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TITLE :Draft Recommendation H.323: VISUAL TELEPHONE SYSTEMS AND EQUIPMENT FOR LOCAL AREA NETWORKS WHICH PROVIDE A NON-GUARANTEED QUALITY OF SERVICE

This document reflects changes agreed to prior to January 9, 1996.

Some changes this revision:

- Clarified Binding text (7.2 and 7.2.1)
- Updated definitions, moved some from section 1 to section 3, incorporated some of the definitions from TUB/TEL-06-C (3.0)
- Replaced LAN Transport Address with Transport Address according to our new definitions (various).
- Replaced Port with TSAP Identifier according to our new definitions (various).
- Provided additional description for the MP (6.6)
- Clarified Terminal Address, added place for well known TSAP Identifiers. (7.1)
- Changed Bandwidth change description (8.4.1)
- Added Annex A.
- Changed disconnect procedure to use Disengage H.225.0 message (8.5)

Still need to:

- Bandwidth Changes. (8.4.1)
- Describe the use of master slave determination. (8.2??)
- Add suplementary services from BT contribution (8.4)
- Timeouts???? Retries???
- Encryption IV Channel, IV synchronization ???

INTERNATIONAL TELECOMMUNICATION UNION

ITU-T DRAFT H.323

TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU

~~December 28, 1995~~January 11, 1996
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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 H.225.0 packet and synchronization, H.245 control, H.261 and H.263 video codecs, G.711, G.722, G.728, G.729, and G.723 audio codecs, and the T.120 series of multimedia communications protocols.

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 used by Recommendation H.310 for ATM networks, and Recommendation H.324 for GSTN, interworking with these systems will not require H.242 to H.245 translation as would be the case for H.320 systems.

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.

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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)

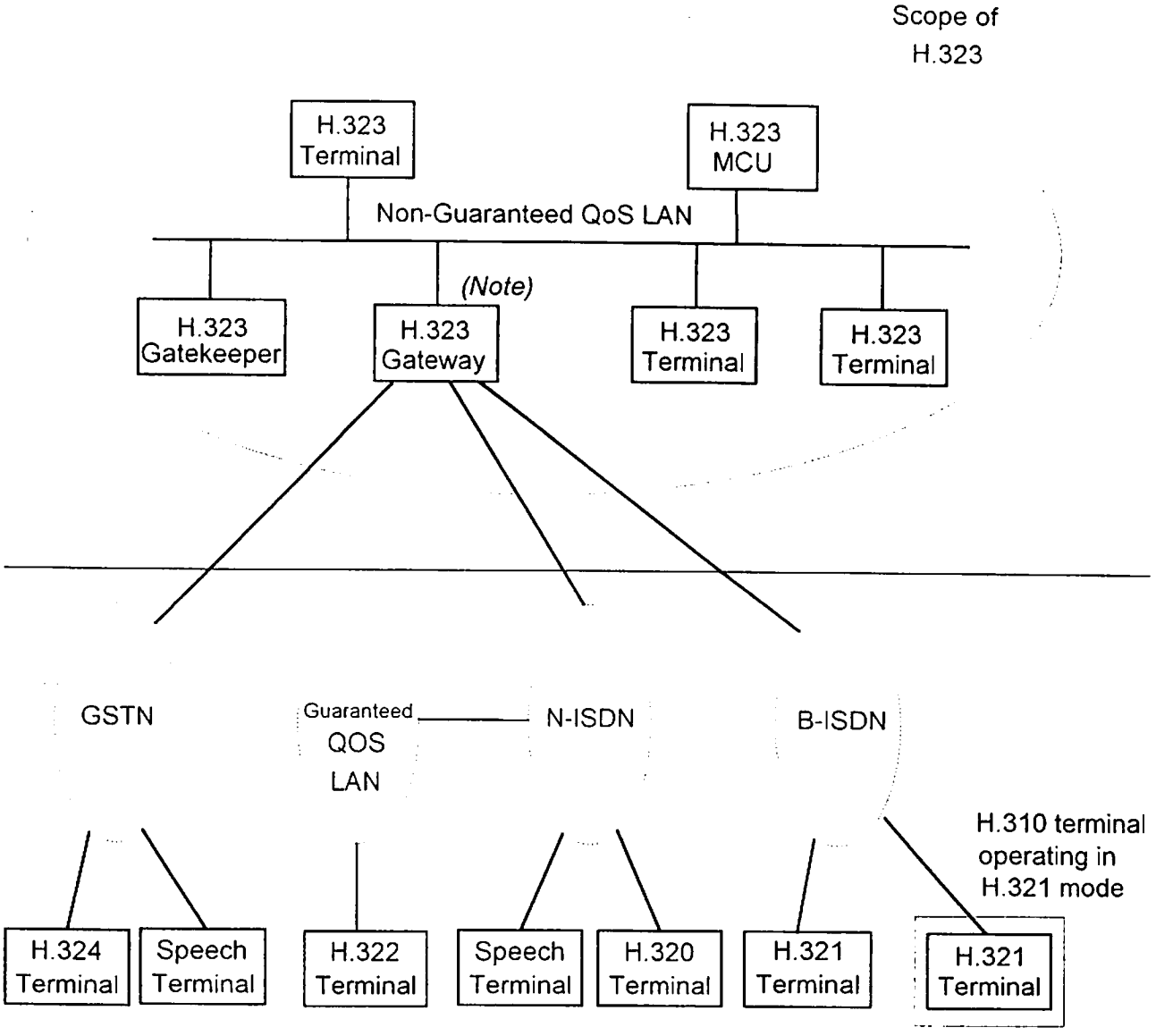
-FDDI (non-guaranteed quality of service mode)

-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.

The scope of H.323 does not include the LAN itself, or the transport layer which may be used to connect various LANs-. Only elements needed for interaction with the Switched Circuit Network (SCN) are within the scope of H.323-. The combination of the H.323 Gateway, the H.323 terminal, and the out-of-scope LAN appears on the SCN as an H.320, H.310, or H.324 terminal.



Note: A gateway may support one or more of the GSTN, N-ISDN and/or B-ISDN connections.

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

~~1.1 H.323 Components~~

~~*{This section has been revised to be a brief description of the H.323 components. More detailed descriptions and characteristics have been moved to section 5.}*~~

This Recommendation describes the components of an H.323 system. This includes Terminals, Gateways, Gatekeepers, Multipoint Controllers, Multipoint Processors, 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~~6.

The components described ~~below~~in this Recommendation consist of H.323 endpoints and H.323 entities. The endpoints can call and are callable according to the call setup procedures of Section ~~7~~8. The entities are not callable, however, they can be addressed in order to perform their specific functions. For example, a terminal cannot place a call to a Gatekeeper, however, the Gatekeeper is addressed as part of the call establishment procedures.

~~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 Synchronization on Non-Guaranteed Quality of Service LANs".~~

~~[2] ITU-T Recommendation H.245 (1995): "Control of communications between Visual Telephone Systems and Terminal Equipment".~~

~~[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.729 (1995): "Speech codec for multimedia telecommunications transmitting at 8/13kbit/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 (1995): "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 (1995): "Narrow-band ISDN visual telephone systems and terminal equipment".~~

~~[12] ITU-T Recommendation H.321 (1995): "Adaptation of H.320 Visual Telephone Terminals to B-ISDN Environments".~~

~~[13] ITU-T Recommendation H.322 (1995): "Visual Telephone Systems and Terminal Equipment for Local Area Networks which Provide a Guaranteed Quality of Service".~~

~~[14] ITU-T Recommendation H.324 (1995): "Terminal for Low-Bitrate Multimedia Communications".~~

~~[15] ITU-T Recommendation H.310 (1996): "Narrow-band ISDN visual telephone systems and terminal equipment".~~

~~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 Addressable: Having a LAN transport address . Not the same as being callable. A Gatekeeper is addressable but not callable. An MC 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 control, audio, or 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.~~

~~Session: the part of the call that begins with the establishment of an H.245 control channel, and ends with the receipt of the H.245 Session_End command . Not to be confused with a call, which is delineated by the H.225.0 Setup and Release Complete messages.~~

~~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~~

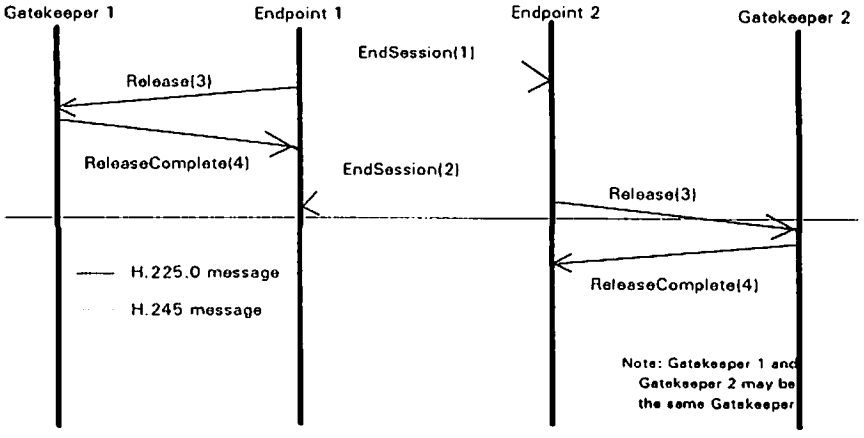
~~For the purposes of this~~ Recommendation ~~, the following symbols and abbreviations apply.~~

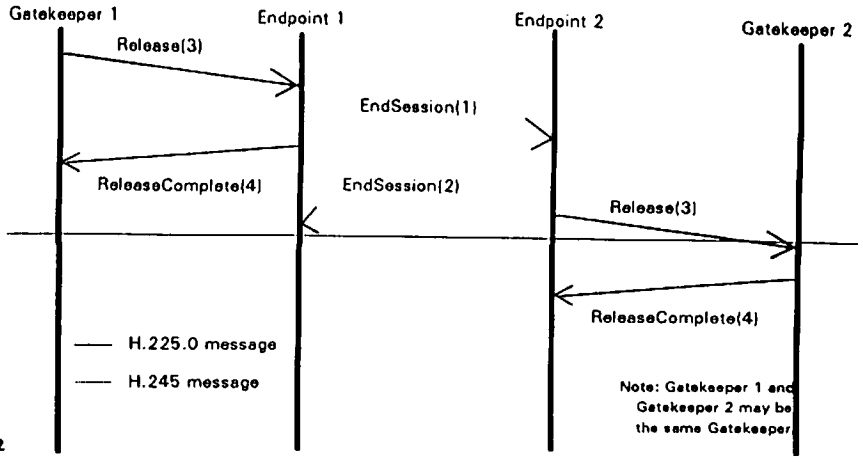
~~ACE Audio Command Equalize~~
~~AIA Audio Indicate Active~~
~~AIM Audio Indicate Mute~~
~~B-ISDN Broadband - Integrated Services Digital Network~~
~~CI Call Indication Signal~~
~~C&I Control and Indication~~
~~CIF Common Intermediate Format~~
~~CR Capabilities Request~~
~~DCE Data Communication Equipment~~
~~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~~
~~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~~
~~MP — Multipoint Processor~~
~~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~~

~~6.3.1 Status Requests~~

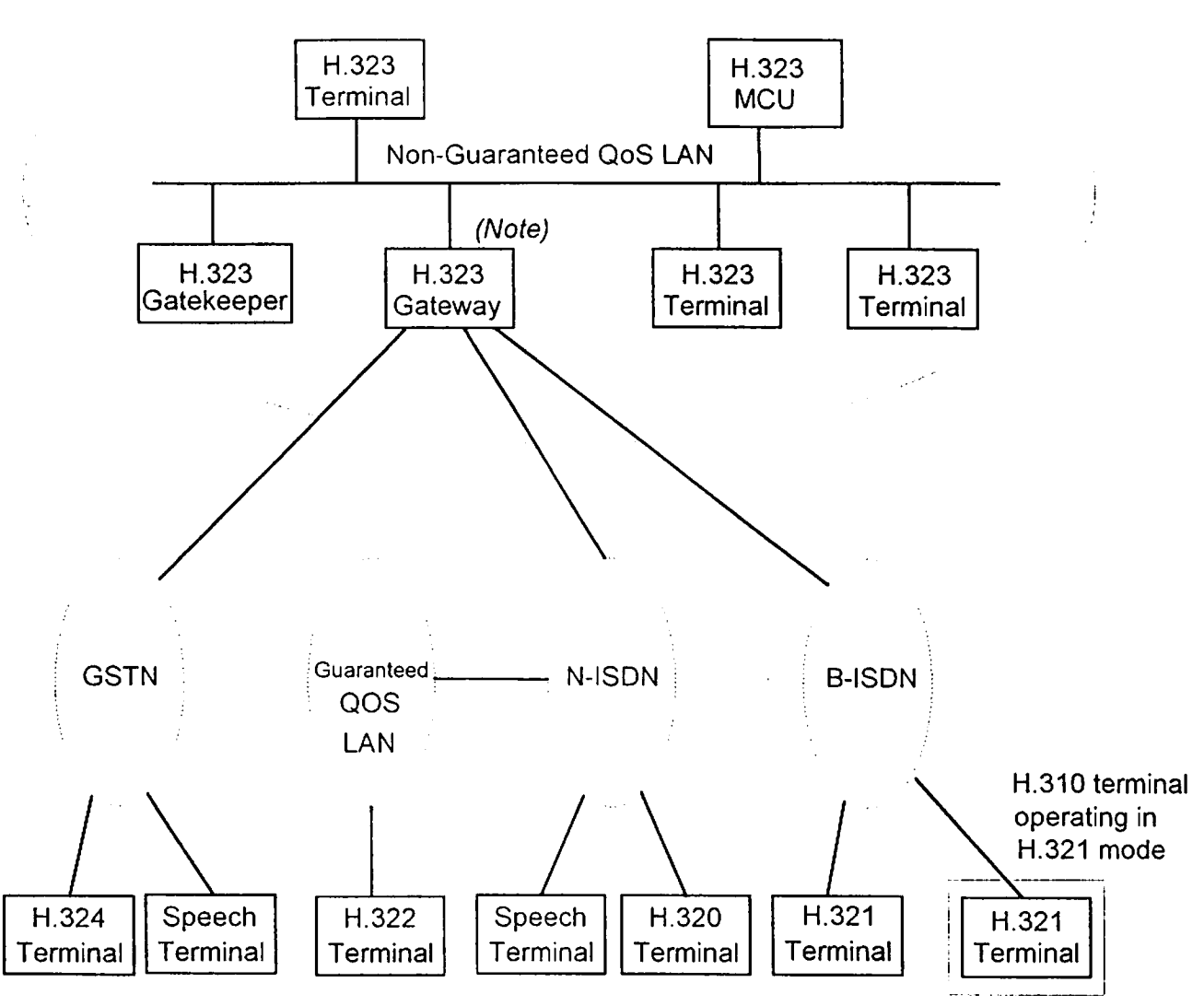
~~In order for the Gatekeeper to determine if an endpoint is turned off, or has otherwise enter a failure mode, the Gatekeeper may use the SRQ/SRR message sequence (see H.225.0) to poll the endpoints on active calls at an interval decided by the manufacturer. The endpoint shall respond within 5 seconds, and the polling interval shall be greater than 10 seconds. This message may also be used by a diagnostic device as described in section A. Gatekeeper wishing to change the transmitted bitrate of an endpoint sends a BRQ(1) message to the endpoint. The endpoint shall always comply with this request from the Gatekeeper and returns a BCF(2). If the request is for a decrease in bitrate, the endpoint shall reduce its bitrate prior to sending the BCF. If the request if for an increase, the endpoint may increase its bitrate when desired.~~





~~Figure 18/H.323??~~

~~Figure 19/H.323 Gatekeeper Initiated Call Clearing~~



Note: A gateway may support one or more of the GSTN, N-ISDN and/or B-ISDN connections.

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

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.

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[13] ITU-T Recommendation H.322 (1995): "Visual Telephone Systems and Terminal Equipment for Local Area Networks which Provide a Guaranteed Quality of Service".

[14] ITU-T Recommendation H.324 (1995): Terminal for Low Bitrate Multimedia Communications".

[15] ITU-T Recommendation H.310 (1996): "Narrow-band ISDN visual telephone systems and terminal equipment".

3 Definitions

{NOTE: This section is organized logically, not alphabetically.}

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~~ ose in this section. These definitions apply to the LAN side only; on the SCN other terms might be more appropriate.

Information Stream: A flow of information of a specific media type (e. g. audio) from a single source to one or more destinations.

Unreliable Channel: A logical communication path used for unreliable transmission of an information stream from its source to one or more destinations.

Unreliable Transmission: Transmission of PDUs from a sender to one or more receivers by means of connectionless-mode data transmission. The transmission service is *best-effort* delivery of the PDU, meaning that PDUs transmitted by the sender may be lost, duplicated, or received out of order by (any of) the receiver(s). Bit errors in the received PDUs are detected but not corrected.

Reliable Channel: A transport connection used for reliable transmission of an information stream from its source to one or more destinations.

Transport Connection: An association established by a transport layer between two H.323 entities (the TS users) for the transfer of data. In the context of H.323, a transport connection provides reliable transmission of information.

Reliable Transmission: Transmission of PDUs from a sender to a receiver using connection-mode data transmission. The transmission service guarantees sequenced, error-free, flow-controlled transmission of PDUs to the receiver for the duration of the transport connection.

LAN address: The layer three address of an H.323 entity as defined by the (inter)network layer protocol in use (e. g. an IP address). This address is mapped onto the layer one address of the respective system by some means defined in the (inter)networking protocol.

Transport Address: The layer four address of an addressable H.323 entity as defined by the (inter)network protocol suite in use. The Transport Address of an H.323 entity on an H.323 system is composed of the LAN address plus the TSAP identifier of the addressable H.323 entity.

TSAP Identifier: The piece of information used to multiplex several transport connections of the same type on a single H.323 entity with all transport connections sharing the same LAN address, (e. g. the port number in a TCP/UDP/IP environment). TSAP identifiers may be (pre)assigned statically by some international authority or may be allocated dynamically during setup of a call. Dynamically assigned TSAP identifiers are of transient nature, i. e. their values are only valid for the duration of a single call.

Well-known TSAP Identifier: A TSAP identifier that has been allocated by an (international) authority that is in charge for the assignment of TSAP identifiers for a particular (inter)networking protocol and the related transport protocols -- (e. g. the IANA for TCP and UDP port numbers). This identifier is guaranteed to be unique in the context of the respective protocol.

Addressable: An endpoint or entity on the LAN having a Transport Address. Not the same as being callable. A terminal or MCU is addressable and callable. A gatekeeper is addressable but not callable. An MC ~~is not addressable by itself; as part of a terminal, MCU, Gateway, or Gatekeeper, an MC becomes addressable when actively managing a multipoint conference.~~

or MP is neither callable nor addressable but is contained within an endpoint or Gatekeeper that is.

~~Audio mute: muting the loudspeaker of a terminal.~~ ~~*(proposal to split into send and receive mute)*~~

~~Call: the establishment of an H.225.0 reliable call signaling channel, followed by the establishment of an H.245 reliable control channel, followed by the opening of one or more media steams as described in H.225.0 using H.245 logical channel signaling.~~

~~Callable: Capable of being called in the H.323 sense. Terminals, MCUs, and Gateways are callable, but Gatekeepers, MCs and MPs are not . Being callable requires the ability to terminate H.225.0 call signaling plus the audio media stream and H.245.~~

~~Channel: a unidirectional link between two users.~~

~~Conference (point-to-point): A set of connections between two users (e.g. an audio connection, an H.245 control connection, etc.[see connection]) . A conference has an identifier assigned by either the Gatekeeper or the called terminal; not to be confused with the multipoint conference identifier assigned by an MCU. *{This is already defined in section 1!}*~~

~~Conference (multipoint): A set of point to point conferences between terminals and an MCU, or between terminals and a terminal with an MC acting as an MCU. *{This is not complete or not correct!}* *{This is already defined in section 1!}*~~

~~Connection: a bi directional link between two users.~~

~~1.1.1 Terminals~~Callable: Capable of being called as described in Section 8. Terminals, MCUs, and Gateways are callable, but Gatekeepers and MCs are not.

Call: Point-to-point multimedia communication between two H.323 endpoints. The call begins with the call setup procedure and ends with the call termination procedure. The call consists of the collection of reliable and unreliable channels between the endpoints. In case of interworking with some SCN endpoints via a gateway, all the channels terminate at the Gateway where they are converted to the appropriate representation for the SCN end system.

Local Area Network (LAN): A shared or switched medium, peer-to-peer communications network that broadcasts information for all stations to receive within a moderate-sized geographic area, such as a single office building or a campus. The network is generally owned, used, and operated by a single organization. In the context of H.323 LANs also include internetworks composed of several LANs that are interconnected by bridges or routers.

Switched Circuit Network (SCN): A public or private switched telecommunications network such as the analog telephone system (POTS), N-ISDN, or B-ISDN. *{This may need some work!!}*

End point: An H.323 terminal, Gateway, or MCU. An endpoint can call and be called. It generates and or terminates information streams.

Terminal: 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, or Multipoint Control Unit. This communication 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 (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).

~~1.1.3~~Multipoint Controller

: The Multipoint Controller (MC) is an entity on the local area network which provides for the control of 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.

~~1.1.4~~Multipoint Processor

: The Multipoint Processor (MP) is an entity on the local area network 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 MP may process a single media stream or multiple media streams depending on the type of conference supported.

~~1.1.5~~Multipoint Control Unit

: The Multipoint Control Unit (MCU) is an endpoint on the local area network which provides the capability for three or more terminals and Gateways to participate in a multipoint conference. The MCU generally operates in the fashion of an H.231 MCU, however, an audio processor is not mandatory. The MCU consists of two parts: a mandatory Multipoint Controller and optional Multipoint Processors-. In the simplest case, an MCU may consist only of an MC with no MPs.

~~1.1.6 Gatekeeper~~Gatekeeper: The Gatekeeper (GK) is an entity on the LAN 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, Gateways, and MCUs such as bandwidth management and locating Gateways and ~~MCs.~~

~~1.2 Topology~~

~~The following logical topology element is defined in order to explain the scope and intercommunications of H.323 components.~~Mcs.

Zone: A Zone (Figure 2/H.323) is the collection of all terminals (Tx), Gateways (GW), and Multipoint Control Units (MCU) managed by a single Gatekeeper (GK). A Zone includes at least one terminal, and may or may not include Gateways or MCUs. A Zone has one and only one Gatekeeper. Multiple LAN segments may be connected using routers (R) or other devices.

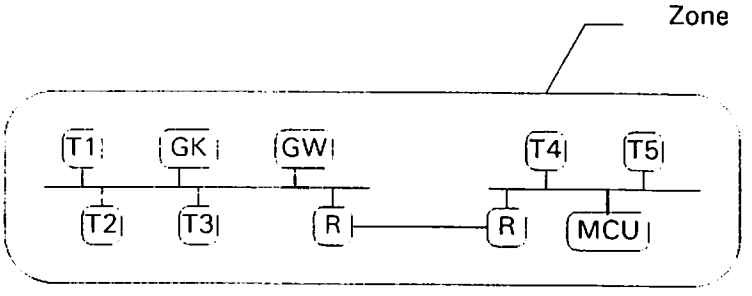


Figure 2/H.323 Zone

~~1.3 Conference Models~~

~~H.323 supports the conference types described in this section.~~

~~1.3.1 Point-to-Point~~

Point-to-Point Conference: A Point-to-Point conference is a conference between two terminals. ~~These terminals can both be on the LAN or one on the LAN and one on the SCN.~~

May be either directly between two H.323 terminals or between an H.323 terminal and an SCN terminal via a gateway. A call between two terminals.

~~1.3.2 Multipoint~~Multipoint Conference: A Multipoint conference is a conference between three or more terminals. The terminals may be on the LAN or on the SCN. The multipoint conference shall always be controlled by an MC. Various multipoint conference types are defined in this section but they all require a single MC per conference. They may also involve one or more H.231MCUs on the SCN. ~~*{Is it a multipoint conference when two LAN terminals are connected through a Gateway to a SCN MCU without using an MC?}*~~

A terminal on the LAN may also participate in an SCN multipoint conference by connecting via a Gateway to an SCN MCU. This does not require the use of an MC.

~~1.3.2.1 Centalized Multipoint~~Centalized Multipoint Conference: A Centralized Multipoint conference is one in which all participating terminals communicate in a point-to-point fashion with an MCU. The terminals transmit their control, audio, video, and/or data streams to the MCU. The MC within the MCU centrally manages the conference. The MP within the MCU processes the audio, video, and/or data streams, and returns the processed streams to each terminal.

~~1.3.2.2~~Decentralized Multipoint

Conference: A Decentralized Multipoint conference is one in which the participating terminals multicast their audio and video to all other participating terminals without using an MCU. The terminals are responsible for (a) summing the received audio streams and (b) selecting one or more of the received video streams for display-. No audio or video MP is required in this case. The terminals communicate on their ~~control c~~H.245 Control Channels with an MC which manages the conference-. The data steam is still centrally processed by the MCS top provider which may be within an MP.

~~1.3.2.3~~Hybrid Multipoint Conference - Centralized Audio

: A Hybrid Multipoint - Centralized Audio 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.

~~1.3.2.4~~Hybrid Multipoint Conference - Centralized Video

: A Hybrid Multipoint - Centralized Video conference is one in which terminals multicast their audio to other participating terminals, and unicast their video to the MP for mixing. The MP returns a mixed video stream to each terminal.

~~1.3.2.5~~Mixed Multipoint Conference

: A Mixed Multipoint conference has some terminals participating in a centralized mode while other terminals are participating in a decentralized mode-. A terminal is not aware of the mixed nature of the conference, only of the type of conference it is participating in. The MCU provides the bridge between the two types of conferences.

~~1.3.3~~Ad Hoc Multipoint Conference

: An Ad Hoc Multipoint 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 MC as a multipoint call between only two terminals

~~1.3.4 Broadcast~~Broadcast Conference: A Broadcast conference is one in which there is one transmitter of media streams and many receivers. There is no bidirectional transmission of control or media streams. Such conferences should be implemented using LAN transport multicast facilities, if available . This conference type is for further study.

~~1.3.5 Broadcast Panel~~Broadcast Panel Conference: 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 bidirectional transmission between the terminals in the multipoint portion of the conference and no bidirectional transmission between them and the listening terminals. This conference type is for further study.

H.245 Session: the part of the call that begins with the establishment of an H.245 Control Channel, and ends with the receipt of the H.245 Session End command. Not to be confused with a call, which is delineated by the H.225.0 Setup and Release Complete messages.

RTP Session: The association among a set of participants communicating with RTP. For each participant, the session is defined by a particular pair of destination Transport Addresses (one LAN address plus a TSAP identifier pair for RTP and RTCP). The destination Transport Address pair may be common for all participants, as in the case of IP multicast, or may be different for each, as in the case of individual unicast network addresses plus a common TSAP identifier pair. In a multimedia session, the media audio and video are carried in separate RTP sessions with their own RTCP packets. The multiple RTP sessions are distinguished by different TSAP Identifier pairs and/or different multicast addresses.

Audio mute: Suppressing of the audio signal of a single or all source(s). Send muting means that the originator of an audio stream mutes its microphone and/or does not transmit any audio signal at all. Receive mute means that the receiving terminal ignores a particular incoming audio stream or mutes its loudspeaker.

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 stream other than audio, video, and control, carried in the logical data channel (see H.225.0 [1]).

~~Endpoint: An entity on the LAN which can place calls or be called such as a terminal, Gateway, or MCU.~~

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.~~

RAS Channel: Unreliable channel used to convey the binding, registration, admmissions, bandwidth change, and status messages (following H.225.0) between two H.323 entities.

Call Signalling Channel: Reliable channel used to convey the call setup and teardown messages (following Q.931) between two H.323 entities.

H.245 Control Channel: Reliable Channel used to carry the H.245 conforming control information messages between two H.323 systems. Transmission of PDUs on this connection is reliable.

H.245 Logical Channel: Channel used to carry the other information streams between two H.323 endpoints. These channels are established following the H.245 OpenLogicalChannel procedures. An unreliable channel is used for audio, audio control, video, and video control information streams. A reliable channel is used for data information streams.

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
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
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
MP	Multipoint Processor
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

~~1.4~~5 Conventions

In this document the following conventions are used:

"Shall" indicates a mandatory requirement.

"Should" indicates a suggested but optional course of action.

"May" indicates something that could occur as a logical consequence of events rather than a recommendation that something take place.

References to Sections, Paragraphs, Annexes, and Appendicies refer to those items within this Recommendation unless another document is explicitely listed. For example, Section 1.4 refers to section 1.4 of this Recommendation; H.245 Section ~~5~~6.4 refers to section ~~5~~6.4 in H.245.

Where items exist on both the LAN and on the SCN, references to the SCN item will be explicit. For example, and MCU is an H.323 MCU on the LAN, an SCN MCU is an MCU on the SCN.

~~5~~6 System description

This Recommendation describes the elements of the H.323 components. These 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~~6.1 Information Streams

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

Audio signals 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 contain digitized and coded motion video. Video is transmitted at a rate no greater than that 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.

Communications 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 that are part of communications control.

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

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

56.2 Terminal Characteristics

An example of an H.323 terminal is shown in Figure 3/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.

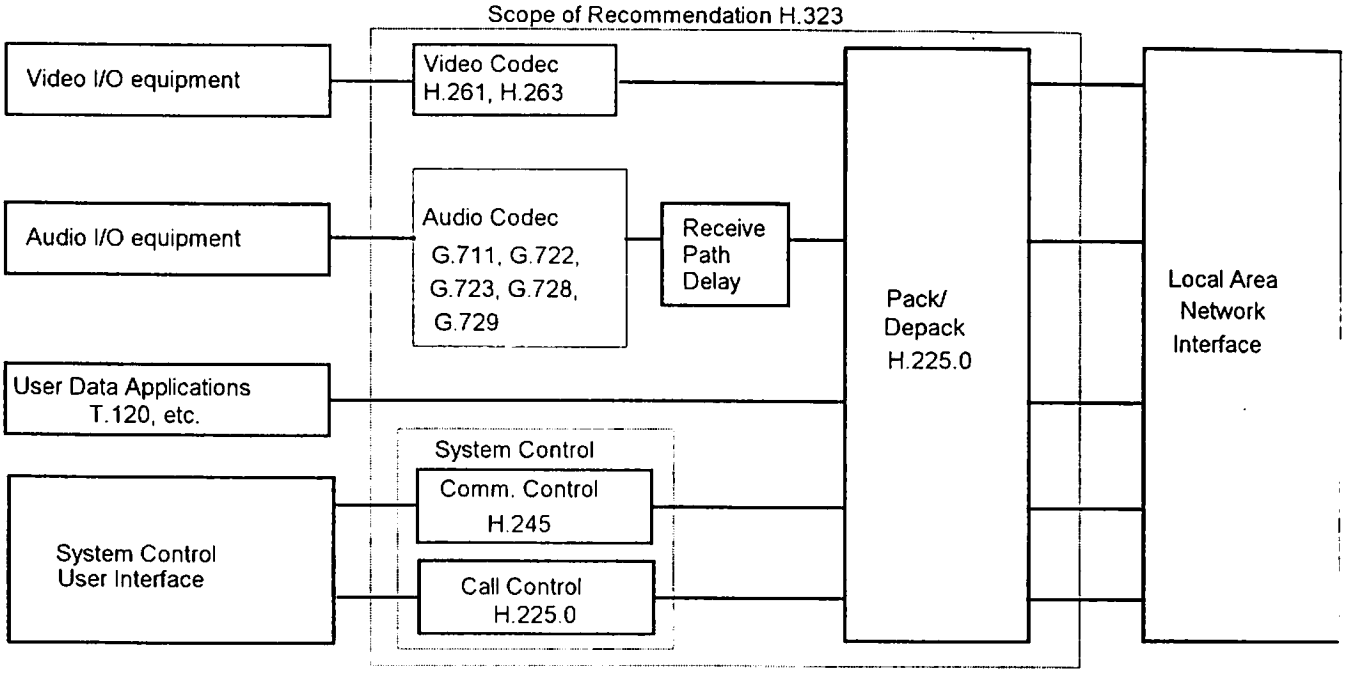


Figure 3/H.323 H.323 Terminal Equipment

{Editor's Note: a box will be added for terminal to Gatekeeper signals that are not part of call control or H.245}{there are those who don't like the term packetizer for H.225.0, suggestions?}

56.2.1 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 and international standards.

- Human user system control, user interface and operation.

5~~6~~.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 (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 Section 5~~6~~.2.6.

- 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 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 as appropriate to each media type.

5~~6~~.2.3 LAN Interface

The LAN interface is implementation specific and is outside the scope of this recommendation. However, the LAN interface shall provide the services described in Recommendation H.225.0. This includes the following: ~~Duplex r~~Reliable (e.g. TCP, SPX) end-to-end service is mandatory for the H.245 Control Channel, the Data Channels, and the C~~ontrol Channel and the Data~~all Signalling Channel. Unreliable (e.g. UDP, IPX) end-to end service is mandatory for the ~~audio and video channels depending on the application.~~ Audio Channels, the Video Channels, and the RAS Channel. These services may be duplex or simplex, unicast or multicast depending on the application and the capabilities of the terminals.

~~*{Reliable or unreliable service for the Call signalling channel?}*~~

5~~6~~.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 and/or received, as negotiated via the H.245 ~~control~~ eControl 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 within the decoder capability set. 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 bitrates, frame rates, and picture resolutions. For example, this will allow a CIF capable terminal to transmitt 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, maximum codec bit rate, 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.

The H.323 terminal may optionally send more than one video channel at the same time, for example, to convey the speaker and a second video source.

~~5~~6.2.4.1 Terminal Based Continuous Presence

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 terminal to the user-. The H.323 terminal shall use H.245 simultaneous capabilities to indicate how many simultaneous video streams it is capable of decoding-.

~~5~~6.2.5 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. 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 more than one audio channel at the same time, for example, to allow two languages to be conveyed.

~~5~~6.2.5.1 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 composit audio signal to the user. The H.323 terminal shall use H.245 simultaneous capabilities to indicate how many simultaneous audio streams it is capable of decoding-.

~~5~~6.2.6 Receive Path Delay

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 shall 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 Gateway Units may alter the video/audio skew, and shall transmit appropriately modified time tags, reflecting their transmitted signals except in the following cases:

a). In hybid multipoint conferences where video is multicast and audio is mixed in the MP.

b) Other cases may be added here.

~~5~~6.2.7 Data Channel

One or more data channels are optional.

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. A terminal that provides far-end camera control using H.281 and H.224 is not required to also support a T.120 far end camera control protocol.

Note that non-standard data applications (DataApplicationCapability = non-standard, DataProtocol Capability = non-standard) and Transparent User Data (DataApplicationCapability = userdata, DataProtocol Capability = transparent) may be used whether the equivalent T.120 application is provided or not.

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

~~5~~6.2.8 Communications Control Function

The communications control function uses the ~~control c~~H.245 Control Channel to carry 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.

H.245 signaling is established between two terminals, a terminal and a Gateway, a terminal and an MC, or the terminal and a Gatekeeper. The endpoint shall establish exactly one bi-directional ~~control c~~H.245 Control Channel for each conference that the endpoint is participating in. This channel shall use the messages and procedures of Recommendation H.245. Note that ~~an MC (including~~ a terminal, MCU, ~~or Gateway that contains an MC) or a~~Gateway, or Gatekeeper may support many point-to-point conferences, and thus many H.245 ~~control channels. The control c~~Control Channels. The H.245 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 ~~control c~~Channel until the termination of this channel; the normal procedures for opening and closing logical channels shall not apply to the ~~control c~~H.245 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 Annex A, 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. Annex A contains a table showing which H.245 commands and indications are mandatory, optional, or forbidden for H.323 terminals-. H.323 terminals shall send the **FunctionNotSupported** message in response to unrecognized request, response, or command messages

A ~~control channel~~In H.245 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 may optionally support DTMF signaling as well.

NOTE - If the encryption procedures of this Recommendation are in use, the ~~control c~~H.245 Control Channel will not be encrypted. Users are therefore cautioned regarding the carriage of user data in the ~~control c~~H.245 Control Channel, the use of non-standard messages, and the confidentiality risk from traffic analysis of the ~~control c~~H.245 Control Channel.

~~5~~6.2.8.1 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~~6.2.8.2 Logical channel signaling

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. 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 bi-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.

For the audio channel, the H.323 terminal shall use only MultiUseAudioChannel-. This channel has associated with it a set of capabilities that indicate which protocols may be used-. The actual protocol in use is indicated by the H.225.0 media packet headers.

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

A logical channel's bandwidth shall have an upper limit specified by the minimum of the sending endpoints transmit capability and the receiving endpoints receive capability. Based on this limit, an endpoint shall open a logical channel at a bitrate at or below this upper limit. A transmitter shall transmit an information stream within the logical channel at any bitrate at or below the open logical channel bitrate. This transmit bitrate shall be further reduced by a flow control command from the receiving endpoint which specifies a lower bitrate.

~~5~~6.2.8.3 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 comply with the RequestMode command if it is within its capability set-. Note that in a decentralized conference, as in a centralized conference, all terminal RequestMode commands are directed to the MC-. The MC may grant the request or not; the basis for this decision is left to the manufacturer.

~~5~~6.2.9 Call Signalling Function

The call signalling function uses H.225.0 call signalling to establish a conection between two H.323 endpoints. The ~~call signalling c~~Call Signalling Channel is independent from the H.245 eControl Channel and H.245 open logical channel procedures are not used to establish the ~~call signalling channel. The call signalling c~~Call Signalling Channel. The Call Signalling Channel is opened prior to the establishment of any communications between H.323 endpoints. In systems that do not have a Gatekeeper, the ~~call signalling c~~Call Signalling Channel is opened between the two endpoints involved in the call. In

systems which contain a Gatekeeper~~-Unit, the call signalling c~~, the Call Signalling Channel is opened between the end point and the Gatekeeper, or between the endpoints themselves as chosen by the Gatekeeper. This channel is described in detail in Section ~~6~~7 of this document.

~~5~~6.2.10 Packetizer/Depacketizer

Logical channels of video, audio, data 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 c~~Control Channel of which there shall be one per conference. The packetization used to transmit these logical channels shall conform to Recommendation H.225.0.

~~5~~6.2.10.1 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 c~~Control Channel. The actual ~~transport port numb~~TSAP Identifier that the transmitter shall transmit to in the receiver shall be returned by the receiver in the **OpenLogicalChannelAck** message.

~~5~~6.2.10.2 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~~-~~. 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 on the LAN in order to maintain a specific data rate.

{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.}

~~5~~6.3 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; this conversion is decribed in H.24I)~~-~~. The Gateway Unit must also perform call setup and clearing on both the LAN side and the SCN side. Translation between video, audio, and data formats may also be performed in the Gateway Unit. In general, the purpose of the Gateway (when not operating as an MCU) is to reflect the characteristics of the LAN terminal to the SCN terminal, and the reverse, in a transparent fashion.

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) 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.

The Gateway has the characteristics of an H.323 Terminal or MCU on the LAN, and of the SCN terminal or MCU on the SCN. The choice of terminal or MCU is left to the manufacturer. The Gateway provides the necessary conversion between the different terminal types. Note that the Gateway may intially operate as a terminal, but later using H.245 signaling begin to operate as an MCU for the same

call that was initially point-to-point. Gatekeepers are aware of which terminals are Gateways since this is indicated when the terminal/Gateway registers with the Gatekeeper.

Four examples of an H.323 Gateway Unit are shown in Figure 4/H.323–. The diagrams show the H.323 terminal or MCU function, the SCN terminal or MCU function, and the conversion function. The H.323 terminal function has the characteristics described in Section ~~5~~6.2. The H.323 MCU function has the characteristics described in Section ~~5~~6.5. The Gateway Unit appears to the other H.323 terminals on the LAN as one or more H.323 terminals, or an H.323 MCU. It communicates with the other H.323 terminals using the procedures in this Recommendation.

The SCN 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 SCN as one or more of the same terminal types or MCUs. It communicates to another terminal on the SCN using the procedures described in the appropriate Recommendation for that terminal. SCN signaling procedures are beyond the scope of H.323, including such topics as whether the H.323 Gateway appears as a terminal or a network to the SCN. Note that a Gateway may convert H.323 directly to H.324 or H.310 without going to H.320.

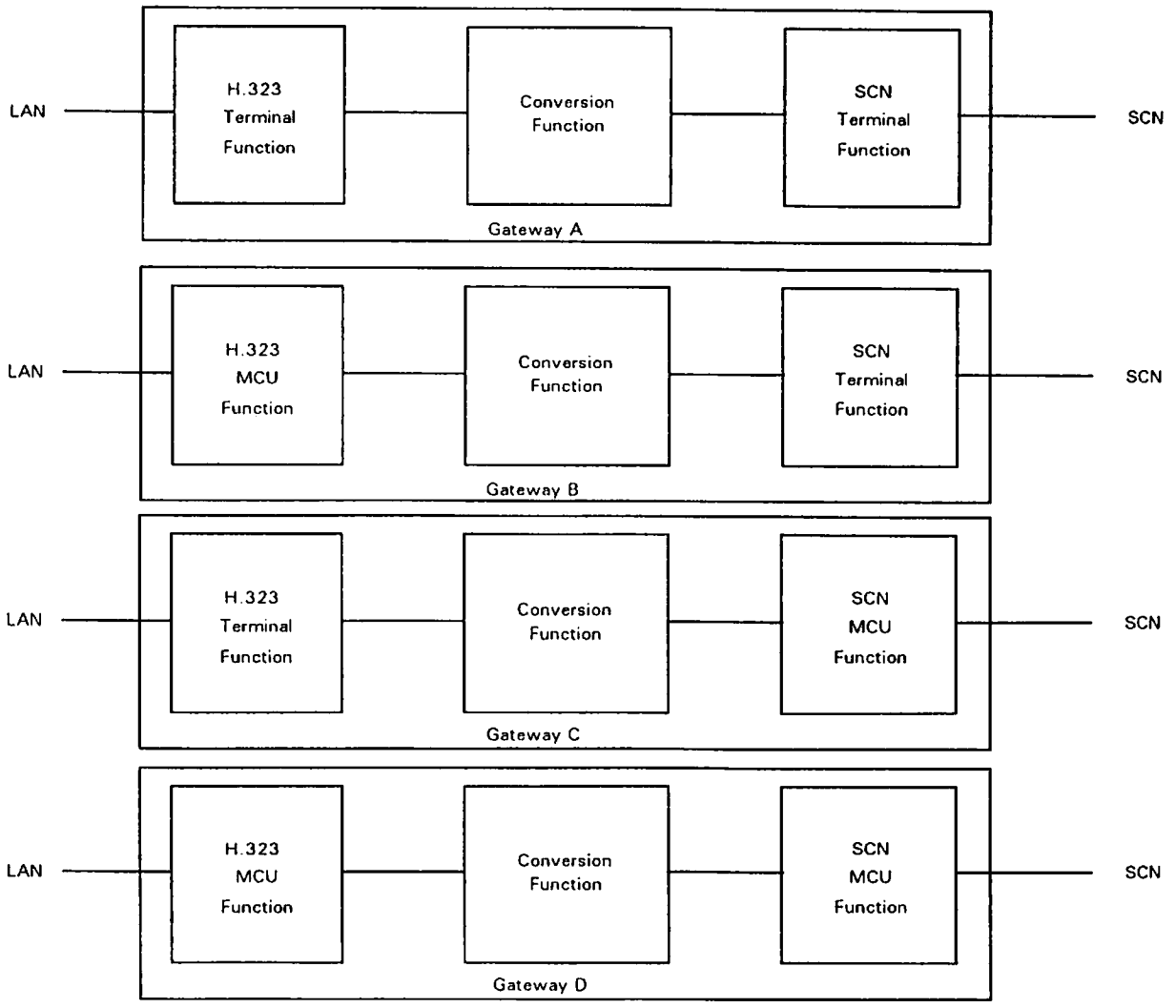


Figure 4/H.323 H.323 Gateway Units

The conversion function provides the necessary conversion of transmission format, control, audio, video, and/or data streams between the different terminal recommendations. At a minimum, the Gateway shall provide a conversion function for the transmission format, call setup signals and procedures, and communications control signals and procedures. When required, the Gateway shall provide for H.242 to H.245 conversion as described in ~~Annex B~~H.24I. The Gateway performs the appropriate inter-exchange signaling procedures between the H.225.0 Call Signalling and the SCN signaling system (Q.931, Q.2931, etc.).

All Q.931 signalling received by the Gateway from an SCN endpoint and not applicable to the Gateway shall be passed through to the LAN endpoint, and vice versa. This signalling includes Q.932 and Q.95X series messages. This will allow H.323 endpoints to implement the Supplementary Services defined in those Recommendations.

This recommendation describes the connection of one H.323 terminal on the LAN to one external terminal on the SCN through the Gateway Unit. The actual number of H.323 terminals that can communicate through the Gateway Unit is not subject to standardization. Similarly, the number of SCN connections, number of simultaneous independent conferences, audio/video/data conversion functions, and inclusion of multipoint functions is left to the manufacturer~~-~~. However, if the Gateway includes an MCU function on the LAN side, it shall function as an H.323 MCU as described in H.323~~-~~. On the SCN it may appear as an H.231/H.243 MCU~~-~~, or as an MCU for H.310 or H.324 systems (these MCUs are indicated as for further study in the respective Recommendations).

The Gateway Unit may be connected via the SCN to other Gateway Units to provide H.320 communication between H.323 terminals which are not on 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.

~~5~~6.4 Gatekeeper Characteristics

The Gatekeeper, which is optional in an H.323 system, provides call control services to the H.323 endpoints. The Gatekeeper may consist~~s~~ of one or more entities connected in an unspecified fashion to form a unified whole that appears to the terminal as a single Gatekeeper~~-~~. The means by which these entities interact is left for further study. The Gatekeeper is logically separate from the endpoints, however, its physical implementation may coexist with a terminal, MCU, Gateway, server, or other ~~network~~LAN entity.

When it is present in a system, the Gatekeeper shall provide the following services:

- LAN~~ Transport~~ Address Translation - The Gatekeeper shall perform E.164 or H.323 ID to LAN ~~transport address translation~~ 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 ~~M~~messages described in section ~~6~~7.

- Admissions Control - The Gatekeeper shall authorize LAN access using ARQ/ACF/ARJ H.225.0 messages~~-~~. This may be based on call authorization, bandwidth, or some other criteria which is left to the manufacturer. It may also be a null function which admits all requests.

- Bandwidth Control - The Gatekeeper shall support BRQ/BRJ/BCF messages-. This may be based on bandwidth management. It may also be a null function which ~~rejee~~accepts all requests for bandwidth changes. ~~*{I dont think it makes sense for the null function to accept all requests?}*~~

- Zone Management - The Gatekeeper shall provide the above functions for terminals, MCUs, and Gateways which have registered with it as described in Section ~~6~~7.2.

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 endpoints. It acts as the *network* as defined in H.225.0 and processes the call signalling itself-. Alternatively, the Gatekeeper may direct the endpoints to connect the H.225.0 call signalling channel directly to each other. In this manner, the Gatekeeper can avoid handling the H.225.0 call control signals.

- Call Authorization - 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 passes or fails 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.

- 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.

- Gatekeeper management information data structure - For further study.

- Bandwidth reservation for terminals not capable of this function-. A bit has been reserved in the ARQ message to indicate that an endpoint desires the Gatekeeper to make QOS reservations for it, or to indicate that any such reservations have already been made-. The use of this bit is for further study. If the terminal indicates that a bandwidth reservation has been made, the Gatekeeper shall not also make a reservation for the same call.

- Directory services. For further study.

In order to support Ad Hoc Multipoint Conferences, the Gatekeeper may choose to receive the H.245 ~~control c~~Control Channels from the two terminals in a point-to-point conference. When the conference switches to a multipoint conference, the Gatekeeper can redirect the H.245 ~~control c~~Control Channel to an MC. The Gatekeeper need not process the H.245 signalling, it only needs to pass it between the terminals or the terminals and the MC.

56.5 Multipoint Controller Characteristics

The MC provides control functions to support conferences between three or more endpoints in a multipoint conference~~-~~. The MC carries out the capabilities exchange with each endpoint in a multipoint conference. The MC sends a capability set to the endpoints 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 the Selected Communication Mode (SCM) for the conference. The SCM may be common for all endpoints in the conference. Alternatively, some endpoints may have a different SCM than other endpoints in the conference. ~~In the latter case, either the endpoints or the MCU must be able to resolve the different SCMs.~~ The manner in which the MC determines a SCM is not within the scope of this Recommendation.

As part of mulitipoint conference setup, an endpoint will become connected to an MC on its H.245 ~~control e~~Control Channel. This connection may occur:

- via an explicit connection with an MCU.

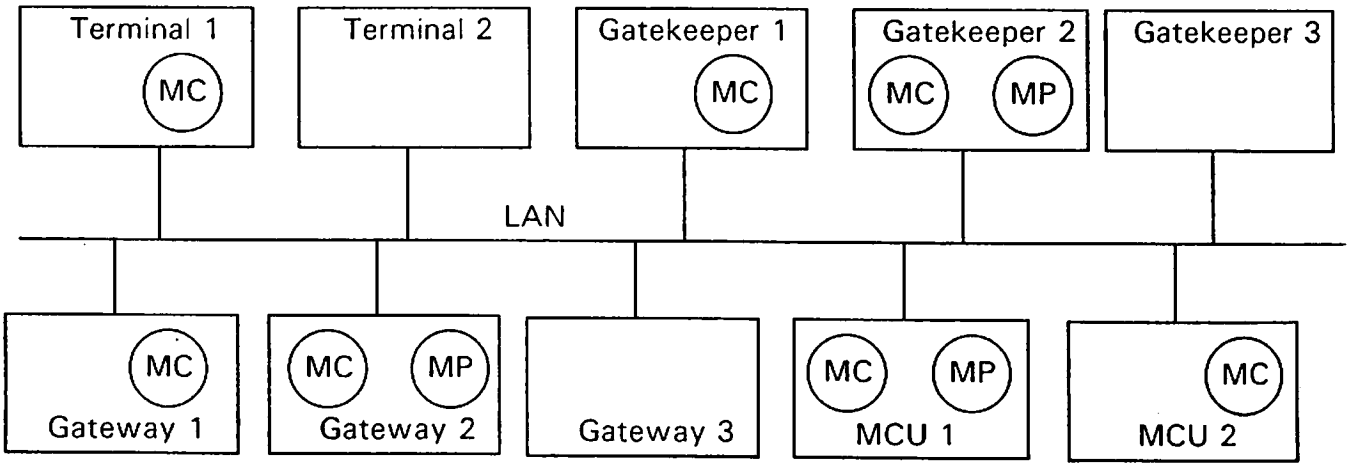
- via an implicit connection to the MC within a Gatekeeper.

- via an implicit connection to the MC within another terminal or Gateway in the multipoint conference.

- via an implicit connection through a Gatekeeper to an MCU.

The choice of conference mode (e.g. decentralized or centralized) occurs after connection with the MC using H.245 signaling. The choice of conference mode may be limited by the capability of the endpoints or the MC.

The MC may be located within a Gatekeeper, Gateway, terminal, or MCU. See Figure 5/H.323.



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

Figure 5/H.323 Possible locations of MC and MP in H.323 system

An MC within a terminal is not a callable entity. It can be included in the call in order to process the H.245 signalling to support Ad Hoc multipoint conferences. In this case, there may be no distinction between the MC and the Communications control Function (~~5~~6.2.8) of the terminal. They may be the same entity or separate entities. If separate, communications between them is outside the scope of this recommendation.

An MC within the Gatekeeper is not a callable entity, however, an MCU within ~~the Gatekka~~ Gatekeeper is callable. ~~The~~An MCU within a Gatekeeper functions as an independent MCU. ~~The~~An MC within a Gatekeeper may be used to support Ad Hoc multipoint conferences when the Gatekeeper receives the H.245 Control Channels from the endpoints. In this manner, the Gatekeeper can redirect the H.245 Control Channels to the MC when the conference switches to multipoint.

The Gateway can function as a terminal or an MCU. When fuctioning as a terminal, the Gateway may contain an MC. This has the same characteristics as described above for an MC within a terminal.

An MCU always contains an MC. The MCU is callable and the MC processes the H.245 Control channel from all of the endpoints.

When two or more endpoints in a decentralized multipoint conference contain an MC, the endpoints shall either: 1) use the MasterSlaveResolution procedure of H.245 to determine the MC that will control the conference, or 2) use the MCU cascading procedure of Section 6.8.9 to allow all MCs to participate in the control of the conference.

~~5~~6.6 Multipoint Processor Characteristics

The MP receives audio, video, and data streams from the endpoints involved in a centralized or hybrid multipoint converence. The MP processes these media streams-, and returns them to the endpoints.

Communications between the MC and the MP ~~is~~are not subject to standardization.

The MP may process one or more media stream types. When the MP processes video, it shall process the video algorithms and formats as described in ~~5~~6.2.4. When the MP processes audio, it shall process the audio algorithms as described in ~~5~~6.2.5. When the MP processes data, it shall process data streams as described in ~~5.2.7.~~6.2.7.

An MP which processes video shall provide either video switching or video mixing. Video switching is the process of changing the video that the MP outputs to the terminals from one source to another. The criteria used to make the switch is typically through detection of a change in speaker (sensed by the associated audio level), through H.245 control, or through T.AVC*{128???}* control. Video mixing is the process of formatting more than one video source into the video stream that the MP outputs to the terminals. An example of video switching is combining four source pictures into a two by two array in the video output picture. The criteria for which sources and how many are mixed is through T.AVC control. *{Does T.AVC provide this kind of control???}*

An MP which processes audio shall prepare N audio outputs from N audio inputs by switching, mixing, or a combination of these. Audio mixing requires decoding the input audio to linear signals (PCM or analog), performing a linear combination of the signals, and recoding the result to the appropriate audio format. The MP may elliminate or attenuate some of the input signals in order to reduce noise and other unwanted signals. Each audio output may have a different mix of input signals providing for private conversations. The terminals may assume that their audio is not present in the audio stream returned to them. Terminal removal of its own audio from the MP audio output is for further study.

An MP which processes T.120 data shall be an MCS Top Provider. An MP may also process non-standard data, transparent user data, and/or other types of data.

The MP ~~should provide video switching and/or mixing, audio mixing, and be an MCS top provider for data. The MP may also~~may provide algorithm and format conversion, allowing terminals to participate in a conference at different SCMs.

The MP is not callable, the MCU which it is a part of is callable. The MP terminates and sources the media channels.

~~*{Should there be an audio MP, a video MP, and a data MP, or can one MP handle all media types?}*~~

5~~6~~.7 Multipoint Control Unit Characteristics

The MCU is an endpoint which provides support for multipoint conferences. The MCU may consist of an MC or an MC and one or more MPs. The MCU uses H.245 messages and procedures to implement features similar to those found in H.243-. More information on H.245 MCU operation can be found in H.MCU245(proposed). ~~*{Is this appropriate here??}*~~ This is for further study.

A typical MCU that supports centralized multipoint conferences consists of an MC and an audio, video, and data MP. A typical MCU that supports decentralized multipoint conferences consists of an MC and a data MP supporting T.120. It relies on decentralized audio and video processing.

The LAN side of a Gateway may be an MCU. A Gatekeeper may also include an MCU, however, they are independent functions that happen to be co-located.

The MCU is callable by other endpoints using the procedures of Section ~~7~~8.

{What is mandatory in an MCU, an MC, or an MP? Do we need to indicate the mandatory H.245 messages in Annex A?

5~~6~~.8 Multipoint Capability

~~*{DLS: 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 termainls since they represent H.320 terminals. GT: This is not true, a Gateway appears to the LAN as an H.323 terminal or MCU.}*~~

5~~6~~.8.1 Centralized Multipoint Capability

All terminals shall have centralized multipoint capability. A Gateway which appears as a terminal on the LAN shall also have centralized multipoint capability. In this mode of operation they communicate with the MC of the MCU 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 MCU may use multicast to distribute the processed audio and/or video it the terminals in the conference can receive multicast transmissions.

~~5~~6.8.2 Decentralized Multipoint Capability

If the terminals have decentralized multipoint capability, they communicate with the MC of an MCU, Gateway, Gatekeeper, or terminal in a point-to-point mode on the ~~control e~~H.245 Control Channel and optionally with an MP on data channels. The terminals shall have the capability to multicast their video channels to all other endpoints in the conference. The MC shall determine which terminal or terminals are actively multicasting video-. All terminals in the conference multicast their audio channels.

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

The MC may provide conference control functions such as chair control, video broadcast and video 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.

~~When two or more terminals in a decentralized multipoint conference contain an MC, the terminals shall either: 1) use the MasterSlaveResolution procedure of H.245 to determine the MC that will control the conference, or 2) use the MCU cascading procedure of Section 5.8.9 to allow all Mcs to participate in the control of the conference.~~

~~5~~6.8.3 Hybrid Multipoint - Centralized Audio

If the terminals and MCU have hybrid multipoint-centralized audio capability, they may use distributed multipoint for video and centralized multipoint for audio. In this mode, the terminals communicate with the MC in a point-to-point mode on the ~~control e~~H.245 Control Channel and optionally with an MP on data channels.

The terminals shall have the capability to multicast their video channels to all other endpoints in the conference. The MC shall determine which terminal or terminals are actively multicasting video. 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. The MP may produce an exclusive audio sum for each terminal in the conference. Alternatively, the MP may multicast a selected audio stream to all participating terminals other than the source, in order to minimize the bandwidth used on the LAN.

~~5~~6.8.4 Hybrid Multipoint - Centralized Video

If the terminals and MCU have hybrid multipoint-centralized video capability, they may use distributed multipoint for audio and centralized multipoint for video. In this mode, the terminals communicate with the MC in a point-to-point mode on the ~~control e~~H.245 Control Channel and optionally with an MP on data channels.

The terminals shall have the capability to multicast their audio channels to all other endpoints in the conference. The MC shall determine which terminal or terminals are actively multicasting audio. The terminals receive multicast audio channels and perform a mixing function in order to present a composite audio signal to the user.

All of the terminals in the conference transmit their video_channels to the MP. The MP performs the video switching, mixing, or format conversion functions and outputs the resulting video streams to the

terminals. The MP may produce an exclusive video stream for each terminal in the conference, or it may multicast a video stream to all participating terminals other than the source, in order to minimize the bandwidth used on the LAN.

56.8.5 Establishment of Common Mode

The MC shall coordinate a common communications mode between the terminals in the multipoint conference. 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 and mode preference commands to enforce mode symmetry. The later approach should be used since it allows the teminals to know the full range of conference capabilities available that can be requested.

If the MCU has the capability to convert audio and/or video formats, it may not be necessary to force all teminals into the same communications modes.

56.8.6 Multipoint rate matching

Since the terminals on each link in a multipoint configuration may attempt to operate at different bit rates. The MC shall send H.245 FlowControlCommand messages to limit the transmitted bit rates to those which can be sent to receivers.

56.8.7 Multipoint Lip 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.

In the case of distributed multipoint conferences, the receiving terminal may be able to maintain lip syncronization by aligning the selected video stream and its associated audio. Alighnment of the other audio streams may not be necessary. If multiple video streams are displayed, the associated audio streams should be aligned.

It may not be possible to guarantee lip synchronization hybrid multipoint conferences.

56.8.8 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 910.1. Operation of an untrusted MCU is for further study.

56.8.9 Cascading Multipoint Control Units

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

67 Call Signaling

Call signalling is the messages and procedures used to establish a call, request changes in bandwidth of the call, get status of the endpoints in the clall , and disconnect the call. Call signalling uses messages

defined in H.225.0 and the procedures described in Section ~~7~~8. This section describes some call signalling concepts.

~~6.1 Terminal Address~~7.1 Addresses

7.1.1 LAN Address

Each endpoint and entity shall have a LAN Address. This address uniquely identifies the endpoint or entity on the LAN. Some entities may share a LAN Address (ie. a terminal and a co-located MC). This address is specific to the LAN environment in which the endpoint is located. Defferent LAN environments may have different LAN Address formats.

7.1.2 TSAP Identifier

For each LAN Address, each endpoint and entity may have several TSAP Identifiers. These TSAP Identifiers allow multiplexing of several channels or connections sharing the same LAN Address.

Each Terminal, Gateway, and MCU shall have the following well known TSAP Identifiers:

RAS Channel TSAP Identifier (Port TBD for IP networks)

Call Signalling Channel TSAP Identifier (Port TBD for IP networks)

Each Gatekeeper shall have the following well known TSAP Identifiers:

RAS Channel TSAP Identifier (Port TBD for IP networks)

Call Signalling Channel TSAP Identifier (Port TBD for IP networks)

Endpoints and entities shall also have other dynamic TSAP Identifiers for the H.245 Control Channel, Audio Channels, Video Channels, and Data Channels. The RAS Channel and Signalling Connection may be redirected to dynamic TSAP Identifiers diring the call establishment procedure.

7.1.3 Alias Address

~~Each endpoint shall have a LAN transport address. The endpoint may also have an~~An endpoint may also have one or more alias addresses associated with it. The alias addresses provide an alternate method of addressing the endpoint. Gatekeepers, MCs, and MPs shall not have alias addresses. These address include E.164 address (network access number, telephone number, etc.)~~ and/or an~~, H.323 IDs (name, e-mail like address, etc.)~~–~~, and NSAP addresses. *{Are there others???}*

When there is no Gatekeeper in the system, the calling endpoint ~~may~~shall address the called endpoint directly using the LAN ~~transport~~ aAddress of the called endpoint. When there is a Gatekeeper in the system, the calling endpoint may address the called endpoint by its LAN ~~transport address, E.164 address or H.323 ID. The latter two~~Address, or alias address. The latter shall be translated into a LAN ~~transport a~~Address by the Gatekeeper.

{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 endpoint's 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. 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.

The H.323 ID consists of a string of up to 64 ASCII *{Need correct character standard!}* characters terminated with a NULL—. The H.323 ID must be unique within a Zone. It may be a user name, email name, or other identifier. An endpoint may have more than one H.323 ID which is translated to the same LAN ~~transport a~~Address.

67.2 Endpoint Binding and Registration

A Gatekeeper must be aware of the endpoints within its Zone. When a Gatekeeper is present, all endpoints within its Zone shall register with it. ~~*{Is this correct, no unbound terminals when a Gatekeeper is present?}*~~ This is done through the binding and registration processes. The binding and registration processes associate an endpoint's E.164 address and/or H.323 ID with it's LAN ~~transport a~~Address.

67.2.1 Endpoint Binding

Binding is the process ~~of associating an endpoint with a Gatekeeper~~an endpoint uses to determine which Gatekeeper to register with. This may be done manually or automatically. Manual binding relies on methods outside the scope of this Recommendation to determine which Gatekeeper, an endpoint is associated with. The endpoint is configured with the LAN ~~transport address of the binding~~Address of the ~~Gatekeeper~~associated Gatekeeper. For example, it may be entered at endpoint configuration, or it may be entered into a initialization file. In this way, the endpoint knows a-priori which Gatekeeper it is associated with. The endpoint can now register with that Gatekeeper.

Auto binding allows the endpoint - Gatekeeper association to change over time-. The endpoint may not know who its Gatekeeper is, or may need to identify another Gatekeeper due to a failure. This may be done through auto binding. Auto binding allows for lower administrative overhead in configuring individual endpoints and additionally allows replacement of an existing Gatekeeper without manually reconfiguring all of the affected endpoints.

The endpoint may 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 on a ~~reliable connection~~n unreliable channel to the Gatekeepers well known ~~port~~RAS Channel TSAP Identifier. One or more Gatekeepers may respond with the Gatekeeper Confirmation (GCF) message indicating "I can be your Gatekeeper.", and returns its LAN ~~transport a~~Address. See Figure 6/H.323. If more than one Gatekeeper responds, the endpoint may choose the Gatekeeper it wants to use. At this point, the endpoint knows which Gatekeeper it is associated with. The endpoint can now register with that Gatekeeper.

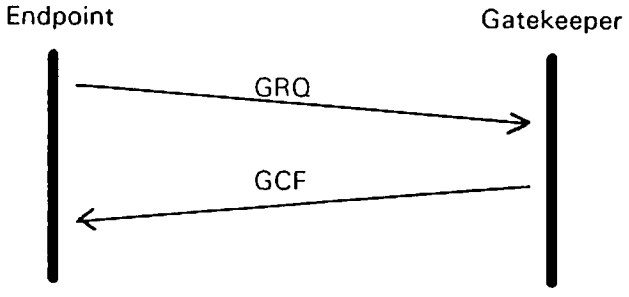


Figure 6/H.323 Auto Binding

If no Gatekeeper responds within a timeout, the endpoint may retry the GR~~C.~~Q. An endpoint shall not send a GRQ within 5 seconds after sending a previous one. If no response is received,the endpoint shall use the manual binding method~~. *{Editor's Note: we need to address retry intervals, perhaps as advice to the manufacturer}*~~.

If at any time an endpoint determines it has an invalid binding with its Gatekeeper, it must re-bind. The invalid binding may be detected by either receiving an RRJ message from a Gatekeeper in response to an RRQ from the endpoint, or not receiving any response to an RRQ from the endpoint within a timeout.

The GRQ may be repeated periodically (ie, at terminal power up) so the Gatekeeper ~~must~~shall be able to handle multiple requests from the same terminal.

An endpoint which is not associated with a Gatekeeper is called an unbound endpoint. This type of endpoint does not request admission permission from a Gatekeeper and so cannot participate in admission control, bandwidth control, address translation, and other functions performed by the Gatekeeper.

~~6~~7.2.2 Endpoint Registration

Registration is the process by which an endpoint informs the Gatekeeper of its LAN ~~transport address, E.164 address, and/or its H.323 ID~~Address, and alias addresses. Registration may be done manually or automatically. Manual registration relies on methods outside the scope of this Recommendation to configure the Gatekeeper with LAN ~~transport address~~ Address translation tables for the endpoints in its Zone. This may include configuration by an operator, or the pre-loading of static translation tables.

Automatic registration requires communications between the endpoints and the Gatekeeper. As part of their configuration, endpoints using automatic registration, shall send a Registration Request (RRQ) to the Gatekeeper which they are bound to. This is sent on a unreliable connection to the Gatekeepers well known Addmissions TSAP ~~port~~Identifier. The Gatekeeper shall respond with either a Registration Confirmation (RCF) or a Registration Rejection (RRJ). The RRQ may be repeated periodically (ie, at terminal power up) so the Gatekeeper shall be able to handle multiple requests from the same endpoint. See Figure 7/H.323.

It is presumed that the endpoint has the LAN ~~transport a~~Address of the Gatekeeper from the binding process. An endpoint using auto binding shall also use auto registration.

The Gatekeeper shall assure that each E.164 address or H.323 ID translates uniquely to a single LAN ~~transport a~~Address. Ambiguous registrations shall be rejected by the Gatekeeper.

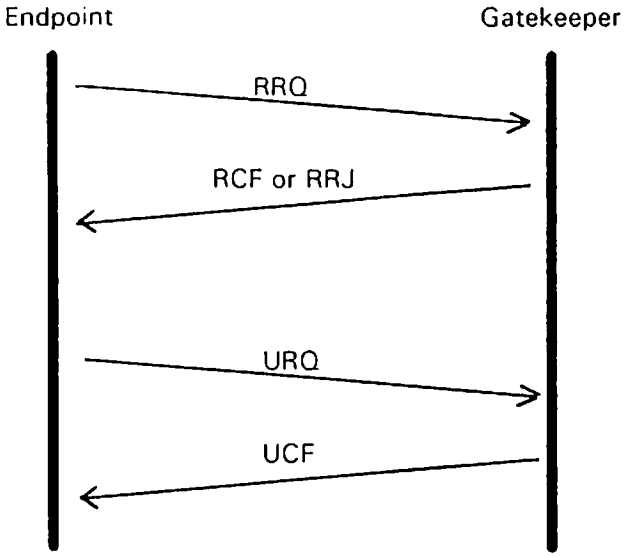


Figure 7/H.323 Auto Registration

An endpoint may cancel its registration by sending an Unregister Request message (URQ) to the Gatekeeper. The Gatekeeper shall respond with an Unregister Confirmation message (UCF). This allows endpoints to change the E.164 address or H.323 ID associated with its LAN ~~transport a~~Address, or vice versa.

~~6~~7.3 Call Signalling Channel

In networks that do not contain a Gatekeeper, call signaling messages are passed directly between the calling and called endpoints using reliable well known ~~port~~TSAP Identifiers. In these networks, it is assumed that the calling endpoint knows the LAN ~~transport a~~Address of the called endpoint and thus can communicate directly.

In networks that do contain a Gatekeeper, the initial admission message exchange takes place between the calling endpoint and the Gatekeeper using the Gatekeeper's unreliable well known ~~port~~TSAP Identifier. After the initial admissions message exchange, call signaling between endpoints and Gatekeepers ~~changes to~~ take place between reliable well known ~~port~~Call Signalling TSAP Identifiers. Further call signaling messages may be passed in two ways. The first method is Gatekeeper Routed Call Signalling (Figure 8/H.323). In this method, call signalling messages are routed through the Gatekeeper between the endpoints. The second method is Direct Endpoint Call Signalling (Figure 9/H.323). In this method, the call signalling messages are passed directly between the endpoints. The ~~use of these two methods is selected~~choice of which methods is used is made by the Gatekeeper.

Both methods use the same kinds of connections for the same purposes, and the same messages. Admissions messages are exchanges on unreliable c~~onnection~~hannels with the Gatekeeper, followed by an exchange of H.225.0 call signaling messages on a reliable connection. This is then followed by the setup of another reliable connection for H.245 Control Channel messages. 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 endpoint.

For the Gatekeeper Routed method, the Gatekeeper may chose to close the reliable ~~call signaling channel after the termination of a call, or it may~~Call Signaling Channel after the call setup is completed, or it may chose to keep it open for the duration of the call to support supplementary services. Only the

Gatekeeper shall close the reliable Call Signalling Channel, and it shall not be closed when a ~~chose to keep it open to support possible additional calls.~~

~~***There is no need to differentiate between bound and unbound endpoints in either method.~~

~~In both methods, two types of "well known" ports exist:~~

~~1. Each Gatekeeper has a well known unreliable port that is used for H.225.0 admissions messages.~~

~~2. Each endpoint and Gatekeeper has a well known reliable port that is used for H.225.0 call signaling~~Gateway is involved in the call.

When there is no Gatekeeper in the system, or there is a Gatekeeper using Direct Endpoint call signalling, the called endpoint functions as the *network* as defined in H.225.0. When there is a Gatekeeper using Gatekeeper Routed call signalling in the system, endpoints communicate with the Gatekeeper as if the Gatekeeper were the *network* as defined in H.225.0.

The following table indicates the roles (user or network, as used in H.225.0) taken by endpoints and Gatekeepers as a function of the call signalling method-. This table does not address the role that a Gateway might play on the SCN side using Q.931 or other call protocols.

Entity	Case	Action	H.225.0 Role
Endpoint	Figure 8	Calling	User
	Figure 8	Called	User
	Figure 9	Calling	User
	Figure 9	Called	Network
Gatekeeper	Figure 8	Called/Calling	Network
	Figure 9	Called/Calling	Not involved

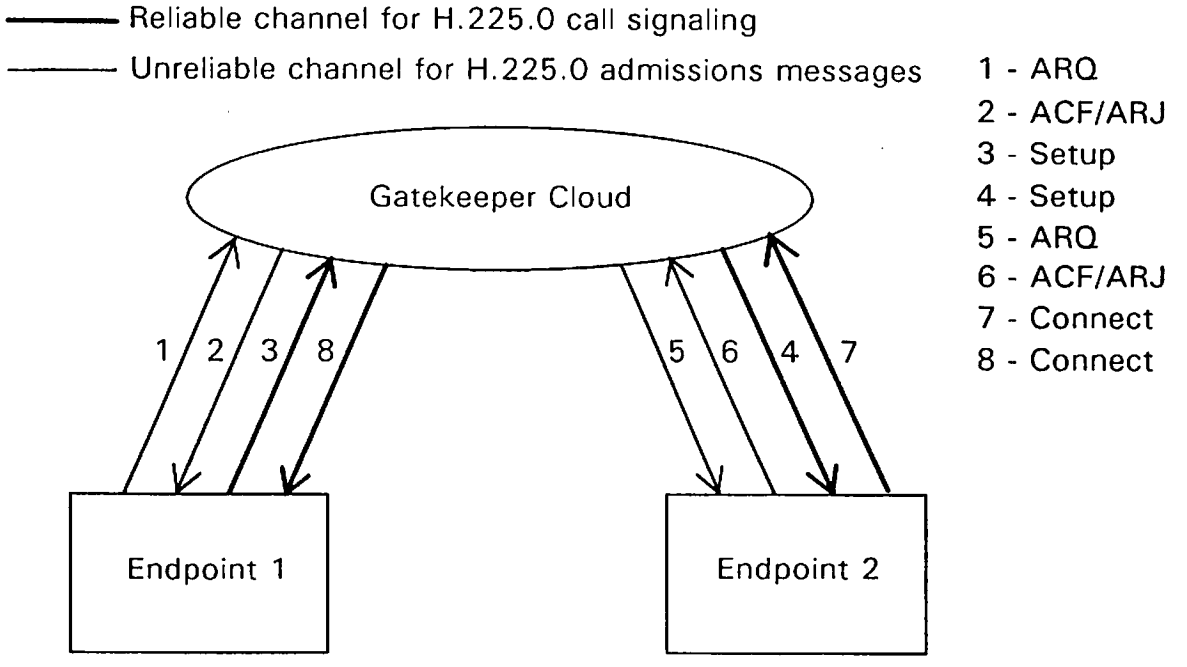


Figure 8/H.323 Gatekeeper Routed Call Signaling

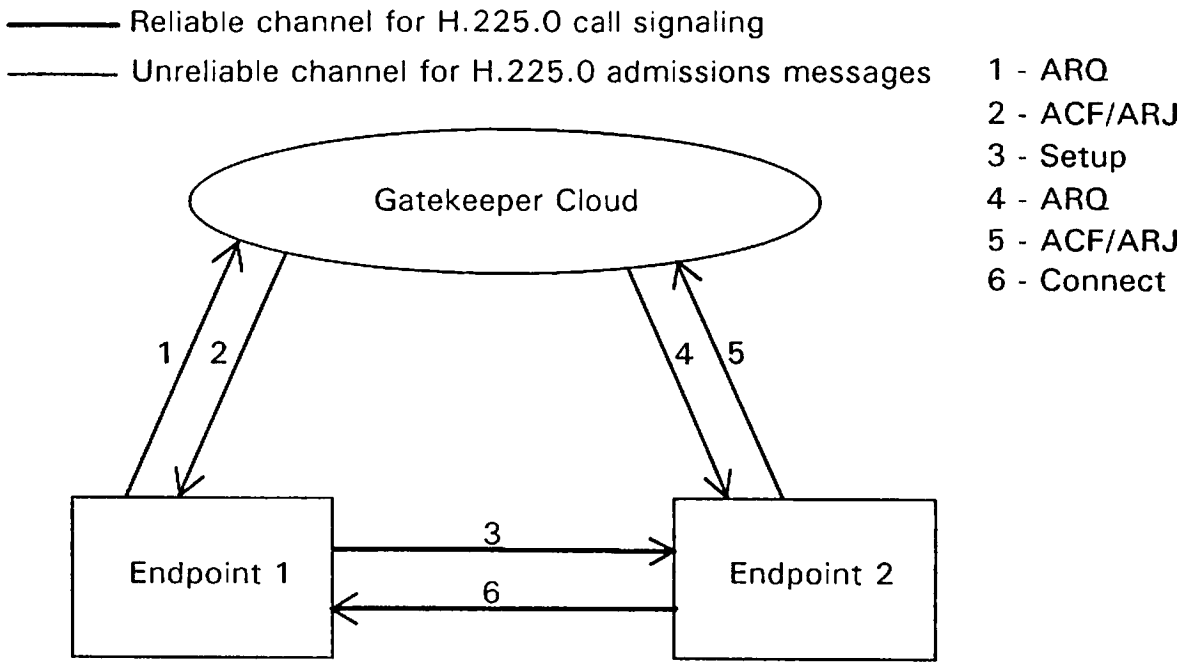


Figure 9/H.323 Direct Endpoint Call Signaling

7.4 Control Channel Routing

~~*{Is this the same status request in Section 7.4.2 ???}*~~

~~6.4 Control Channel Routing~~

When Gatekeeper Routed call signalling is used, there are two methods to route the H.245 ~~control channel~~ Control Channel. In the first method, the H.245 ~~control~~ eControl Channel is established directly between the endpoints See Figure 10/H.323. In the second method, the H.245 ~~control~~ eControl Channel is routed between the endpoints through the Gatekeeper. See Figure 11/H.323. This method allows the Gatekeeper to redirect the H.245 ~~control~~ eControl Channel to and MC when an Ad Hoc multipoint conference switches from a point-to-point conference to a multipoint conference. This choice is also made by the Gatekeeper. H.245 signaling shall be on a seperate reliable channel~~.~~ When Direct Endpoint call signalling is used, the H.245 ~~control~~ eControl Channel can only be connected directly between the endpoints.

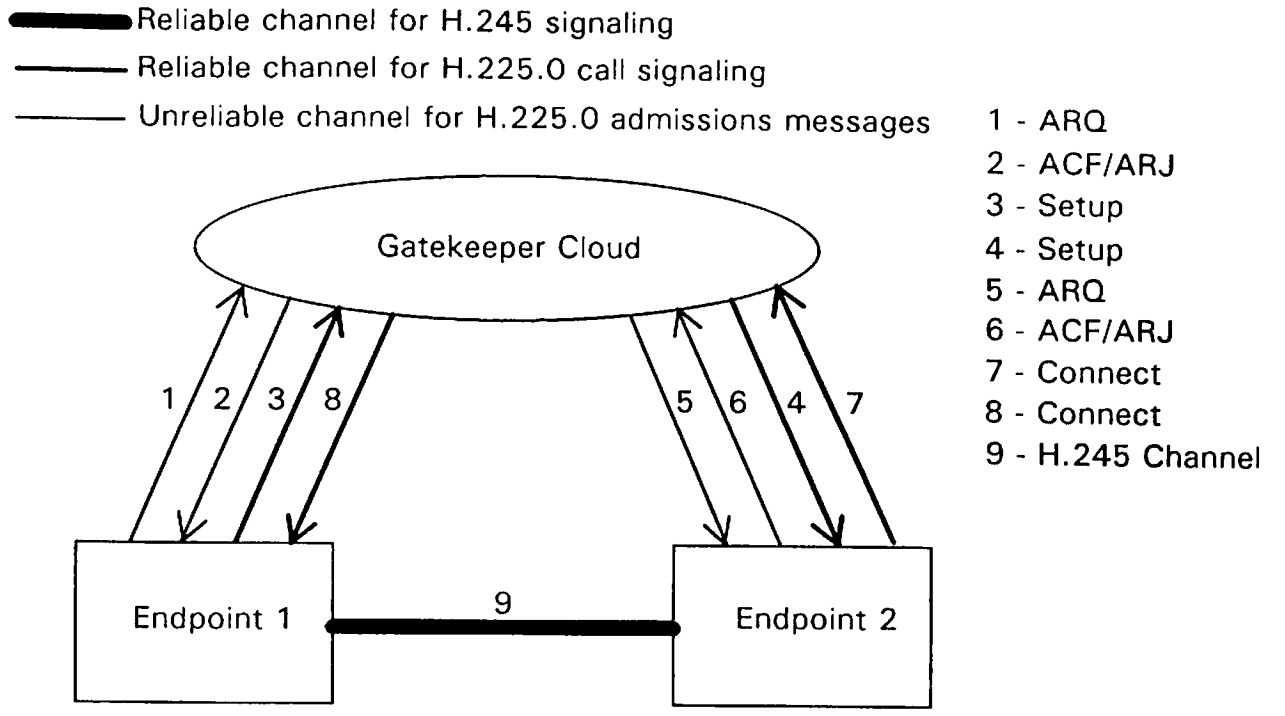


Figure 10/H.323: Direct H.245 Control Channel Connection Between Endpoints

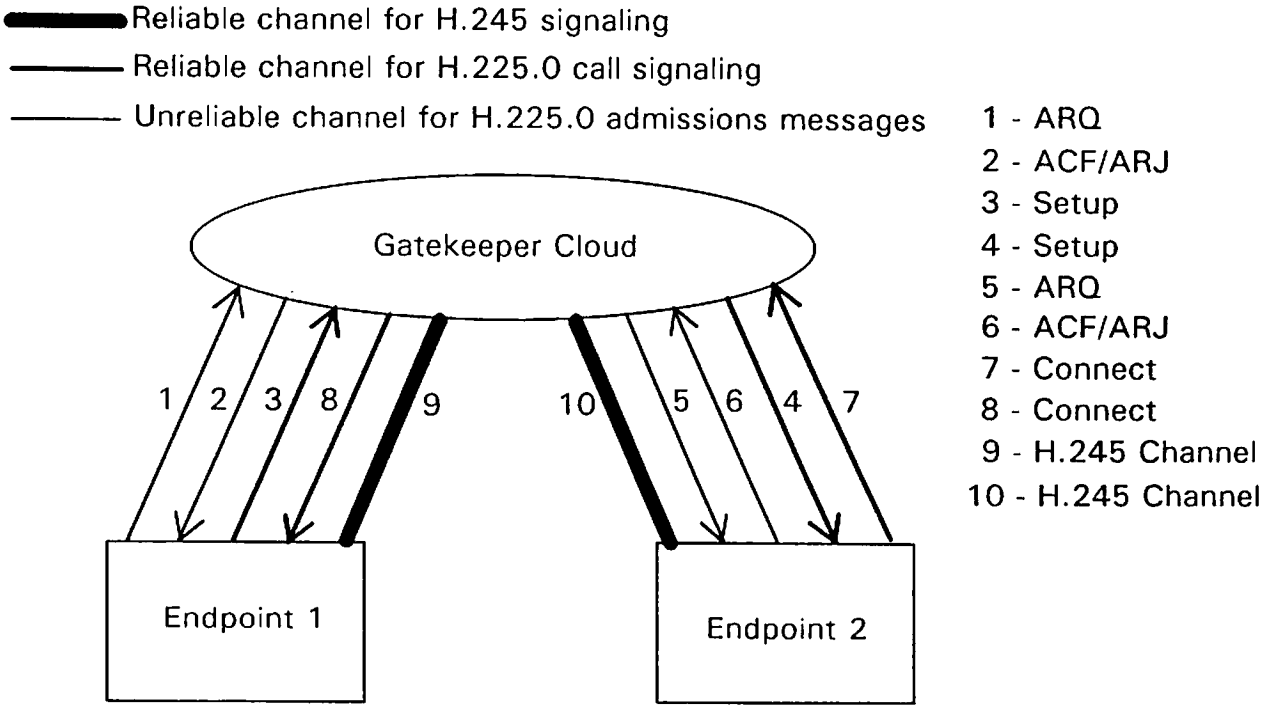


Figure 11/H.323 Gatekeeper Routed H.245 Control

67.5 Conference ID

The Conference ID (CID) is a value passed in the Setup and Connect message. This CID is used to indicate if a call setup exchange is to create a new conference or to join an existing conference.

In order to create a new conference, either point-to-point or multipoint, the calling endpoint sends a Setup message containing a CID=0. When call signalling is routed through the Gatekeeper, the Gatekeeper shall assign a unique non-zero CID to this conference. That CID is sent to the called endpoint in the Setup message and to the calling endpoint in the Connect message. When call signalling is routed directly between endpoints, the called endpoint returns a random non-zero CID to the calling endpoint in the Connect message. If the called endpoint is already active, it responds with a Release Complete message. This may contain the CID of the active conference and the LAN ~~transport~~ aAddress of the endpoint containing the MC. This will allow the calling endpoint to properly join the conference.

In order to invite an endpoint to join and existing conference, the endpoint containing the MC sends a Setup message to the invited endpoint containing the CID of the existing conference. In this case, if call signalling is routed through the Gatekeeper, the CID will not be changed.

An endpoint receiving a Setup message with a non-zero CID is being asked to join an existing conference (point-to-point or multipoint). If the endpoint wishes to join, it responds with the same CID in the Connect message. If the called endpoint responds with a Release Complete message containing a different non-zero CID, it is indicating that it is already in an active conference having that CID. It also indicated which endpoint contains the MC, so that the calling endpoint can properly join the conference.

An endpoint wishing to join an existing conference sends Setup message containing the CID of the existing conference to the endpoint containing the MC.

{Is there a method to determine the CIDs of the active conferences??}

78. Call Signalling Procedures

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

- phase A: Call set-up (subclause 78.1);
- phase B: Initial communication and capability exchange (subclause 78.2);
- phase C: Establishment of audio visual communication (subclause 78.3);
- phase D: Suplementary Services (subclause 78.4);
- phase E: Call termination (subclause 78.5)

78.1 Phase A - Call set-up

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

78.1.1 Basic Call Setup

In the basic call scenario as shown in Figure 12/H.323, two endpoints communicate directly without a Gatekeeper-. The Setup (3) is sent to the well known reliable ~~port~~TSAP Identifier of endpoint 2-. The

Connect (8) contains a dynamic reliable network address for use in H.245 signaling-. Messages (6) and (7) are optional.

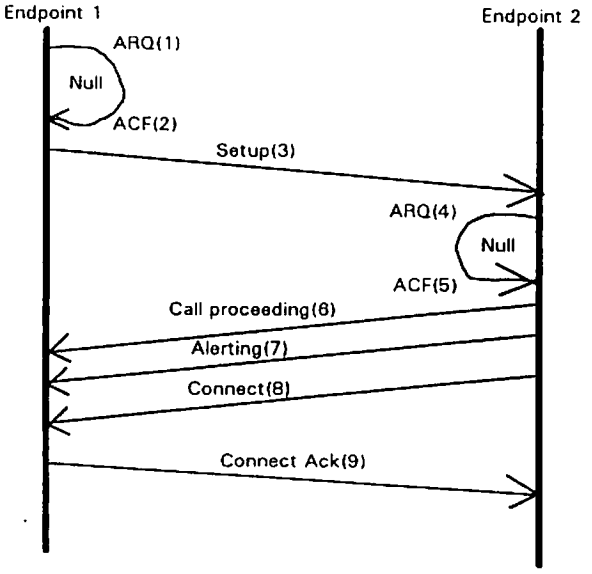


Figure 12/H.323 Basic Call Setup, no Gatekeepers

~~7~~8.1.2 Calling Endpoint has Gatekeeper

If endpoint 1 (calling endpoint) has a Gatekeeper, the ARQ (1)/ACF (2) exchange takes place with that Gatekeeper-. If the Gatekeeper does not wish to route the call signalling, the Gatekeeper shall return the LAN ~~transport a~~Address of endpoint 2 (called endpoint) in the ACF. See Figure 13/H.323-. If endpoint 2 is not bound to a Gatekeeper, a null ARQ(5)/ACF(6) exchange takes place. If endpoint 2 is bound, and the endpoint wishes to accept the call, an ARQ (5')/ACF (6') exchange takes place. It is possible that an ARJ (6') is received by endpoint 2, in which case it sends Release Complete to endpoint 1.

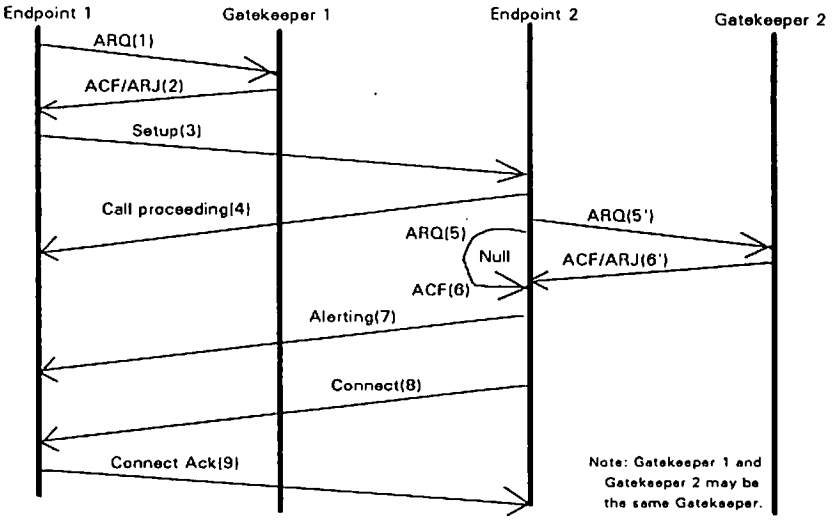


Figure 13/H.323 Calling Endpoint Bound to Gatekeeper - Direct Call Signalling

If the Gatekeeper of endpoint 1 choses to route the call signalling, the case shown in Figure 14/H.323 results. In this case, endpoint 1 gets back from the ARQ (1)/ACF(2) exchange a reliable ~~port~~TSAP Identifier that is on the Gatekeeper, not endpoint 2–. When the Gatekeeper receives Setup(3) it responds with Call Proceeding(4) and Setup(4) to endpoint 2–. Endpoint 2 may engage in an ARQ(5')/ACF(6') exchange with its Gatekeeper if it is bound, or a null ARQ(5)/ACF(6) exchange if it is not bound. The Connect (8) from endpoint 2 to the Gatekeeper contains a reliable ~~port~~TSAP Identifier for H.245 connection, but the Connect (8') that arrives at endpoint 1 may or may not contain this same ~~port~~TSAP Identifier, based on whether the Gatekeeper choses to route the H.245 Control Channel or not.

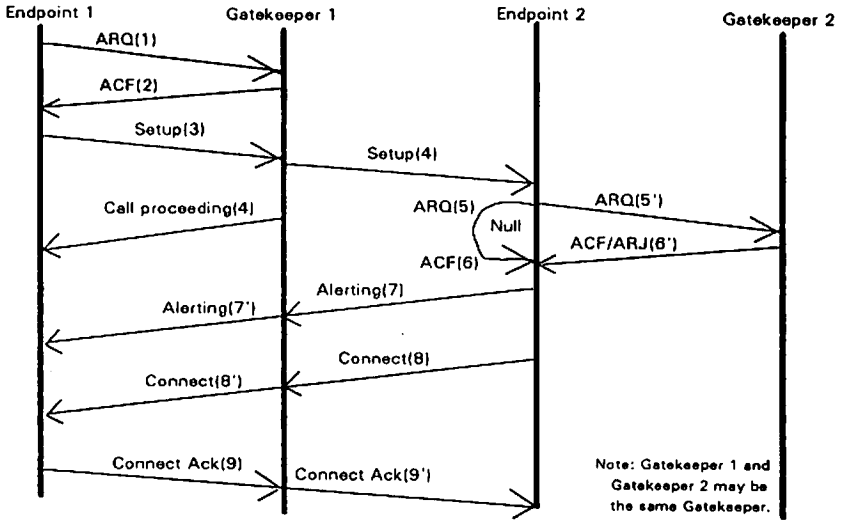


Figure 14/H.323 Calling Endpoint Bound to Gatekeeper - Gatekeeper Routed Call Signalling

~~7~~8.1.3 Called Endpoint has Gatekeeper

If endpoint 1 (calling endpoint) does not have a Gatekeeper, a null ARQ (1)/ACF (2) exchange takes place and a Setup (3) message is sent to endpoint 2 (called endpoint). See Figure 15/H.323-. Endpoint 2 completes an ARQ(5)/ACF(6) exchange with its Gatekeeper. If the Gatekeeper does not wish to route the call signalling, the Gatekeeper shall return the LAN ~~transport address of endpoint 1in the ACF~~Address of endpoint 1 in the ACF message. It is possible that an ARJ (6') is received by endpoint 2, in which case it sends Release Complete to endpoint 1.

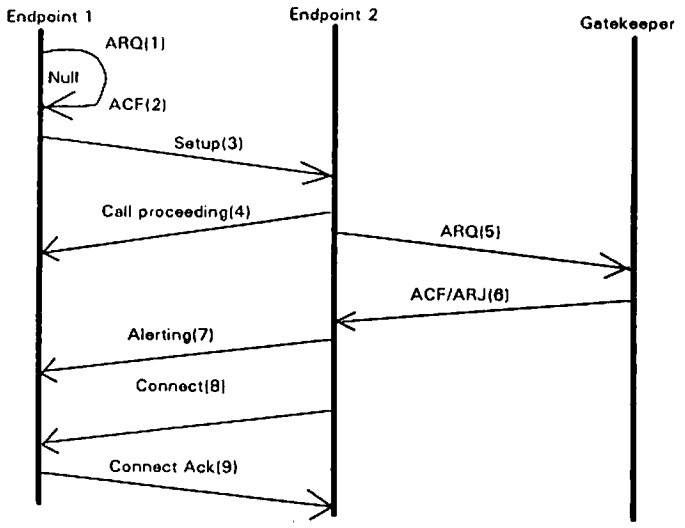


Figure 15/H.323 Called Endpoint Bound to Gatekeeper - Direct Call Signalling

{Does this next case make sense???}

If the Gatekeeper of endpoint 2 choses to route the call signalling, the case shown in Figure 16/H.323 results. In this case, endpoint 2 gets back from the ARQ (1)/ACF(2) exchange a reliable ~~port~~TSAP Identifier that is on the Gatekeeper, not endpoint 1. The Connect (8) from endpoint 2 to the Gatekeeper contains a reliable ~~port~~TSAP Identifier for H.245 connection, but the Connect (8') that arrives at endpoint 1 may or may not contain this same ~~port~~TSAP Identifier, based on whether the Gatekeeper choses to route the H.245 Control Channel.

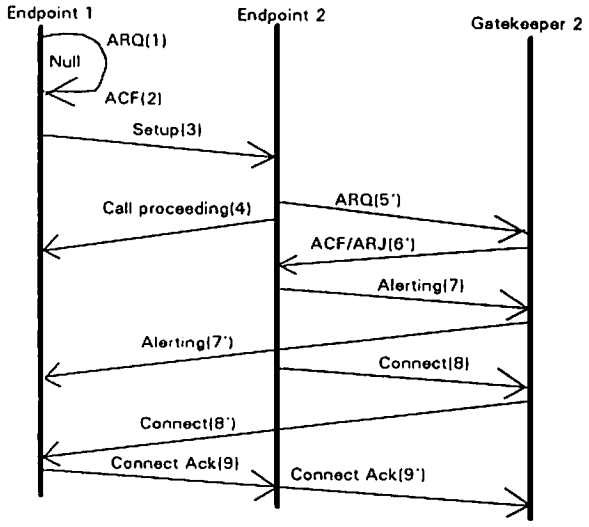


Figure 16/H.323 Called Endpoint Bound to Gatekeeper - Gatekeeper Routed Call Signalling

~~7~~8.1.4 Call Set-up via Gateways

~~7~~8.1.4.1 Gateway Inbound Call Set-up

When an external terminal calls a LAN endpoint via the Gateway, call set-up between the Gateway and the LAN endpoint proceeds the same as the endpoint to endpoint call setup~~-~~. The Gateway 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, the Gateway shall be able to accept ~~DTMF or~~two stage dialling. For Gateways to H.320 networks (also H.321, H.322, and H.310), the Gateway shall accept SBE numbers from the H.320 ~~external~~terminal. For Gateways to H.324 networks, the Gateway shall accept DTMF numbers from the H.324 terminal. These numbers will indicate a second stage dialing number to access the individual endpoint on the LAN.~~Two stage dialing from an H.320 terminal requires either DTMF or SBE numbers . Two stage dialing from an H.324 terminal requires DTMF signaling.~~

~~7~~8.1.4.2 Gateway Outbound Call Set-up

When a LAN endpoint calls an external terminal via the Gateway, call set-up between the LAN endpoint and the Gateway proceeds the same as the endpoint to endpoint call setup~~-~~. The Gateway 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 LAN endpoint while establishing the outgoing call.

The Progress Indicator information element is used to indicate that inter-networking is occuring. 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~~8.1.5 Call Setup with an MCU

For multipoint conferences, all endpoints exchange call signalling with the MCU. Call set-up between a endpoint and the MCU proceeds the same as the endpoint to endpoint call setup. The MCU may be the called endpoint or the calling endpoint.

In a Centralized Multipoint Conference, the H.245 Control Channel is opened between the endpoints and the MC within the MCU, The audio, video, and data channels are opened between the endpoints and the MP within the MCU. In a Decentralized Multipoint Conference, only the H.245 Control Channel is open between the endpoint and the MC (there may be many such ~~control e~~H.245 Control Channels, one for each endpoint). The Audio and Video Channels will be multicast to all endpoints in the conference. The Data Channel shall be opened with the Data MP.

In an Ad Hoc Multipoint Conference where there is no MC within the endpoints, the H.245 eControl Channel may be routed through the Gatekeeper. Initially the H.245 Control eChannel will be routed between the endpoints through the Gatekeeper. When the conference switches to multipoint, the Gatekeeper may connect the endpoints to an MC within the Gatekeeper, or to an MC external to the Gatekeeper. No additional call setup is required for the MC within the Gatekeeper. For the MC external to the Gatekeeper, the Gatekeeper shall exchange call signalling with the MCU ~~for~~that contains the MC on behalf of each endpoint. The Gatekeeper shall then establish an H.245 ~~a control e~~Control Channel

with the MCU for each endpoint, and route the H.245 messages between the endpoints and the MCU through the Gatekeeper.

~~7~~8.2 Phase B - Initial communication and capability exchange

Once both sides have exchanged call setup messages from section ~~7~~8.1, each knows the dynamic reliable LAN ~~transport a~~Address for H.245 control. The endpoints shall immediately establish a reliable connection for the H.245 ~~control e~~Control Channel. The procedures of H.245 are used over the H.245 Control Channel for the capability exchange and to open the media channels.

Endpoint 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.

{Should the master slave determination process take place here ???}

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

~~7~~8.3 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 ~~port~~TSAP Identifiers 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 ~~port~~TSAP Identifiers using a guaranteed underlying protocol (see H.225.0).

The OpenLogicalChannelAck returns the ~~port numb~~LAN Address and TSAP Identifier that the receiving endpoint has assigned to that logical channel. The transmitting channel shall then send ~~all media bits(audio, video, data)~~ the information stream associated with the logical channel to that ~~port~~LAN Address and TSAP Identifier.

~~7~~8.3.1 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~~8.3.2 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.

Endpoint X has been set so that video is not transmitted unless, and until, the remote endpoint has also indicated readiness to transmit video. Endpoint 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 endpoint 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.

~~7.4 Phase D: Suplementary~~8.4 Phase D: Call Services

~~7~~8.4.1 Bandwidth Changes

~~*{This section needs work.}*~~

Call bandwidth is initially est~~blished~~ablished and approved by the Gatekeeper during the admissions exchange. An endpoint shall assure that the aggregate for all transmitted and received channels is within this bandwidth.

At any time during a conference, the endpoints 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 endpoints. The H.245 flow control commands shall not exceed~~. An endpoint may change the bitrate of a logical channel without requesting a bandwidth change from the Gatekeeper if the aggregate bitrate of all transmitted and received channels does not exceed the current call ~~the bandwidth approved by the Gatekeeper.~~ bandwidth. If the change will result in a aggregate bitrate that exceeds the current call bandwidth, the endpoint shall request a change in the call bandwidth. A bandwidth change request is recommended when an endpoint will use a reduced bandwidth for an extended period of time, thus freeing up bandwidth for other calls.

An endpoint wishing to change its ~~transmitted bitrate~~call bandwidth sends a BRQ(1) 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 BRJ(2) message to endpoint. If the Gatekeeper determines that the request is acceptable, it returns a BCF(2) message. ~~The endpoint may now change its transmitted bitrate.~~

~~An endpoint wishing to change the transmitted bitrate of another endpoint in a conference, sends a BRQ(1) 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 BRJ(2) message to endpoint. If the Gatekeeper determines that the request is acceptable, it returns a BCF(2) message. The endpoint sends an H.245 FlowControlCommand to the other endpoint over the control channel. When the receiving endpoint wishes to change its transmitted bitrate it follows the procedure above, requesting the change from its Gatekeeper.~~

If endpoint 1 wishes to increase its transmitted bitrate on a logical channel, it first determines if the call bandwidth will be exceeded. See Figure 17/H.323. If it will, endpoint 1 shall request a bandwidth change (1 and 2) from Gatekeeper 1. When the call bandwidth is sufficient to support the change, endpoint 1 sends a CloseLogicalChannel (3) message to close the logical channel. It then re-opens the logical channel using the OpenLogicalChannelRequest (4) specifying the new bitrate. If the receiving endpoint wishes to accept the channel with the new bitrate, it must first assure that its call bandwidth is not exceeded by the change. If it is, the endpoint shall request a call bandwidth change (5 and 6) with its Gatekeeper. When the call bandwidth is sufficient to support the channel, the endpoint replies with an OpenLogicalChannelAck (7), otherwise, it responds with an OpenLogicalChannelReject indicating unacceptable bitrate.

~~Endpoint 1 then sends an H.245 flow control command to the endpoint 2.~~

~~If endpoint 2 is bound to a Gatekeeper, it sends a BRQ(4) message to the Gatekeeper. The Gatekeeper determines if the request is acceptable. If the Gatekeeper determines that the request is not~~

~~acceptable, it returns a BRJ(5) message to endpoint 1. If the Gatekeeper determines that the request is acceptable, it returns a BCF(5) message.~~

~~If a Gatekeeper is not managing the H.245 control channel, the other endpoint 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 endpoints shall still send the BRQ. Note that the endpoint is not aware of whether the H.245 channel is managed by the Gatekeeper or not . If the call is multi point, and the endpoints are in receipt of multipointModeIndicate, they shall not issue BRQs; it is assumed that the Gatekeeper has reserved sufficient bandwidth for all its requests.~~

~~See Figure 17/H.323.~~

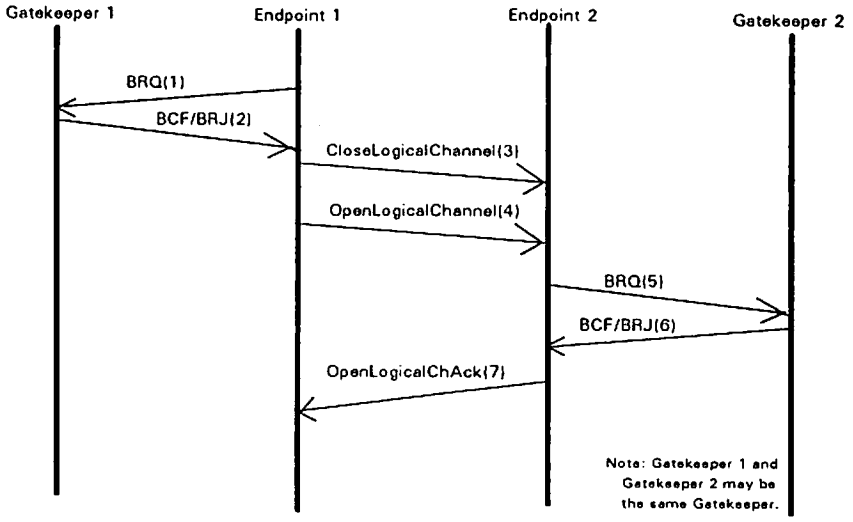


Figure 17/H.323 Bandwidth Requests

If the endpoint 1 wishes to increase its transmitted bitrate of on a logical channel from endpoint 2, endpoint 1first determines if the call bandwidth will be exceeded. See Figure 18/H.323. If it will, endpoint 1 shall request a bandwidth change from Gatekeeper 1. When the call bandwidth is sufficient to support the change, endpoint 1 sends a FlowControlCommand (3) to indicate the new upper limit on bitrate for the channel. If endpoint 2 decides to increase the bitrate on the channel, it must first assure that its call bandwidth is not exceeded by the change. If it is, endpoint 2 shall request a call bandwidth change (4 and 5) with its Gatekeeper. When the call bandwidth is sufficient to support the channel, endpoint 2 wll send the CloseLogicalChannel (6) message to close the logical channel. It then re-opens the logical channel using the OpenLogicalChannelRequest (7) specifying the new bitrate. Endpoint 1 should then accept the channel with the new bitrate, and it replies with an OpenLogicalChannelAck (6).

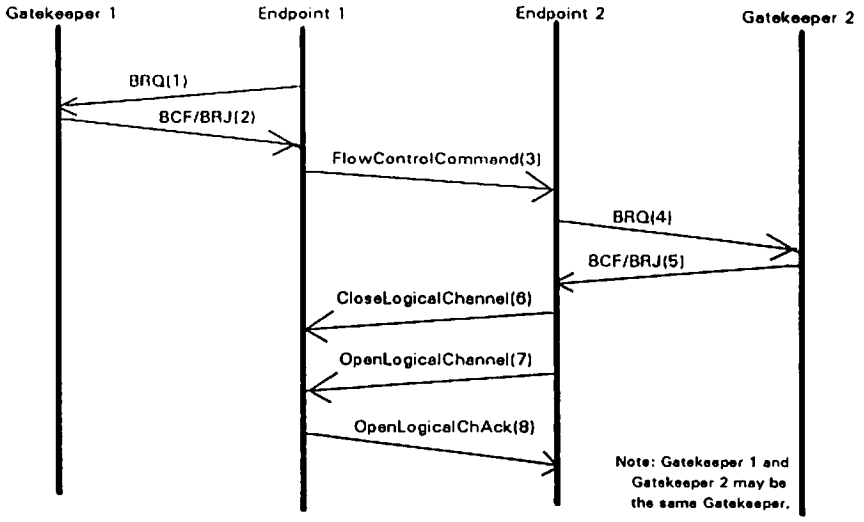


Figure 18/H.323 ~~Endpoint Initiated Call Clearing~~Bandwidth Requests

~~7.5.3 Call Clearing by Gatekeeper~~

A Gatekeeper wishing to change the transmitted bitrate of endpoint 1 sends a BRQ message to endpoint 1. If the request is for a decrease in bitrate, endpoint 1 shall always comply by reducing its aggregate bitrate and returning a BCF. Endpoint 1 may initiate the approprite H.245 signalling to inform endpoint 2 that bitrates have changed. This will allow endpoint 2 to inform its Gatekeeper of the change. If the request if for an increase, the endpoint may increase its bitrate when desired.

{Editor's Note: Need to address adding a B-channel on the ISDN side to an on-going call}

~~7.4.2 Call~~8.4.2 Status

In order for the Gatekeeper to determine if an endpoint is turned off, or has otherwise enter a failure mode, the Gatekeeper may use the SRQ/SRR message sequence (see H.225.0) to poll the endpoints on active calls at an interval decided by the manufacturer. The endpoint shall respond within 5 seconds, and the polling interval shall be greater than 10 seconds. This message may also be used by a diagnostic device as described in section 101.2.

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

~~7~~8.4.3 Ad Hoc Conference Expansion

~~7~~8.4.3.1 Direct Endpoint Call Signalling

In an Ad Hoc Multipoint call having direct endpoint call signalling, if the endpoint containing the MC wishes to add another endpoint to the conference, the following procedure is used:

1)Endpoint 1 calls endpoint 2 with CID = 0 according to the procedure in Section ~~7~~8.1 and endpoint 2 responds to endpoint 1 with the CID = N.

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

3)Endpoint 1 and endpoint 2 may be attached to the MC now, or when the user initiates the multipoint conference function, at the choice of the manufacturer.

4)Endpoint 2 calls endpoint 3 with CID = N according to the procedures in Section ~~7~~8.1.

5)Endpoint 2 attaches endpoint 3's H.245 ~~control channel to its MC~~ Control Channel to its MC. All negotiation of multi-cast vs uni-cast is done via H.245-.

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

If the endpoint that does not contain the MC wishes to add another endpoint to the conference, the following procedure is used:

1) thru 3) Are the same as above.

4)Endpoint 1 sends a Setup message to endpoint 2 indicating a call to endpoint 3 with CID = N.

5)Endpoint 2 calls endpoint 3 with CID = N according to the procedures in Section ~~7~~8.1. Thus, endpoint 2 remains at the center of the conference; in effect it is acting as a dial-out MCU.

6)Endpoint 2 attaches endpoint 3's H.245 ~~control channel to its MC~~ Control Channel to its MC. All negotiation of multi-cast vs uni-cast is done via H.245-.

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

It should be noted that the call is ended by a failure of the endpoint that is providing the MC.

~~7~~8.4.3.2 Gatekeeper Routed Call Signalling

In an Ad Hoc Multipoint call having Gatekeeper Routed call signalling and Gatekeeper routed H.245 ~~control c~~Control Channel, if either endpoint wishes to add another endpoint to the conference, the following procedure is used:

1)Endpoint 1 calls endpoint 2 via the Gatekeeper. endpoint 1 sends CID = 0, the Gatekeeper sends CID = N to endpoint 2, and returnd CID = N to endpoint 1, according to the procedures in Section ~~7~~8.1.

2)Using H.245 master/slave determination procedure, it is determined that the Gatekeeper is the master, and hence has the MC (or has access to it).

3)The Gatekeeper may route the H.245 ~~control c~~Control Channels from endpoint 1 and 2 to an MC at this time, or later when endpoint 3 is connected-. Whether endpoint 1 or 2 has an MC, the Gatekeeper by definition shall always win the master/slave determination process-.

4)Endpoint 1 sends a Setup message to the Gatekeeper indicating a call to endpoint 3 with CID = N.

5)The Gatekeper calls endpoint 3 with CID = N according to the procedures in Section ~~7~~8.1. Thus, Gatekeeper rcontinues to route the H.245 ~~control c~~Control Channels.

6)The Gatekeeper routes endpoint 3's H.245 ~~control channel to the MC~~ Control Channel to the MC. All negotiation of multi-cast vs uni-cast is done vie H.245-.

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

In systems having Gatekeeper Routed call signalling but not having Gatekeeper routed H.245 ~~control~~ eControl Channel, Ad Hoc multipoint conferences would take place as follows:

1)Endpoint 1 calls endpoint 2 via the Gatekeeper. endpoint 1 sends CID=0, the Gatekeeper sends CID=N to endpoint 2, and returnd CID=N to endpoint 1, according to the procedures in Section ~~7~~8.1.

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

3)Endpoint 1 and endpoint 2 may be attached to the MC now, or when the user initiates the multipoint conference function, at the choice of the manufacturer.

4)The procedure continues as described in Section ~~7~~8.4.3.1 steps 4) thru 7) for either endpoint initiating the addition of endpoint 3.

~~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.~~

~~*{This requires further investigation, we have never associated MP functions with the Gatekeeper.}*~~8.4.4 Suplementary Services

Provissions have been made within this Recommendation to allow endpoints to the use the Supplementary Services as defined in Q.931, Q.932, and the Q.95X series of Recommendations. These services shall use the reliable Call Signalling Channel within Q.931 messages. These services will provide features such as hold, transfer, forward, and redirection.

~~7~~8.5 Phase E: Call termination

Either endpoint 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 e~~H.245 Control Channel, and then discontinue all transmissions on the ~~control e~~H.245 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 clear the call by sending the using the procedures defined in H.225.0 and tailored below.

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

~~7~~8.5.1 Call Clearing without a Gatekeeper

In networks that do not contain a Gatekeeper, after transmitting the **EndSessionCommand**, the call is terminated and no further action is required.

~~7~~8.5.2 Call Clearing with a Gatekeeper

In networks that do contain a Gatekeeper, the Gatekeeper needs to know about the release of bandwidth. After transmitting the **EndSessionCommand (1 or 2)**, each endpoint shall transmit an H.225.0 ~~Releas~~Disengage(3) message to its Gatekeeper. The Gatekeeper shall respond with a ~~Releas~~Disengage Complete(4) message. See Figure 1~~8~~9/H.323. At this point the call is terminated.

The ~~Release and Release Complete may be sent on a reliable connection or an unreliable connection. This connection~~Disengage and Disengage Complete may be sent on the reliable Call Signalling Channel or the unreliable RAS Channel. This channel may have been left open since call setup, or it may be re-opened for call clearing.

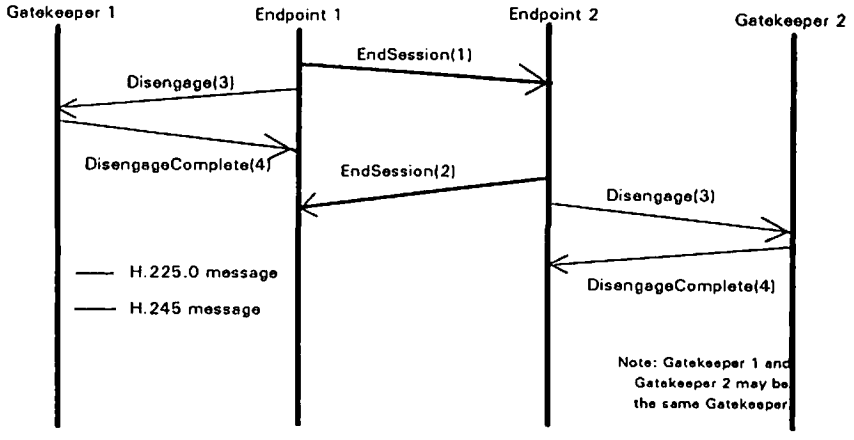


Figure 19/H.323 Endpoint Initiated Call Clearing

~~*(Is this sufficient or do we also need an explicit bandwidth release??)*~~8.5.3 Call Clearing by Gatekeeper

The Gatekeeper may terminate any conference by sending a ~~Releas~~Disengage to an endpoint. See Figure ~~19~~20/H.323. The endpoint shall immediately follow steps 1 through 4 from above and then reply to the Gatekeeper with ~~Releas~~Disengage Complete. The other endpoint, upon receiving End_Session shall follow the procedure described above.

If the conference is a multipoint conference, the Gatekeeper must sent a ~~Releas~~Disengage for each point-to-point connection to the MC, in order to close the entire conference.

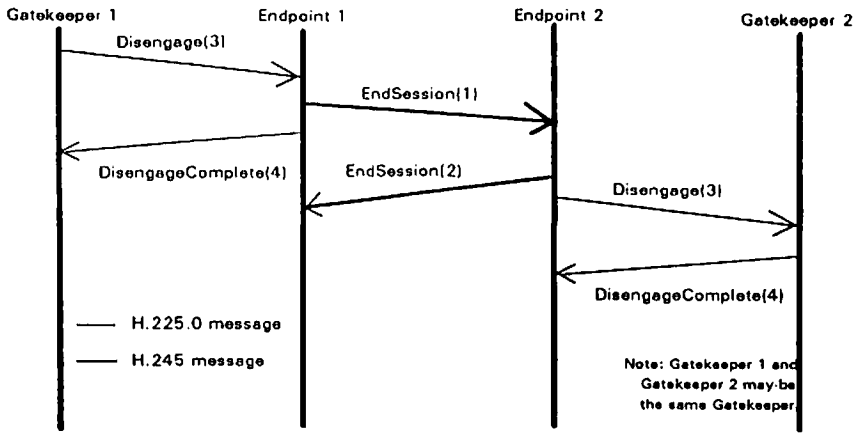


Figure 20/H.323 Gatekeeper Initiated Call Clearing

~~7~~8.6 Broadcast Call Setup

This section is for further study.

A Broadcast Call does not use broadcast transfers in the LAN sense; broadcast is implemented via multicast transfers.

A Broadcast 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 endpoint since it is not interactive, merely a broadcast point.

~~8~~9 Interoperation with other terminal types

Interoperation with other terminals shall be accomplished through the Gateway Unit. See Section ~~5~~6.3.

~~8~~9.1 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 uses G.711
  GSTN: from 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~~9.2 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.

89.3 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 n 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.

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

For further study

89.5 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.

89.6 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.

89.7 T.120 Terminals on the LAN

An H.323 terminal that has T.120 capability should be capable of being configured as a T.120 Only terminal which listens and transmits on the standard T.120 well known ~~port~~TSAP Identifier. This will allow the T.120 capable H.323 terminal to participate in T.120 conferences.

A T.120 only terminal on the LAN should be able to participate in the T.120 portion of multipoint H.323 conferences by connecting to the MCS top provider.

910 Optional enhancements

{Editor's Note: we must address spoofing}

910.1 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.

910.1.1 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 c~~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.

910.1.2 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 media streams, 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.

910.1.3 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 e~~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.

910.1.4 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 bitstreams 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.

910.1.5 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.

101 Maintenance

101.1 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 Ispwich,

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 2~~0~~1/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 2~~0~~1/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 2~~0~~1/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 2~~0~~1/H.323. This loopback is optional, and should be used only on logical channels opened using the bi-directional channel procedures of H.245. *{Bidirectional channels are not used in H.323.}*

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

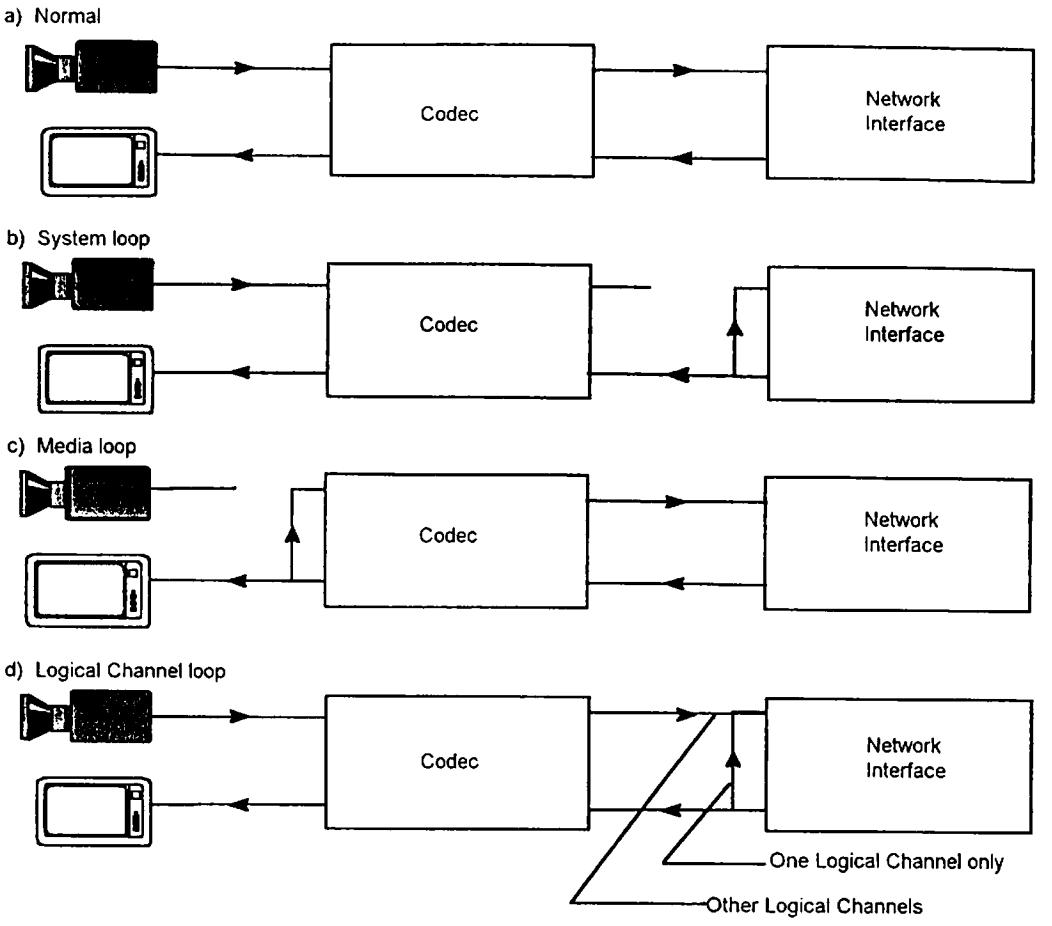


FIGURE 2~~0~~1/H.323 - Loop back

1~~0~~1.2 Monitoring Methods

All terminals shall support the Status Request/Status Report Response (SRQ/SRR) message of H.225.0 . The Status Report Response message contains the ~~port ids of all transport~~TSAP Identifier of all channels currently active on the call, including T.120 and H.245 control, as well as audio and video~~.~~. This information can be used by third party maintenance devices to monitor H.323 conferences to verify system operation.

ANNEX A

H.245 Messages Used by H.323 Endpoints

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

~~ANNEX B~~

~~H.242 to H.245 Conversion~~*{This may need to expand to include a receive and transmit column for each H.323 entity (term, GW, GK, MC, MCU) to indicate mandatory or optional use.}*

Assumptions:

. If you receive an unregognized request or response command, return "function not supported". (This is not required for indications)

. The following abbreviations are used in the table: M = Mandatory, O = Optional, F = Forbidden to transmit.

. Everyone will review this!

Notes:

. A preceding * indicates that this command is proposed in TD27 as an addition to H.245 for H.323.

. A preceding # indicates that this command is a translation of an H.243 command and H.243 should be consulted for its use with respect to mandatory or optional requirements.

A. Master Slave Determination Messages

Command	Status
Determination	M
Determination Acknowledge	M
Determination Reject	M
Determination Release	M

B. Terminal Capability Messages

Command	Status
Capability Set	M
Capability Set Acknowledge	M
Capability Set Reject	M
Capability Set Release	M

C. Logical Channel Signaling Messages

Command	Status (RX)	Status (TX)
Open Logical Channel	**M**	**M**
Open Logical Channel Acknowledge	**M**	**M**
Open Logical Channel Reject	**M**	**M**
Open Logical Channel Confirm	M	M
Close Logical Channel	M	M
Close Logical Channel Acknowledge	M	M
Request Channel Close	M	O
Request Channel Close Acknowledge	O	O
Request Channel Close Reject	O	M
Request Channel Close Release	O	O

D. Multiplex Table Signaling Messages

Command	Status
Multiplex Entry Send	F
Multiplex Entry Send Acknowledge	F
Multiplex Entry Send Reject	F

Multiplex Entry Send Release	F

E. Request Multiplex Table Signaling Messages

Command	Status
Request Multiplex Entry	F
Request Multiplex Entry Acknowledge	F
Request Multiplex Entry Reject	F
Request Multiplex Entry Release	F

F. Request Mode Messages

Command	Status (RX)	Status (TX)
Request Mode	M	O
Request Mode Acknowledge	O	O
Request Mode Reject	O	M
Request Mode Release	O	O

G. Round Trip Delay messages

Command	Status
Round Trip Delay Request	O
Round Trip Delay Response	O

H. Maintenance Loop Messages

Command	Status

Maintenance Loop Request	O
System Loop	M
Media Loop	O
Logical Channel Loop	O
*au H230 Loop	O
*vid H230 Loop	O
*dig H230 Loop	O
*off H230 Loop	O
Maintenance Loop Acknowledge	O
Maintenance Loop Reject	O
Maintenance Loop Command Off	O

I. Commands

Command	Status
Send Terminal Capability Set	M
Encryption	O
Flow Control	M (RCVR must obey)
End Session	M
Miscellaneous Commands	
Equalize Delay	F
Zero Delay	F
Multipoint Mode Command	M
Cancel Multipoint Mode Command	M
Video Freeze Picture	M
Video Fast Update Picture	M
Video Fast Update GOB	M

Video Temporal Spatial Trade Off	M
Video Send Sync Every GOB	O
Video Send Sync Every GOB Cancel	O
*Diagnostic Request	O
*Diagnostic Response	O
#*Terminal ID Request	O
#*Terminal List Request	O
#* broadcast me	O
#*cancel Broadcast Me	O
#*Make Terminal Broadcaster	O
#*Send This Source	O
#*Cancel Send This Source	O
#* Drop Terminal	O
#* Make Me Chair	O
#* Cancel Make Me Chair	O
#* Drop Conference	O
#* Enter H.243 Password	O
#* Enter H.243 Terminal Id	O
#* Enter H.243 Conference ID	O
#* Request Terminal ID	O
#* Terminal ID Response	O
#* Terminal List Response	O
#* Video Command Reject	O
#* Make ME Chair Response	O

J. Conference Mode Commands

Command	Status
Communication Mode Command	M
Communication Mode Request	M
Communication Mode Response	M

K. Indications

Command	Status
Function Not Supported	M
Miscellaneous Indication	
Logical Channel Active	M
Logical Channel Inactive	M
Multipoint Conference	M (RX)
Cancel Multipoint Conference	M (RX)
Multipoint Zero Comm	M (RX)
Cancel Multipoint Zero Comm	M (RX)
Multipoint Secondary Status	M
Cancel Multipoint Secondary Status	M
Video Indicate Ready to Activate	M
Video Temporal Spatial Trade Off	M
*SBE Number	O
#*Terminal Number Assign	O
#*Terminal Joined Conference	O
#*Terminal Left Conference	O
#* Seen By At Least One Other	O
#* Cancel Seen By At Least One Other	O

#* Seen By All	O
#*Cancel Seen By All	O
#*Terminal You Are Seeing	O
#* Request For Floor	O
Jitter Indication	O
H.223 Skew Indication	F
New ATM Virtual Channel Indication	F
User Input	M (for 0-9, * and #)