminolgy~~}***

1. Each terminal and Gatekeeper shall have ~~has~~ a well known reliable port that is used for H.225.0 call signaling. Note that gatekeepers use the same well known reliable port along with their own network address for~~address for~~ H.225.0 call signaling.

2. Each gatekeeper shall have ~~has~~ a well known unreliable port ~~that is used~~ for H.225.0 admissions messages.

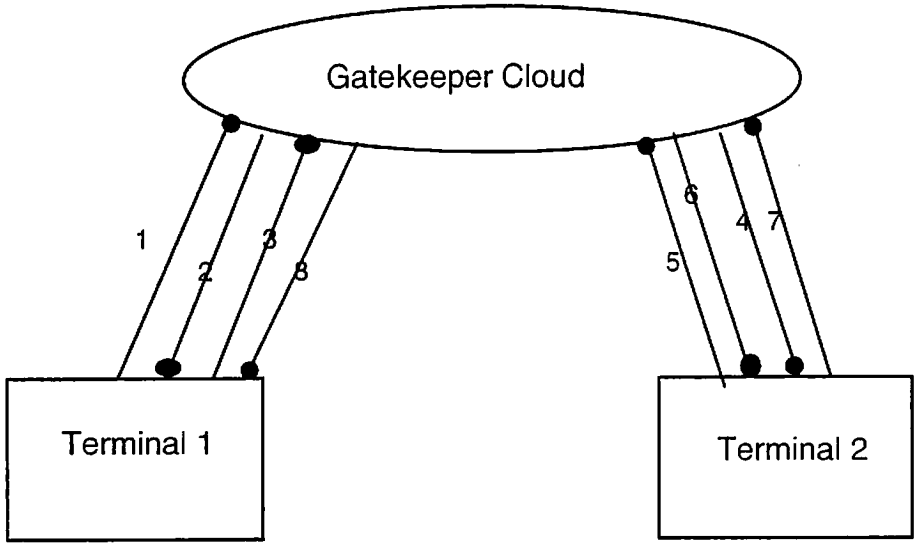


Figure 6A: call signaling via gatekeeper

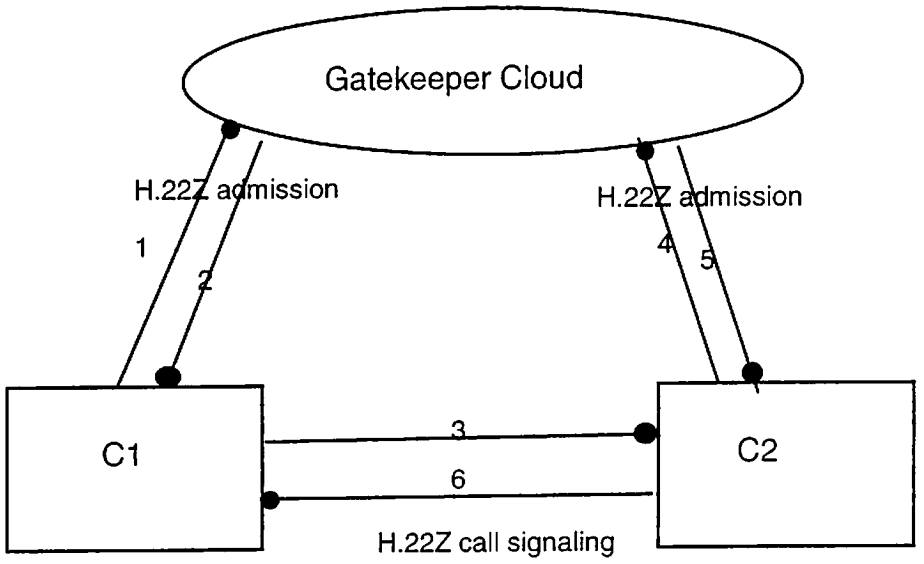


Figure 6B: direct call signaling

6.0.1 H.245 Connection

For figure A, a second choice exists:

1)H.245 signaling mediated by the gatekeepers

2)H.245 signaling directly between the terminals.

This choice shall be ~~is also~~ made by the gatekeeper. H.245 signaling shall be on a seperate~~sperate~~ reliable channel. For~~channel.For~~ Figure B, the H.245 channel shall ~~can only~~ be connected directly between C1 and C2.

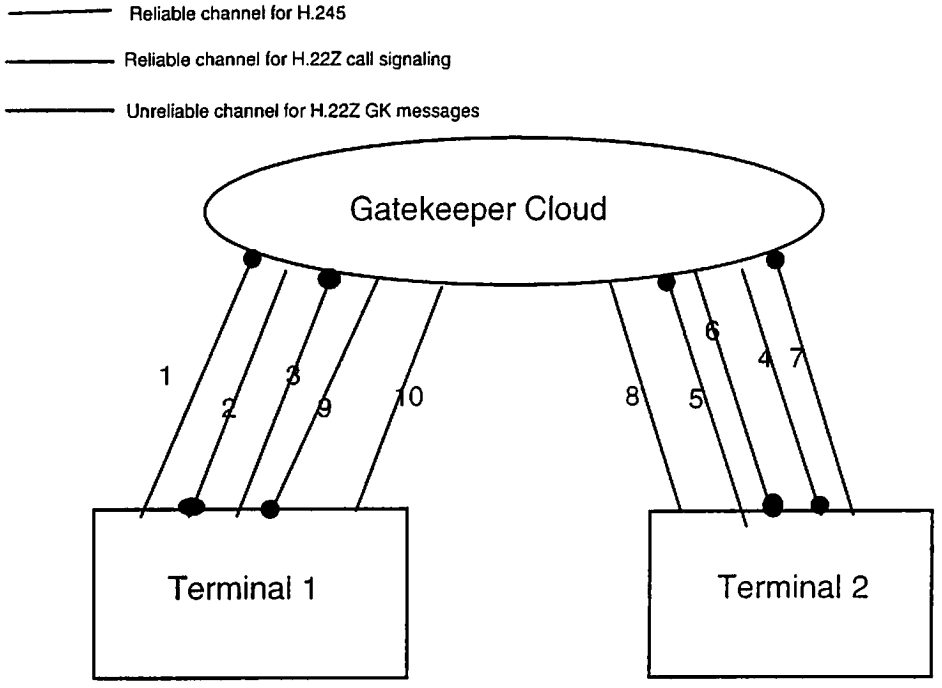


Figure 6C: H.245_channel between gatekeepers

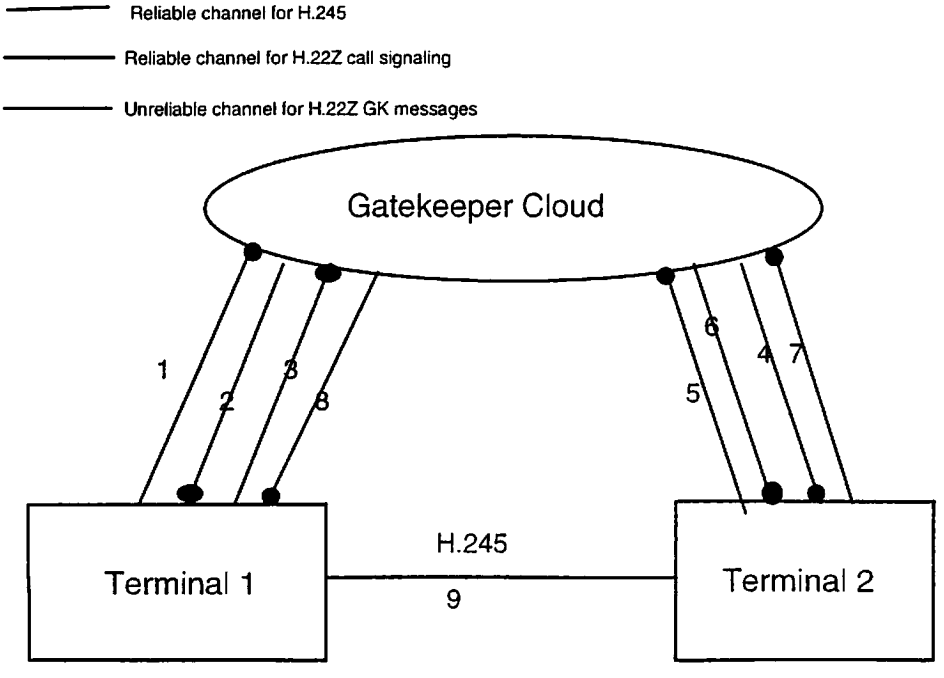


Figure 6D: H.245 signaling between terminals

When a call is terminated, the ~~gatekeeper needs to know about the release of bandwidth immediately. Thus, the~~ message BWR (Bandwidth Release) shall be sent to the GK (if the terminal is bound) after a Disconnect is received.~~) If another call is made, there is no need to send the release.~~

~~A need also exists for the gatekeeper to be informed of terminals that are turned off, or otherwise enter a failure mode.~~ The gatekeeper should ~~may~~ use the~~use the~~ SRQ/SRR message sequence (see H.225.0) to poll the terminals on active calls at an interval decided by the manufacturer. The terminal shall respond within less than 5 seconds, and the polling interval shall be greater than 10 seconds. Note that this message may also be used by a diagnostic device as described in section 10.2.

6.1 Terminal Addresses

Each H.323 terminal shall have a network address. The H.323 terminal may also have an E.164 address (network access number, telephone number, etc.) and may also have ~~or~~ an H.323 ID (name, e-mail like address, etc.)~~:~~ . The H.323 ID consists of n ASCII characters. The number of characters is left to the discretion of the manufacturer. ***{Shouldn't we require a minimum length???}***

~~When there is no Gatekeeper in the system, the calling terminal may address the called terminal directly using the network address of the called terminal.~~ (Was stated in previous paragraph)

{Editor's note: let's discuss the following - what addresses the gatekeeper is required to translate for a terminal, and when the terminal is required to send E.164 addresses. There were some rules in the text, requiring that E.164 addresses be used for destinations outside the super-Zone. However, this should be reconsidered in light of the simplified call model; it may only apply to certain cases. Also, additional detail on the assignment of the H.323 ID is required.}

The called terminal E.164 address may consist of an optional access code followed by the E.164 address. The access code consists of n digits from the set of 0 to 9, * (star) and # (pound). The number of digits and their meaning is left to the discretion of the manufacturer. One purpose of such an access code might be to request access to a gateway.

6.2 Terminal Registration

When a Gatekeeper is present, it should be~~must be~~ aware of the terminals and Gateways within its Zone. The registration process also associates a terminal's network address with its E.164 address and an optional terminal identifier. Registration may be done statically or dynamically. Static registration includes methods such as manual configuration of the Gatekeeper by an operator, or the pre-loading of static tables. Dynamic~~tables.Dynamic~~ registration requires communications between the Terminal and the Gatekeeper. There are two methods of dynamic registration. The first method is an auto registration mode, primarily controlled by physical topology. The second method provides for a deterministic registration. The process of registration binds a terminal to a Gatekeeper.

For all cases, the Terminal should not be registered with two Gatekeepers. For the Dynamic registration processes, it shall be the responsibility of the Terminal to make sure that it does not register twice. Since static registration is done by an operator, the responsibility is outside the scope of this recommendation.

{Editor's note: Do we need some text on how these modes interact? Are they mutually exclusive?}

6.2.1 Deterministic Registration

As part of their configuration, H.323 terminals and Gateway units, may send a Registration Request (RRQ) to the appropriate Gatekeeper for their site. The Gatekeeper shall respond with either a Registration Confirmation (RCF) or a Registration Rejection (RRJ). The RRQ may be repeated periodically (i.e.~~ie~~, at terminal power up) so the Gatekeeper shall be able to handle multiple requests from the same terminal. See Figure 7/H.323. . ***Editor's Note: An unreqistration message and appropriate procedures will be added.}*** It is presumed that during install or at some other appropriate point, the user of a H.323 terminal or Gateway will be given the opportunity to enter an transport address of the appropriate Gatekeeper.

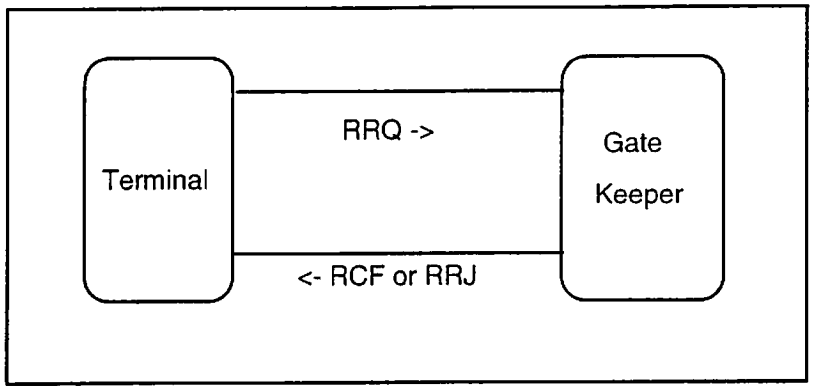


Figure 7/H.323 Deterministic Registration

6.2.2 Auto Registration

A terminal may not know who its Gatekeeper is, or may need to register with ~~identify~~ another Gatekeeper due to a Gatekeeper failure. This may be done through auto registration. Auto registration allows for lower administrative overhead in configuring individual H.323 terminals and additionally allows replacement of an existing Gatekeeper without manually reconfiguring all of the affected terminals.

The H.323 terminals and Gateway units, may issue ~~broadcast~~***{Editor's Note: there is controversy over whether this should be multicast; further discussion is needed}*** a Gatekeeper Request (GRQ) message, asking "who is my Gatekeeper?". This is sent to the gatekeeper's well known port. One or more Gatekeepers may respond with the Gatekeeper Confirmation (GCF) message indicating "I can be your Gatekeeper.". If more than one Gatekeeper responds, the terminal may choose the Gatekeeper it wants to use. If no Gatekeeper responds, the terminal shall use~~must use~~ either the static or deterministic registration methods. ***{Editor's Note: we need to address retry intervals, perhaps as advice to the manufacturer}***

The terminals then may send a Registration Request (RRQ) to the selected ~~appropriate~~ Gatekeeper ~~for their site~~. The Gatekeeper shall respond~~must respond~~ with either a Registration Confirmation (RCF) or a Registration Rejection (RRJ).

The GRQ and RRQ may be repeated periodically (i.e.~~ie~~, at terminal power up) so the Gatekeeper must be able to handle multiple requests from the same terminal. See Figure 8/H.323.

If at any time a terminal determines it has an invalid binding with its Gatekeeper, it must re-register. The invalid binding may be detected by either receiving an RRJ message from a Gatekeeper in response to an RRQ from the terminal, or not receiving any response to an RRQ from the terminal within a timeout. Before it re-registers, it should issue an GRQ message to re-discover its Gatekeeper.

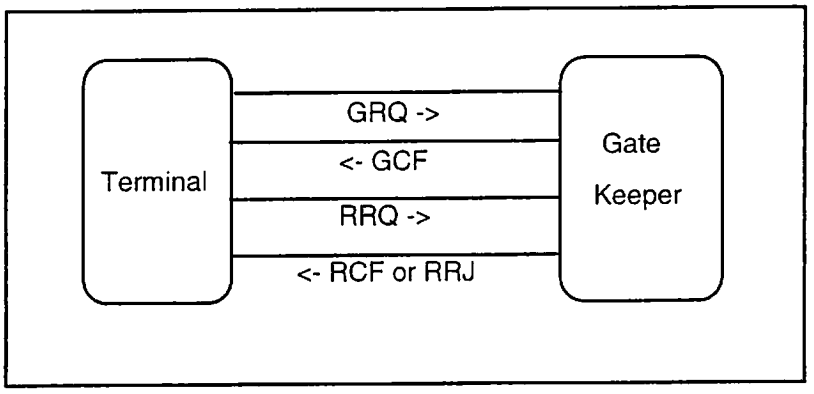


Figure 8/H.323 Auto Registration

7. Terminal procedures

The provision of the communication is made in the following steps:

- phase A: Call set-up (subclause 7.1);
- phase B: Initial communication and capability exchange (subclause 7.2);
- phase C: Establishment of audio visual communication (subclause 7.3);
- phase D: Supplementary~~Suplementary~~ Services (subclause 7.4);
- phase E: Call termination (subclause 7.5)

7.1 Phase A - Call set-up

{Editor's Note: Need to address adding a B-channel~~schanne~~ or bandwidth changes I on the ISDN side to an on-going call}

Call Set-up takes place according to the call control procedures defined in H.225.0 as tailored below.

7.1.1 Basic Call Setup

{Editor's note: as promised, a massive simplification is provided}

In the basic call scenario as shown in Figure 7A, two terminals communicate directly without a gatekeeper. The Setup(3) is sent to the well known reliable port of terminal 2. The Connect(8) contains a dynamic reliable network address for use in H.245 signaling. Messages (6) and (7) are optional.

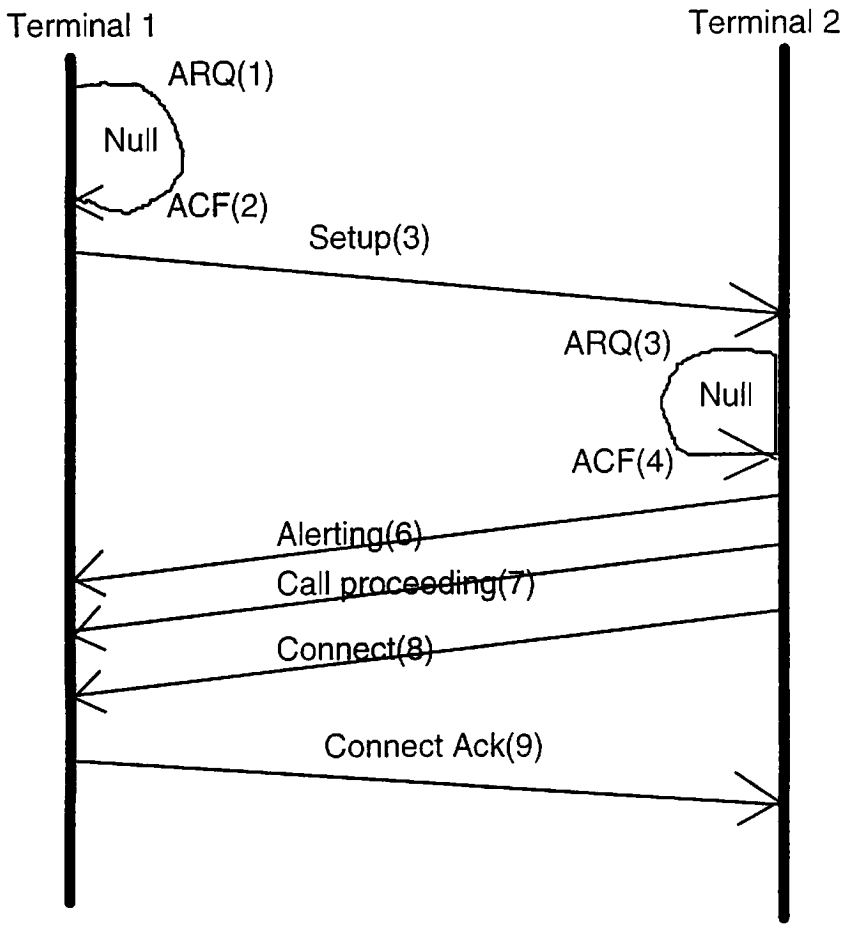


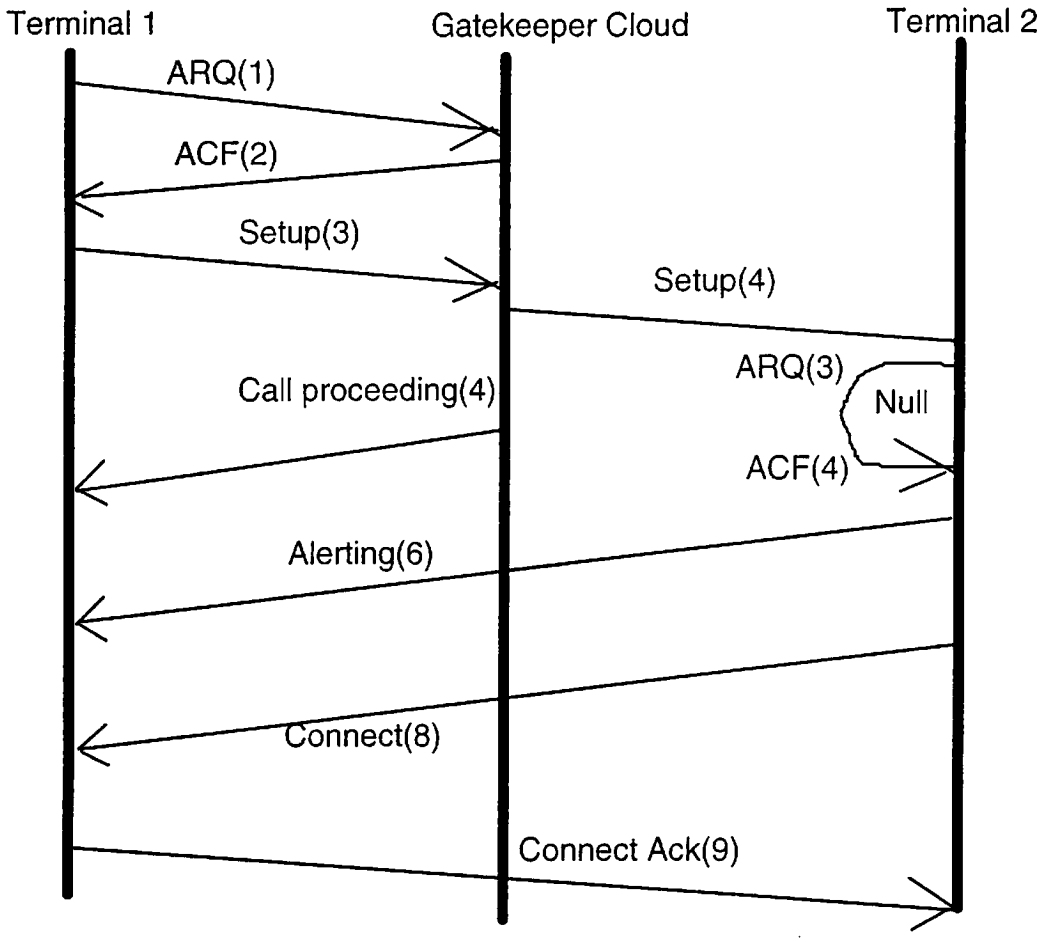
Figure 7A Basic Call Setup, no gatekeepers

Note alerting and call proceeding are in the wrong order; this will be fixed.

7.1.2 Caller has gatekeeper

If the caller has a gatekeeper, the ARQ/ACF exchange takes place with that gatekeeper. The gatekeeper may chose to return the network address of terminal 2 in the AdmissionAdminssion ConfirmationConfirmaction(ACF). After this, the call proceeds as in Figure 7A if terminal 2 is unbound. If terminal 2 is bound, and ARQ/ACF exchange takes place with its Guardian, and it is possible that an ARJ(Admission Reject) is received by terminal 2, in which case it sends Disconnect to terminal 1. {Editor's Note: a Figure 7C will be added showing the case where terminal 2 has a gatekeepe, and terminal 1 does not}

If the gatekeeper of terminal 1 chooseschoses to remain in the call (per model shown in fig 6B), the case shown in Figure 7B results.


Terminal 1
Gatekeeper Cloud
Terminal 2
ARQ(1)
ACF(2)
Setup(3)
Setup(4)
ARQ(3)
Null
Call proceeding(4)
ACF(4)
Alerting(6)
Connect(8)
Connect Ack(9)

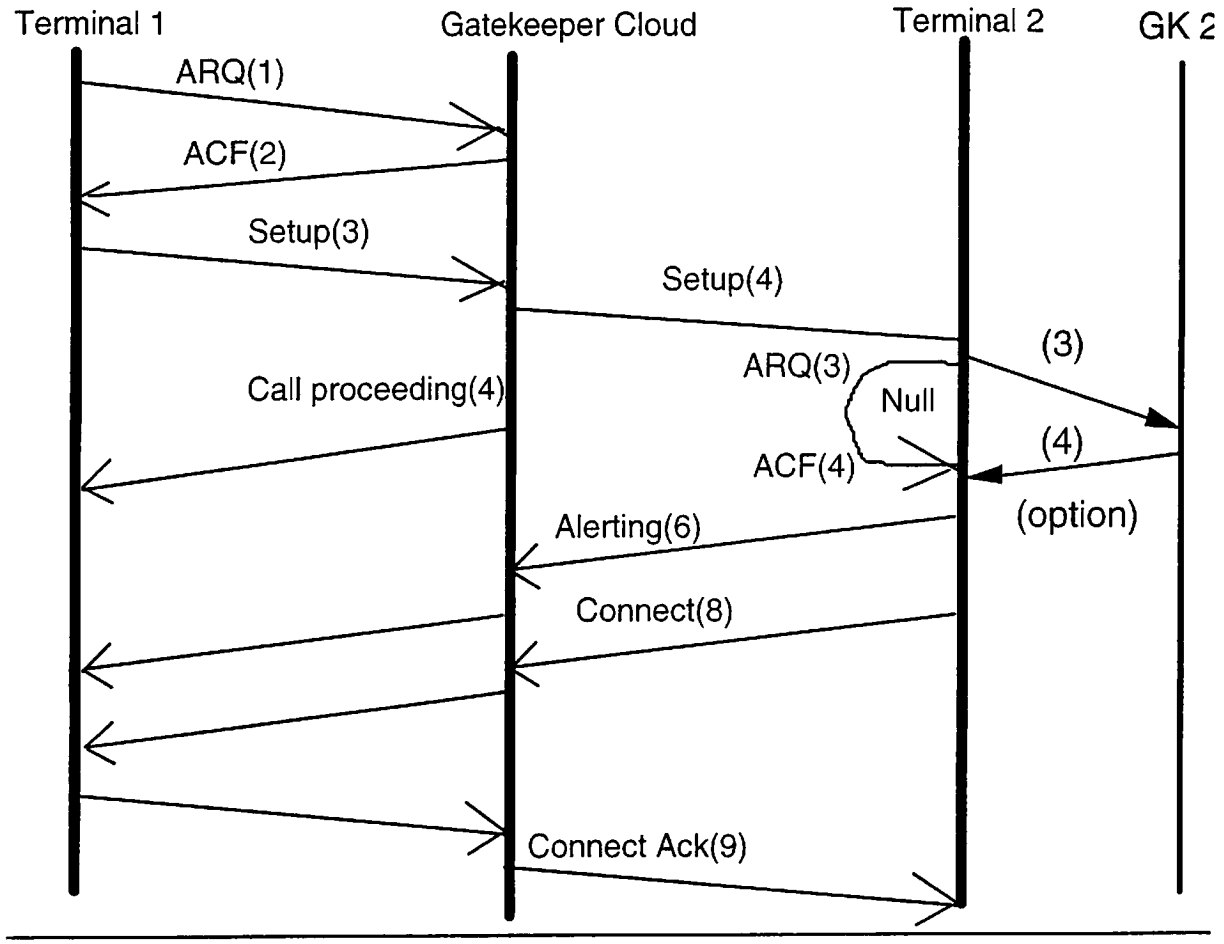


Figure 7B***{make Alerting/Connect terminate on Gatekeeper}***

In this case, terminal 1 gets back from the ARQ/ACF exchange a reliable port that is on the gatekeeper~~, not teminal 2~~. When the gatekeeper receives setup(3) it responds with call proceeding(4) and Setup(4) to terminal 2. Terminal 2 may_ engage in an ARQ/ACF exchange with its gatekeeper, or not, (depending on whether it is bound). Figure 7B shows the case where terminal 2 is unbound. The connect from terminal 2 to the gatekeeper cloud contains a reliable port for H.245 connection, but the connect that arrives at terminal 1 may or may not contain this same port, based on whether the gatekeeper chooses~~eheses~~ to insert itself between the two terminals~~teminals~~. ***{Make it clear that the gatekeepr in involved in the call signaling}***

7.1.6 Call Set-up via Gateways

7.1.6.1 Gateway Inbound Call Set-up

Call set-up between a Gateway and a terminal proceeds the same as the terminal to terminal call setup. The Gateway ~~Unit~~ may need to issue Call Proceeding messages to the external terminal while establishing the call on the network.

If the network does not have Multiple Subscriber Number (MSN)***{Need further consideration of whether DID or Sub-addressing is appropriate here}***capability, it shall be able to accept SBE numbers from other H.323 gateways. These numbers will indicate a second stage dialing number to

access the individual terminal on the LAN. Support of GSTN terminals requires the H.323 gateway to have an attendant, or to support DTMF signaling. Two stage dialing from an H.320 terminal requires the H.320 device to support either DTMF or SBE numbers. Two stage dialing from an H.324 terminal relies on DTMF signaling.

Since incoming calls do not carry a network address, a Gateway shall always be bound to a Gatekeeper.

The following figure 7.1.6.1-1 shows the basic procedure that may involve adding bandwidth due to gradual additions of B Channels on the H.320 side

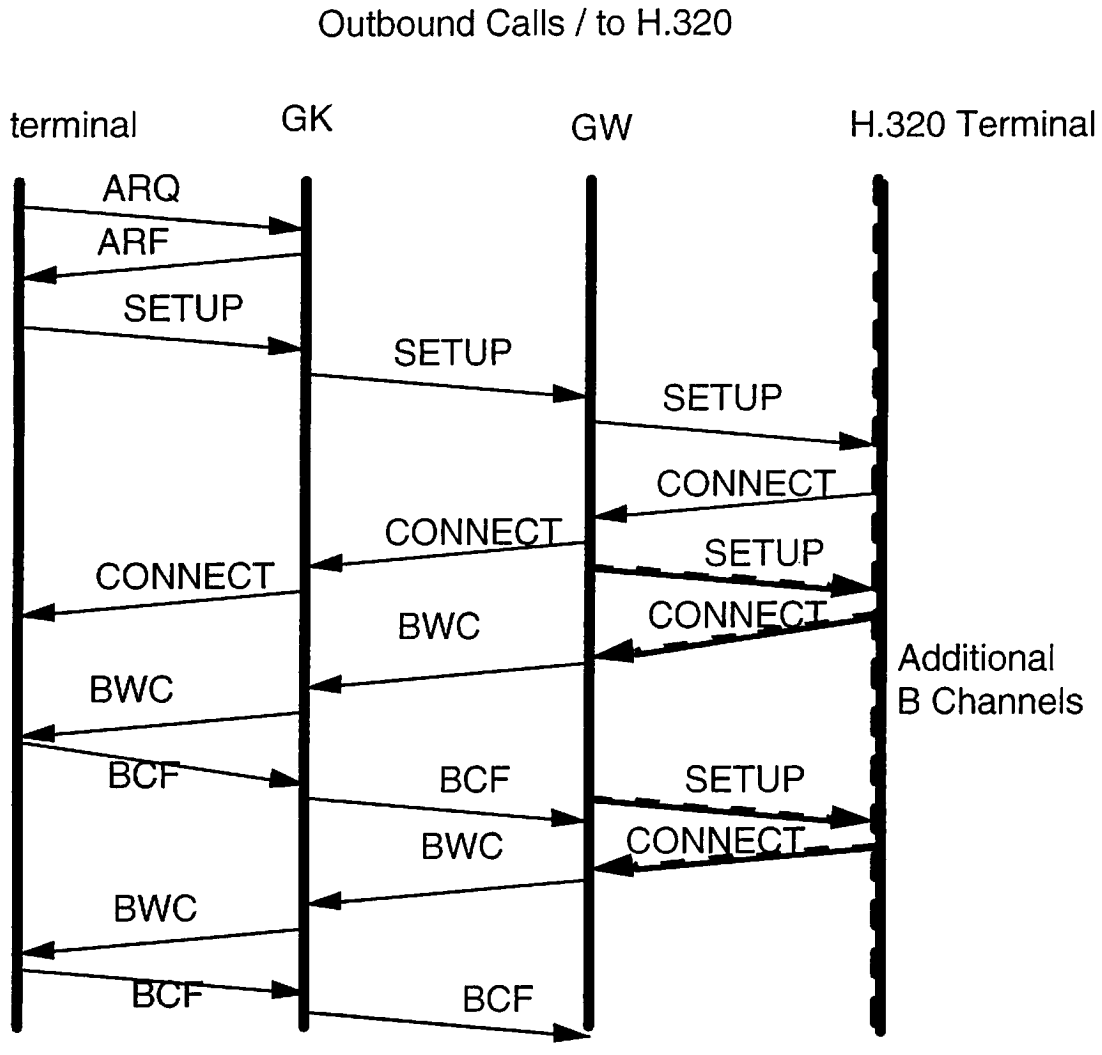


Fig. 7.1.6.1-1 Outbound Calls with Gateway

The major difference from 7.1.5 is the need for additional Bandwidth Change Requests (BWC) the associated BCF (accept) or BCR (reject).

7.1.6.2 Gateway Outbound Call Set-up

A similar drawing is shown for Inbound Calls (fig 7.1.6.2-1)

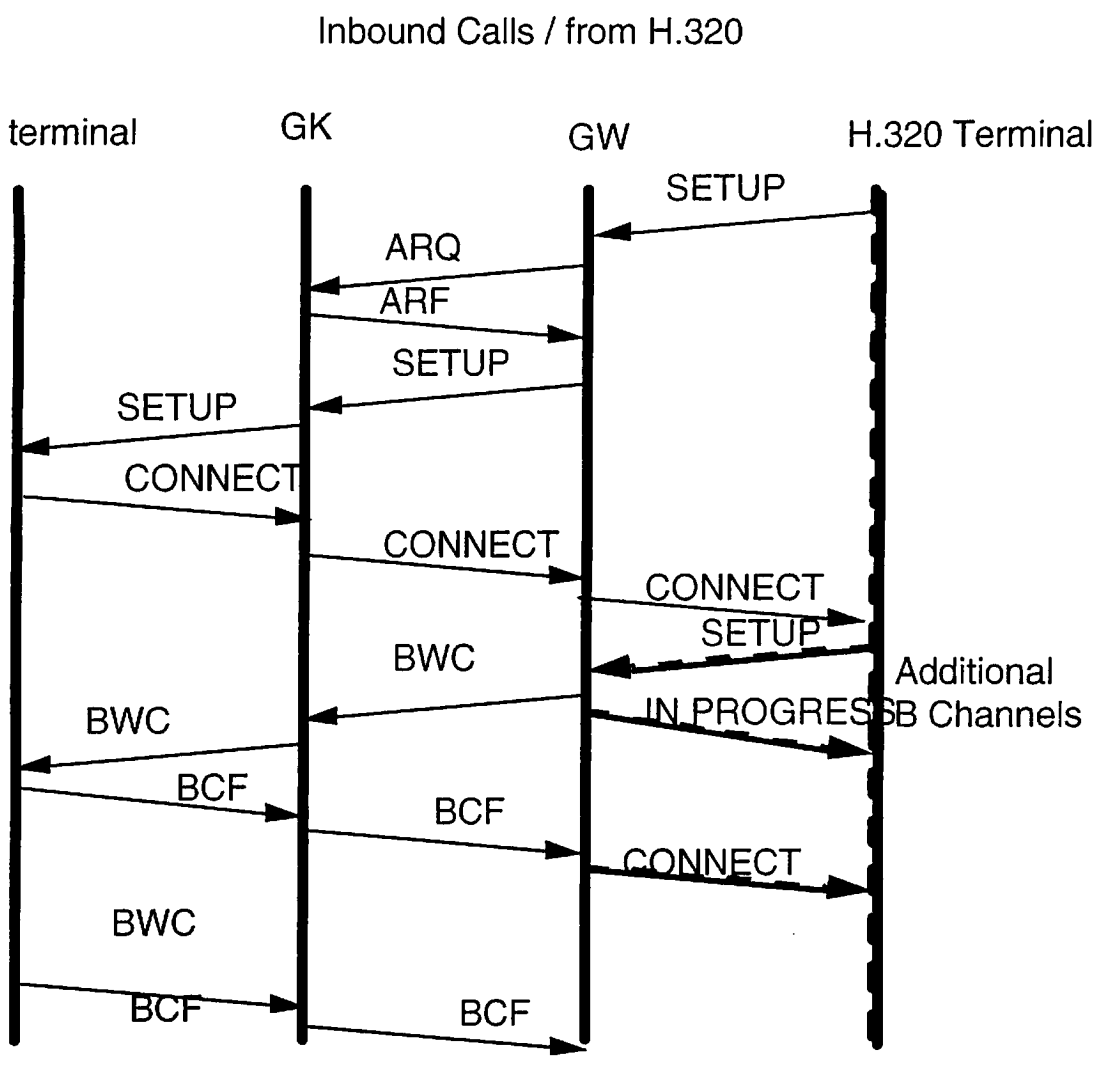


FIG. 7.1.6.2-1 Inbound Calls from H.320 Terminals

~~*{Add fence post drawing}*~~

Call set-up between a terminal and a Gateway unit proceeds the same as the terminal to terminal call setup. The Gateway unit will receive the destination E.164 address in the Setup message. It will then use this address to place the outbound call. The Gateway unit may issue Call Proceeding messages to the Gatekeeper while establishing the outgoing call.

The Progress Indicator information element is used to indicate that inter-networking is occurring~~eeeuring~~. The Gateway shall issue a Progress indicator information element within the Alerting, Call Proceeding, or Connect messages. This information may also be sent in a Progress message.

7.1.7 Call Setup with an MCU

For multipoint conferences, all terminals establish a call with the MCU. Call set-up between a terminal and the MCU proceeds the same as the terminal to terminal call setup. Call-out capability

in the MCU is also possible. The MCU initiates the call setup procedure by exchanging the H.225.0 call setup messages as in the point-to-point case..

In a Centralized Multipoint Conference, the H.245 control channel is opened between the terminals and the MCU, The audio, video, and data channels are opened between the terminals and the MP. In a Decentralized Multipoint Conference, only the H.245 Control Channel is open between the terminal and the MC (note that there may be many such control channels, one for each terminal). The Audio and Video Channels may ~~will~~ be multicast to all terminals in the conference. The Data Channel shall be opened with the MP , ***{Editor's Note: We need to address the location of the MCS top provider}***

7.2 Phase B - Initial communication and capability exchange

Once both sides have traded the call setup messages from section 7.1, each knows the dynamic reliable transport address for H.245 control. The terminals shall ~~immediately~~ establish a reliable connection for the H.245 control channel. The procedures of H.245 are used over the Control Channel for the capability exchange and to open the media channels.

Terminal system capabilities are exchanged by transmission of the H.245 **TerminalCapabilitySet** message. This capability PDU shall be the first message sent.

The Audio Channel may optionally be opened prior to capability exchange, providing the capability to have speech communications at the earliest possible opportunity and before proceeding to visual telephony. If the Audio Channel is opened prior to the capability exchange, the audio channel shall use G.711 audio at 64 kbps.

Following this exchange of capabilities, the terminals shall proceed directly to the desired operating mode i.e. Phase C.

7.3 Phase C - Establishment of audiovisual communication

Following the exchange of capabilities, the procedures of H.245 shall then be used to open logical channels for the various information streams. The audio and video streams, which ride on the logical channels setup in H.245, are transported over dynamic ports using a non-guaranteed protocol (see H.225.0). Data communications which ride on the logical channels setup in H.245, are transported over dynamic ports using a guaranteed underlying protocol (see H.225.0).

The **OpenLogicalChannelAck** returns the port number that the receiving terminal has assigned to that logical channel. The transmitting channel shall then send all media bits(audio, video, data) associated with the logical channel to that port.

7.3.1 Mode changes

During a session the procedures for changing channel structure, capability, receive mode etc. shall be carried out as defined in Recommendations H.245.

7.3.2 Exchange of video by mutual agreement

The indication, **VideoIndicateReadyToActivate**, is defined in H.245. Its use is optional, but when used the procedure shall be as follows.

Terminal X has been set so that video is not transmitted unless, and until, the remote terminal has also indicated readiness to transmit video. Terminal X shall send the indication

VideoIndicateReadyToActivate when the initial capability exchange has been completed, but shall not transmit a video signal until it has received either **VideoIndicateReadyToActivate** or incoming video.

A terminal which has not been set in this optional way is not obliged to wait until receipt of **VideoIndicateReadyToActivate** or video before initiating its video transmission.

{Editor's Note: Should we prohibit the usage of VIA in multicast operation???}

7.4 Phase D: Supplementary~~Suplementary~~ Services

7.4.1 Bandwidth Changes

At any time during a conference, the terminals or Gatekeeper may request an increase or decrease in the call bandwidth. . Any bandwidth change shall be in accordance with the declared capability of the terminals. The H.245 flow control commands shall not exceed the bandwidth approved by the Gatekeeper.

In terminal initiated changes, the terminal sends a Bandwidth Request (BRQ) message to the Gatekeeper. The Gatekeeper determines if the request is acceptable. The criteria for this determination is outside the scope of this Recommendation. If the Gatekeeper determines that the request is not acceptable, it returns a Bandwidth Reject (BRJ) message to the requesting terminal. If the Gatekeeper determines that the request is acceptable, it returns a Bandwidth Confirmation (BCF) message. The terminal then sends an H.245 flow control command to the other terminal, and adjusts the desired information streams.

If a gatekeeper is not managing the H.245 control channel, the called terminal shall request bandwidth from its gatekeeper using BRQ. In the event that it receives BRJ, it shall not follow the H.245 initiated changes. **{Editor's note: do we need more signaling???}**

If the gatekeeper is managing the H.245 control channel, and the call is point-to-point, the terminals shall still send the BRQ. Note that the terminal is not aware of whether the H.245 channel is managed by the gatekeeper or not. If the call is multi-point, and the terminals are in receipt of **multipointModeIndicate**, they shall not issue BRQs; it is assumed that the gatekeeper has reserved sufficient bandwidth for all its requests.

Ad hoc conferences require BRQs during the conference.

7.4.2 Call Status

During the duration of a call, a terminal or Gatekeeper may periodically request status from another terminal. The requesting terminal or Gatekeeper issues a Status Inquiry~~Enquiry~~ message. The Terminal receiving the Status Inquiry~~Enquiry~~ message shall respond with a Status message indicating the current call state. This procedure should ~~shall~~ be used by the Gatekeeper in order to periodically~~periodiecaly~~ check if a call is still active.

7.4.3 Ad Hoc Conference Setup

7.4.3.1 Terminal Centricr Case

{Editor's Note: two changes will be made in this section:

a)The bandwidth request messages will be added (BRQ), and further consideration will be given to the coordination of bandwidth requests.

b)In this section "Terminal 1 calls Terminal 2" is used as a shorthand for a number of steps, including gatekeeper admission request and H.22Z call messages such as Setup and Connect. This will be clarified.}

The peer-to-peer model for ad hoc (no pre-arrangement~~errangment~~, no knowledge of an MCU) and the terminals are not bound to a Gatekeeper, conferencing follows. Here conference id(CID) is the H.225.0 conference id, a call identifier assigned by the called terminal. The following scenario applies for peer-to-peer ad hoc conference initiation as shown in Figure 6B where the Q.931 signaling is directly between the two terminals. Terminal 2 has MC capability. Note CID=1 could be any number. CID=0 implies a request to start a new conference; CID=XXX implies a request to add a party to an existing conference.

1)Terminal 1 calls Terminal 2 (CID=0)

2)Terminal 2 sends Terminal 1 the CID=1)

3)Using H.245 master/slave determination procedure, it is determined that Terminal 2 is the master, and hence has the MC.

4)Terminal 1 and Terminal 2 may be attached to MC now, or when the user initiates the conference function, at the choice of the manufacturer.

5)Terminal 2 calls Terminal 3(CID=1).

6)Terminal 2 attaches Terminal 3's H.245 channel to its MC. .All negotiation of multi-cast vs uni-cast is done on the H.245 plane.

7The MC may chose to send **multipointModeCommand** at this time.

In this case, the MCS top provider shall be at the same terminal that has the MC.

If Terminal 1(or any terminal that cannot provide the MC/MCS top provider) wishes to initiate the call, a somewhat different procedure is followed:

1)Terminal 1 calls Terminal 2 (CID=0)

2)Terminal 2 sends Terminal 1 the CID=1.

3)Using H.245 master/slave determination procedure, it is determined that Terminal 2 is the master, and hence has the MC. In this case, we are assuming Terminal 1 does not have an MC.

4)Terminal 1 and Terminal 2's H.245 control channels may be attached to MC at Terminal 2 now, or when the user initiates the conference function, at the choice of the manufacturer.

5)Terminal 1 sends a Setup for Terminal 3 with (CID=1) to Terminal 2.

6)Terminal 2 passes the Setup on to Terminal 3(CID=1). Thus, Terminal 2 remains at the center of the conference; in effect it is acting as a dial-out only MCU.

7)After the completion of Terminal 2/Terminal 3 call signaling, Terminal 2 attaches Terminal 3's H.245 channel to its MC. .All negotiation of multi-cast vs uni-cast is done on the H.245 plane.

It should be noted that the call is ended by a failure of the terminal that is providing the MC and/or the MCS top provider.

7.4.3.2 Gatekeeper Case

Terminals are bound to a Gatekeeper. Now consider the model of Figure 6A in more detail, first taking the case where the H.245 signaling is via the gatekeeper(Figure 6C). Note CID=1 could be any number.

1)Terminal 1 sends Setup(CID=0) to the gatekeeper.

2)The gatekeeper sends Setup(CID=1) to terminal 2.

3)When Connect is sent by the gatekeeper to Terminal 1, it contains CID=1.

4)Terminal 1 (or 2) sends Setup(CID=1) to the gatekeeper. The gatekeeper may insert an MC into the call at this time, or later when Terminal 3 is connected. Whether terminal 1 (or 2) has an MC, the gatekeeper by definition shall always win the master/slave determination process. In the event that the gatekeeper does not have an associated MC, it shall choose the call model of Figure 6B.

5)The gatekeeper sends Setup to Terminal 3(CID=1). At the conclusion of this, the Terminal 3 H.245 channel is connected to the Terminal 1 and 2 H.245 channels via the gatekeeper.

6) The MC may choose to send **multipointModeCommand** at this time.

Consider again Figure 6A, but as modified by Figure 6D (H.245 channel directly between Terminal 1 and Terminal 2). It is not recommended that gatekeepers choosing~~chosing~~ to offer ad hoc conferencing operate in this mode. Possible initiation of ad hoc conferencing in this mode is for further study.

For the cases just mentioned, the MCS-top provider shall be associated with the gatekeeper to facilitate the support of T.AVC and T.124. Note that this does not mean the MCS top provider is part of the gatekeeper, merely that the gatekeeper chooses which MCS top provider to connect to.

(Editor's Note: Further consideration and review shall be given to ad hoc conference initiation be given to this issue at Ipswich)

7.5 Phase E: Call termination

Either terminal may terminate a call by the following procedure:

1) It shall transmit the H.245 **VideoFreezePicture** command, discontinue transmission of video packets at the end of a complete picture, and the close the logical channel for video.

2) It shall discontinue transmission of data and then close the logical channel for data.

3) It shall discontinue transmission of audio and then close the logical channel for audio.

4) It shall transmit the H.245 **EndSessionCommand** message in the control channel, and then discontinue all transmissions on the control channel. ***{Editor's Note: We need to coordinate our solution with that agreed to for the purpose of speeding up H.324 call clearing}***

5) It shall***{Editor's Note: simplification of call clearing will be considered at Ipswich}*** clear the call by sending the using the procedures defined in H.225.0 and tailored below.

A terminal receiving **EndSessionCommand** without first having transmitted it, shall carry out 1) to 5) above.

7.5.1 Call Clearing without a Gatekeeper

In networks that do not contain a gatekeeper, after transmitting the **EndSessionCommand**, the terminating terminal shall transmit an H.225.0 Disconnect message (1) to the other terminal. A terminal receiving the Disconnect message (1) shall respond with a Release message (2). A terminal receiving the Release message (2) shall respond with a Release Complete message (3). At this point the call is terminated. See figure 16/H.323. ***{Editor's Note: At Ipswitch we shall consider whether this can be simplified; it is said that only Release Complete is needed; this is what is used in T.123}***

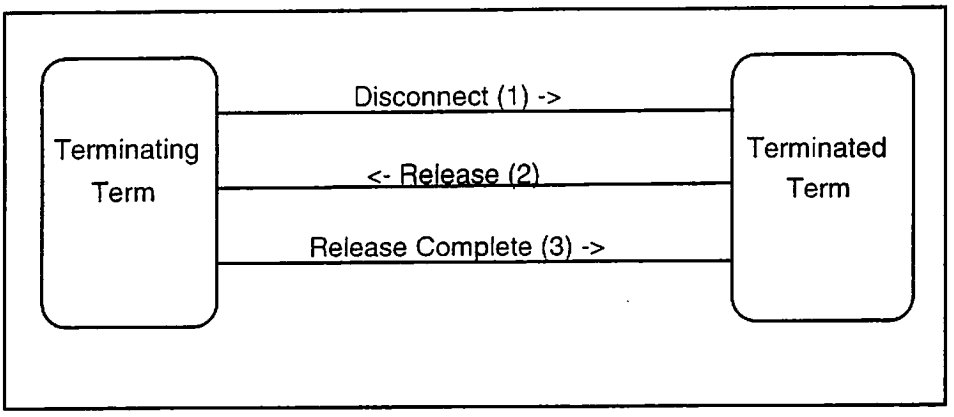


Figure 16/H.323 Disconnect without a Gatekeeper

7.5.2 Call Clearing with a Gatekeeper

In networks that do contain a gatekeeper, after transmitting the **EndSessionCommand**, the terminating terminal shall transmit an H.225.0 Disconnect message (1) to the Gatekeeper. The Gatekeeper Cloud shall forward the Disconnect message (1') to the other terminal if it is in the same Zone, or the other terminals Gatekeeper if it is in a different Zone. The Gatekeeper then responds to the terminating terminal with the Release message (2). A terminal receiving the Disconnect message shall respond with a Release message (3). The terminating terminal receiving the Release message (3) shall respond with a Release Complete message (4). The Gatekeeper receiving the Release message (2) shall respond with a Release Complete message (5). At this point the call is terminated. See figure 17/H.323. ***{Editor's note: As noted above, we may be able to simplify this; used of Release Complete alone will be considered at Ipswich} {We also need to show Bandwidth release; use fencepost diagram}***

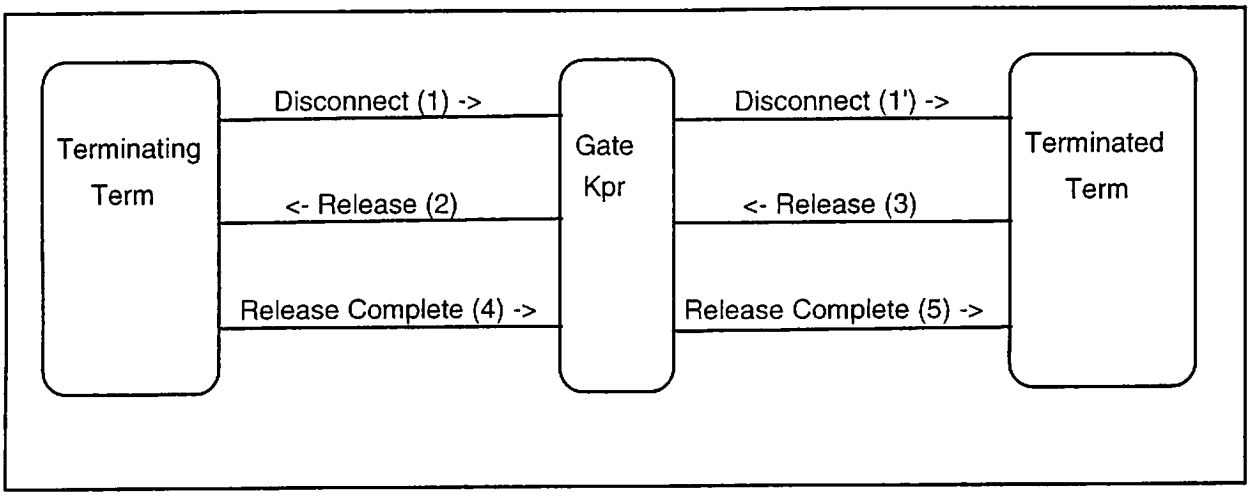


Figure 17/H.323 Call Clearing with a Gatekeeper

7.5.3 Broadcast Call Setup

This section is for further study.

In this case, broadcast is not used in the LAN sense; broadcast is implemented via multicast.

This kind of conference does not involve H.245 capability exchange; it is equivalent to an H.331 conference. If such a conference is joined to an H.245 mediated conference, it appears as a receive-only terminal since it is not interactive, merely a broadcast point.

8 Interoperation with other terminal types

Interoperation with other terminals shall be accomplished through the Gateway Unit. See Section 5.3.

8.1 Speech only terminals

Interoperation with speech only terminals over the ISDN or GSTN can be provided by:

1) using a H.323-ISDN Gateway Unit
2) using a H.323-GSTN Gateway Unit

The Gateway Unit must consider the following issues:

- Audio code conversion.
  ISDN: If desired, since ISDN may uses G.728~~11~~
  GSTN: from analogue~~analog~~ to G.711
- Bitstream conversion.
  ISDN: H.225.0 to/from unframed
  GSTN: generate H.225.0
- Control conversion. (Generate H.245)
- Call Control Signalling conversion.

8.2 Visual telephone terminals over the ISDN (H.320)

Interoperation with visual telephone terminals over the ISDN (H.320) can be provided by:

1) using a H.323-ISDN Gateway Unit.

The Gateway Unit must consider the following issues:

- Video format conversion. (if desired, H.261 is mandatory for both terminal types.)
- Audio code conversion. (if desired, G.711 is mandatory for both terminal types.)
- Bitstream conversion. (H.225.0 to/from H.221)
- Control conversion. (H.245 to/from H.242)
- Call Control Signalling conversion.

8.3 Visual telephone terminals over GSTN (H.324)

Interoperation with visual telephone terminals over the GSTN (H.324) can be provided by two methods:

1) using a H.323-GSTN Gateway Unit.
2) using a H.323-ISDN Gateway Unit assuming that there exists an ISDN/GSTN Interworking Unit on the network.

The Gateway Unit must consider the following issues:

- Video format conversion. (if desired, H.261 is mandatory for both terminal types.)
- Audio code conversion. (G.711 is mandatory for H.323 terminal, G.723 is mandatory for H.324 terminal.)
- Bitstream conversion. (H.225.0 to/from H.223)
- Call Control Signalling conversion.

8.4 Visual telephone terminals over Mobile Radio (H.324/M)

For further study

8.5 Visual telephone terminals over ATM (H.321)

Interoperation with visual telephone terminals over ATM networks (H.321) can be provided by two methods:

1) using a H.323-ATM Gateway Unit.
2) using a H.323-ISDN Gateway Unit assuming that there exists an I.580 ISDN/ATM Interworking Unit in the network.

The Gateway Unit must consider the following issues:

- Video format conversion. (if desired, H.261 is mandatory for both terminal types.)
- Audio code conversion. (if desired. G.711 is mandatory for both terminal types.)
- Bitstream conversion. (H.225.0 to/from H.221)
- Control conversion. (H.245 to/from H.242)
- Call Control Signalling conversion.

8.6 Visual telephone terminals over Guaranteed Quality of Service LANs (H.322)

Interoperation with visual telephone terminals over Guaranteed Quality of Service LANs (H.322) can be provided by:

1) using a H.323-ISDN Gateway Unit assuming that there exists a GQOSLAN-ISDN Gateway Unit in the network.

The Gateway Unit must consider the following issues:

- Video format conversion. (if desired, H.261 is mandatory for both terminal types.)
- Audio code conversion. (if desired, G.711 is mandatory for both terminal types)
- Bitstream conversion. (H.225.0 to/from H.221)
- Control conversion. (H.245 to/from H.242)
- Call Control Signalling conversion.

8.7 T.120 Terminals on the LAN

An H.323 terminal that has T.120 capability shall be configured to allow the T.120 capable terminal to also listen and transmit on the T.120 well known port. This will allow an H.323 terminal to operate in a "T.120 only" mode. ***{Editor's note: more work is needed on this at Ipswich, but I do not believe that the statements just crossed out are true; the desirable state is for the data part of an H.323 conference to fully interwork with a T.120 data conference on the same LAN.*** ~~T.120 terminals on the LAN should be able to participate in the T.120 portion of multipoint H.323 conferences.~~

8.8 RTP sessions

H.323 terminals, MCUs, Gateways and Gatekeepers will not admit an RTP Terminal which is not an H.323 terminal to join a conference.

9 Optional enhancements

{Editor's Note: we must address spoofing}

9.1 Encryption

Encryption may optionally be used by H.323 terminals. Encryption, including selection of algorithm and key exchange, shall be according to the procedures of Recommendations H.233 and H.234 with the following modifications to the procedures defined in H.233. The ability to support encryption shall be signaled by the presence of the **h233EncryptionTransmitCapability** and **h233EncryptionReceiveCapability** parameters of the **Capability** message of H.245.

In H.233, specific reference is made to H.221 in describing how encryption takes place. In applying H.233 to H.323 terminals, references to H.221, FAS, and BAS channels therein shall be ignored and appropriate substitute recommendations be taken from this section. Messages referred to as carried in the H.221 ECS channel shall be re-interpreted as being carried within the **encryptionSE** parameter of the H.245 **EncryptionCommand** or encryption initialization vector (EIV) logical channel, as specified below.

9.1.1 EncryptionSE messages

H.233 session exchange (SE) messages shall be carried in the **encryptionSE** parameter of the H.245 **EncryptionCommand** message. Since the H.245 control channel is carried on a reliable data link layer

using retransmission of errored frames, the error protection bits described in H.233 shall not be applied to SE messages.

If the 8th bit is set in the media identifier, the following encodings are indicated. The normal tuple of 3 bytes containing the media identifier, algorithm identifier, and parameter identifier (each with one byte respectively) will be replaced by a tuple of 5 bytes containing media identifier, algorithm identifier, parameter identifier, and a 16 bit channel identifier.

NOTE - Non-standard encryption algorithms may be referenced in SE messages after associating a non-standard algorithm with a H.233 Algorithm Identifier value using the **encryptionAlgorithmID** parameter of the **EncryptionCommand** message.

9.1.2 Encryption initialization vector (EIV) channel

The encryption initialization vector (EIV) logical channel is used for the transmission of H.233 initialization vector (IV) messages.

To ensure accurate synchronization of the IV messages with the H.225.0 multiplex bitstream, the EIV channel is an independent logical channel which shall be non-segmentable and use a reliable transport mechanism. The entire IV message, exactly as defined in H.233, including error protection bits, shall be placed in a single H.225.0 PDU.

Messages carried within the EIV channel shall retain the error protection mechanism of H.233.

9.1.3 Encryption procedure

The encryptor shall produce an independent pseudo-random bitstream (cipher stream) for each media stream being encrypted.

When encryption is activated according to H.233, the media stream shall be exclusive-ORed with the pseudo-random bitstream generated by the encryptor. However, the exclusive-OR procedure shall not be applied to the RTP header octets and all octets belonging to the H.245 control channel or EIV channel, which shall all be output unencrypted.

For each transmitted RTP header octet, eight bits shall be discarded from the pseudo-random bitstream generated by the encryptor. The receiver shall apply the reverse procedure.

9.1.4 Encryption initialization vectors

Once an encrypted session is in progress the transmitter should periodically send new IV messages in order to limit the duration of repeated pseudo-random bitstream in the event of a collision with a previously used state of the pseudo-random bitstream generator. The frequency of these messages is left to the discretion of the implementor.

The new initialization vectors (IVs) will be synchronized with the media packets utilizing RTP sequence numbers. This implies having the H.233 implementation extract this information from the RTP header in order to provide the encryption synchronization.

9.1.5 Error recovery

In the event that the receiver suspects that it has lost encryption synchronization it shall send an **encryptionIVrequest** command, except that it should not re-send such commands at intervals less than the maximum expected round-trip response time.

Upon receipt of an **encryptionIVrequest** command, the transmitter shall, at its earliest opportunity, send a new IV message, except that it should ignore **encryptionIVrequest** commands received within the minimum expected round-trip response time since sending the last IV message.

10 Maintenance

10.1 Loopbacks for maintenance purposes

{Editor's Note: Consensus was not reached on this topic; some feel it must be possible to address the gateway, and others feel all loopbacks should be end-to-end. Additional work is required at lpwichlspwich, and also to coordinate with H.245 changes. Also, loopbacks must be thought out carefully with multicast in mind.}

Some loopback functions are defined in H.245 to allow verification of some functional aspects of the terminal, to ensure correct operation of the system and satisfactory quality of the service to the remote party. The system loopback (**systemLoop**) request may also be used during actual conversations, for example to measure the network delay.

a) Normal mode: no loop. Indicated in (a) of Figure 18/H.323.

b) System loop at codec-network interface (toward network interface). Upon receiving the **systemLoop** request as defined in H.245, loopback toward the network side shall be made, as indicated in (b) of Figure 18/H.323. The bit rate should not be changed in response to this request. Support for this loopback is mandatory for all terminals, but users may optionally disable response to it

c) Media loop at analog I/O interface (optional): Upon receiving the **mediaLoop** request as defined in H.245, loopback of the content of the selected logical channel shall be activated as close as possible to the analog interface of the video/audio codec towards the video/audio codec, so that decoded and re-coded media content is looped, as indicated in (c) Figure 18/H.323. This loopback is optional, and should be used only on logical channels opened using the bi-directional channel procedures of H.245.

d) Logical channel loopback in H.225.0 multiplex (toward network interface). Upon receiving the **logicalChannelLoop** request, each information stream for the specified logical channel should be looped back on the corresponding reverse logical channel, as indicated in (d) Figure 18/H.323. This loopback is optional, and should be used only on logical channels opened using the bi-directional channel procedures of H.245.

The message loopback off (**MaintenanceLoopOffCommand**) requires that all loopbacks currently in effect be turned off.

10.2 Monitoring Methods

All terminals shall support the Status Request/Status Report Response (SRQ/SRR) message of H.225Z. The Status Report Response message contains the port ids of all transport channels currently active on the call, including T.120 and H.245 control, as well as audio and video SSRCs and CNAMES. This information can be used by third party maintenance devices to monitor H.323 conferences to verify system operation.

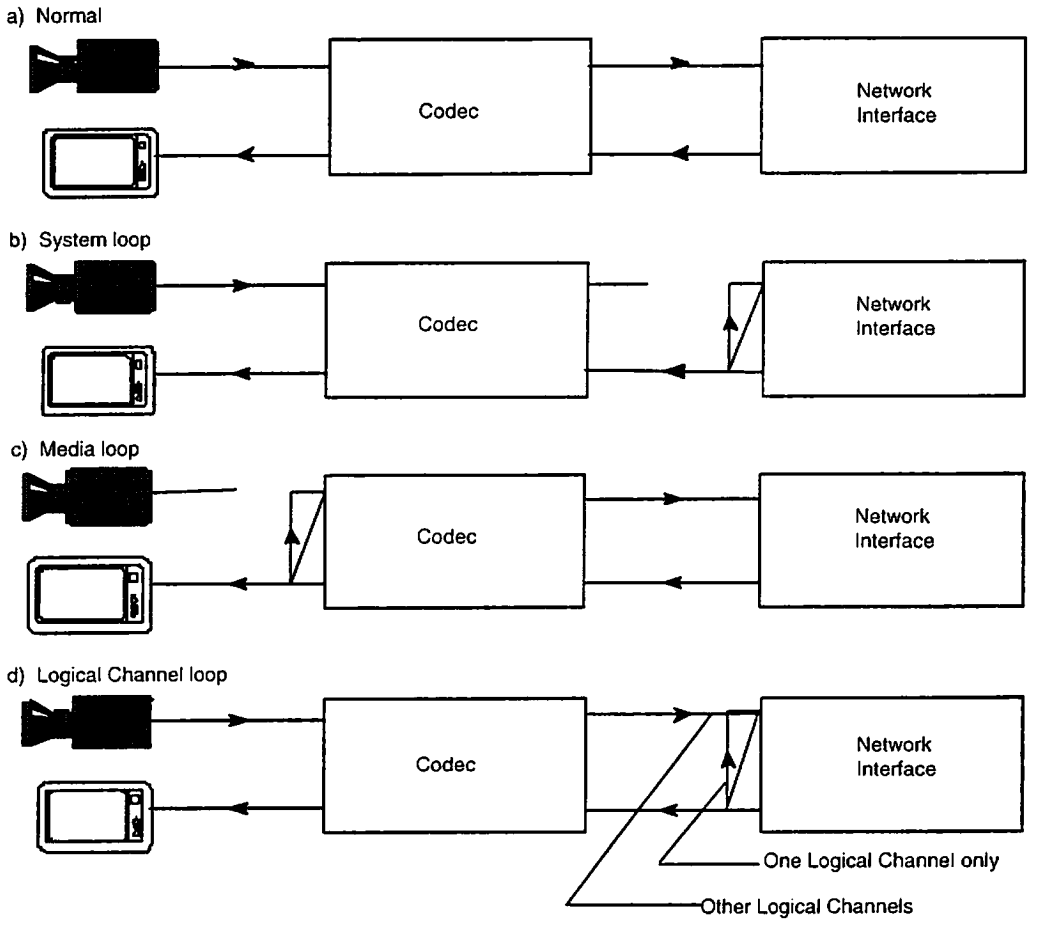


FIGURE 18/H.323 - Loop back