FTR 1080B-2002

FEDERAL TELECOMMUNICATIONS RECOMMENDATION

Video Teleconferencing Services

Prepared and Published By:
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VIDEO TELECONFERENCING SERVICES

(This Recommendation supersedes FTR 1080A-1998, dated October 8, 1998)

Federal Telecommunications Recommendations (FTR) are issued by the Technology and Programs Division, National Communications System (NCS), after approval by the Federal Telecommunications Standards Committee and the Deputy Manager, NCS, pursuant to Executive Order 12472,[1] NCS Directive 4-1,[2] and Public Law 104-113.[3]

1. Name of Recommendation. Video Teleconferencing Services.

2. Category. Video Teleconferencing, Telecommunications Standards.

3. Explanation. This FTR, by adoption of International Telecommunication Union - Telecommunication Standardization Sector (ITU-T) Recommendations H.320 and H.323, defines the specifications for video teleconferencing and video telephony systems. This FTR supersedes FTR 1080A-1998, which did not include H.323.

4. Approving Authority. Deputy Manager, National Communications System.

5. Maintenance Agency. Technology and Programs Division, National Communications System.

6. Related Documents.

a. American National Standards Institute (ANSI) T1.800.01-

[1]Executive Order 12472, "Assignment of National Security and Emergency Preparedness Telecommunications Functions," April 3, 1984.
[2]NCS Directive 4-1, "Federal Telecommunication Standards Program," February 21, 1991.
[3]Public Law 104-113, "The National Technology Transfer and Advancement Act of 1995," February 27, 1996.

1995, American National Standard for Telecommunications - Visual Telephone Systems and Terminal Equipment Using Digital Channels up to 1920 kbit/s.

b. ANSI T1.800.03-1995, American National Standard for Telecommunications - Frame Structure for Audiovisual Services at 56 to 1,920 kbit/s.

c. ANSI T1.800.04-1995, American National Standard for Telecommunications - Procedures for Establishing Communications Between Two Audiovisual Terminals Using Digital Channels up to 1,920 kbit/s.

d. ANSI T1.800.05-1995, American National Standard for Telecommunications - Frame Synchronous Control and Indication Signals for Audiovisual Systems.

e. ANSI T1.800.06-1995, American National Standard for Telecommunications - Multipoint Control Units for Audiovisual Systems Using Digital Channels up to 1,920 kbit/s.

f. ANSI T1.800.07-1995, American National Standard for Telecommunications - Procedures for Establishing Communication Between Three or More Audiovisual Terminals Using Digital Channels up to 1,920 kbit/s.

g. ANSI T1.801.03-1996, Digital Transport of One-way Video Signals - Parameters for Objective Performance Assessment.

h. The International Telecommunications Union-Telecommunications Standardization Sector (ITU-T) Recommendation G.711 (1988), Pulse Code Modulation (PCM) of Voice Frequencies.

i. ITU-T Recommendation G.722 (1988), 7 kHz Audio-coding Within 64 kbit/s.

j. ITU-T Recommendation G.725 (1988), System Aspects for the Use of the 7 kHz Audio Code Within 64 kbit/s.

k. ITU-T Recommendation G.723.1 (1996), Speech Codes: Dual Rate Speech Coder for Multimedia Communications Transmitting at 5.3 and 6.3 kbit/s.

l. ITU-T Recommendation G.728 (1992), Coding of Speech at 16 kbit/s Using Low-delay Code Excited Linear Prediction.

m. ITU-T Recommendation G.729 (1996), Coding of Speech at

8 kbit/s using Conjugate-Structure Algebraic-Code-Excited Linear-Prediction (CS-ACELP).

n. ITU-T Recommendation G.821 (1996), Error Performance of an International Digital Connection Operating at a Bit Rate Below the Primary Rate and Forming Part of an Integrated Services Digital Network.

o. ITU-T Recommendation I.464 (1999), Multiplexing, Rate Adaptation and Support of Existing Interfaces for Restricted 64 kbit/s Transfer Capability.

p. ITU-T Recommendation T.35 (2000), Procedure for the Allocation of CCITT Defined Codes for Non-standard Facilities.

q. ITU-T Recommendation V.120 (1996), Support by an ISDN of Data Terminal Equipment with V-Series Type Interfaces with Provision for Statistical Multiplexing.

r. ITU-T Recommendation H.221 (1999), Frame Structure for a 64 to 1920 kbit/s Channel in Audiovisual Teleservices.

s. ITU-T Recommendation H.225.0 (1998), Call Signaling Protocols and Media Stream Packetization for Packet-based Multimedia Communications Systems.

t. ITU-T Recommendation H.230 (1999), Frame-synchronous Control and Indication Signals for Audiovisual Systems.

u. ITU-T Recommendation H.231 (1997), Multipoint Control Units for Audiovisual Systems using Digital Channels up to 1920 kbit/s.

v. ITU-T Recommendation H.233 (1995), Confidentiality Systems for Audiovisual Services.

w. ITU-T Recommendation H.234 (1994), Encryption Key Management and Authentication System for Audiovisual Services.

x. ITU-T Recommendation H.235 (1998), Security and Encryption for H-series (H.323 and other H.245 based) Multimedia Terminals.

y. ITU-T Recommendation H.242 (1999), System for Establishing Communication between Audiovisual Terminals using Digital Channels up to 2 Mbit/s.

z. ITU-T Recommendation H.243 (2000), Procedures for

Establishing Communication between Three or More Audiovisual Terminals using Digital Channels up to 2 Mbit/s.

aa. ITU-T Recommendation H.244 (1995), Synchronized Aggregation of Multiple 64 or 56 kbit/s Channels.

bb. ITU-T Recommendation H.245 (1998), Control Protocol for Multimedia Communication.

cc. ITU-T Recommendation H.261 (1993), Video Codec for Audiovisual Services at p x 64 kbit/s.

dd. ITU-T Recommendation H.263 (1998), Video Coding for Low Bit Rate Communication.

ee. ITU-T Recommendation H.320 (1997), Narrow-band Visual Telephone Systems and Terminal Equipment.

ff. ITU-T Recommendation H.323 (1998), Packet-based Multimedia Communications Systems.

gg. ITU-T Recommendation T.120 (1996), Data Protocols for Multimedia Conferencing.

hh. ITU-T Recommendation T.122 (1998), Multipoint Communication Service-Service Definition.

ii. ITU-T Recommendation T.123 (1999), Network Specific Data Protocol Stacks for Multimedia Conferencing.

jj. ITU-T Recommendation T.124 (1998), Generic Conference Control.

kk. ITU-T Recommendation T.125 (1998), Multipoint Communication Service Protocol Specification.

ll. ITU-T Recommendation T.126 (1997), Multipoint Still Image and Annotation Protocol.

mm. ITU-T Recommendation T.127 (1995), Multipoint Binary File Transfer Protocol.

nn. ITU-T Recommendation P.30 (1988), Transmission Performance of Group Audio Terminals.

oo. ITU-T Recommendation P.340 (2000), Transmission Characteristics of Hands-Free Telephones.

pp. ITU-T Recommendation P.64 (1999), Determination of

Sensitivity/Frequency Characteristics of Local Telephone Systems.

qq. ITU-T Recommendation P.79 (1999), Calculation of Loudness Ratings for Telephone Sets.

At the time of publication of this FTR, the editions indicated above were valid. All publications are subject to revision, and parties to agreements based on this FTR are encouraged to investigate the possibility of applying the most recent editions of these publications. You may obtain copies of the specifications and related documents from:

ANSI and ISO Documents - American National Standards Institute
25 West 43rd Street
New York, NY 10036
(212) 642-4900; FAX (212) 302-1286
www.ansi.org

ITU-T Recommendations - National Technical Information Service
US Department of Commerce
Springfield, VA 22161
(703) 605-6000
www.ntis.org

7. Objectives. This FTR is intended to facilitate interoperability among Federal video teleconferencing (VTC) and video phone systems over digital switched networks at rates between 56 kilo bits per second (kb/s) and 1,920 kb/s, and over packet-based networks at rates above 56 kb/s. Equipment designed for use over asynchronous transfer mode networks, and public switched telephone networks are outside of the scope of this recommendation.

8. Applicability. This FTR may be used by all Federal departments and agencies in the design and procurement of video teleconferencing and videophone systems. Appendix A, which contains a VTC profile, is normative (mandatory) for the Department of Defense and is informative (optional) for all other Federal departments and agencies. This FTR is used only for those audiovisual systems operating over digital switched networks, such as Integrated Services Digital Networks (ISDN), and audiovisual systems operating over packet-based networks, such as TCP/IP. ISDN (discussed in the recommendation) is

actually a part of the public switched telephone network. The FTR could be used in the planning, design, and procurement, including lease and purchase, of all new video communications systems that utilize video coders/decoders (codecs).

The portion of the FTR, which addresses digital switched systems, was designed primarily for use with ISDN. Many ITU-T Recommendations specify service from 64 kb/s through 1,920 kb/s, and some ANSI standards specify service from 56 kb/s through 1,536 kb/s. To avoid confusion on applications within the

Federal Government involving both national and international interoperability, this standard encompasses both ranges of data rates to specify service from 56 kb/s through 1,920 kb/s. It should be noted that most standard data networks in the United States carry data from 56 kb/s to 1,536 kb/s.

In an ISDN, the overall transmission channel may consist of one to six B (64 kb/s) channels, one to four H_0 (384 Kkb/s) channels, an H_{10} (1,472 kb/s) channel, or an H_{11} (1,536 kb/s) channel. The framed video signal can also be carried on other switched or dedicated digital transmission facilities, such as one to six multiplexed 56 kb/s connections, a DS1 connection, or a fractional DS1 connection.

The portion of the FTR which covers the technical requirements for packet-based networks does not provide a guaranteed Quality of Service (QOS). These packet-based networks include Local Area Networks, Enterprise Area Networks, Metropolitan Area Networks, Intra-Networks, and Inter-Networks (including the Internet). They also include dial up connections or point-to-point connections over the GSTN or ISDN, which use an underlying packet-based transport such as point-to-point protocol (PPP). These networks may consist of a single network segment, or they may have complex topologies, which incorporate many network segments interconnected by other communications links.

The technical parameters of this document may be exceeded in order to satisfy certain specific requirements, provided that interoperability is maintained. That is, the capability to incorporate features such as additional standard and nonstandard interfaces is not precluded.

Neither this recommendation nor any standard in high technology fields such as telecommunications can be considered complete and ageless. Periodic revisions will be made as required.

The FTR is not intended to hasten the obsolescence of equipment currently existing in the Federal inventory; nor is it intended to provide systems engineering or applications guidelines.

9. Specifications. The following sections specify the requirements for video teleconferencing and video telephony terminals.

9.1 Digital Switched VTC Systems Description. Specific

requirements for different types of video terminals using digital switched circuits are defined in ITU-T Recommendation H.320. All terminals that meet FTR 1080B-2001 shall follow the specifications of H.320. At a minimum, all terminals shall be capable of operating over one and two channels (p=1 and 2) at quarter common intermediate format (QCIF) resolution. If a terminal is able to operate at values for p greater than 2, then the terminal shall be able to operate at all p values in the set {1,2,6,12,23,24} less than the highest p value capable by the terminal.

Examples of a few terminal configurations are given below:

- Terminal operating over two B channels of an ISDN.
- Terminal operating over six B channels of an ISDN.
- Terminal operating over an H_0 channel of an ISDN.
- Terminal operating over one switched 56 kb/s channel.

9.1.1 Multiplexing/Framing. The different parts of a VTC call (video, audio, data) shall be multiplexed into single or multiple channels.

9.1.1.1 Frame Structure. All terminals that meet this section of the FTR shall use all the specifications defined in ITU-T Recommendation H.221. The H.221 framing structure multiplexes subchannels for audio, video, data, and telematic transmission, as well as in-channel terminal-to-terminal signaling information, within an overall transmission channel of 56 to 1,920 kb/s.

This section of the FTR addresses data channels at nominal bit rates of px64 kb/s, where p is an integer that can range from 1 to 30. For unrestricted networks, such as provided by ISDN, each increment of data rate may actually be 64 kb/s, but in restricted networks each increment may be only 56 kb/s.

Equipment that meets this section of the FTR shall be capable of operating on unrestricted and/or restricted networks. Equipment that meets this section of the FTR shall be capable of operating with other terminals on unrestricted and restricted networks. Equipment that meets this section of the FTR shall be capable of operating over a network connection where a middle segment or segments of the network are restricted. Restricted networks are discussed in annex B of H.221 and Section 3.6 of H.230. The problem concerns the differences between the signaling protocols for restricted verses unrestricted network operations, or operating with

terminals not having network timing. Annex A of T1.800.04 addresses procedures to alleviate these issues, which are recommended.

9.1.1.2 Channel Aggregation. It is possible for a VTC terminal or Multipoint Control Unit (MCU) to have a single channel interface to multiple channels using channel aggregation. An example is aggregating six B channels into a single 384 kb/s channel. The use of channel aggregation increases interoperability between equipment on different networks and allows a high-speed interface to low speed networks. Use of channel aggregation is optional for VTC, but when it is built into a VTC terminal or MCU, that equipment shall be capable of operating using the combination of Case B and Mode B1 as specified in H.244.

9.1.2 System for Establishing Communication Between Audiovisual Terminals. All terminals that meet this section of the FTR shall use all specifications of ITU-T Recommendation H.242 for establishing communications between two audiovisual terminals. H.242 describes the in-channel terminal-to-terminal communications control procedures. The procedures allow audiovisual terminals with different capabilities to interwork and switch among compatible modes to support additional applications, for example, exchanging data.

9.1.3 Video Codec. All terminals that meet this section of the FTR shall be capable of color and near-full motion operation using, at a minimum, the QCIF format defined in ITU-T Recommendation H.261. All terminals shall meet all specifications of H.261. An encoder shall be capable of coding at a minimum average of six frames per second. The decoder shall be capable of decoding at least 7.5 frames per second. This is the minimum picture interval and is discussed in H.261, H.221, and H.242. Higher rates can be negotiated using the procedures in H.242.

A terminal is not precluded from using coding algorithms other than H.261, but for every video coding rate the terminal is capable of, the terminal shall be capable of using the H.261 coding algorithm. The purpose of this requirement is to prevent two terminals which are capable of communicating at a high transmission rate, such as p = 24, from having to communicate at a lower rate to be interoperable.

A terminal is not precluded from having proprietary picture formats other than QCIF or FCIF, but if a terminal has a picture format with more pixels than QCIF (176x144 = 25344

pixels), it shall also have the FCIF picture format implemented using H.261. The purpose of this requirement is to prevent two terminals, which are capable of FCIF-like resolutions, from having to communicate at a QCIF resolution to be interoperable.

Motion compensation is optional in the encoder. Motion compensation is required in the decoder, where the reconstruction of the motion is relatively simple. The decoder shall accept one vector per macroblock.

NOTE: The video coding algorithm described in this section of the FTR is a variable-rate algorithm. Video transmission is not fixed at multiples of 56 or 64 kb/s, but instead occupies all bandwidth available for video within an overall audiovisual communications system. The term "px64 kb/s" defines the nominal transmission rates of the overall system. ITU-T Recommendation H.221 provides for operating at multiples of 56 and 64 kb/s.

9.1.4 Audio.

9.1.4.1 Audio Algorithms. All terminals that meet this section of the FTR shall follow mandatory requirements in H.320. Further, terminals shall be capable of coding and decoding audio using G.711 framed μ-law mode and G.728. If a terminal is capable of coding or decoding audio using G.722, it shall be capable of operating mode 2 and 3 of G.722.

9.1.4.2 Audio Arrangements. A terminal can have one or more of the following three functions:

a. Handset function,
b. Hands free function for up to three users,
c. Hands free function for more than three users.

The audio characteristics for each of these functions shall be as defined in H.320.

The principles used are identical with those for telephony terminals. That is, the sensitivity for handset function and hands-free function designed for personal use/a small group of users is specified in loudness ratings, and the sensitivity

for conference terminals is specified as output levels.

9.1.5 Frame-Synchronous Control and Indication Signals for Audiovisual Systems. All terminals that meet this section of the FTR shall use ITU-T Recommendation H.230. H.230 provides additional frame-synchronous control and indication signals such as freeze picture, video loopback, and simple multipoint controls. These control and indication signals are necessary to provide additional functionality and to provide extensibility to future standards.

9.1.6 Telematic Services. The ability to transmit freeze-frame images is optional within this FTR. If a terminal is capable of transmitting freeze-frame images, it shall be capable of transmitting the images according to the procedures described in Annex D of H.261.

Use of telematic services is optional within this FTR. If telematic services are used, beyond those defined as freeze-frame, the requirements of the T.120, T.122 and T.123 recommendations shall be implemented.

9.1.7 Multipoint Control Operation. Multipoint control operation is defined as the interconnection of 3 or more VTC terminals through an MCU. MCUs perform many tasks intended to allow many VTC terminals to see, hear, and exchange information with others in a conference.

9.1.7.1 Multipoint Control Operation in a Terminal. A VTC terminal can connect to a MCU using the same protocols as for connecting to another VTC terminal. Optionally, additional features can be added to a terminal to allow greater functionality when operating with a MCU. The specification for these features can be found in Recommendation H.230, H.231, and H.243.

9.1.7.2 Multipoint Control Operation in a MCU. All MCUs that meet this section of the FTR shall meet all previous mandatory sections of this FTR, with the exception of coding and decoding of video. However, if the MCU provides for video mixing, then the requirement of H.261 shall apply. All MCUs that meet this section of the FTR shall meet all mandatory specifications of ITU-T Recommendation H.231, H.243, H.320, H.221, H.230, and H.242. H.231 describes the functional representation of a MCU, and H.243 describes the in-channel terminal-to-MCU communications control procedures. These procedures allow MCUs to interwork with each other and with VTC terminals. These procedures also allow terminals and MCUs to switch among compatible modes of operation to support additional applications, for example, exchanging data.

MCUs shall be able to connect and work with VTC terminals that do not have specific MCU capability as stated in Section 9.9.1.

MCUs shall be capable of coding and decoding audio using G.711 framed μ-law and A-law.

9.2 Packet-Based Network VTC Systems Description. Specific requirements for different types of packet-based network video terminals are defined in ITU-T Recommendation H.323. These requirements shall apply to all video teleconferencing systems operating over packet-based networks. These may not provide a

guaranteed Quality of Service. H.323 entities may be used in point-to-point, multipoint, or broadcast configurations. H.323 interoperability with H.320 terminals on ISDN is through Gateways, as described in Section 9.2.1.2 below. H.323 has gone through several versions through its development. H.323 version 2 is the mandatory version for this FTR.

9.2.1 H.323 Components. H.323 defines the following components: Terminals, Gatekeepers, Gateways and MCUs.

9.2.1.1 Terminal Characteristics. In terms of the client/server model for networking, H.323 terminals are the client endpoints providing real-time, two-way audio, video and data communications to the user. All terminals shall support voice communications; video and data are optional. H.323 specifies the modes of operation required for different audio, video, and/or data terminals to work together.

All H.323 terminals shall also support H.245, which is used to negotiate channel usage and capabilities. Three other standard components, defined in H.225.0, are mandated: Call signaling for call establishment, Registration/Admission/Status (RAS) Signaling for communications with the Gatekeeper; and RTP/RTCP for packetization and synchronization of audio and video streams.

Optional components in an H.323 terminal are video codecs, ITU-T Recommendation T.120 data conferencing protocols, and MCU capabilities.

9.2.1.2 Gateway Characteristics. The Gateway is an optional element in an H.323 conference. Gateways provide many services, the most common being a translation function between H.323 terminals and other terminal types. In general, the purpose of the Gateway is to reflect the characteristics of a packet-based network terminal to a switched circuit network terminal, such as an ISDN H.320 terminal, and vice versa.

This function includes translation between transmission formats and between the signaling and communications procedures for H.323 terminals (as defined in H.245) and H.320 terminals (as defined in H.242). In addition, the Gateway also translates between audio and video codecs and performs call setup and disconnect on both the packet-based network side and the ISDN side.

Gateways are not required if connections to other networks are not needed, since H.323 terminals may directly communicate with other H.323 terminals on a common packet-based network, such as a LAN.

Many Gateway functions are left to the designer. For example, the actual number of H.323 terminals that can communicate through the Gateway is not subject to standardization. Similarly, the number of switched circuit network connections, the number of simultaneous independent conferences supported, the audio/video/data conversion functions, and inclusion of multipoint functions are left to the manufacturer.

9.2.1.3 Gatekeeper Characteristics. H.323 Gatekeepers act as control points for all calls within its Zone and provide call control services to registered users. Gatekeepers act as virtual switches for H.323 conferences.

A Zone is the collection of all terminals, Gateways, and Multipoint Control Units (MCU) managed by a single Gatekeeper. A Zone includes at least one terminal, and may or may not include Gateways or MCUs. A Zone has one and only one Gatekeeper. A Zone may be independent of network topology and may be comprised of multiple network segments, which are connected using routers or other devices.

9.2.1.4 Multipoint Control Units (MCU) Characteristics. The Multipoint Control Unit (MCU) supports multipoint conferences. The required Multipoint Controller (MC) handles the common capability negotiations for audio and video processing, as well as controls audio and video multicasting. The MCU may include zero or more Multipoint Processors (MP), which provide the mixing, switching and processing of audio, video and/or data. These capabilities are all optional and the purchaser should specify whether audio, video and/or data capabilities are required. The MC and MP capabilities may exist in other H.323 components. The MCU uses H.245 messages and procedures to implement features similar to those found in H.243 for H.320 systems.

9.2.2 H.323 Requirements. The audio, video, data and control requirements are summarized below.

9.2.2.1 Audio Requirements. H.323 terminals that meet this section of the FTR shall support G.711 A-law and μ-law speech compression. The terminal may optionally support G.722, G.728, G.729, MPEG 1 audio, and G.723.1 encoders. If G.723.1 is supported, then both 5.3 kb/s and 6.3 kb/s modes shall be supported. Multiple receive channels may be supported, in this case an audio mixing function may be included.

9.2.2.2 Video Requirements. If the H.323 terminal supports video then it shall support H.261 QCIF to

meet this section of the FTR. It may optionally support other H.261 modes and H.263.

9.2.2.3 Control Functions. The H.245 Control Function uses the H.245 Control Channel to carry end-to-end control messages governing operation of the H.323 entity, 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, between a terminal and a Multipoint Controller, or between a terminal and a Gatekeeper. The terminal shall establish exactly one H.245 Control Channel for each call that it is participating in. This channel shall use the messages and procedures of Recommendation H.245. *Note that a terminal, MCU, Gateway, or Gatekeeper may support many calls, and thus many H.245 Control Channels.*

H.245 specifies a number of independent protocol entities, which support terminal-to-terminal signaling. A protocol entity is specified by its syntax (messages), semantics, and a set of procedures, which specify the exchange of messages and the interaction with the user. H.323 terminals that meet this section of the FTR shall support the syntax, semantics, and procedures of the following protocol entities:

- Master/slave determination
- Capability Exchange
- Logical Channel Signaling
- Bi-directional Logical Channel Signaling
- Close Logical Channel Signaling
- Mode Request
- Round Trip Delay Determination
- Maintenance Loop Signaling.

General commands and indications shall be chosen from the message set contained in Recommendation 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. H.245 messages fall into four categories: Request, Response, Command, and Indication. Request and Response messages are used by the protocol entities. 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 that meet this section of the FTR shall respond to all H.245 commands and requests as specified in Annex A of H.323, and shall transmit indications reflecting the state of the terminal.

9.2.2.4 Multipoint Capabilities. H.323 provides for centralized, decentralized and hybrid multipoint operation. All endpoints that meet this section of the FTR shall support centralized multipoint capability. Distributed audio and distributed video control messages are to be used to specify the optional decentralized and hybrid modes of operation.

9.2.2.5 Multicast. Multicast is the optional process defined in H.323 of transmitting Packet Data Units (PDUs) from one source to many destinations. The actual mechanism (i.e. IP multicast, multi-unicast, etc.) for this process may be different for different network technologies. Multicast, in contrast to unicast or broadcast, handles streaming audio and video over the network with RTP. In multicast transfers, data is transferred from a single source to multiple network destinations. Unicast, conversely, sends multiple point-to-point transmissions, and broadcast sends to all destinations. Multicast is significantly more efficient in use of bandwidth than unicast or broadcast, as packets are not replicated for transmission throughout the network.

9.2.2.6 Layered Video Codecs. Annex B of H.323 defines the use of the optional layered video coding procedures. Layered video coding is a technique that allows the video information to be transmitted in multiple data streams in order to achieve video scalability. This mode can be useful for heterogeneous networks with varying bandwidth capacity and also in conjunction with error correction schemes. H.263 Annex O describes the use of layered coding within H.263.

Conferences can take advantage of this feature to service connected users that have different capabilities (i.e., computing power or bandwidth limitations) using one bitstream that can be decoded in part. This will allow more efficient use of network bandwidth.

9.3 Data Conferencing Requirements. H.320 and H.323 terminals may optionally support one or more data channels. When the optional data conferencing capability (shared

whiteboards, application sharing and file transfer) is supported, then the terminals shall meet the requirements of ITU-T Recommendations T.120, T.122 and T.123.

9.4 Privacy and Secure Operation. The use of privacy and/or secure operation is optional. Privacy operation is defined as the protection of sensitive, but unclassified, information using Type 3 protection. Secure operation is defined as the protection of classified information using Type 1 or 2 protections.

If privacy or secure operation is required, it is recommended that National Security Agency (NSA) approved equipment be used and NSA approved procedures be followed. For security and privacy issues see appendix A.

H.320 or H.323 VTC terminals that have privacy or secure capability should provide a real-time indication of the current level of protection. This indication can be a video overlay on the output image, or some other indication.

10. Where to Obtain Copies. Additional copies of this document can be obtained from the National Communications System, Technology and Programs Division (N2), 701 South Court House Road, Arlington, Virginia 22204-2198. When requesting copies, refer to Federal Telecommunications Recommendation 1080B-2002, Video Teleconferencing Services.

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Appendix A of FTR 1080B-2002

Video Teleconferencing Profile

FOREWORD

The Video Teleconferencing Profile (hereafter referred to as the Profile) was created through the cooperative efforts of members of industry and government. The Profile is mandatory for the Department of Defense (DOD) and optional for all other government agencies. In addition to the main body of FTR 1080B-2002, this Profile is the official VTC standards profile to be used by DOD per ASD (C3I) direction; see Section 11.1. Before using this document, DOD users should check with DISA Center for Information Technology Standards, Interoperability Directorate (IN42), or at www.ncs.gov, to see if a more recent version has been approved.

The purpose of a video teleconferencing profile is to provide a standards-based reference document for users as an aid in the acquisition of video teleconferencing equipment, and for manufacturers as a guide to understand what features and functionality users may request.

The Profile provides DOD and other federal agencies with interoperability and performance requirements and options. The technical parameters of this Profile may be exceeded to satisfy certain specific requirements, provided that the minimum mandatory requirements are met and that interoperability is maintained.

This Profile is based on the international Recommendations from the International Telecommunications Union - Telecommunication Standardization Sector (ITU-T) for video teleconferencing, specifically the H.320, H.323 and T.120 series of Recommendations. It also includes the multipoint features and functionality of H.231.

Wherever possible, this Profile implements the ITU standards as ratified. There are a few exceptions to meet specific Government requirements, such as security that is not currently included or not clear in the ITU standards.

The Profile also defines Protocol Implementation Conformance Statements (PICS) that may be found in Section 9. The users may require that PICS be completed prior to conformance or interoperability testing of equipment. On the basis of the completed PICS, the products may be tested to determine whether the features claimed in the PICS are implemented in the products tested. Users should feel free to request completed PICS as part of their acquisition process to determine if the features and functionality they require have been implemented.

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VIDEO TELECONFERENCING PROFILE

1 SCOPE

The Video Teleconferencing Profile is applicable to end systems concerned with operating in the video teleconferencing environment. It specifies a combination of standards, which cover national and international agreements for providing interoperable video teleconferencing services. It also specifies and recommends particular options within the individual standards.

The Profile is based primarily upon the ITU-T (International Telecommunications Union – Telecommunication Standardization Sector) H.320, H.323, H.231, and T.120 Recommendations for switched and dedicated digital circuits. Standards for operation over the following types of networks are also mentioned in Section 10.4, but only as objective standards:

- Asynchronous Transfer Mode (ATM)
- Public Switched Telephone Network (PSTN), also known as Plain Old Telephone Service (POTS).

Further details on these objective standards will be provided in future versions of this profile.

For the purposes of this Profile, an H.320 or H.323 Video Teleconferencing Unit (VTU) performs the following functions: coding/decoding of audio and video; multiplexing of video, audio, data, and control signals; system control; and end-to-end signaling. It does not include, but must process the necessary multimedia application protocol events for Input/Output (I/O) devices, network interface equipment, end-to-network signaling, the network connections, or the network itself.

The scope of the Profile does include optional encryption devices for classified operations, which are placed between the multiplexer/demultiplexer and the network interface.

An H.320 VTU communicates using digital networks at transmission rates above 56 kb/s; see Section 5 for details.

H.323 version 2 defines the requirements for VTU terminals and support entities required to operate on packet-based networks, such as TCP/IP over Ethernet, Fast Ethernet and Token Ring. The support entities include Gatekeepers for call control, Gateways for inter-network communications, and Multipoint Control Units (MCUs) for multi-point communication; see Section 6 for details.

The functions of the VTU do not need to be in a single physical box. They may be in one or more separate physical components. NOTE: The scope of this Profile is broader than the scope of the VTU because the Profile includes items that are not a part of the VTU. The solid lines of Figures 1.1-1 and 1.1-2 depict the scope of the VTC Profile.

It is the intention of this Profile to provide enough specificity, which, if followed, should ensure baseline interoperability between VTUs. As ANSI and ITU-T Recommendations mature this document will be amended to include those changes. Proprietary or non-standard features or algorithms are not precluded by this Profile; however, such features or algorithms are not supported by this Profile. If both standard and non-standard modes are required, the feature must be easily switched back to the standards mode.

Certain functions and features of the ITU-T H.320, H.323 and T.120 suite of Recommendations are described in Section 5, 6 and 8 respectively to give users a high level overview of the Recommendations included in this Profile. These sections are not intended to be all encompassing. The Protocol Information Conformance Statements (PICS) given in Section 9 are the definitive list of functions and features provided by the ITU-T H.320, H.323 and T.120 suite of protocols. The users may require that PICS be completed as part of an acquisition or prior to conformance or interoperability testing of equipment. Users planning the acquisition of video teleconferencing systems are directed to such completed PICS to determine which features and functions are supported by commercial video teleconferencing systems.

As used in this document, "shall" or "will" denotes a mandatory provision of the standard. "Should" or "recommended" denotes a provision that is suggested under certain specified conditions, but not mandatory. "May" denotes a feature whose absence does not preclude compliance, that may or may not be present as an option of the implementor. "Optional" applies to a feature that is not mandatory, but if implemented must be done in accordance with the standards specified in that option. See the definitions for "mandatory feature" and "optional feature" in Section 3 for further details.

1.1 Block Diagrams

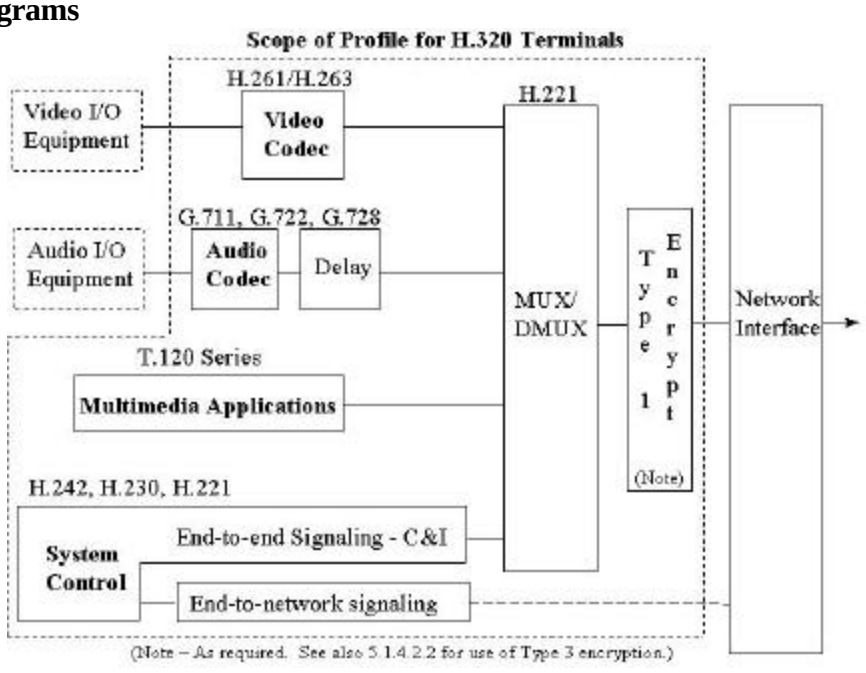

Figure 1.1-1. H.320 Video Teleconferencing Terminal Block Diagram

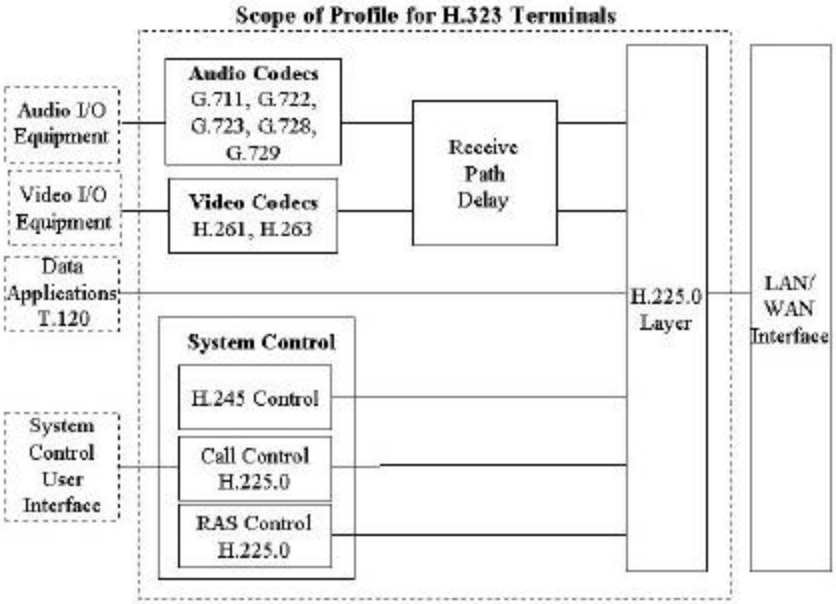

Figure 1.1-2. H.323 Video Teleconferencing Terminal Block Diagram

1.2 Application

The Profile is mandatory for DOD and optional for all other government agencies. The Profile applies to all acquisitions initiated for DOD VTC and videophone equipment. Examples include, but are not limited to, roll-about units as well as portable, modular, and desktop systems, studios, and cards integrated into personal computers. The Profile does not preclude the proprietary features as long as the corresponding standard features are also included. See the definitions of *mandatory* and *optional* features for further explanation. The Profile is also recommended for federal agencies with classified security requirements, their contractors and anyone else who needs to communicate with DOD by way of VTC. The Profile can be used in the design and installation of new VTC equipment and subsystems and in authorized upgrading of existing VTC subsystems and equipment.

1.3 Comments

Beneficial comments (recommendations, additions, and deletions) and any pertinent data that may be of use in improving this VTC Profile should be addressed to the Defense Information Systems Agency (DISA), JEBBC (ATTN: FTR 1080 POC), Fort Monmouth, NJ 07703-5613.

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2 REFERENCES

The following documents contain provisions, which, through reference in this text, constitute provisions of this part of this Profile. At the time of publication, the editions indicated were valid. All documents are subject to revision. Parties to agreements based on this Profile are warned against automatically applying any more recent editions of the documents listed below, since the nature of references made by the Profile to such documents may be specific to a particular edition. Members of the cited standards organizations maintain registers of currently valid national and international standards and the ITU maintains published editions of its current Recommendations.

2.1 Government Documents

2.1.1 Specifications, Standards, and Handbooks

Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplements thereto, cited in the solicitation.

2.1.1.1 Federal Standards

FED-STD-1037C *Glossary of Telecommunication Terms, August 7, 1996.*

Federal Standard 1037C is available from:

National Telecommunications and Information Administration (NTIA)
325 Broadway
Boulder, CO 80303-3328 Telephone: 1-303-497-5216
Internet: http://www.its.bldrdoc.gov/projects/telecomglossary2000

2.1.1.2 Military Standards

MIL-STD-188-198A *Joint Photographic Experts Group (JPEG) Image Compression for the National Imagery Transmission Format Standard, December 15, 1993.*

Military Standards are available from:

DOD Single Stock Point (DODSSP)
Standardization Document Order
700 Robbins Avenue, Bldg. 4D
Philadelphia, PA 19111-5094 Telephone: 1-215-697-2667/2179
Internet: http://www.dodssp.daps.mil or http://www-library.itsi.disa.mil

2.1.1.3 Federal Information Processing Standards

FIPS PUB 140-2 — *Security Requirement for Cryptographic Modules, May 25, 2001.*

FIPS PUB 197 — *Specification for the Advanced Encryption Standard (AES), November 26, 2001.*

FIPS Publications are available from:
National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161-2171 Telephone: 1-800-553-6847
Internet: http://www.ntis.gov/search-by-topic.htm

2.1.1.4 Federal Telecommunications Recommendations

FTR 1080B-2002 — *Video Teleconferencing Services, August 15, 2002.*

Federal Telecommunications Recommendations are available from:
National Communications System
701 South Court House Road
Arlington, VA 22204-2198 Telephone: 1-703-607-6200
Internet: http://www.ncs.gov

2.1.2 Other Government Documents, Drawings, and Publications

The following Government documents, drawings, and publications also form a part of this Profile to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

2.1.2.1 DOD Instruction

4640.14 — Base and Long-Haul Telecommunications Equipment and Services, *December 6, 1991.*

2.1.2.2 Other Government Documents

DODISS — *Department of Defense Index of Specifications and Standards.*

DISA/JIEO Circular 9008 — *NITFS Certification Test and Evaluation Program Plan.*

NSTISS 4009 — *National INFOSEC Glossary, National Security Telecommunications and Information Systems Security.*

NSTISSAM TEMPEST/2-95	*Red/Black Installation Guidance, National Security Agency, December 12, 1995.*
OSD Memorandum	*Implementation of the Joint Technical Architecture, August 22, 1996.*
OSD Memorandum	*Video Teleconferencing (VTC) Standards Guidance, March 30, 1998.*
Warner Amendment	*Public Law 97-86, December 1, 1981.*
FAR 39.106	*Year 2000 Compliance, FAC 90-46, April 23, 1997.*

2.2 Non-Government Publication

The following documents form a part of this Profile to the extent specified herein. Unless otherwise specified, the issues of the documents that are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation. If not in the DODISS and not in the solicitation, then use the latest approved version of the standard.

2.2.1 Telecommunication Industries Association (TIA)/Electronic Industries Association (EIA) Publications

EIA-170-A	*Electrical Performance Standards Monochrome Television Studio Facility, with Revision IET NTS 1 Color Television Studio Picture Line Amplifier Output Drawing, November 1977.*
TIA/EIA-232-F	*Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange, October 1997.*
EIA-366-A	*Interface Between Data Terminal Equipment and Automatic Calling Equipment for Data Communication, March 1979.*
TIA/EIA-422-B	*Electrical Characteristics of Balanced Voltage Digital Interface Circuits, May 1, 1994, Rev. 2000.*
TIA/EIA-423-B	*Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits, February 1996.*

EIA-449-1	*37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment, 1980.*
TIA/EIA-530-A	*High-Speed 25-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment, December 1998.*

Copies of EIA and TIA standards can be purchased from:

Telecommunications Industry Association
1300 Pennsylvania Avenue, Suite 350
Washington, D.C. 20004 Telephone: 1-202-383-1480
Internet: http://www.tiaonline.org

2.2.2 ANSI Publications

ANSI T1-523-2001	*Telecom Glossary 2000, February 2001.*
ANSI T1.601	*ISDN Basic Access Interface for Use on Metallic Loops for Application on the Network Side of the NT, Layer 1 Specification, 1999.*
ANSI T1.603	*Minimal Set of Bearer Services for the ISDN Primary Rate Interface, 1990. Rev. 2000.*
ANSI T1.605	*ISDN Basic Access Interface for S and T Reference Points and Layer 1 Specification, 1991, Rev. 1999.*
ANSI T1.801.01	*Digital Transport of Video Teleconferencing /Video Telephony Signals - Video Test Scenes for Subjective and Objective Performance Assessment, 1995, Rev. 2001.*
ANSI T1.801.02	*Digital Transport of Video Teleconferencing/ Video Telephony Signals - Performance Terms, Definitions and Examples, 1996, Rev. 2001.*
ANSI T1.801.03	*Digital Transport of One-Way Video Signals - Parameters for Objective Performance Assessment, 1996.*
ANSI T1.801.04	*Multimedia Communications Delay, Synchronization, and Frame Measurement, 1997.*

Copies of the Telecomm Glossary 2000 are available from:

National Telecommunications and Information Administration (NTIA)

325 Broadway
Boulder, CO 80303-3328 Telephone: 1-303-497-5216
Internet: http://www.its.bldrdoc.gov/projects/telecomglossary2000

Copies of ANSI and ISO documents are available from:
American National Standards Institute
25 West 43rd Street
New York, NY 10036 Telephone: 1-212-642-4900
Internet: http://www.ansi.org Facsimile: 1-212-302-1286

2.2.3 ITU-T Publications

ITU-T G.711	*Pulse Code Modulation (PCM) of Voice Frequencies, November 1988.*
ITU-T G.722	*7 KHz Audio-coding within 64 kbit/s, November 1988.*
ITU-T G.722.1	*7 KHz Audio - Coding at 24 and 32 kbit/s for Hands-Free Operation in Systems with Low Frame Loss, September 1999.*
ITU-T G.723.1	*Speech Coders: Dual Rate Speech Coder for Multimedia Communications Transmitting at 5.3 and 6.3 kbit/s, March 1996.*
ITU-T G.728	*Coding of Speech at 16 kbit/s using Low-Delay Code Excited Linear Prediction (LD-CELP), September 1992.*
ITU-T G.729	*Coding of Speech at 8 kbit/s using Conjugate Structure Algebraic-Code-Excited Linear-Prediction, March 1996.*
ITU-T H.200	*Framework for Recommendations for Audiovisual services, March 1993.*
ITU-T H.221	*Frame Structure for a 64 to 1,920 kbit/s Channel in Audiovisual Telervices, May 1999.*
ITU-T H.222.0	*Information Technology-Generic Coding of Moving Pictures and Associated Audio Information: Systems, February 2000.*
ITU-T H.224	*Real Time Control Protocol for Simplex Applications using the H.221 LSD/HSD/MLP Channels, February 2000.*

ITU-T H.225.0	*Call Signaling Protocols and Media Stream Packetization for Packet-Based Multimedia Communications Systems, February 1998.*
ITU-T H.230	*Frame-Synchronous Control and Indication Signals for Audiovisual Systems, May 1999.*
ITU-T H.231	*Multipoint Control Units for Audiovisual Systems Using Digital Channels up to 2 Mbit/s, July 1997.*
ITU-T H.242	*System for Establishing Communication Between Audiovisual Terminals Using Digital Channels up to 2 Mbit/s, May 1999.*
ITU-T H.243	*Procedures for Establishing Communications Between Three or More Audiovisual Terminals Using Digital Channels up to 1920 kbit/s, February 2000.*
ITU-T H.244	*Synchronized Aggregation of Multiple 64 or 56 kbit/s Channels, July 1995.*
ITU-T H.245	*Control Protocol for Multimedia Communication, July 1997.*
ITU-T H.261	*Video CODEC for Audiovisual Services at px64 kbit/s, March 1993.*
ITU-T H.263	*Video Coding for Low Bit Rate Communications, February 1998.*
ITU-T H.281	*Far End Camera Control Protocol for Video Conferences Using H.224, November 1994.*
ITU-T H.282	*Remote Device Control for Multimedia Applications, May 1999.*
ITU-T H.283	*Remote Device Control Logical Channel Transport, May 1999.*
ITU-T H.310	*Broadband Audiovisual Communication System and Terminals, September 1998.*
ITU-T H.320	*Narrowband Visual Telephone Systems and Terminal Equipment, May 1999.*
ITU-T H.321	*Adaptation of H.320 Visual Telephone Terminals to B-ISDN Environments, February 1998*.

ITU-T H.322	*Visual Telephone Systems and Terminal Equipment for Local Area* Networks Which Provide a Guaranteed Quality of Service, *March 1996.*
ITU-T H.323	*Packet-based Multimedia Communications Systems, February 1998.*
ITU-T H.324	*Terminal for Low Bitrate Multimedia Communication, February 1998.*
ITU-T H.450.1	*Generic Functional Protocol for the Support of Supplementary Services in H.323, February 1998.*
ITU-T H.450.2	*Call Transfer Supplementary Service for H.323, February 1998.*
ITU-T H.450.3	*Call Diversion Supplementary Service for H.323, February 1998.*
ITU-T H.450.4	*Call Hold Supplementary Service for H.323, May 1999.*
ITU-T H.450.5	*Call Park and Call Pickup Supplementary Services for H.323, May 1999.*
ITU-T H.450.6	*Call Waiting Supplementary Service for H.323, May 1999.*
ITU-T H.450.7	*Message Waiting Indication Supplementary Service for H.323, May 1999.*
ITU-T H.450.8	*Name Identification Supplementary Service for H.323, February 2000.*
ITU-T H.450.9	*Call Completion Supplementary Services for H.323, November 2000.*
ITU-T H.450.10	*Call Offer Supplementary Service for H.323, March 2001.*
ITU-T H.450.11	*Call intrusion supplementary service for H.323, March 2001.*
ITU-T H.450.12	*Common Information Additional Network Feature for H.323, July 2001.*

ITU-T P.30	*Transmission Performance of Group Audio Terminals, November 1988.*
ITU-T P.50	*Artificial Voices, September 1999.*
ITU-T P.51	*Artificial Mouth, August 1996.*
ITU-T P.64	*Determination of Sensitivity/Frequency Characteristics of Local Telephone Systems, September 1999.*
ITU-T P.79	*Calculation of Loudness Ratings for Telephone Sets, September 1999.*
ITU-T Q.922	*ISDN data link layer specification for frame mode bearer services, February 1992.*
ITU-T Q.931	*ISDN User-Network Interface Layer 3 Specification for Basic Call Control, May 1998.*
ITU-T T.4	*Standardization of Group 3 Facsimile Apparatus for Document Transmission, April 1999.*
ITU-T T.6	*Facsimile Coding Schemes and Coding Control Functions for Group 4 Facsimile Apparatus, November 1988.*
ITU-T T.38	*Procedures for Real Time Group 3 Facsimile Communication Between Terminals using IP Networks, June 1998.*
ITU-T T.81 (JPEG)	*Information Technology - Digital Compression and Coding of Continuous Time Still Images - Requirements and guidelines, September 1992.*
ITU-T T.82 (JBIG)	*Information Theory - Coded Representation of Picture and Audio Information - Progressive Bi-level Image Compression, March 1993.*
ITU-T T.90	*Characteristics and Protocols for Terminals for Telematic Services in ISDN, February 1992.*
ITU-T T.120	*Data Protocols for Multimedia Conferencing, July 1996.*
ITU-T T.120, Annex C	*Lightweight Protocols for the T.120 Architecture, February 1998.*

ITU-T T.122	*Multipoint Communication Service for Audiographics and Audiovisual Conferencing Service Definition, February 1998.*
ITU-T T.123	*Network-specific Data Protocol Stacks for Multimedia Conferencing, May 1999.*
ITU-T T.124	*Generic Conference Control for Audiographic and Audiovisual Terminals and Multipoint Control Units, February 1998.*
ITU-T T.125	*Multipoint Communications Service Protocol Specification, February 1998.*
ITU-T T.126	*Multipoint Still Image and Annotation Conferencing Protocol Specification, July 1997.*
ITU-T T.127	*Multipoint Binary File Transfer Protocol, August 1995.*
ITU-T T.128	*Multipoint Application Sharing, February 1998.*
ITU-T T.137	*Virtual Meeting Room Management: Services and Protocol, February 2000.*
ITU-T V.42bis	*Data Compression Procedures for DCEs Using Error Correction Procedures, January 1990.*
ITU-T V.120	*Support by an ISDN of Data Terminal Equipment with V-series Type Interfaces with Provision for Statistical Multiplexing, October 1996.*

Copies of ITU-T and CCITT documents are available from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161 Telephone: 1-703-605-6000
Internet: http://www.ntis.gov

International Telecommunications Union
Place des Nations
CH-1211 Geneva 20
Switzerland Telephone: 41-22-730-5111
Internet: http://www.itu.int

2.2.4 Other Publications

Mykotronx	*Embeddable KG-84 COMSEC Module (KIV-7) User's Manual, Mykotronx, Inc., 1998.*
NSA	*Guidelines for the Use and Operation of the KG-94/94A/194/194A KAO-218B/TSEC, June 1992.*
NIUF 426-93	*NIUF Video Conferencing Application Profile (89-007.4, 940007.0), October 1993.*
NIUF 415-93	*A Catalog of National ISDN Solutions for Selected NIUF Applications, Second Edition, Revision 1 – Update of Section 4, March 1995.*
	Newton's Telecom Dictionary, by Harry Newton, March 2002.

Non-Government standards and other publications are normally available from the organizations that prepare or distribute them. These documents also may be available in or through libraries or other informational services. Copies of NIUF documents are available from the Internet at http://www.niuf.nist.gov. Copies of Newton's Telecom Dictionary are available from the Internet at http://www.cmpbooks.com.

2.3 Order of Precedence

For the references cited in each of these documents, the following order of precedence shall apply for DOD:

(1) Main body of Appendix A,
(2) Main body of FTR 1080B-2002,
(3) References cited in these documents.

Nothing in this Annex, however, supersedes applicable laws and regulations, unless a specific exemption has been obtained.

3 DEFINITIONS

Definitions of terms used in this Appendix shall be as specified in FED-STD-1037C. Those definitions unique to this Appendix and not defined in FED-STD-1037C are provided in this section. Also see the Telecom Glossary 2000 (ANSI T1-523-2000) and Newton's Telecom Dictionary for additional terms used in this document.

AAL5: ATM Adaptation Layer Type 5: AAL functions support of variable bit rate, delay-tolerant connection-oriented data traffic requiring minimal sequencing or error detection support.

A-Law: A companding (compressing and expanding) method for encoding and decoding audio waveforms into/from digital data in a pulse-code-modulated (PCM) system. A-Law is the primary companding method for E1 transmissions. *(See also m-Law, in the "M" section.)*

Annotation: Text, graphics, or free hand markings used to highlight or provide explanation to areas of interest on an image or whiteboard.

Audio: The voice or sound portion of a teleconference.

Audio Mixing: The process of combining two or more audio signals to produce a single composite audio signal. This allows each participant in a conference to hear all other participants simultaneously.

Audio Switching: The process of switching the audio portion of the VTC system to be heard by all participants so that the input signal comes from the designated speaker. No other participants can be heard until they are selected as the audio source.

Basic-Rate Interface (BRI): The basic ISDN service, consisting of two 64 kb/s B-channels (bearer channels), which carry data and voice in both directions, and one 16 kb/s D-channel (data channel), which carries call-control information.

Bitmap: A two dimensional array of pixels representing an image.

Bit-Rate Allocation Signal (BAS): An eight-bit word within the frame structure of ITU-T Recommendation H.221 that is used to transmit commands, control and indication signals, and capabilities.

Broadband ISDN (B-ISDN): An Integrated Services Digital Network (ISDN) offering broadband capabilities. B-ISDN is a proposed service that may (a) include interfaces operating at data rates from 150 to 600 Mb/s, (b) use asynchronous transfer mode (ATM) to carry all services over a single, integrated, high-speed packet-switched network, (c) have LAN interconnection capability, (d) provide access to a remote, shared disk server, (e) provide voice/ video/data teleconferencing, (f) provide transport for programming services, such as cable-TV, (g) provide single-user controlled access to remote video sources, (h) handle voice/video telephone calls, and (i) access shop-at-home and other information services.

Broadcasting: The transmission of a data or information that may be simultaneously received by stations that usually make no acknowledgement. *(See also multicasting and unicasting.)*

Call Association: The process of associating multiple channel calls to an individual VTU by an MCU. In a dial-in MCU configuration in which each call is placed over multiple channels (i.e., 2B channels) and there is a single network access (phone) number for all ports in a conference, this provides the means of associating each channel to the VTU making the call.

Camera: In television, an electronic device using an optical system and a light-sensitive pickup tube or chip to convert visual signals into electrical impulses.

Capabilities Exchange: The process by which the capabilities of each VTU to receive and decode multimedia signals is known to the other VTUs and MCUs in the conference.

Cascading: The process of providing a conference involving more than one MCU, so that information must pass not only between VTU and MCU, but also from one MCU to another.

Chair Control: A method of providing the capability for one of the VTUs involved in a conference to exercise some measure of authority over the conference, particularly in making the decision of which video will be broadcast to the other VTUs.

Chair-Control Port: That port of the MCU serving the VTU to which chair-control has been assigned.

Chair-Control VTU: An enhanced VTU possessing the capability to exert a certain measure of authority over the operation of the multipoint conference. The chair-control assignment may be prearranged, assigned by an operator, or by protocol during the call. The person controlling need not be the actual chairperson of the meeting.

Chrominance: The color component of a pixel. The Cb and Cr components in YCbCr. The A and B components in CIElab. *(See also luminance and FED-STD-1037C.)*

Classified: Any information that has been determined to require protection against unauthorized disclosure to avoid harm to U.S. national security. The classifications TOP SECRET, SECRET, and CONFIDENTIAL are used to designate such information, referred to as "classified information".

Client: Management Entity (CME): A data link client that uses Client ID 0x00 to send a complete list of locally registered clients and their optional extra capabilities.

CODEC: Acronym for Coder/Decoder. In video teleconferencing, an electronic device that converts analog signals, typically video, and/or voice into digital form and compresses them into a fraction of their original size to save frequency bandwidth on a transmission path. It also performs the inverse operation; decompressing received signals and converting them back to analog.

Collaborative Desktop Data Conferencing: The ability to instantly share files and data stored in a PC with all or any of the participants in a teleconference.

Common Intermediate Format: See *Full Common Intermediate Format* component in CIElab.

Compression: See *data compression*, FED-STD-1037C, definition 1.

Conferencing: Programs and meetings for purposes such as: presenting and exchanging information, comparing views, learning, planning, and/or decision-making. Conferences can be held in one location or conducted simultaneously at multiple locations and linked together by telecommunications systems contains images, annotations, or pointers.

Continuous Presence: Enables each site to see multiple sites simultaneously. The participants' video window is divided into two, four, six or nine sections that display pre-selected sites.

Cryptographic Resynchronization: The process by which the VTU has the capability to automatically send a signal for resynchronization to the cryptographic device whenever resynchronization is needed.

Data Communications Port: A port used to transfer information between functional units by means of data transmission, according to a protocol.

Data Port: See *data communications port*.

Data Rate: In digital data communications, the rate at which data (bits in this case) is transmitted, usually expressed in bits per second.

DB-25: A standardized 25-pin connector used in TIA/EIA-232-F and TIA/EIA-530 data communications.

Desktop and Individual Workstation: An input/output display device with local computer capability that allows an individual to perform some computational work and/or database access from a local or remote location. This device may also have videophone and/or VTC capabilities.

Directly-Connected VTU: A VTU that is directly connected to the MCU in question, rather than through another MCU. It may or may not be collocated with the MCU.

Dithered image: An image with apparent levels of gray by grouping black and white dots into cells. According to the number of black and white dots and their arrangement in the cell, the eye perceives the cell as a single gray, not as a group of black and white dots.

Dumb-bell Configuration: A network configuration in which there are two MCUs that are connected to each other.

DVS-G: The Defense Information Network, Video Services, Global is a service provided by the Defense Information Systems Agency. It is meant to provide a bridging service for DoD VTC users. It uses industry standards for interoperability and Multipoint VTC requirements. The DVS-G has three operational areas, Continental U.S. (CONUS), Europe and Pacific.

EIA-449 (formerly RS-449): EIA-449 was a serial mechanical interface standard for transmission of balanced and unbalanced signals between a variety of computer, media, and multimedia peripherals. EIA-449 allows a maximum data rate of 10 Mb/s and uses a 37- or 9-pin connector. *(Note: EIA-449 has been replaced by TIA/EIA-530, however equipment is still in use which implements this interface.)*

Electronic Industries Association (EIA): An U.S. commercial standards organization. The abbreviation TIA/EIA (which replaces the obsolete designation "RS") precedes a technical recommendation's numerical designation. An example is TIA/EIA-232-F, indicating its acceptance by both those bodies, replacing RS-232. *(See also TIA.)*

Embedded Encryption: Encryption integrated into the VTU box.

Encoder: A device that converts plain text to equivalent cipher text by means of a code.

Encryption: The process of converting plain text into unintelligible form by means of a crypto system.

Ethernet: Popular network hardware standard, which uses data transfer rates of either 10 Mb/s or 100 Mb/s.

Fast Ethernet: A high-speed ethernet network, which uses data transfer rates of 100 Mb/s.

Frame: 1. When referring to an image, the set of all the picture elements in an image. 2. When referring to ITU-T H.221, a frame consists of 80 octets (bytes) of multiplexed signals. This is opposed to the term field referring to interlaced television pictures where 60 fields/seconds considered full motion compared to 30 frames/second for our case of computer displays.

Frame Alignment: In the Industry Profile, frame alignment refers to the ITU-T H.221 frame, not the image frame.

Frame Alignment Signal (FAS): In the transmission of data frames, a distinctive sequence of bits used to accomplish frame alignment. In ITU-T H.221, this signal also contains additional bits for status, control and error detection.

Freeze-Frame Image: A frame of visual information selected from a video signal and processed through the video CODEC, usually for transmission to remote sites.

Full Common Intermediate Format (FCIF): A video format defined in ITU-T H.261 that is characterized by 352 luminance pixels on each of 288 lines, with half as many chrominance pixels in each direction.

Gateway: An H.323 entity that provides real time communication between H.323 terminals and terminals on other networks, such as ISDN or PSTN.

Gatekeeper: An H.323 entity that provides management functions, such as address translation and control access for terminals and other endpoints.

Grayscale Image: A still image where each pixel represents one of 256 shades of gray.

Halftone image: An image in which combinations of dots are used to create an impression of grays or colors by grouping and density. For example, the eye will see shades of gray in black dots on a white background. Where the dots are large, dense and possibly overlapping, the eye sees dark gray or black; where the dots are small and sparse, the eye sees light gray or white.

Hardcopy Image: A still image typically sent to a printer or facsimile machine.

High-Resolution Graphics: Graphics captured and displayed at a higher resolution than the NTSC standard (EIA-170-A).

Inverse Multiplexer: A device used to create a single, higher-speed network data channel by combining, separating, and synchronizing multiple, independent 56- or 64-kb/s network data channels. Also known as an *aggregator*.

ISDN: *See FED-STD-1037C, Integrated Services Digital Network. Note: Access channels include a basic rate (two 64-kb/s "B" channels + one 16-kb/s "D" channel) and a primary rate (twenty-three 64-kb/s "B" channels and one 64-kb/s "D" channel). Also known as Narrowband-ISDN or N-ISDN.*

KG-194/194A: (National Security Agency (NSA) cryptographic device nomenclature) A federally-certified cryptographic device used to provide data encryption at data rates from 9.6 kb/s up to 13 Mb/s on dedicated circuit networks.

KIV-7/KIV-7HS: (National Security Agency (NSA) cryptographic device nomenclature) A federally-certified cryptographic device used to provide data encryption at data rates up to 2.048 Mb/s on dial-up and other non-dedicated networks.

Local MCU: When referring to a particular VTU, the local MCU is that MCU to which the particular VTU is directly connected. It may or may not be collocated with the VTU.

Luminance: The intensity component of a pixel. The Y component in YCbCr. The L component in CIElab. *(See also chrominance.)*

m**-Law:** The PCM coding and companding (compressing and expanding) standard used for non-linear compression in the analog-to-digital conversion process that is used primarily in Japan and North America. *(See also A-Law.)*

Mandatory Feature: If the profile makes a given feature mandatory then the feature shall be included in all DOD VTC acquisitions, unless a waiver is obtained.

Minimum Picture Interval: The minimum time between pictures selected for encoding. Allowable values, per ITU-T H.221, are 1/29.97, 2/29.97, 3/29.97, and 4/29.97 seconds per picture.

Motion Compensation: A type of interframe coding used by CODECs in the compression of motion video images. The process relies upon an algorithm that examines a sequence of image frames to measure the motion that occurs between frames.

Multicasting: The process of transmitting data/information from one source to many destinations in a single transfer. *(See also broadcast and unicasting.)*

Multipoint: A telecommunications system that permits three or more locations to intercommunicate in a conference call.

Multipoint Control Unit (MCU): A multi-port device, by means of which three or more VTUs may intercommunicate in a conference call. It can also be used with two VTUs, e.g., while beginning or ending a multipoint conference.

Multipoint Controller: The Multipoint Controller (MC) is an H.323 entity on the network, which provides for the control of three or more terminals participating in a multipoint conference. It may also connect two terminals in a point-to-point conference, which may later develop into a multipoint conference. The MC provides for capability negotiation with all terminals to achieve common levels of communications. It may also control conference resources such as who is multicasting video. The MC does not perform mixing or switching of audio, video and data.

Multipoint Processor: The Multipoint Processor (MP) is an H.323 entity on the network, which provides for the centralized processing of audio, video, and/or data streams in a 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.

Narrowband ISDN (N-ISDN): *See definition for ISDN.*

Network: *See FED-STD-1037C.* In this Profile, *network* refers to the system of cables, microwave links, and switching centers that allow the transmission of data, as opposed to the terminal equipment (such as CODECs and I/O devices) connected to the cables.

Network Interface Equipment: The equipment connected between the network and the VTU. Such examples of this equipment include (a) the channel service unit (CSU), (b) the data service unit (DSU), and the (c) terminal adapters.

Network Terminator Type 1 (NT-1): A device that converts a two wire U-interface to a four wire S/T interface, allowing multiple VTU connections.

NITFS: National Imagery Transmission Format Standard. A set of military standards described in MIL-HDBK-1300, for secondary imagery dissemination.

Non-Developmental Item (NDI): NDIs are items procured from immediately available stock, with no development costs.

Optional Feature: If a feature is optional in this Profile, the user must decide whether to acquire the feature or not. If acquired, this feature shall meet the specifications in the Profile. (Anyone wanting to

be exempt from this rule shall first obtain a waiver.) The purpose is to improve interoperability, without forcing users to buy unnecessary features.

For example, if a high-resolution, still imagery mode is an optional feature in this Profile, it would be the user's decision to purchase the Profile high-resolution, still-image-mode or not. If purchased, the version shall meet the Profile specifications for the high-resolution, still image mode. This will allow for interoperability of high-resolution, still images among those users purchasing this Profile feature. If the procuring agency desires, it can also buy a nonstandard version of the high-resolution, still image mode, as long as the equipment can be easily switched back to the standard high-resolution, still image mode. For "mandatory optional" see 10.1.3.

***p*:** An integer that can range from 1 to 30 and is limited to the values of 1, 2, 3, 4, 5, 6, 12, 18, 23, 24 and 30 for VTU operation over digital-switched networks. It relates to VTUs that operate at nominal bit rates of integer "*p*" multiples of 64000 bits per second (bit/s). For unrestricted channels, such as provided by ISDN, each increment of data rate may actually be 64000 bit/s, but in restricted channels, each increment may be only 56000 bit/s.

Palletized Image: A digitized representation of an image where each pixel of the image has been converted to a number which is an index into a color lookup table. Any color can be represented in the table, however, only a limited number of colors can be present in the image depending on the size of the index. For example, a 4-bit pixel can represent 16 different colors. The actual colors in the table can be customized for each picture.

Pixel: The smallest discrete picture element that can be transmitted using the video or still image coding algorithms. A pixel is similar to grains in a photograph or dots in a halftone. Each pixel can represent a number of different shades or colors, depending upon how many bits are allocated for it.

Plane: A portion of an image that consists of a two-dimensional virtual area defined to have the same pixel dimensions as the workspace with which it is associated. A plane provides a canvas for the use of annotation tools such as drawing, erasing, and text, as well as for bitmaps. *(See also workspace.)*

Pointer: A small image (for example, an arrow) representing a cursor position that is moveable over the workspace.

Port: A point of access where signals may be inserted or extracted into or out of a device, as a VTU or MCU.

Primary-Rate Interface (PRI): A high speed ISDN service, consisting of 23 B-channels (30 in Europe) and one D-channel.

Primary VTU: A VTU that fully participates in the conference.

Principal MCU: An MCU that has been assigned a superior controlling function in a call where two or more MCUs are interconnected. Called "master" MCU in ITU-T Recommendations.

Protocol Implementation Conformance Statements (PICS): A detailed table of all the features that are included in the standards covered by the VTC Profile. It clearly specifies whether each feature is mandatory or optional, which is not always clear in the international standards. It can be used as a screening device to determine if a manufacturer's video conferencing equipment meets all the mandatory features and those optional features that the user requires. (See Section 9.)

***p*x64:** In video teleconferencing, pertaining to a family of ITU-T Recommendations, where *p* is a non-zero positive integer indicating the number of 64 kb/s channels. These Recommendations form the basis for video telecommunications interoperability. *(Note: The p × 64 family includes ITU-T Recommendations H.261, H.221, H.242, H.230, and H.320.)*

Quality of Service: The collective effects of service performances, which determine the degree of satisfaction of a *user* of the *service*.

Quarter Common Intermediate Format (QCIF): A video format defined in ITU-T H.261 that is characterized by 176 luminance pixels on each of 144 lines, with half as many chrominance pixels in the horizontal and vertical directions. QCIF has 1/4 as many pixels as FCIF (q.v.).

Recommended Standard: A prefix to EIA standards, such as RS-232. This designation is now obsolete; it has been replaced by the prefix TIA/EIA, for example, TIA/EIA-232-F.

Resolution: A measurement of the number of pixels in the horizontal and vertical directions. For example, the resolution of FCIF is 356X288 meaning that it contains 352 pixels in each horizontal row and 288 rows of pixels in the vertical direction for a total of 101,376 pixels.

Restricted Channel: A digital communications channel for which each increment of *p* gives a useful capacity of only 56000 bits per second, instead of 64000 bits per second. This is currently common in North America, and was originally due to ones-density limitation in T1 circuits.

Satellite MCU: An MCU that has been assigned a controlling function that is subordinate to a Principal MCU in a call where two or more MCUs are interconnected. Called "slave" MCU in ITU-T Recommendations.

Scalability: The degree to which the H.323 standard and products based on that standard can support IP based conferences containing both small and large numbers of participants. Typically for large numbers of participants, most would be in a receive-only mode, listening to one or a small group (panel) of talkers.

Secondary VTU: A VTU that participates in the conference, but perhaps without the full range of services that primary terminals receive due to capability or bandwidth limitations. For example, a secondary VTU may not be able to send or receive video.

Segmentation: The procedure whereby an MCU can simultaneously be used in more than one conference.

Selected Communication Mode: The common mode of communication that is selected by the MCU for communication during the call. The mode includes the transfer rate, and the audio, video, and data rates.

Service Definition: A standards document, which defines the scope of the standardization effort of commercial standards. Service definitions for video teleconferencing have been written by the ANSI T1A1.5 committee, and by ITU-T Study Group 1.

Shared Whiteboard: An application program that simulates a conference room whiteboard or chalkboard, allowing multiple users in a video conference to type in notes, make free hand drawings or otherwise mark-up the whiteboard area. All users can view the combined annotations.

Softcopy Image: A still image typically displayed on a monitor or CRT.

Star Configuration: A network configuration of MCUs in which there is one MCU to which all other MCUs are directly connected. A chain of three MCUs, a dumb-bell configuration, and a single MCU are all degenerate forms of the star configuration.

Still Image: Non-moving visual information such as graphs, drawings, pictures, or video frames not processed by the video CODEC portion of the VTU.

Still Image Transfer with Annotation Capabilities: The capability to transfer images (graphics, photos, maps, etc.) to others in the conference and to annotate them (mark them up) to highlight or change portions of the image. The images and annotations show up simultaneously on the screens of others in the conference.

Teleconferencing: A conference among people remote from one another who are linked by one of more telecommunications devices.

Teleconferencing System: A collection of equipment and integral components (customer premises equipment and facilities) required to process teleconferencing programs and control data, less network interface devices.

TEMPEST-approved: See *TEMPEST* in FED-STD-1037C. A device endorsed by the NSA as meeting stringent signal radiation requirements. The electromagnetic waves it emits have been reduced through shielding or other techniques to a point where it would be extremely difficult for a hostile force to gather information from the electromagnetic waves and disclose the classified information being transmitted.

Terminal Equipment: A device or devices connected to a network or other communications system used to receive or transmit data. It usually includes some type of I/O device.

Terminal ID: A form of identification that allows a VTU to be assigned an alphanumeric string such as a name or location rather than just an arbitrary terminal number.

Terminal Number: A number assigned by an MCU to a VTU for identifying VTUs in a conference. Terminal numbering is necessary for call association, chair control, and video select capabilities.

TIA: Telecommunications Industry Association (http://www.tiaonline.org) is a U.S. commercial standards organization aligned with EIA. The acronym TIA/EIA precedes a numerical designation, such as TIA/EIA-232-F, which replaces the now obsolete RS (Recommended Standard) designation, for example, RS-232.

TIA/EIA-232-F (formerly RS-232): A serial interface standard for transmission of unbalanced signals between a variety of computer, media, and multimedia peripherals. TIA/EIA-232-F transmits at a maximum of 19.2 kb/s for up to a distance of about 50 feet and uses a type D-subminiature 25-pin (DB-25) connector, though other connectors have been used.

TIA/EIA-422 (formerly RS-422): A serial electrical interface standard for transmission of balanced and unbalanced signals between a variety of higher-end computer, media, and multimedia peripherals. TIA/EIA-422 allows a maximum data rate of 10 Mb/s at a distance of 40 feet.

TIA/EIA-423 (formerly RS-423): A serial electrical interface standard for transmission of unbalanced signals between a variety of higher-end computer, media, and multimedia peripherals. TIA/EIA-423 allows a maximum data rate of 100 kb/s at a distance of 30 feet.

TIA/EIA-530: A replacement for EIA-449 that uses a DB-25 connector instead of a 37-pin connector, while keeping the critical EIA-449 signals intact. TIA/EIA-530 is to be used in conjunction with TIA/EIA-422-B.

Token Ring: A network whereby a logical token is passed sequentially between terminals connected in a ring configuration. Only the terminal actually in possession of the token is allowed to transmit data at any give time.

Type 1: A classified or controlled cryptographic equipment, assembly, component, or item endorsed by the National Security Agency (NSA) for securing telecommunications and automated information systems for the protection of classified or sensitive U.S. Government information exempted by the Warner Amendment for use by the U.S. Government and its contractors, and subject to restrictions in accordance with the International Traffic in Arms Regulation.

Type 2: An unclassified cryptographic equipment, assembly, component, or item endorsed by the National Security Agency for use in telecommunications and automated information systems for the protection of unclassified but sensitive information. Type 2 equipment is exempted by the Warner Amendment. Type 2 is available to U.S. Government departments, agencies, sponsored elements of state and local government, sponsored U.S. Government contractors, and sponsored private sector entities. It is subject to restrictions in accordance with the International Traffic in Arms Regulation.

Type 3: An unclassified cryptographic equipment, assembly, component, or item that implements an unclassified algorithm registered with the National Institute of Standards and Technology (NIST) as a FIPS for use in protecting unclassified sensitive, or commercial, information. This definition does not include Warner-Amendment-exempt equipment.

Unclassified: Information or material that does not require protection in the interests of national security and that is not classified for such purposes by appropriate classifying authority in accordance with the provisions of Executive order 12356, "National Security information," of April 2, 1982.

Unclassified Sensitive: A designation for information that is not classified, but needs to be protected from unauthorized disclosure. Examples of types of information that fall under this category are For Official Use Only (FOUO), proprietary, contractor sensitive, limited distribution, and personal in nature.

Unicasting: The process of transmitting data/information from one source to many destinations using multiple point-to-point transmissions. *(See also broadcasting and multicasting.)*

Unrestricted Channel: A digital communications channel, in which for each increment of *p*, all 64000 bits per second (bit/s) are available for information transfer. ISDN is an example of a network that uses 64000 bit/s communication channels.

Video: That portion of a signal that is related to moving images.

Video CODEC: See *CODEC.*

Videoconferencing: See *Video Teleconferencing.*

Video Mixing: The process of combining two or more video signals to produce a single composite frame (video image). This allows each participant in a conference to view more than one of the other participants in the conference simultaneously. For example, the composite video image may be a two by two array in which the video from four participants appears in four blocks within the array (i.e., Hollywood Squares (*See continuous presence*)). This is contrasted with the method of mixing signals in the analog domain using a video quad splitter. This is also contrasted with windowing that uses multiple frames to display images from different sources, such as data, motion video and/or graphics.
Video Switching: The process of switching the video signal that a participant sees to one of the other participants. The participant that is seen can be determined by the chairman, the participants, or as a function of the audio signal (*see Voice Activated Switching.*).

Video Teleconferencing (VTC): Two-way electronic form of communications that permits two or more people in different locations to engage in face-to-face audio and visual communication. Meetings, seminars, and conferences are conducted as if all of the participants are in the same room.

Video Teleconferencing Unit (VTU): VTC equipment that performs the following functions: coding/decoding of audio and video; multiplexing of video, audio, data, and control signals; system control; and end-to-end signaling. It does not include I/O devices, embedded and non-embedded cryptographic devices, network interface equipment, end-to-network signaling, network connections, or the network itself. *NOTE: The scope of this Profile is broader than the scope of the VTU because the scope of the Profile includes cryptographic devices and other items that the VTU does not include.*

Video Telephony: Relating to videophones and video teleconferencing.

Videophone: A VTC terminal where most of the equipment is integrated into a single desktop unit.

Voice Activated Switching: The function of an MCU that determines which video signal is seen by the participants in a conference based on the audio signal. Typically, the loudest speaker will be seen by all of the participants.

Warner Amendment: Title 10, United States Code, Section 2315, "Law inapplicable to the procurement of automatic data processing equipment and services for certain defense purposes." Enacted as Public Law 97-86, 1 December 1981. The Warner Amendment amends Section 111 of the Federal Property and Administrative Services Act of automatic data processing equipment (currently defined to include telecommunications services and equipment) if the function, operation, or use of the equipment or services:

(1) involves intelligence activities;
(2) involves cryptologic activities related to national security;
(3) involves the command and control (C2) of military forces;

(4) involves equipment that is an integral part of a weapon or weapons system; or
(5) subject to (6) is critical to the direct fulfillment of military or intelligence missions.
(6) subpart (5) does not include procurement of automatic data processing equipment or services to be used for routine administrative and business applications, including payroll, finance, logistics, and personnel management applications.

See DOD Directive 4640.14 for detailed instructions for Warner exemption determinations.

Warner-exempt: A telecommunications requirement that meets the stipulations as stated in the Warner Amendment.

Wideband Audio: In audio transmission, an audio signal of a wider bandwidth than 3 KHz (nominal), or a carrier channel or system supporting that signal. *(Note: G.722 specifies a bandwidth of 7 KHz.)*

Windowing: Capability to divide the video display into two or more separate regions (frames) with displays from different sources in each region. For example, four separate frames (windows) on the same display could simultaneously show a) data, b) motion video of the remote site, c) a still image, and d) motion video of the home site. This is in contrast to video mixing that combines two or more video images into a single frame.

Workspace: A workspace is an area comprising N independent but coincident planes of the same pixel dimensions. The assembly of N planes forms the complete image, which can be displayed or printed. At a given workspace coordinate, data in any plane hides data present in underlying planes in the stack unless the pixel value at that plane is transparent. If there are no data at a specific pixel location in the middle or front planes, the location is said to be transparent and does not hide the data from underlying planes.

4 ABBREVIATIONS AND ACRONYMS

All of the abbreviations and acronyms used in this part of the Profile are defined either in the referenced base standards (see Section 2) or listed below. Those that are common with the terms in FED-STD-1037C have been included for the convenience of the reader. Also see the Telecom Glossary 2000 (ANSI T1-523-2000) for additional abbreviations and acronyms used in this document.

AAL	ATM Adaptation Layer
AIA	Audio Indicate Active
AIM	Audio Indicate Mute
ANSI	American National Standards Institute
APU	Audio Processing Unit
AR	Army Regulation
ASCII	American Standard Code for Information Interchange
ATM	Asynchronous Transfer Mode
BAS	bit rate allocation signal
B-ISDN	Broadband ISDN
b/s or bit/s	bit(s) per second
BNC	bayonet Neill-Concelman
BRI	Basic Rate Interface
CCA	Chair Command Acquire
CCD	Chair Command Disconnect
CCITT	International Telegraph and Telephone Consultative Committee (now ITU-T)
CCK	Chair Command Kill
CCR	Chair Command Release/Refuse
CD-ROM	compact disk - read only memory
CIC	Chair-control Indicate Capability
CIF	common intermediate format
CIR	Chair Indicate Release/Refuse
CIS	Chair Indicate Stopped-using
CIT	Chair Indicate Token
CM	Conditional Mandatory
CME	Client Management Entity
CODEC	coder-decoder
COMSEC	communications security
COTS	commercial off-the-shelf
CPU	Central Processing Unit
CSU	Channel Service Unit
dBm	decibel(s) referenced to 1 milliwatt
DCA	LSD/HSD Command Acquire Token
DCC	LSD/HSD Command Close

DCE	Data Circuit-Terminating Equipment
DCR	LSD/HSD Command Release/Refuse
DCT	discrete cosine transform
DES	data encryption standard
DIS	LSD/HSD Indicate Stopped Using Token
DISA	Defense Information Systems Agency
DIT	LSD/HSD Indicate Token
DOD	Department of Defense
DODISS	Department of Defense Index of Specifications and Standards
DPCM	Differential Pulse Code Modulation
DPU	Data Processing Unit
DSU	Data Service Unit
DSVD	Digital Simultaneous Voice and Data
DTE	Data Terminal Equipment
DVS-G	Defense Information Systems Network, Video Services, Global
ECS	Encryption Control Signal
EEG	Electroencephalogram
EIA	Electronic Industries Association
EKG	Electrocardiogram
EPROM	erasable programmable read only memory
FAS	Frame Alignment Signal
FCIF	full common intermediate format
FEC	forward error correction
FED-STD	federal standard
FHDR	file header
FIPS	Federal Information Processing Standards
FOUO	For Official Use Only
fps	frames per second
FSCLAS	File Security Classification field
GCC	Generic Conference Control
H-MLP	High Speed - Multilayer Protocol Channel
HSD	High speed data
Hz	hertz
I/O	input/output
IC	Image Compression field
IIS	Information Indicate String
IMUX	inverse multiplexer
IP	Internet Protocol
IPX	Internetwork Protocol Exchange
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ITU	International Telecommunication Union

ITU-T	ITU Telecommunication Sector (formerly CCITT)
JBIG	Joint Bilevel Image Experts Group
JIEO	Joint Interoperability and Engineering Organization
JPEG	Joint Photographic Experts Group
kb/s or kbit/s	kilobits per second
KHz	kilohertz
LAN	Local Area Network
LCA	Loopback Command, Audio Loop Request
LCD	Loopback Command, Digital Loop Request
LCO	Loopback Command Off
LCV	Loopback Command, Video Loop Request
LOS	loss of synchronization
LSD	Low speed data
M	Mandatory
MAN	Metropolitan Area Network
MBE	multi-byte extension
Mbit/s or Mb/s	megabits per second
MC	Multipoint Controller
MCC	Multipoint Command Conference
MCN	Multipoint Command Negating MCS
MCS	Multipoint Command Symmetrical Data-transmission
MCU	Multipoint Control Unit
MCV	Multipoint Command Visualization-forcing
MIL	Multipoint Indication - Loop
MIL-HDBK	military handbook
MIL-STD	military standard
MILDEP	military department, such as the Air Force, Army, Navy
MIM	Multipoint Indicate Master
MIS	Multipoint Indicate Secondary-status
MIV	Multipoint Indicate Visualization
MIZ	Multipoint Indicate Zero-communication
MLP	Multilayer Protocol
MMS	Multipoint command Mode-Symmetrize
MP	Multipoint Processor
MPEG 1	Motion Picture Experts Group, Version 1
MPI	Minimum Picture Interval
MRM	Meeting Room Management
ms	milliseconds
NACSIM	National COMSEC Information Memorandum
NDI	Non-Developmental Item
NIPRNET	Non-classified IP Router Network
N-ISDN	Narrowband ISDN

NIST	National Institute of Standards and Technology
NITFS	National Imagery Transmission format Standard
NIUF	North American ISDN Users Forum
NSA	National Security Agency
NSTISS	National Security Telecommunications and Information Systems Security
NSTISSAM	National Security Telecommunications and Information Systems Security Advisory Memorandum
NT1	Network Termination 1
NTISSI	National Telecommunications and Information Systems Security Instruction
NTISSP	National Telecommunications and Information Systems Security Policy
NTSC	National Television Standards Committee
O	Optional
OFB	Output feedback mode
OPNAVINST	Chief of Naval Operations Instruction
OPNAVNOTE	Chief of Naval Operations Note
PCM	pulse code modulation
PDU	Packet Data Unit
PICS	Protocol Implementation Conformance Statements
POTS	Plain Old Telephone System
PSTN	Public Switched Telephone Network
PUB	publication
QCIF	quarter common intermediate format
QOS	Quality of Service
RAN	Random Number
RAS	Registration/Admission/Status
RD	Receive Data
RDC	Remote Device Control
RGB	Red-Green-Blue
RS	recommended standard
RSVP	Resource Reservation Protocol
RT	receive timing
RTCP	Real Time Control Protocol
RTP	Real time Protocol
RTS	Request To Send
SB-ADPCM	sub-band adaptive differential pulse-code modulation
SBE	Single Byte Extension
SCIF	Sensitive Compartmented Information Facility
SCM	Selected Communication Mode
SCN	Switched Circuit Network
SD	Send Data
SIPRNET	Secret IP Router Network

SPX	Sequential Protocol Exchange
ST	Send Timing
TA	Terminal Adapter
TCI	Terminal Command Identify
TCP	Transport Control Protocol
TCP	Terminal Command Personal Identifier
TCS	Terminal Command String
TCU	Terminal Command Update
TEMPEST	compromising emanations
TIA	Terminal Indicate Assignment
TIC	Terminal Indicate Capability
TID	Terminal Indication Dropped
TIF	Terminal Indicate Floor-request
TII	Terminal Indicate Identity
TIL	Terminal Indicate List
TIN	Terminal Indicate Number
TIP	Terminal Indicate Personal Identifier
TIS	Terminal Indicate Secondary
TIX	Terminal Indicate Additional Channel X
TT	terminal timing
UDP	User Datagram Protocol
VCB	Video Command Broadcast
VCF	Video Command "Freeze-picture request"
VCR	Video Command Reject
VCS	Video Command Select
VCU	Video Command "fast Update request"
VIA	Video Indicate Active
VIN	Video Indicate Number
VIS	Video Indicate Suspend
VPU	Video processing unit
VTC	video teleconferencing
VTU	video teleconferencing unit
YCbCr	Luminance; Chroma:blue; Chroma:red

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5 VTC OVER NARROWBAND INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

5.1 H.320 Subnetwork-Type Independent Requirements

These requirements shall apply to all video teleconferencing (VTC) systems operating at data rates between 56 and 1,920 kb/s using non-packet-based networks. ISDN and switched-56 circuits are the most commonly used. The video teleconferencing unit (VTU) requirements are specified in Sections 5.1.1, 5.1.2, 5.1.3, 5.1.4, and 5.1.5. MCU requirements are specified in Section 5.1.6.

5.1.1 Video, Communications and Control

5.1.1.1 General

Except as noted, the VTU shall conform with the requirements set forth in the five ITU-T *p*x64 Recommendations, H.221, H.230, H.242, H.261, and H.320, and FTR 1080B-2002.

5.1.1.2 Operating Mode

The VTU shall provide point-to-point bi-directional operation. Operation in multi-point topologies is covered in Sections 5.1.5 and 5.1.6.

5.1.1.3 Data Transmission Rates

The Recommendations relate to VTUs that operate at nominal bit rates of *p*x64,000 bits per second (bit/s), where *p* is an integer in the set 1, 2, 3, 4, 5, 6, 12, 18, 23, 24 and 30. For unrestricted channels, such as provided by ISDN, each increment of data rate may actually be 64,000 bit/s, but in restricted channels, each increment may be only 56,000 bit/s. VTUs shall be able to operate with other VTUs on unrestricted and restricted channels. VTUs shall provide operation at least for p=1 and p=2. VTUs shall also be able to operate at p = 2 with a single 128-kb/s channel, and if a second network interface port is specified, with two 64-kb/s channels. For other *p* values, operation with only a single channel is required. Operation at $p > 2$ is optional. If a higher *p* value is required, then all *p* values in the set {1, 2, 6, 12, 23, 24} less than or equal to the requirement shall also be provided. Proprietary algorithms for video coding are allowed by FTR 1080B-2002. If a certain value of *p* is required, the VTU shall operate at that value according to ITU-T H.261 and not just the proprietary video algorithm.

5.1.1.4 Video Coding and Decoding

The video CODEC subsystem used to provide VTC services within the scope of this Profile shall conform to the specifications set forth in ITU-T H.261. In addition to the mandatory requirements of ITU-T H.261, the video CODEC subsystem may optionally be provided in accordance with the specifications of ITU-T H.263. H.263 can provide higher picture quality than H.261, especially at data rates below 384 kb/s. H.263 is recommended for improving video quality at $p = 2$.

The video CODEC subsystem can also provide other proprietary solutions in addition to ITU-T H.261. For every video coding rate the terminal is capable of, however, the terminal shall be capable of using the ITU-T H.261 coding algorithm. The purpose of this requirement is to prevent two terminals which are capable of communicating at a high transmission rate such as $p = 24$ having to communicate at a lower rate to be interoperable.

A terminal is not precluded from having proprietary picture formats other than QCIF or FCIF, but if a terminal has a picture format with more pixels than QCIF (176x144 = 25344 pixels), it shall also have the FCIF picture format implemented using ITU-T H.261. The purpose of this requirement is to prevent two terminals, which are capable of FCIF-like resolutions having to communicate at a QCIF resolution to be interoperable.

5.1.1.5 Picture Format (resolution)

The video CODEC shall provide full-color operation using at least the QCIF format in accordance with ITU-T H.261. If a resolution of 352 (horizontal) by 288 (vertical) or higher is required for motion video, then the standard algorithm of ITU-T H.261 shall be available at FCIF resolution.

5.1.1.6 Motion Rendition

The decoder shall decode at least 7.5 pictures per second. This is equivalent to a Minimum Picture Interval (MPI) of 4/29.97 seconds per picture as described in ITU-T H.221, Annex 1, ITU-T H.261, Section 3.1, and ITU-T H.263, Section 4.1.

The encoder shall be capable of encoding at least an average of 6 pictures per second, excluding pictures with scene changes. This is to help ensure a minimum level of motion rendition, however, depending on the user's needs, higher frame rates may be required. *See Section 10.1.8.1.*

5.1.1.7 Forward Error Correction (FEC)

The use of the FEC code in the decoder, as specified in ITU-T H.261 Section 5.4 and ITU-T H.263 Annex H, to correct transmission errors is optional.

5.1.1.8 Motion Compensation

The requirement for Motion Compensation in the encoder is optional.

5.1.1.9 Freeze-Frame Image

All VTUs may optionally support a freeze-frame image transmission capability. Freeze-frame image is a frame selected from a video signal, and processed through the video CODEC for transmission to remote sites. Motion video transmission is suspended until freeze-frame transmission is complete. If multimedia applications are used, beyond those defined as freeze-frame, the requirements of the T.120 series of recommendations shall be used as per Section 8.

The VTU may optionally have the capability to output video signals representing both motion video and freeze-frame image simultaneously, or provide a single video output, which can be switched by the user between motion video and freeze-frame images. If the capability of coding of freeze-frame images is provided it shall be performed by means of the technique described in ITU-T H.261 Annex D. Optionally, it may also be provided per ITU-T H.263. This technique provides an image up to twice the resolution in each direction of the format currently being used for motion video, i.e. 352 horizontal (h) x 288 vertical (v) equals 101,376 pixels for VTUs using QCIF motion video, and 704(h) x 576(v) equals 405,504 pixels for VTUs using FCIF motion video. VTUs capable of QCIF motion video may optionally provide QCIF freeze-frame video (176 (h) x 144 (v) = 25,344 pixels) capability. Four times QCIF (FCIF) freeze-frame video (352 x 288) may be optional. VTUs capable of FCIF motion video may optionally provide FCIF freeze-frame video (352 (h) x 288 (v) = 101,376 pixels) capability. Freeze-frame image having two times horizontal and two times vertical resolutions is also allowable. Four times FCIF freeze-frame image (704 (h)x 576 (v) = 405,504 pixels) is therefore another option.

5.1.1.10 Real-Time Control Protocol for Far-end Camera Control

The capability for a VTU to control one or more far-end cameras is optional. The capability for a VTU to allow far-end control of its local camera(s) is optional. Far-end camera control requires that both VTUs have the far-end camera control capability. Far end camera control may be desirable even if the near end camera is fixed, since the far end VTU may have the capability to have its camera controlled. The following describes the control protocols and capabilities for far-end camera control with H.320 systems. For H.323 far-end camera control, see Section 6.2.7.

5.1.1.10.1 Control Protocols

If far-end camera control is required, the VTU shall have the capability to use the H.224 Real Time Control Protocol for Simplex Applications using the H.221 LSD/HSD/MLP or aggregated MLP/H-MLP Channels and H.281 Far End Camera Control Protocol for Video Conferences using H.224. The H.224 Recommendation specifies the protocols for low delay, low latency broadcast services using the H.221 data channels. The H.281 Recommendation specifies the procedures and messages to be used to provide far-end camera control using H.224.
A VTU implementing the H.224 protocol shall use the LSD and the MLP or aggregated MLP/H-MLP data channels as described in H.242, and may optionally use the HSD data channel. These channels

provide data rates from 4 kb/s up to 448 kb/s. All VTUs providing far-end camera control shall support the common LSD and MLP rate of 6.4 kb/s. This data rate provides a common point of interoperability for VTUs using H.224. If higher data rates are provided, it is recommended that all lower data rates (down to 6.4 kb/s), as specified in H.221, also be provided. This will allow VTUs to interoperate at the higher data rates.

Use of the LSD and/or HSD channels for H.224 is recommended for far end camera control since these channels use a token system to assure that there is only one VTU transmitting at a time. The MLP and H-MLP channels do not have this capability, so other measures are required to assure that only one VTU is attempting to control a camera.

5.1.1.10.2 Remote Camera Positioning

A VTU may have the optional capability to have the camera position of one or more of its video sources changed by a remote VTU. A VTU that has this capability may allow, as an option, one or more of the following action operations:

- Pan (Right or Left)
- Tilt (Up or Down)
- Zoom (In or Out)
- Focus (In or Out)

A VTU may optionally allow one or more of these operations simultaneously. A VTU that cannot perform multiple operations simultaneously shall perform at least one of the operations and may disregard the others. Visual feedback to the user, who is controlling the remote camera positioning, will indicate if any commands were ignored.

A VTU may have the optional capability to attempt to control the position of a far-end camera. A VTU that has this capability may attempt to perform the action operations indicated above, if the remote VTU has indicated the capability to perform these operations. These actions may be performed individually or simultaneously.

5.1.1.10.3 Remote Video Source Selection

A VTU shall have at least one video source and may have up to 16 video sources. A VTU may have the optional capability to have the video source that it transmits to the video teleconference selected by a remote VTU. The following sources are pre-defined:

- 1 Main Camera
- 2 Auxiliary Camera
- 3 Document Camera
- 4 Auxiliary Document Camera
- 5 Video Playback Source e.g., a Video Cassette Recorder

Other sources (6 to 15) may have an identifier assigned. The identifier consists of up to 16 ASCII characters. A request to select a non-existent source shall result in no change in source. As an option, a VTU may indicate to the other VTUs in a conference that it has changed the video source. If a VTU makes this indication it shall use the H.230 *Video Indicate Active* (VIA) message.

A VTU may have the optional capability to attempt to select the far-end video source to be transmitted. A VTU having this capability may attempt to select a source, if the remote VTU has indicated that the source exists in its capabilities.

5.1.1.10.4 Remote Video Mode Selection

A VTU may have the optional capability to allow a remote VTU to select the video mode of the near end video source that it transmits to the other VTU or MCU. The video modes are motion video; normal resolution freeze-frame image and high-resolution freeze-frame image. Normal resolution freeze-frame images are at the current motion video resolution (i.e., FCIF or QCIF). High-resolution freeze-frame images are at twice the horizontal and vertical resolution of the current motion video (i.e., 4xFCIF or 4xQCIF = FCIF). Still images are sent within the H.261 video stream following the procedures in H.261 Section 4.2.1.3 and Annex D. A request to select an unsupported mode shall result in no change in mode.

A VTU may have the optional capability to allow the user to attempt to select a video mode for the remote video source being transmitted to it. A VTU having this capability may, upon user initiated action, attempt to select a mode, if the remote VTU has indicated, in its capabilities, that the remote VTU can support the desired mode.

5.1.1.10.5 Camera Presets

A VTU may have the optional capability to set camera presets for its video sources. A VTU having this capability will store this information when commanded. A VTU that supports camera presets will select the video source and camera position previously stored for that preset when activated by the remote VTU. A VTU may support up to 16 presets.

A VTU may have the optional capability to attempt to store the current remote video source and camera position as a preset, if the remote VTU has indicated the capability to support presets. A VTU may attempt to activate a previously stored remote preset selection, if the remote VTU has indicated the capability to support presets.

5.1.1.11 Transparent Data

There are four H.221 data channels: Low Speed Data (LSD), High Speed Data (HSD), MLP Data, and H-MLP Data. A VTU may use any of the 4 data channels to provide a transparent channel for other applications to use. An application used in this way would require both VTUs in the conference to contain the application, which may be proprietary to a single manufacturer. An example of this type of application is the real-time transmission of medical data such as EKG or EEG.

The ability to open and use data channels is optional; however, it is recommended that VTUs that do not have a data capability still be able to open dummy-data channels as described in H.242. In multipoint conferences where several VTUs are using a data channel, other VTUs may be relegated to secondary status (audio only), if they are not able to open a data channel. If those VTUs can open dummy data channels, they will be able to continue to participate in the video communications even without having the full data capability.

5.1.2 Control and Indication Signals

The VTUs shall provide additional information, which is needed for the proper functioning of the system. This additional information will contain ITU-T H.221 frame-synchronous control signals and indication signals such as freeze picture, video loopback, simple multipoint controls, etc., as specified in ITU-T H.230.

Among these Control and Indication (C&I) signals are AIM and AIA which indicate whether the remote VTU has audio muted or active. The VIS, VIA and VIR signals perform similar functions for the video stream. The loopback C&I signals are LCV (video), LCA (audio), LCD (digital) and LCO (loopback off). *Note that there is no requirement in the Recommendation for the receiving VTU to display this information.*

5.1.2.1 Call Control (handshaking)

The VTUs shall interoperate with each other and the existing telecommunications system as specified in ITU-T H.242 and H.320.

5.1.2.2 Frame Structure

The VTUs shall comply with the ITU-T H.221 frame structure for audiovisual teleservices in single or multiple channels as specified in ITU-T H.221. This requirement allows for the synchronization of multiple connections and the control of multiplexing audio, video, data, and other signals. Use of the unframed mode as per ITU-T H.221 is outside the scope of this Profile.

5.1.2.3 Camera Interface

All systems shall support the capture of motion video and freeze frame video images using video cameras. For VTC equipment intended for use in North America that has external cameras, the electrical interfaces between the cameras and the VTU may optionally meet the NTSC (EIA-170-A) standard. The mechanical interface may optionally be BNC, F-type, or RCA connectors.

5.1.2.4 Monitor Interface

For VTC equipment intended for use in North America that has external video display monitors, the electrical interface between the monitors and the VTU may optionally meet the NTSC (EIA-170-A), RGB, VGA, SVGA or S-VHS standards. The mechanical interface may optionally be BNC, F-type, RCA, or 15-pin D-subminiature connectors.

5.1.3 Audio

5.1.3.1 General

The audio coder/decoder (CODEC) subsystem shall be an integrated subsystem of the VTU equipment used for the purpose of video teleconferencing. This means the audio signal shall be transmitted in-band as per ITU-T H.221, and not out-of-band.

5.1.3.2 Speech Quality Modes

The audio subsystem shall be capable of operating in the narrow band speech modes as specified in Sections 5.1.3.2.1 and 5.1.3.2.2, and may optionally support the higher voice quality wideband speech modes in Sections 5.1.3.2.3 and 5.1.3.2.4. The key parameters are the analog bandwidth and the data rate used by each speech mode. The analog bandwidth can be either 3KHz for narrowband or 7KHz for wideband. The higher analog bandwidth normally provides for better voice quality. The data rate used by each speech mode varies from 16 kb/s to 64 kb/s. The lower the data rate devoted to audio, the more capacity (bandwidth) is available for video, thus allowing for higher quality video.

5.1.3.2.1 Narrowband Speech at 64 kb/s Data Rate

Capability to operate in this mode is mandatory. This narrowband (3 KHz analog bandwidth) speech mode shall conform to the specifications set forth in ITU-T G.711, H.221, H.230, H.242, and H.320.

This audio mode is known as Mode 0 in ITU-T H.221. Mode 0 is further broken out into four submodes, as specified in Annex 1 of ITU-T H.221: Mode 0U (unframed A-law), Mode 0F (framed A-law), Mode 0U (unframed μ-law), and Mode 0F (framed μ-law).

The audio subsystem shall be capable of operating in Mode 0F (μ-law). Mode 0F (A-law) is optional. *See Section 10.1.5 for a further recommendation.* The use of the unframed modes (0U) are outside the scope of the Profile and is not recommended.

5.1.3.2.2 Narrowband Speech at 16 kb/s

ITU-T G.728 is mandatory (providing 3KHz analog bandwidth) and shall be available at all the data rates at which the VTU is capable of operating.

5.1.3.2.3 Wideband Speech at 48-56 kb/s

This wideband speech mode at 48–56 kb/s, with 7 KHz analog bandwidth, is optional. If provided, it shall conform to the specifications set forth in ITU-T G.722, H.221, H.230 and H.242.

The audio subsystem shall be capable of operating in the following two modes as specified in ITU-T G.722 and H.221:

G.722 Mode 2: 56 kb/s audio (unrestricted network)
G.722 Mode 3: 48 kb/s audio (restricted or unrestricted network)

The indication signals for identifying the mode of operation shall conform to the specifications set forth in ITU-T G.722, H.242, and H.221 (Table H.221/A1).

The audio subsystem shall have the capability of automatically switching over from Mode 0 *(see Section 5.1.3.2.1)* to one of the higher quality Modes 2 or 3 if the other VTU to which it is connected has the capability for Modes 2 or 3.

5.1.3.2.4 Wideband Speech at 24 kb/s and 32 kb/s

This wideband speech mode with 7KHz bandwidth is optional. If provided, it shall conform to the specifications set forth in ITU-T G.722.1, H.221, H.230 and H.242. G.722.1 is recommended for use in hands-free applications such as conferencing where there is a low probability of frame loss.

The audio subsystem shall be capable of operating in the following two modes as specified in ITU-T G.722.1 and H.221:

- G.722.1-32: 32 kb/s audio
- G.722.1-24: 24 kb/s audio

The indication signals for identifying the mode of operation shall conform to the specifications set forth in ITU-T G.722.1, H.242, and H.221 (Table H.221/A1).

The audio subsystem shall have the capability of automatically switching over from Mode 0 *(see 5.1.3.2.1)* to one of the higher quality G.722.1-32 or G.722.1-24 if the other VTU to which it is connected has the capability.

5.1.3.3 Encoding and Decoding

For Mode 0 narrowband speech, using the mandatory Mode 0F (μ-law), the characteristics of the Pulse Code Modulation (PCM) converter shall conform to the specifications set forth in G.711. The optional mode 0F (A-law) shall conform to G.711.

For wideband speech (G.722), the analog speech signal shall be encoded into and decoded from a digital bit stream using sub-band adaptive differential pulse code modulation (SB-ADPCM) for Modes 2 and 3. The characteristics of the SB-ADPCM converter shall conform to the specifications set forth in ITU-T G.722.

For low bit rate wideband speech (G.722.1), the speech signal shall be encoded into and decoded from a digital bit stream using a Modulated Lapped Transform (MLT) algorithm.

5.1.3.4 Lip Synchronization

In order to conform to this Profile, synchronization between the video and audio signals shall be addressed in both the encoding and decoding processes of the audio subsystem. While delay compensation is not required, if it is used, the compensation for delay between the video signal and audio signal introduced during the encoding process shall be compensated for at the encoding process. Likewise, compensation for delay introduced at the decoding process shall be compensated for during the decoding process. The time delay between audio and video signal shall be measured as specified in Annex C of H.261.

5.1.3.5 Electrical and Mechanical Interfaces

The requirements in Sections 5.1.3.5.1 and 5.1.3.5.2 are optional if the audio system is completely integrated into the VTU (i.e., videophone, PC-based desktop system, integrated rollabout system).

5.1.3.5.1 Electrical Specification

Input and output line level room audio interfaces shall be provided that meets the following specifications. They shall have a 600 ohm balanced impedance, with a nominal signal level of -3 dBm ±1 dB. The digital overload point shall be +7 dBm ±1 dB. The audio gain from input to output, measured using digital loop-back, shall be 0 dB ±0.5 dB. All level measurements are made using pink noise. *See Section 10.1.7 for further information on the audio subsystem.*

5.1.3.5.2 Mechanical Specification

The VTU shall provide mechanical connections for the room audio system. The room audio system connection shall provide either:

- one XLR male/female pair; or
- one pair RCA Phono jacks, one for input and one for output.

For the XLR pair, the female connector shall be the input to the VTU from the room audio system. The male connector shall be the output of the VTU to the room audio system.

5.1.3.6 Loudness

Sensitivity, loudness ratings and volume control are specified in ITU-T H.320. There are three options to choose from. A VTU can have one or more of the following three functions:

- Handset function (meant for a single user, such as an ordinary telephone handset);
- Hands-free function for up to three users (for example, a desktop speakerphone);
- Hands-free function for more than three users (for example, a room audio system).

The audio requirements are different for each of these functions and shall be as defined in ITU-T H.320.

5.1.4 H.320 Security and Confidentiality

5.1.4.1 General

This section specifies a standard means of securing the transmitted signals for classified information. The capability to interface and operate with cryptographic equipment for classified operation is optional. If the user requires the VTU for use in conducting classified conferences, the requirements of Sections 5.1.4.3 and 5.1.4.4 and their subparagraphs are mandatory.

Additional security considerations are addressed in Section 10.2, but only as recommendations, not as a mandatory or optional features. The following areas related to security are outside the scope of this Profile: physical security, including room security, user authorization, key management, and key distribution.

5.1.4.2 Levels of Security

The sections below (5.1.4.2.1 through 5.1.4.2.3) identify different levels of security for the protection of the information transmitted between VTUs.

5.1.4.2.1 Unencrypted

Information that is unclassified and not sensitive requires no protection by cryptographic equipment and can be transmitted in an unencrypted (plain-text) mode. All VTUs shall be able to transmit and receive unencrypted information.

5.1.4.2.2 Unclassified but Sensitive (Type 3)

Information that is unclassified but sensitive and not exempted by the Warner Amendment (as defined in Title 10, United States Code, Section 2315) shall be protected by Type 3 cryptographic equipment that is certified by the National Institute of Standards and Technology (NIST), or Type 1 equipment certified by NSA. In this Profile, unclassified but sensitive information will be referred to as "Type 3."

5.1.4.2.3 Classified (Type 1)

Information that is classified and information that is unclassified but sensitive Warner Amendment information shall be protected by Type 1 cryptographic equipment certified by the National Security Agency (NSA). In this Profile, this information will be referred to as "Type 1." As an option, it is strongly recommended that VTUs be able to interface with and operate with Type 1 cryptographic equipment. For the purposes of this Profile, Type 2 Warner-exempt information shall be protected by Type 1 cryptographic equipment.

The protection of classified VTC information shall be accomplished by encrypting the signal output from the VTU before it enters the network interface equipment to go out to the network, and by decrypting the signal coming from the network through the network interface equipment before it goes into the VTU. To minimize the number of encryption devices and simplify the key management required in a conference above 56/64 kb/s, the VTUs shall operate in a single-port mode (using a single EIA-449 or TIA/EIA-530 network interface). A cryptographic device is placed between the network interface equipment and the VTU. *See Figure 5.1-1 for a simplified diagram of the connections between the network, network interface equipment, cryptographic device, and VTU.* To operate over a network that contains a restricted channel at one end of the link and an unrestricted channel at another end of the link, special provisions must be made. *See Section 10.2.4 for more details.*

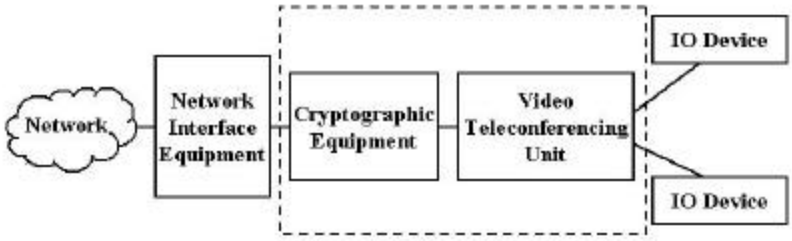

Figure 5.1-1. Line of Demarcation with External Cryptographic Device

ITU-T H.233 recommends that the VTU service channel (which contains the FAS, BAS, and ECS signals) remains unencrypted; however, the encryption scheme just described is a trunk encryption applied between VTUs that encrypts the entire signal, including the VTU service channel. The encrypted signal is decrypted prior to reaching the destination VTU.

If a requirement exists for classified conferencing, each transmission channel used by the VTU shall be protected by Type 1 cryptographic equipment. This will require one cryptographic unit at each VTU. If more than one transmission channel is used, an inverse multiplexer (IMUX) shall be used to combine multiple transmission channels for operation with a single cryptographic unit. An example is for p=2 using ISDN. In this case two transmission channels are used in the ISDN network. These two channels are combined by the IMUX into a single channel that is connected to the cryptographic device. The cryptographic device is in turn connected to a single VTU port. Another example is for p=6, where six transmission channels are used in the ISDN network. The six transmission channels are combined by the IMUX into a single channel that is connected to the cryptographic device, which in turn is connected to a single VTU port. *See an additional example in Section 10.3.2.2 and Figure 10.3-7.*

Two families of cryptographic equipment are permitted for securing VTC: KG-194 and KIV-7/KIV-7HS. KG-194 (and compatible) devices have traditionally been used for VTC and will continue to be used for dedicated networks. The newer, smaller, KIV-7/KIV-7HS (or compatible) devices may now be used for dial-up and other non-dedicated circuits. The KIV-7/KIV-7HS uses a KG-84 type encryption algorithm. Its small size makes it particularly well suited for desktop and portable applications. Interoperability between the two families will be achieved through classified MCUs, which will have both encryption devices on their ports. It is anticipated that most new classified VTC applications will use the KIV-7/KIV-7HS or compatible, and that eventually DOD will migrate to entirely using KIVs or compatible.

5.1.4.3 Type 1 Cryptographic Equipment for Dedicated Networks

For existing dedicated networks such as DISN Video Services-Global (DVS-G), the KG-194/194A or compatible equipment shall be used to protect Type 1 information passing through the VTU. If KG-194-compatible equipment is used, it shall be compatible in terms of both encryption and key-management schemes.

5.1.4.3.1 Electrical and Mechanical Interfaces

The KG-194 cryptographic equipment is compatible with the TIA/EIA-422-B electrical interface specification. The cryptographic equipment will appear to the VTU as a DCE (data circuit-terminating equipment). The cryptographic equipment will appear to the network interface equipment as a data terminal equipment (DTE). The mechanical interfaces to the network interface equipment may be either EIA-449 or TIA/EIA-530. Likewise the mechanical interface to the VTU may be either EIA-449 or TIA/EIA-530. See Figure 5.1-2 for EIA-449 and Figure 5.1-3 and for TIA/EIA-530.

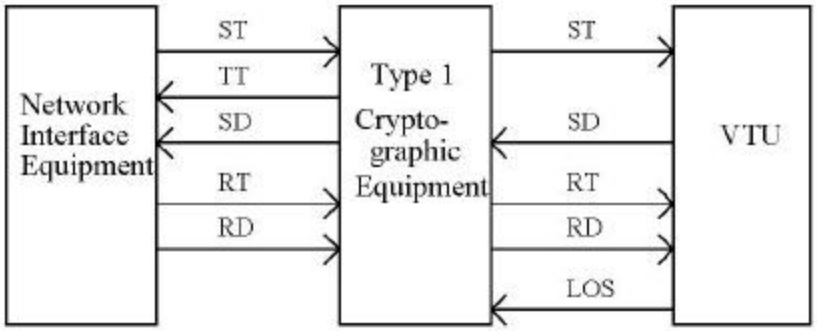

Figure 5.1-2. EIA-422-B Electrical Interface for VTU, KG-194, and Network Interface Device with EIA-449 Mechanical Interface.

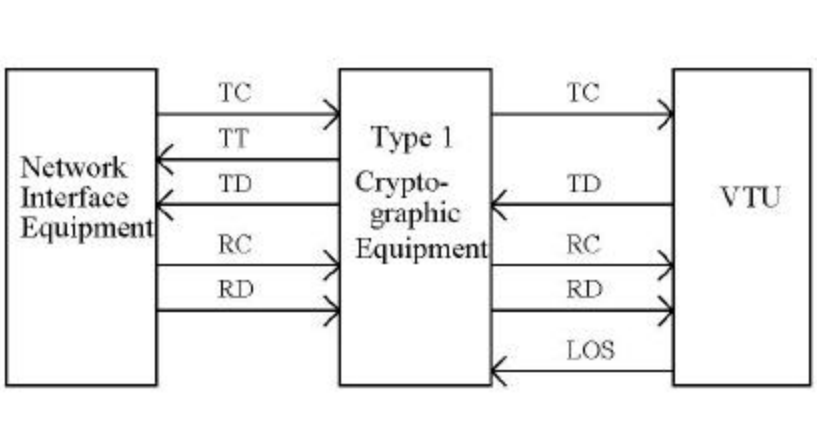

Figure 5.1-3. EIA-422-B Electrical Interface for VTU, KG-194, and Network Interface Device with TIA/EIA-530 Mechanical Interface.

5.1.4.3.1.1 Connection between Network Interface Equipment and Cryptographic Device

The interface between the network interface equipment and the cable to the cryptographic equipment, that is the cipher-text (black) interface, shall conform to the specifications of TIA/EIA-422-B (electrical) and either EIA-449 or TIA/EIA-530 (mechanical). All of the data and timing signal lines connecting the cryptographic equipment to the network interface equipment shall have differential balanced connections. For EIA-449, this interface shall include the following signals: Send Timing (ST),

Terminal Timing (TT), Send Data (SD), Receive Timing (RT), and Receive Data (RD). For TIA/EIA-530, this interface shall include Terminal Timing (TT), Transmit Clock (TC), Transmit Data (TD), Receive Clock (RC) and Receive Data (RD). *See Table 5.1-1*. The cryptographic equipment does not generate an internal clock signal to the network interface equipment. Rather, the TT signal is derived by the cryptographic equipment from the ST signal provided by the network interface equipment.

5.1.4.3.1.2 Connection between VTU and Cryptographic Device.

A minimum of one synchronous EIA-449 or TIA/EIA-530 attachment port shall be provided on the VTU to provide capability to connect to a cryptographic device. The electrical characteristics shall be as specified in TIA/EIA-422-B for balanced voltage digital-interface circuits, except that the LOS signal may follow either TIA/EIA-422-B for balanced circuits or TIA/EIA-423-B for unbalanced circuits. The interface between the VTU and the cable to the cryptographic equipment, that is the plain-text (red) interface, shall include the signals ST, SD, RT and RD for EIA-449 or the signals TC, TD, RC and RD for TIA/EIA-530. *See Table 5.1-1*. The interface shall also use a nonstandard loss of synchronization (LOS) signal. It is recommended that the EIA-449 LOS signal be either balanced, in accordance with TIA/EIA-422-B, with pin 3 designated as the "A" lead and pin 21 as the "B" lead, or unbalanced in accordance with TIA/EIA-423-B, with pin 36 designated as the signal lead. For the TIA/EIA-530 LOS signal it is recommended it be balanced, in accordance with TIA/EIA-422-B, with pin 18 designated as the “A” lead and pin 21 as the “B” lead. A balanced signal interconnection is preferred for the LOS over the unbalanced alternative.

Table 5.1-1. KG-194 and Compatible Cryptographic Equipment Interface Signals

Signal	EIA-449 Pins		Description
	A Lead	B Lead	
LOS (Note)	3	21	Loss of Synchronization (balanced)
LOS (Note)	36	-	Loss of Synchronization (unbalanced)
RD	6	24	Receive Data
RT	8	26	Receive Timing
SD	4	22	Send Data
ST	5	23	Send Timing
TT	17	35	Terminal Timing

(Note: The LOS signal may follow either TIA/EIA-422-B for balanced circuits or TIA/EIA-423-B for unbalanced circuits.)

Signal	TIA/EIA-530 Pins		Description
	(+) Lead	(-) Lead	
LOS	18	21	Loss of Synchronization
TD	2	14	Transmit Data
RD	3	16	Receive Data
RC	17	9	Receive Clock
TC	15	12	Transmit Clock
TT	24	11	Terminal Timing

5.1.4.3.2 Resynchronization

The VTU shall be able to provide a resynchronization signal to Type 1 cryptographic equipment. Detection of loss-of-sync and initiation of an automatic resynchronization by the VTU is required to support real-time VTC.

During normal operation, the VTU shall express a logic "1," in accordance with TIA/EIA-422-B, paragraph 4.1 for balanced, or TIA/EIA-423-B for unbalanced, on the LOS line to the cryptographic equipment. If the VTU loses frame alignment, as defined in ITU-T Recommendation H.221, paragraph 2.3, *Loss and Recovery of Frame Alignment*, the VTU shall express a logic "0" pulse with a duration not less than 2^{18} bits plus 3.0 milliseconds, and less than 2^{19} bits plus 3.0 milliseconds on the LOS line.

The logic "0" pulse shall also be in accordance with TIA/EIA-422-B, paragraph 4.1 for balanced or TIA/EIA-423-B for unbalanced. Type 1 cryptographic equipment will continue to provide the clock signal and hold the Receive Data (RD) signal line at a logic "0" while it resynchronizes. The VTU shall restart the Type 1 resynchronization process, as defined in this section, within 30 seconds after both of the following conditions have been met:

- the LOS line has returned to logic "1"; and
- the VTU is unable to find the frame alignment, as defined in ITU-T Recommendation H.221.

This process shall continue until frame alignment is achieved.

5.1.4.4 Type 1 Cryptographic Equipment for Non-Dedicated Networks

For dialup and other non-dedicated networks, and for new dedicated networks, KIV-7, KIV-7HS or compatible equipment shall be used. Existing KG-194s or compatibles may continue to be used in non-dedicated networks until KIV-7/KIV-7HSs become available.

5.1.4.4.1 Electrical and Mechanical Interfaces

The intent of this section is to provide sufficient information to allow the VTU, MCU, and network interface equipment manufacturers to be able to design and build their equipment, so that it will operate and interface with the KIV-7/KIV-7-HS without having to refer to other documents pertaining to the KIV-7.

All of the signal lines connecting the cryptographic equipment to the VTU and the network interface equipment shall have differential balanced connections, except the Loss of Synchronization (LOS) signal which shall have an unbalanced connection. The cipher-text (black) and plain-text (red) interface connections at the KIV-7/KIV-7HS interface shall conform to the mechanical specifications of EIA-449, the signal specifications of TIA/EIA-530, and the electrical specifications of TIA/EIA-422B for all signals except the LOS. The LOS shall conform to the electrical specifications of TIA/EIA-423-B. The suggested interface configuration is listed in Table 5.1-2.

If adapter cables are used to connect the VTU and network equipment to the KIV-7/KIV-7HS, EIA-449 is the preferred connector for the plain-text (red) interface and TIA/EIA-530 is the preferred connector for the cipher-text (black) interface. The red interface shall include the Send Data (SD), Send Timing (ST), Receive Data (RD) and Receive Timing (RT) signals. The corresponding black interface signals are Transmit Data (TD), Transmit Clock (TC), Receive Data (RD) and Receive Clock (RC) signals. In addition to these signals, some control signals (as specified below) shall be present with a logical high value for the KIV-7 to operate. If these control signals are not provided by the VTU, the network interface equipment or the KIV-7 configuration, they shall be provided by placing jumpers in the cable at the appropriate KIV-7 interface.

The required plain-text (red) signals include Request to Send and Terminal Ready. Request to Send may be disabled in the KIV-7 setup configuration. If Terminal Ready is not supported by the VTU, pin 20 should be jumped to pin 28 (+5V) and pin 23 should be jumped to pin 27 (signal ground).

The required cipher-text (black) signals include Clear to Send, Data Mode and Receiver Ready. Clear to Send may be disabled in the KIV-7 setup configuration. If the Data Mode and Receiver Ready signals are not supported in the network interface equipment, pins 6 and 8 should be jumped to pin 28 (+5V), and pins 10 and 22 should be jumped to pin 27 (signal ground).

If the Loss of Synchronization signal from the VTU is used to automatically resynchronize the KIV-7, it shall be configured as an unbalanced signal according to TIA/EIA-423-B and connected to pin 31 on the plain-text interface.

5.1.4.4.2 Resynchronization

Resynchronization can be done either manually or automatically, depending on the application. If done manually, no resynchronization signal is required from the VTU. The operator simply pushes the "initiate" button on the KIV-7/KIV-7HS to resynchronize it. If done automatically, the VTU shall detect loss of frame alignment and shall supply a resynchronization signal to the KIV-7/KIV-7HS.

The choice of manual or automatic resynchronization depends on several factors. For VTU applications where the KIV is difficult to access or there are banks of KIVs co-located, or where "bit slips" on the network transmission timing is frequent, automatic resynchronization of the KIV-7/KIV-7HS by the VTU is recommended. Resynchronization is mandatory for MCU's. Bit slips occur when there are small differences in the network timing between the near and far end. The preferred method of automatic resynchronization is for the VTU or MCU to send a pulse with a duration of not less than 20 microseconds. The electrical specification of this pulse should comply with TIA/EIA-423-B. For applications where network timing "bit slips" are infrequent, and where the operator can easily reach the KIV-7/KIV-7HS front panel (particular desktop configurations), resynchronization may be done manually and no resynchronization pulse is required from the VTU. Further details are available in the booklet "Embeddable KG-84 COMSEC Module (KIV-7) User's Manual".

5.1.4.4.3 Key Management

The KIV allows for local and over-the-air (OTAR) rekeying. For details, see the booklet "Embeddable KG-84 COMSEC Module (KIV-7) User's Manual".

Table 5.1-2. Suggested Interface for Network Interface Device, KIV-7 and VTU.

	TIA/EIA-530 Port	CIPHER-TEXT DTE CABLE	P2 PORT		P3 PORT	PLAIN-TEXT DCE CABLE	EIA-449-A PORT	
NETWORK INTERFACE EQUIPMENT	2	TRANSMIT DATA (TD) A	2	KIV-7/KIV-7HS CRYPTOGRAPHIC DEVICE	2	SEND DATA (SD) A	4	VIDEO TELECONFERENCING UNIT (VTU)
	14	TRANSMIT DATA (TD) B	14		14	SEND DATA (SD) B	22	
	15	TRANSMIT CLOCK (TC) A	15		15	SEND TIMING (ST) A	5	
	12	TRANSMIT CLOCK (TC) B	12		12	SEND TIMING (ST) B	23	
	3	RECEIVE DATA (RD) A	3		3	RECEIVE DATA (RD) A	6	
	16	RECEIVE DATA (RD) B	16		16	RECEIVE DATA (RD) B	24	
	17	RECEIVE CLOCK (RC) A	17		17	RECEIVE TIMING (RT) A	8	
	9	RECEIVE CLOCK (RC) B	9		9	RECEIVE TIMING (RT) B	26	
	5	CLEAR TO SEND (CTS) A	5		5	CLEAR TO SEND (CTS) A	9	
	13	CLEAR TO SEND (CTS) B	13		13	CLEAR TO SEND (CTS) B	27	
	4	REQUEST TO SEND (RTS) A	4		4	REQUEST TO SEND (RTS) A	7	
	19	REQUEST TO SEND (RTS) B	19		19	REQUEST TO SEND (RTS) B	25	
	20	DTE READY (DTR) A	20		20*	TERMINAL READY (TR) A	12	
	23	DTE READY (DTR) B	23		23**	TERMINAL READY (TR) B	30	
	24	TERMINAL TIMING (TT) A	24		24	TERMINAL TIMING (TT) A	17	
	11	TERMINAL TIMING (TT) B	11		11	TERMINAL TIMING (TT)	35	
	1	SHIELD (FRAME GROUND)	1		1	SHIELD (CHASSIS GROUND)	1	
	7	GROUND (GND)	27 7		27 7	SIGNAL GROUND (SG)	19	
	6	DCE READY (DSR) A	6*		6	DATA MODE (DM) A	11	
	22	DCE READY (DSR) B	22**		22	DATA MODE (DM) B	29	
	8	RECEIVED LINE SIGNAL DETECT (RLSD) A	8*		8	RECEIVER READY (RR) A	13	
	10	RECEIVED LINE SIGNAL DETECT (RLSD) B	10**		10	RECEIVER READY (RR) B	31	
		+5V TIE OFF	28		28	+5V TIE OFF		
					VTU AUTOMATIC RESYNC			
					31	LOSS OF SYNC; (OPTIONAL RESYNC)	36	
	* - If not provided by VTU or Network Interface Equipment then jumped to Pin 28 (+5V).							
	** - If not provided by VTU or Network Interface Equipment then jumped to Pin 27 (Ground).							

5.1.5 VTU Control of Multipoint Conference

The following sections describe the various capabilities that a VTU may have in a multipoint conference. Three types of capabilities are defined. They are Normal VTU Multipoint Capability, VTU User Control Capability, and VTU Chair Control Capability. The capabilities defined below are specified in ITU-T H.230 and H.243.

Under VTU User Control capabilities, User Broadcast Control is the least capable technique, User Select Control is more capable and User Chair Control is the most capable multipoint control technique.

5.1.5.1 Normal VTU Multipoint Capability

Note: In the following sections the use of the word 'display' is dependent upon the system configuration. If the VTU consists only of the CODEC then it cannot 'display'.

5.1.5.1.1 Basic Capability

All VTUs shall have the capability to participate in multipoint conferences. These VTUs shall have the following capabilities in a multipoint conference.

- See the video sent by the MCU.
- Have the MCU broadcast its video to other VTUs when determined by the MCU.
- Hear and be heard by the other VTUs.
- Verbally request the floor in a voice controlled or chair controlled conference.
- Freeze its display during video switching to minimize corruption of the video display (VCF).
- Fast update its video when it is selected as the video source by the MCU in order to initialize the displays of the other VTUs (VCU).
- Unfreeze the other VTU's displays when doing a fast update by inserting Freeze Picture Release in the H.261 or H.263 picture header.
- It is recommended that all VTUs be able to open data channels and obey MCS and MCN even if they cannot process the data.
- All VTUs shall equalize their incoming and outgoing rates or be relegated to Secondary VTU status (MCC).

Some of these capabilities may not be available if the VTU is designated as a Secondary VTU by the MCU. See Section 5.1.6.2.4.2.

5.1.5.1.2 Optional Capabilities

The following optional capability is recommended for a VTU that has a direct network interface consisting of more than one physical channel (such as ISDN BRI). This VTU should recognize TIA and transmit TIC and TIX. This will allow call association to take place in dial-in MCUs that use a single network access (phone) number per conference or per MCU. VTUs not having this capability may not be able to participate in multipoint conferences in certain network configurations.

Any VTU may also have the following optional capabilities that will enhance its multipoint conferencing capability.

- Display an ON AIR indication that its video is being broadcast to other VTUs (MIV).
- Display an indication that it is the only VTU connected in a multipoint conference. This indicates why the VTU may not have any video or audio until other participants join the conference (MIZ).
- Display an indication that it is a Secondary VTU in the conference. This indicates that the VTU may not be participating as fully as other VTUs in the conference (MIS).
- Receive a terminal number assignment from the MCU (TIA).
- Request a list of the terminal numbers of all VTUs participating in the conference (TCU).
- Obtain and display a list of the terminal numbers of all VTUs participating in the conference (TIL).
- Obtain and display the terminal number of a VTU added to the conference (TIN).
- Obtain and display the terminal number of a VTU dropped from the conference (TID).
- Obtain and display the terminal number of the current video source (VIN).
- Request the floor in a chair control conference (TIF).
- Respond to the MCU request (TCI) for a Terminal ID with a Terminal ID alpha-numeric string identifier, such as a name or location of the VTU (TII).
- Respond to the MCU request (TCS) for a Terminal ID with a Terminal ID alpha-numeric string identifier, such as a name or location of the VTU (IIS).
- Request the Terminal ID of another terminal (TCP).
- Obtain and display the Terminal ID of another terminal (TIP).
- Access value added services provided by the MCU using SBE characters. Many MCUs provide value-added services such as entering password, accessing an operator, or requesting changes to the conference configuration. These services are not subject to standardization, but they require the VTU to accept user input and issue SBE characters.

5.1.5.2 VTU User Control Capability

VTUs with User Control capability have all of the mandatory capabilities of the normal VTU, plus some additional capabilities that enable them to exercise some degree of control, including being able to request that its video signal be broadcast to other VTUs and that it view a particular VTU's video.

5.1.5.2.1 User Broadcast Control

As an option, the user may want to broadcast its video to all other VTU's in a multipoint conference. This is useful for distributing the video from a document camera to all of the participants without having the video switch to the loudest speaker. This function is called User Broadcast Control.

A VTU intended for user broadcast control shall have all of the capabilities of a normal VTU as described in Section 5.1.5.1.1 plus the following additional capabilities which are described in H.230 and H.243. The VTU may also have any of the optional capabilities of a normal VTU as described in Section 5.1.5.1.2. The VTU shall follow the procedures for user control using BAS codes as described in H.243.

These commands provide the VTU with the following capabilities:

- Request that all other VTUs see its video (MCV)
- Return to automatic video switching mode (Cancel-MCV)

User Broadcast Control capability is mandatory in all MCUs but is optional in the VTU. *See Section 5.1.6.1.2.2*. This command does not need to be honored when the conference is under chair control. Whether or not it is honored depends on the manufacture's implementation.

5.1.5.2.2 User Select Control

As an option, the user may want to control the video that the user's VTU receives in a multipoint conference. This function is called User Select Control. This capability is only effective if the MCU also supports User Select Control (VCS) option. *See Section 5.1.6.1.2.3*.

A VTU intended for user control shall have all of the capabilities of a normal VTU as described in Section5.1.5.1.1 plus the following additional capabilities, which are described in H.230 and H.243. The VTU may also have any of the optional capabilities of a normal VTU as described in Section 5.1.5.1.2. The VTU shall follow the procedures for user control using BAS codes as described in H.243.

A VTU intended for user control shall have a means of obtaining terminal numbers associated with the other VTUs in the conference. This information is received from the MCU in VIN, TIN, TID, and TIL. See Section 5.1.5.1.2. This is necessary to indicate to the user the terminal number associated with each participant. At least one of these commands is necessary to indicate to the users the terminal associated with each VTU.

These commands provide the User Select Control VTU with the following capabilities:

- Obtain and display the terminal numbers of other VTUs (TCU, TIN, TID, TIL, VIN)
- Request to see a specified VTU's video (VCS)
- Return to automatic video switching mode (Cancel-VCS)

5.1.5.3 VTU Chair Control Capability

5.1.5.3.1 Basic Capability

A VTU may optionally have the capability to perform the function of the chairman in a multipoint conference. This VTU shall be capable of exercising control over the conference. This function is called chair control.

A VTU intended for chair control shall have all of the capabilities of a normal VTU as described in Section 5.1.5.1.1 plus the following additional capabilities, which are described in H.230 and H.243. The VTU shall follow the procedures for chair control using BAS codes as described in H.243.

A VTU intended for chair control shall have a means of obtaining terminal numbers associated with the other VTUs in the conference. This information is received from the MCU in VIN, TIN, TID, TIL, and TIF. See Section 5.1.5.1.2. This is necessary to indicate to the chairman the terminal number associated with each participant. The VTU shall have a means of accepting input commands from the chairman so that the chairman can command the MCU. At least one of these commands is necessary to indicate to the users the terminal associated with each VTU.

These commands provide the VTU with the following capability:

- Obtain and display the terminal numbers of other VTUs (TCU, TIN, TID, TIL, VIN)
- Request the Chair (CCA)
- Release the Chair (CIS)
- Broadcast one VTU's video to all other VTUs (VCB)
- Return the conference to voice activated switching mode (Cancel-VCB)
- Drop a VTU from the conference (CCD)
- Drop the entire conference (CCK)

5.1.5.3.2 Optional Capabilities

Additional optional Chair Control capabilities can be provided. These capabilities provide additional control over the conference. This includes the following:

- Request to see a specified VTU's video. In a chair control conference, this command provides a roam capability allowing the chairman (or instructor) to selectively view the conference participants while they view the video selected by voice activation or a previous VCB command (VCS).

The VTU may also have any of the optional capabilities of a normal VTU as described in Section 5.1.5.1.2.

5.1.6 Multipoint Control Unit (MCU)

The MCU shall be capable of enabling three or more VTU systems to participate in an audiovisual conference. Two or more MCUs can be cascaded to provide conferencing between additional VTUs or for network considerations *(See Section 5.1.6.5)*. The MCU shall provide audio mixing and video switching capability as described in the following sections. This Profile defines the requirements for interactive multipoint video teleconferencing. Multipoint broadcast audiovisual transmission is outside the scope of this Profile.

In general, the MCU shall comply with the same requirements as the VTU. This includes ITU-T Recommendations H.221, H.320, H.230, and H.242 except as noted in the following sections. In addition, the MCU shall comply with the requirements of ITU-T Recommendation H.231 that defines the functional representation of the MCU. The MCU and participating VTUs shall comply with ITU-T Recommendation H.243, which describes the detailed specifications and procedures for communications between two or more audiovisual terminals.

The various MCU functions and capabilities are enabled and disabled by transmission and reception of a set of digitally encoded commands. In the ITU Recommendations, each command is designated an acronym, typically three capital letters, such as VCF, which stands for Video Command Freeze-picture request.

5.1.6.1 Video, Communications and Control

5.1.6.1.1 General

In general, each port of the MCU shall meet the provisions of Section 5.1.1 of this Profile, unless otherwise indicated in Table 5.1-3. Table 5.1-3 identifies the applicable sections that shall be met, replacing VTU with MCU in each section:

Table 5.1-3. MCU General Requirements

Section	Title	Exceptions and Additions
5.1.1.1	General	1. The requirements of H.261 do not have to be met, unless video mixing is used. See 5.1.6.1.3. 2. If FEC reframing is performed (see 5.1.6.1.2.5) the requirements of Section 5.4 of Recommendation H.261 or Annex H of H.263 dealing with FEC Coding shall apply. 3. The ability to switch video is mandatory. 4. The MCU shall also comply with the requirements set forth in ITU-T H.231 and H.243.
5.1.1.2	Operating Mode	The MCU shall provide bi-directional point-to-point operation with three or more VTUs.
5.1.1.3	Data Transmission Rates	
5.1.2	Control and Indication Signals	Note that MCUs have a somewhat different set of C&I signals from the VTUs.
5.1.2.1	Call Control (Handshaking)	
5.1.2.2	Frame Structure	

5.1.6.1.2 Video Switching (Selective Presence)

In the video switching mode of multipoint, the video displayed at each VTU is the video from one other VTU. This is in contrast to Video Mixing (Section 5.1.6.1.3) where the video from more than one source may be seen. Several methods are available for selecting whose video is seen by each VTU.

5.1.6.1.2.1 Voice Activated Switching

The ability of the MCU to conduct a conference using voice activation to determine which VTU's video to broadcast to the other VTUs is mandatory. *See Section 5.1.6.2.3.* The video signal to be sent to the selected, voice-active VTU is at the discretion of the MCU manufacturer. The previously selected video is a good candidate. Voice activated switching can be overridden by action of the chair VTU (VCB), or a user control VTU (VCS or MCV).

5.1.6.1.2.2 User Broadcast Control

The ability of the MCU to allow a user to broadcast its video to the other VTUs is mandatory. The MCU shall recognize and obey MCV and Cancel-MCV from the user VTU.

Multipoint Command Visualization-forcing (MCV) allows a VTU to request that an MCU broadcast its video to the other VTUs. Cancel-MCV returns the conference to voice activated switching mode. *See ITU-T H.243 for a detailed description.*

5.1.6.1.2.3 User Select Control

The ability of the MCU to allow a user to select the video that the user's VTU receives is optional. When this capability is provided in the MCU, the MCU shall recognize and, if there is no conflict with other modes, obey VCS and Cancel-VCS from the user VTU.

Video Command Select (VCS) allows a VTU to request that the MCU send the video of a specific VTU to it. Cancel-VCS returns the conference to voice activated switching mode. *See ITU-T H.243 for a detailed description.*

5.1.6.1.2.4 Chair Control

The ability of the MCU to conduct a Chair Control conference is optional. This is indicated by the signal Chair-control Indicate Capability (CIC).

An MCU having Chair Control capability shall provide a conference with the following capabilities:

- Allow a VTU to display the terminal numbers of other VTUs. (TCU, TIN, TID, TIL, VIN)
- Allow a Chair Control VTU to request the Chair (CCA)
- Allow a Chair Control VTU to release the Chair (CIS)
- Broadcast one VTU's video to all other VTUs as directed by the chair (VCB)
- Return the conference to voice activated switching mode as directed by the chair (Cancel-VCB)
- Drop a VTU from the conference (CCD)
- Drop the entire conference (CCK)

When the chair VTU indicates which VTU's video should be seen by the other VTUs (VCB), the video seen by the chair selected VTU is at the discretion of the MCU manufacturer unless it is currently selected by VCS. The previously selected video is a good candidate.

A conference participant who wishes to speak during a chair control conference should request the floor from the conference chair. The conference participant’s action, e.g., pressing a floor request button on the VTU, will cause the request for the floor (TIF) to be sent from the VTU to the MCU. The TIF shall be relayed to the chair control VTU by the MCU. The chair control VTU will indicate to the conference chair that another VTU requests the floor. The action taken in response to the request is at the chair's discretion, possible actions could be:

- Ignore the request.
- Defer the request while handling a request for the floor from another VTU.
- Turn over the floor to the requesting VTU by broadcasting the requesting VTU's video to all other VTUs (VCB) and assuring that the VTU's audio is distributed to all other VTUs either by audio mixing or audio switching.

The following feature is optional.

- Request to see a specified VTU's video. In a chair control conference, this command provides a roam capability allowing the chairman (or instructor) to selectively view the conference participants while they view the video selected by a previous VCB command or voice activated selection (VCS).

5.1.6.1.2.5 FEC Framing on Switching

The capability to do FEC re-framing is optional. When the source of the video signal is changed, due to any of the above procedures, video bit streams that are simply switched will cause a delay before a useful picture becomes available at the receiving VTU. Part of this delay is due to the fact that the FEC incorporated as part of H.261 or H.263 must be reframed by the decoder. At low bit rates, this could take about half a second. This delay could be eliminated if the MCU performs FEC reframing. To perform FEC reframing, the MCU shall always decode the incoming FEC framed video data and re-encode the selected video stream with its own FEC. This process occurs all the time, even when the video is not being switched. When the video source is switched, the FEC framing will not be lost. If this is done, the MCU shall also be able to detect fill FEC frames, strip out the fill, and insert the fill in the outgoing bit stream, in order to keep the same bit rates.

5.1.6.1.2.6 Terminal Identifiers

An MCU may optionally provide enhanced identification of the VTUs by using Terminal ID. Terminal ID allows VTUs to be assigned alphanumeric sequences such as names or locations, rather than arbitrary numbers. An example of the use of the Terminal ID would be that an MCU could merge the ID of the selected video source with the video so that the resulting video contains an alphanumeric overlay. This would allow all receiving VTUs to see the ID of the source of the video. Another example would be for the chair control terminal to request the terminal IDs from the MCU in order to present a list of participants to the chair. This would aid the chair in selecting the proper VTU for various chair control functions. The MCU requests the Terminal ID from a VTU using either TCI or TCS. The VTU responds with TII or IIS. A VTU may request the Terminal ID of another VTU using TCP. The MCU responds with TIP. TCS and IIS (MBE) is the recommended method.

5.1.6.1.3 Video Mixing (Continuous Presence)

Video mixing involves spatially multiplexing the selected images into a single image in "split screen" format. This is an optional feature. It requires the decoding and encoding of the video code, and therefore requires meeting the requirements of H.261 or H.263. The number of images that are mixed, the method of selection and control, and the video format used are left to the discretion of the manufacturer.

Standards for video mixing have not yet been defined. They will be added to this Profile when they are mature. While it may be possible to implement a video mixing scheme within the current standards, control of the scheme must be automatic or out-of-band since there is no facility in the current standards for the terminal to provide this control to the MCU.

5.1.6.1.4 Selection of Selected Communications Mode (SCM)

The Selected Communication Mode (SCM) is the set of four bit-rates (transfer rate, audio rate, video rate, and data rate), that the MCU attempts to maintain during the conference. In order to communicate with the MCU, the bit-rates shall be common between all Primary VTUs, although different audio algorithms may be used if they have the same bit-rate.

The MCU shall determine the SCM for a conference. The SCM may also change during a conference as VTUs join or leave the conference. The user should fully understand the impact that the SCM selection method provided by the MCU may have on conference operation. For example, if the user expects operation at 384 kb/s using G.722 audio then he should make sure the SCM could support that capability. The following methods may be used to determine the SCM. Other methods are possible.

- The SCM is fixed as a permanent feature of the MCU.
- The SCM is determined automatically by the MCU from the capabilities of the connected VTUs.
- Several SCMs are provided. One is selected by the MCU service provider at the time the conference is setup.
- The SCM is determined using procedures defined in MLP (T.120).

5.1.6.1.4.1 Minimum SCM

The SCM determination method shall include those modes that will enable at least minimum interoperability with VTUs having only the mandatory capabilities. For unrestricted VTUs, this would be p=2, 1.6 kb/s FAS/BAS, 56 kb/s G.711 audio, 0 kb/s data, with the remainder of the available bit rate allocated to H.261 or H.263 video. For restricted VTUs, this would be p=2,
1.6 kb/s FAS/BAS, 48 kb/s G.711 audio, 0 kb/s data with the remainder of the available bit rate allocated to H.261 or H.263 video.

5.1.6.1.4.2 Secondary Video Teleconferencing Units (VTUs)

In determining the SCM, the MCU may determine that many VTUs have a common capability set that is greater (more capable) than the remaining VTUs. The former VTUs are called Primary VTUs, while the latter are called Secondary VTUs. An optional capability is that the MCU can allow these Secondary VTUs to participate in the conference, but with a limited functionality. For example, a VTU on a network that can carry only p=1, might participate in a conference in which all other VTUs have video, but it does not. Without this optional capability, the Secondary VTUs would be dropped from the conference. The method of selection of the primary and secondary VTUs is left to the discretion of the manufacturer.

5.1.6.2 Audio

5.1.6.2.1 General

The MCU shall meet the requirements of Sections 5.1.3.2.1, 5.1.3.2.2, 5.1.3.2.3, 5.1.3.2.4 and 5.1.3.3 of this Profile. These sections state that G.722 and G.722.1 are optional, however it is highly recommended that they be included.

The MCU shall have both G.711 A-law and μ-law audio capability, and G.728. G.711 permits conferences with European VTUs, which might have only A-law audio. This allows for A-Law to μ-Law, and μ-Law to A-Law conversion.

5.1.6.2.2 Audio Mixing

Audio mixing shall be the default mode of operation of the MCU. Audio mixing shall be accomplished by the summation of the linear (PCM or analog) audio signals received. In general, all the received audio signals are summed, but small signals may be suppressed in order to minimize interference in large conferences. The actual method is left to the discretion of the manufacturer.

Audio switching connects the audio from only one VTU to the other VTUs. In this case, audio signals from the other VTUs are not mixed. Audio switching may be desirable in some applications such as remote training where spurious sound from the non-speaking sites is unwanted. Audio switching may also be used to connect VTUs in private conversations. The control for audio switching may follow the results of video switching commands, such as VCB, or it may be out of band.

Because the audio must be decoded and recoded, and video is switched, there may be more delay in the audio channel than in the video channel. While delay compensation is not required, a delay in the video channel is allowable to maintain audio and video synchronization. The time delay between audio and video signals shall be measured as specified in Annex C of H.261.

5.1.6.2.3 Voice Activated Switching

The MCU shall analyze the audio inputs to determine which participant will have the floor next. The algorithm for this determination is up to the discretion of the manufacturer. The result of this algorithm shall be used to determine which video signal to transmit to each VTU or MCU in the absence of VCB, VCS or MCV. The video to be sent to the VTU having the floor is up to the discretion of the manufacturer. The previously selected video is a good candidate.

5.1.6.3 MCU Data Communications

An MCU may provide the optional capability to support H.221 data channels. These channels may be used for the applications described in Sections 5.1.1.10, 5.1.1.11, 8 or other non-standard applications.

5.1.6.3.1 MCU Multimedia Teleconferencing Applications

An MCU may have the optional capability to support T.120 audiographic conferencing within the data channel. An MCU that has T.120 capability shall implement the T.122, T.123, and T.125 protocols as described in Section 8.2. The MCU shall implement T.124 as described below. An MCU may also implement any of the optional capabilities of T.124 as described below. Typically, the MCU does not contain any application protocols and it is not an end-point for T.120 applications.

The MCU shall be the Top Generic Conference Control (GCC) Provider as described in T.124. In a multipoint conference, all VTUs establish a point-to-point T.120 data connection with the MCU.

5.1.6.3.1.1 Mandatory MCU Conference Control Capability

An MCU having T.120 capability shall have the following mandatory capabilities defined in T.124 (for further explanation, see Sections 8.2 and 8.2.1):

- Respond to a request from a VTU to create a new conference, specifying the characteristics of that conference (*GCC-Conference-Create*).
- Respond to a query regarding what conferences are currently in progress and the information needed to join them (*GCC-Conference-Query*).
- Respond to a request from a VTU to join an existing conference (*GCC-Conference-Join*).
- Invite a VTU to join an existing conference and respond to a request from a VTU to invite another VTU to join the existing conference (*GCC-Conference-Invite*).
- Respond to a request from a VTU to leave an existing conference (*GCC-Conference-Disconnect*).
- Announce its presence in the conference (*GCC-Conference-Announce-Presence*, *GCC-Conference-Roster-Report*).
- Request the list of VTUs that have a particular application, group of applications, or any application (*GCC-Application-Roster-Inquire*).

- Respond to a request to terminate the entire conference (*GCC-Conference-Terminate*).
- Respond to a request to eject another VTU from the conference (*GCC-Conference-Eject-User*).
- Respond to a request to transfer a VTU to another conference (*GCC-Conference-Transfer*).

5.1.6.3.1.2 Optional MCU Conference Control Capability

An MCU Having T.120 capability may have the following optional capabilities defined in T.124 *(for further explanation, see Sections 8.2 and 8.2.2)*:

- Respond to an inquiry for the list of VTUs that have a particular application, group of applications, or any application (*GCC-Application-Roster-Inquire*).
- Respond to a request by the conductor VTU to prevent other VTUs from joining, or allow other VTUs to join the conference without being explicitly added by the convener (*GCC-Conference-Lock*, *GCC-Conference-Unlock*, *GCC-Conference-Lock-Report*).
- Dial-out to add another VTU to the conference (*GCC-Conference-Add*).
- Respond to a request for how much time is remaining (*GCC-Conference-Time-Inquire*).
- Respond to a request to extend the conference beyond the allocated time (*GCC-Conference-Extend*).
- Support application roster and registry (*GCC-Application-*, *GCC-Registry-*).
- Support conference Conductorship (*GCC-Conductor-*).

5.1.6.3.2 MCU Protocol for Far-end Camera Control

An MCU may optionally support the H.224 Real Time Protocol for Simplex Applications Using the H.221 LSD/HSD/MLP channels. This allows VTUs in a multipoint conference to use H.281 Far End Camera Control Protocol *(See Section 5.1.1.10)*.

An MCU which supports H.224 and receives an H.224 message from a VTU or MCU shall broadcast that message to all other VTUs and MCUs in the conference. The MCU does not examine or act on the message.

An MCU implementing the H.224 protocol shall use either the LSD channel or the MLP channel, or both as described in H.242. The MCU may optionally use the HSD data channel. The MCU shall support the common LSD or MLP data rate of 6.4 kb/s. This data rate provides a common point of interoperability with VTUs using H.224. If higher data rates are provided, it is recommended that all lower data rates (down to 6.4 kb/s), as specified in H.221, also be provided. This will allow VTUs and MCUs to interoperate at the higher data rates.

Use of the LSD and/or HSD channels for H.224 is recommended for far end camera control since these channels use a token system to assure that there is only one VTU transmitting at a time. An MCU, which supports the LSD or HSD data channels, shall follow the procedures of H.243 for data token operations. The MLP channel does not have this capability, so other measures are required to assure that only one VTU is attempting to control a camera.

5.1.6.3.3 MCU Transparent Data

An MCU may allow the H.221 data channels to provide a transparent channel for other applications within the VTUs to use. *See Section 5.1.1.11*. The MCU shall support the H.243 data token procedures for the LSD and HSD channels to assure that only one VTU is transmitting at a time.

Any data received from one VTU or MCU shall be broadcast to all other VTUs and MCUs in the conference. These Recommendations do not provide a mechanism for selectively routing data to a specific VTU. Selective routing of files can be accomplished using T.127 as per Section 8.4. Selective routing of images can be accomplished using T.126 as per Section 8.3.

5.1.6.4 MCU Security and Confidentiality

As an option, the MCU may provide confidentiality or secure operation. When required, confidentiality shall be provided as described in Section 5.1.4. Security for classified information shall be provided as described in Section 5.1.4.4. *See Table 5.1-3 for mandatory and optional requirements*.

Two types of MCUs are specified by this Profile. Unclassified MCUs shall only be used for unclassified or unclassified sensitive conferences. Classified MCUs shall be used for classified conferences, and may also be used for unclassified conferences *(See Section 5.1.4.2.3)*.

The dial-out capability of some MCUs provides an additional level of assurance that only those participants that should be in the conference are in it. This is applicable to both unclassified and classified conferences.

Table 5.1-4. MCU Security

Requirement	M/CM/O*	Transmit	Receive	Notes
Unclassified operation	M	X	X	
Unclassified Sensitive Operation	O	X	X	
Classified Operation	O	X	X	
Type I Encryption KG-194 KG-194 I/F KG-194 Resync	 CM CM CM	X	X	Mandatory if connected to existing dedicated network which provides for Classified Operation
Type 1 Encryption KIV-7/KIV-7HS KIV-7 I/F KIV-7 Resync	 CM CM CM	X	X	Mandatory for Classified Operation (except for existing dedicated networks)
Switching from unclassified to classified	CM	X	X	Mandatory for Classified operation
Multi-level Security	O			
Dial-out Capability	O	X		
Cascading	O	X	X	
Segmentable Operation	O	X	X	

(* - M: Mandatory; CM: Conditional Mandatory; O: Optional, X: Applicable)

5.1.6.4.1 Classified MCU in Classified Operation

5.1.6.4.1.1 MCU Port Encryption

A Classified MCU shall meet all of the requirements for a VTU described in Section 5.1.4. Each transmission channel between the MCU and a VTU or another MCU shall be protected by Type 1 cryptographic devices as described in Sections 5.1.4.3 or 5.1.4.4.

All classified MCUs shall have the capability to operate with KIV-7/KIV-7HSs (or compatible devices). All classified MCUs which connect to existing classified networks shall, in addition to KIV-7/KIV-7HS capability, also have the capability to operate with KG-194s (or compatible devices). The MCUs connected to existing dedicated networks shall provide the interoperability between the dedicated networks using KG-194s and other networks using KIV-7/KIV-7HS and/or KG-194 devices.

This will require a cryptographic device for each port in use on the MCU and one for each VTU in the conference. For example, a three party conference will require six cryptographic devices: three cryptographic devices at the MCU and one cryptographic device at each of three VTUs. *See Sections 5.2.3.1.3, 10.3.1.3, and 10.3.2.2 for interface configurations.*

5.1.6.4.1.2 Trusted Facilities

It is necessary that the Classified MCU be located in a trusted facility such as a SCIF or other protected enclosure (e.g., a controlled area in a tactical environment), since classified, unprotected data is present internal to the MCU. *See Section 10.2.*

5.1.6.4.1.3 Simultaneous Conference Operation

A Classified MCU may provide simultaneous conference operation as described in Section 5.1.6.7 provided that all simultaneous conferences being handled by the MCU are at the same security classification level. If compartmented information is present, all conferences shall have cleared access to the same compartments. For the case of simultaneous classified conferencing at a single classification level, or where all conferences are cleared to the same compartments, there is no specific NSA requirement for conference-to-conference isolation that applies to all cases. There is typically a need for conference-to-conference isolation, because the participants in one conference usually do not have a need to know what is going on in the other conferences. However, the degree of isolation required between these conferences may vary depending on the specific applications and must be determined on a case-by-case basis for each installation. In most cases, 60 dB of isolation will be adequate. Adequate safeguards shall be in place to assure that all the VTUs and MCUs participating in the multipoint conference are at the same level.

5.1.6.4.1.4 Multi-Level Security

A Classified MCU may provide simultaneous conference operation as described in Section 5.1.6.7 for simultaneous conferences at different security classification levels, including unclassified, provided that the MCU has been certified by NSA to the proper level of assurance for the specified security classification levels. In accordance with NSTISSAM TEMPEST/2-95, Section 4.3b, a Classified MCU providing simultaneous conference operation at different security levels, including unclassified, shall provide the following levels of isolation between conferences at different classification levels:

Type of Signal	dB of Isolation	Frequency Range Required
digital (audio, video or data)	60 dB	The entire range 1R through 10R, where R is the composite data rate of the signal
analog audio	100 dB	From 0.3 - 15 KHz
analog baseband video	80 dB	From 0 to 5 MHz

(Note - MCU's typically process only digital data. One exception is analog audio add-ons.)

(As of this date, we are not aware of any MCUs that have been certified by NSA to meet these requirements, so multi-level security may not yet be available.)

5.1.6.4.1.5 Cascading

A Classified MCU may provide cascading capability as described in Section 5.1.6.5 for connecting multiple MCUs in a single conference provided that all MCUs are operating at the same security classification level, and that if compartmented information is present that all MCUs have cleared access to the same compartments. Adequate safeguards shall be in place to assure that all the VTUs participating in the multipoint conference are at the same level.

A Classified MCU may provide combinations of cascading and simultaneous conference operation provided that the above individual requirements are met.

5.1.6.4.2 Classified MCU in Unclassified Operation

5.1.6.4.2.1 Security Level Reconfiguration

Reconfiguration of a classified MCU to unclassified operation is possible. If reconfiguration between classified and unclassified operation is required, the operational doctrine for the site shall assure that no inadvertent connection of an unencrypted channel be made to a classified conference. It is possible for cryptographic devices to be installed on several ports of the MCU, but be inadvertently left off of one or more ports. The decrypted data within the MCU could then be transmitted out of one of the unprotected ports. There is no automatic safeguard to prevent this.

A Classified MCU, which has not been certified for multi-level security operation as described in Section 5.1.6.4.1.4, may be configured with several classified ports and several unclassified ports. In this configuration, the MCU cannot support simultaneous classified and unclassified conferences. The classified ports may be used for classified conferences and the unclassified ports shall be isolated from the unclassified network by at least 100 dB of isolation. Alternatively, the unclassified ports may be used for unclassified conferences and the classified ports shall not be used.

5.1.6.4.2.2 Switching to Classified during a Conference

A Classified MCU shall allow an Unclassified conference to be initiated and then be switched to a classified conference, provided that all operational security measures have been met. This will cause the MCUs and VTUs to lose synchronization. The MCUs and VTUs shall be able to resynchronize to the framing information without having to disconnect and reconnect the call. This also requires that the cryptographic device be switched between bypass and operate modes, or be re-strapped to achieve the same result.

5.1.6.5 Cascading

The ability of an MCU to participate in a conference involving more than one MCU is optional and is called cascading. There are two optional types of cascading, Simple and Principal/Satellite. If the maximum number of MCUs to be connected is two, the Simple cascading capability is all that is needed. If three or more MCUs need to be connected, then Principal/Satellite cascading is required, but note that the Principal/Satellite method will also work with just two MCUs.

The maximum number of MCUs between any two VTUs shall not exceed three. For a star configuration, the Principal MCU shall be designated before the call as the MCU at the center of the star. In Principal/Satellite cascading the Principal MCU shall transmit the MIM command to the Satellite MCU. In the case of contention for Principal designation, the RAN command may also be used as in the contention resolution procedure in ITU-T H.243. The RAN command is mandatory for MCUs that do not support administration of Principal/Satellite status. The RAN command is recommended where the customer does not wish to make use of the administration of Principal/Satellite status feature.

5.1.6.6 Multipoint Rate (Speed) Matching

An MCU may have the capability for Multipoint Rate Matching (Speed Matching) per H.243 and H.231. Two optional methods are available to accomplish rate matching between VTUs operating at different bit rates. In the first method, the MCU shall limit the transmitted bit rates from the sending VTUs to match the lower bit rate of a less capable receiving VTU. For example, an MCU with three VTUs, one endpoint connected at 128 kb/s and two VTUs connected at 384 kb/s. The MCU would limit the two 384 kb/s VTUs to 128 kb/s.

The second method can preserve a higher quality video between the more capable VTUs. The MCU transcodes between the VTUs. In the same example, with one VTU connected to the conference at 128 kb/s and two VTUs connected at 384 kb/s, the MCU will transcode from the 384 kb/s VTUs to 128 kb/s for the lesser capable VTU, while maintaining 384 kb/s between the other two VTUs.

5.1.6.7 Simultaneous Conference Operation

An MCU may be used in more than one conference at a time. This is also known as segmentable operation. The number of simultaneous conferences that can be held is not a matter for standardization, but may be specified in the acquisition document.

A Classified MCU shall have special requirements imposed in order to support multiple simultaneous independent classified conferences. *See Section 5.1.6.4.1.3*.

5.2 H.320 Subnetwork-Type Dependent Requirements

5.2.1 General

VTUs and MCUs shall be capable of operating on unrestricted and/or restricted networks. They shall also be capable of operating with other terminals on unrestricted and restricted networks. If both terminals are set to restricted operations, then they shall be capable of operating over a network connection where a middle segment or segments of the network are restricted. Restricted networks are discussed in Annexes A and B of ITU-T H.221, Section 13.4.5 of ITU-T H.242, and Section 3.6 of ITU-T H.230. There are currently no standard means for terminals to detect such a restricted middle segment.

5.2.2 VTU Network Interface

The VTU to network interface is entirely dependent upon the type of underlying sub-network used. Examples of point-to-point VTU interconnection include leased digital circuits, switched digital circuits, or Integrated Services Digital Network (ISDN).

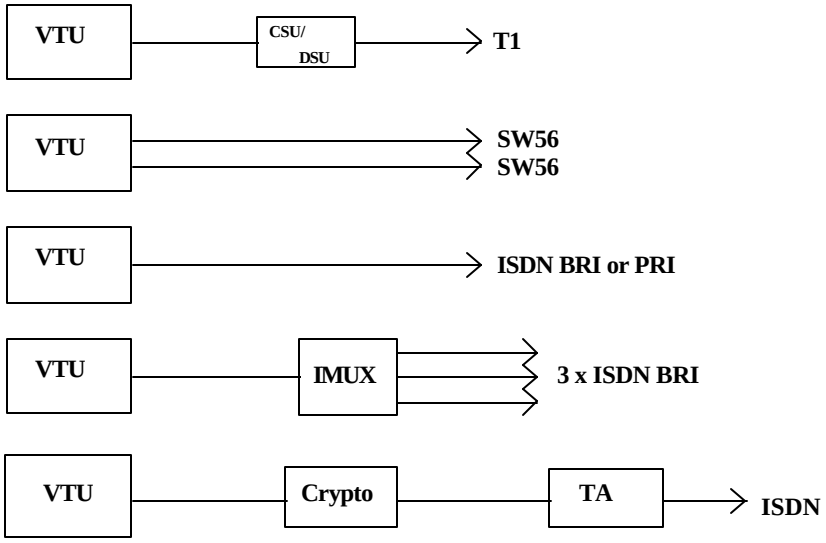

Figure 5.2-1 Examples of Some Network Connections

For VTUs connected to dedicated networks, such as the DISN Video Services (DVS), a minimum of one synchronous EIA-449 attachment port is strongly recommended as specified in Sections 5.1.4.3.1 and 5.1.4.3.2. For other VTUs, a minimum of one EIA-449 attachment port as per Sections 5.1.4.4.1 and 5.1.4.4.2 is strongly recommended. This will allow interface to KG-194 and KIV-7/KIV-7HS cryptographic devices, should a classified conference be required. (There may be a need to do classified conferencing in an emergency even if the VTU is normally used for unclassified purposes.)

5.2.3 Integrated Services Digital Network

ISDN is a popular network service for video teleconferencing, however, given the range of services and network interface possibilities, this Profile does not specify any single approach. An ISDN transmission channel may consist of 1 to 6 B (64 kb/s) channels, 1 to 4 H_0 (384 kb/s) channels, an H_{10} (1,472 kb/s) channel, or an H_{11} (1,536 kb/s) channel.

5.2.3.1 ISDN Basic Rate Interface (BRI)

ISDN interfaces are optional. Two optional BRI ISDN interface configurations are provided for information. See Sections 5.2.3.1.1 and 5.2.3.1.2. A third option for classified operation is also included in Section 5.2.3.1.3. Included in the scope of this Profile are the ISDN BRI interfaces between the VTU and the terminal adapter (TA).

All of the configurations below are in accordance with the North American ISDN Users Forum (NIUF) profile, *NIUF Video Conferencing Application Profile*, and the NIUF catalog, *A Catalog of National ISDN Solutions for Selected NIUF Applications*. Any of these configurations may be chosen, depending on the needs of the user. The use of D-channel signaling is permitted for unclassified and unclassified sensitive operation. The use of D-channel signaling originating from the VTU is not permitted with classified operation.

5.2.3.1.1 Option 1, External Terminal Adapter

Option 1 is for unclassified and Type 3 unclassified sensitive operation. The VTU shall have one or two ports. These shall be used to connect to an external ISDN Terminal Adapter (TA). See Figure 5.2-2. The TA is outside the scope of this Profile. Note that if the VTU user specifies the one port version, and two B channels are used, the necessary aggregation (IMUX) function to go from a single port to two B channels shall be performed by the TA. In the dual port version, the aggregation function is performed within the VTU. See Section 10.3.2 for other possible configurations.

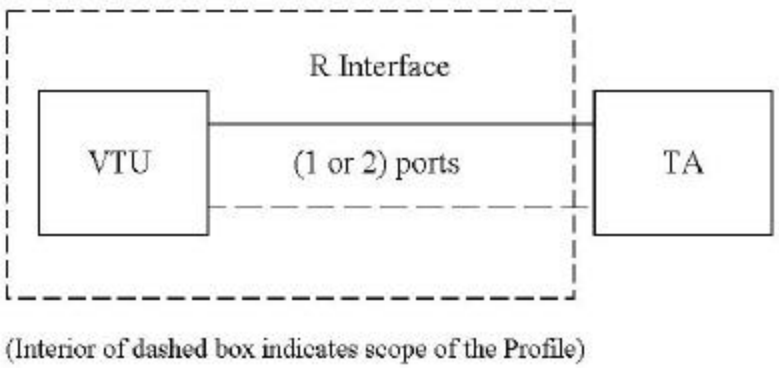

Figure 5.2-2. Option 1, External TA

5.2.3.1.2 Option 2, External Terminal Adapter with Dialing Interface

Option 2 is for unclassified and Type 3 unclassified sensitive operation. In addition to requirements of option 1, the VTU shall have two dialing interfaces (EIA-366-A), one for each B channel, for convenient dialing through the VTU.

Existing VTUs, or VTUs that require the use of specific non-ISDN interface connectors, will require the use of Terminal Adapters.

Other VTUs may be designed to attach at the user side of the Network Termination (S/T reference point on NT1).

Still other VTUs may incorporate the NT1 function. Such design decisions are as much a financial as an engineering choice and are beyond the scope of this Profile.

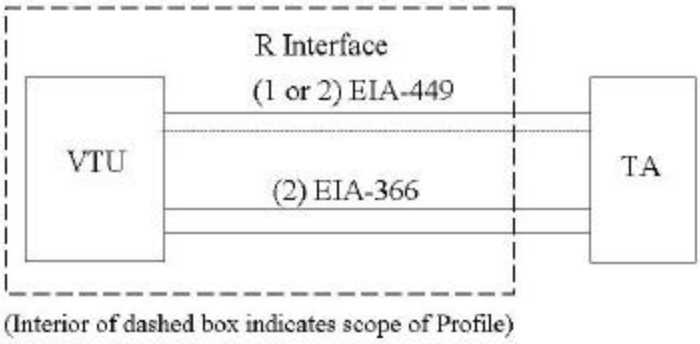

Figure 5.2-3. Option 2, External TA with Dialing Interface.

The EIA-366-A dialing interface is not permitted to be physically or electrically connected during classified operation. *(See Figure 10.3-2 in Section 10.3.1.2 for a typical configuration.)* This disconnect function can be accomplished in the TA, or a special device between the VTU and the TA may be purchased to ensure the disconnect function is accomplished. Note that if the VTU user specifies the one EIA-449 port version, and two B channels are used, the necessary IMUX function to go from a single port to two B channels shall be performed by the TA. *See Figure 5.2-3*. In the dual-port version, the IMUX function is performed within the VTU.

5.2.3.1.3 Option 3, Classified Operation

Option 3 is for Type 1 classified operation, in accordance with Section 5.1.4.3. The VTU shall use only one EIA-449 port, as described in Sections 5.1.4.3.1, 5.1.4.3.2, 5.1.4.4.1 and 5.1.4.4.2. *See Figures 5.2-4 and 5.2-5.*

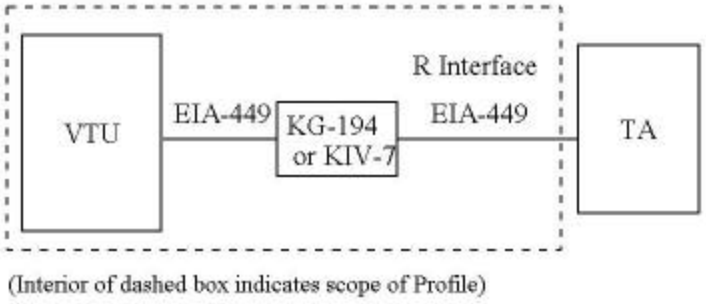

Figure 5.2-4. Option 3, Classified Operation with Single Channel.

Dialing shall be performed on the network side of the cryptographic device. In this option, dialing is typically done through the TA. *(See Figure 10.3-3 in Section 10.3.1.3 for a more detailed configuration.)* No other physical or electrical connection between the VTU and the network or network interface is permitted other than through the cryptographic device, unless written permission for a specific configuration has been obtained from NSA. *Note that if two B channels are used, the necessary IMUX function to go from a single channel to two B channels shall be performed by the IMUX/TA, as shown in Figure 5.2-5.*

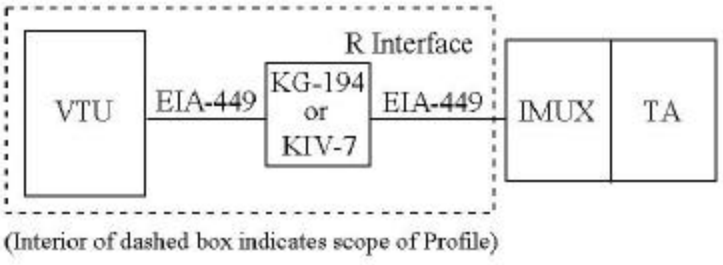

Figure 5.2-5. Option 3, Classified Operation with Multiple Channels.

5.2.3.2 VTU Network Interface (BRI)

As an option, a two-channel network interface to the VTU is recommended. This is needed for interoperability at p=2 unless an inverse multiplexer (aggregator) is used to interface to the network.

5.2.4 Channel Aggregation

It is possible for a VTC terminal or MCU to have a single channel interface to multiple channels using channel aggregation. Channel aggregation is also known as inverse multiplexing. An example is aggregating 6 ISDN B channels into a single 384 kb/s channel using an Inverse Multiplier (IMUX). The use of channel aggregation increases interoperability between equipment on different networks, and allows a high-speed interface to low speed networks. Use of channel aggregation is optional for VTC, but when it is built into a VTU or MCU, that equipment shall adhere to the requirements of ITU-T H.244.

There are four different "cases" described in ITU-T H.244. Case "B" has been commonly called BONDING. When channel aggregation is build into a VTU or MCU, it shall be capable of operating using the combination of case "B" and Mode B1 as specified in ITU-T H.244.

5.2.5 MCU Network Interface

5.2.5.1 Physical and Electrical Interface

An MCU may have any appropriate network interface for the network to which it is connected. The network interface may consist of one or more channels. The MCU may be able to be configured with different network interfaces on different ports. This provides a video teleconferencing gateway capability between different networks. *See Sections 5.2.2 and 5.2.3 for possible configurations of network interface ports.*

Alternatively, the MCU may be configured with a wideband interface to the network such as a PRI or T1. In this configuration, the MCU shall demultiplex the individual channels from the wideband interface and route them to the appropriate MCU ports. This approach reduces the number of physical ports required on the MCU because a single interface carries calls from multiple VTUs.

If an external inverse multiplexer is needed for networks with more than 1 channel, such as ISDN and dual-switched 56 kb/s networks, *see Section 10.3.2*.

An MCU intended for classified operation shall have a network interface as described in Section 5.2.5.2.

Table 5.2-1. MCU - Network Interface.

Requirement	M/CM/O*	Transmit	Receive	Notes
BRI	O	X	X	
PRI	O	X	X	
E1/T1	O	X	X	
RS-449	CM	X	X	Mandatory for Classified MCU
EIA-366	O	X	X	
Switched-56	O	X	X	
OTHER	O	X	X	
Restricted Operation	M	X	X	

(* - M: Mandatory; CM: Conditional Mandatory; O: Optional, X: Applicable)

5.2.5.2 Classified MCU Network Interface

One synchronous EIA-449 interface for each attachment port shall be provided on the MCU to provide the capability to connect to a cryptographic device. The electrical characteristics shall be as specified in TIA/EIA-422-B for balanced voltage digital-interface circuits. The requirements of Section 5.1.4.3 shall apply to the EIA-449 network interface ports that are required for the MCU to interface with KG-

194-compatible cryptographic equipment. The requirements of Section 5.1.4.4 shall apply to the EIA-449 network interface ports that are required to interface with KIV-7/KIV-7HS compatible equipment. The user will need to specify how many ports are to be used with KG-194s and how many with KIV-7/KIV-7HSs.

If an external inverse multiplexer is needed for networks with more than 1 channel, such as ISDN and dual-switched 56 kb/s networks, *see Section 10.3.2*.

5.2.6 VTU and MCU Restricted Operation

All VTUs and MCUs shall implement the mandatory restrict capabilities and commands defined in ITU-T H.221 and follow the procedures for restricted operation in ITU-T H.242.

A VTU or an MCU connected to an unrestricted network and having a network interface that does not provide network octet timing should implement the procedure described in Section 13 of ITU-T H.242. This will provide for interoperation with VTUs or MCUs on a network with a restricted segment. A VTU or MCU connected to an unrestricted network and having a network interface that does not provide network octet timing may not be able to communicate with a VTU or MCU on a restricted network. It may also not be able to communicate with a VTU or MCU connected to an unrestricted network but passing through a restricted segment. The latter is quite common in long distance connections in North America. Restricted mode operation is primarily a North American problem; however, systems outside of North America may need to interoperate with North American systems.

5.3 Year 2000 Compliance

All VTC equipment shall be Year 2000 compliant as per the Federal Acquisition Regulation (FAR). Year 2000 compliant means information technology that accurately processes date/time data (including to calculating, comparing, and sequencing) from into, and between the twentieth and twenty-first centuries, and years 1999 and 2000, and leap year calculations. Furthermore, Year 2000 compliant information technology, when used in combination with other information technology, shall accurately process date/time data if the other information technology properly exchanges date/time data with it.

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6 VTC OVER LOCAL AREA NETWORKS

These requirements shall apply to all video teleconferencing systems operating over packet-based networks, which does not provide a guaranteed Quality of Service. In order to guarantee a given Quality of Service, additional protocols must be implemented that are not yet widely available. H.323 terminals and equipment carry real-time voice, and combinations of data and real-time video.

Except as noted, the H.323 VTU shall conform with the requirements set forth in ITU-T H.323, which refers to several other ITU-T Recommendations. This version of the Profile references version 2 of H.323, since newer versions have not been widely implemented by vendors.

H.323 entities may be used in point-to-point, multipoint, or broadcast configurations. Interoperability with H.320 terminals on N-ISDN, and H.324 terminals on PSTN is through Gateways. In the future, interoperability of H.323 entities with H.310 and H.321 terminals on B-ISDN, and H.322 terminals on Guaranteed Quality of Service LANs may also be supported through Gateways.

H.323 has gone through several versions through its development. H.323 version 2, the mandatory version of the Profile, products are backward compatible and interoperable with H.323 version 1 products which comply with all the mandatory requirements of H.323 of November 1996.

6.1 H.323 Components

H.323 defines the following components: Terminals, Gatekeepers, Gateways and MCU's.

6.1.1 Terminal Characteristics

In terms of the client/server model for networking, H.323 terminals are the client endpoints providing real-time, two-way audio, video and data communications to the user. Figure 1.2 illustrates the terminal organization and components. All terminals shall support voice communications; video and data are optional. H.323 specifies the modes of operation required for different audio, video, and/or data terminals to work together.

All H.323 terminals shall also support H.245, which is used to negotiate channel usage and capabilities. Three other protocol components, defined in H.225.0, are mandated, Call signaling for call establishment, Registration/Admission/Status (RAS) Signaling for communications with the Gatekeeper, and RTP/RTCP for packetization and synchronization of audio and video streams.

Optional components in an H.323 terminal are video codecs, T.120 data conferencing protocols, and MCU capabilities (described further below).

6.1.2 Gateway Characteristics

H.323 Gateways provide translation operations between H.323 and non-H.323 terminals. An example of this is an H.323 terminal communicating to an H.320 compliant terminal such as in Figure 6.1-1. The H.320 terminal communicates over an ISDN network. Other examples are shown in Figure 6.1-2.

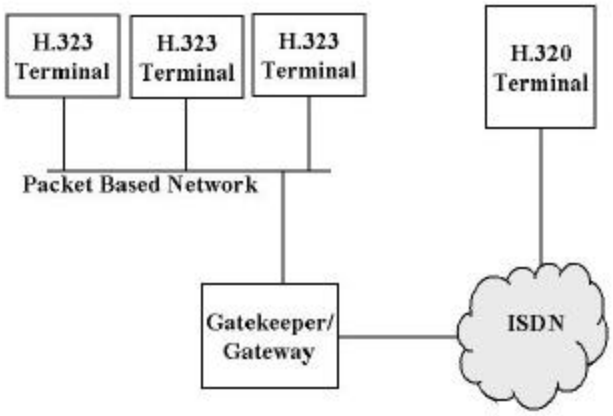


Figure 6.1-1. Typical H.323/H.320 Terminal Conferencing via Gateway

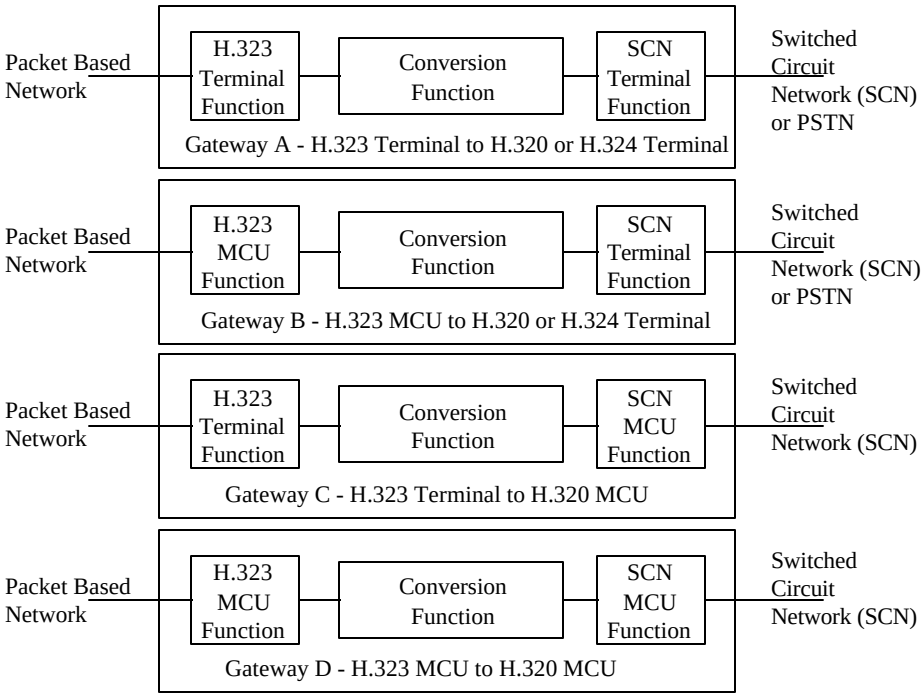


Figure 6.1-2. Four Possible H.323 Gateway Configurations

The Gateway is an optional element in an H.323 conference. Gateways provide many services, the most common being a translation function between H.323 conferencing endpoints and other terminal types. In general, the purpose of the Gateway is to reflect the characteristics of a LAN endpoint to an SCN (Switched Circuit Network) endpoint and vice versa. The primary applications of Gateways are likely to be:

- Establishing links with analog PSTN terminals;
- Establishing links with remote H.320-compliant terminals over ISDN-based switched-circuit networks; and,
- Establishing links with remote H.324-compliant terminals over PSTN networks

This function includes translation between transmission formats and between the signaling and communications procedures for H.323 terminals as defined in H.245, and H.320 terminals as defined in H.242. In addition, the Gateway also translates between audio and video codecs and performs call setup and disconnect on both the LAN side and the Switched-Circuit Network (SCN) side.

Gateways are not required if connections to other networks are not needed, since endpoints may directly communicate with other endpoints on the same LAN.

With the appropriate transcoders, H.323 Gateways may also support terminals that comply with H.310, H.321, H.322, and V.70. *See Figure 6.1-3.* Note: H.310, H.321, H.322, H.324 and V.70 are currently beyond the scope of this document.

Many Gateway functions are left to the designer. For example, the actual number of H.323 terminals that can communicate through the Gateway is not subject to standardization. Similarly, the number of SCN connections, the number of simultaneous independent conferences supported, the audio/video/data conversion functions, and inclusion of multipoint functions are left to the manufacturer. By incorporating Gateway technology into the H.323 specification, the ITU has positioned H.323 as the critical element that holds the world of standards-based conferencing endpoints together.

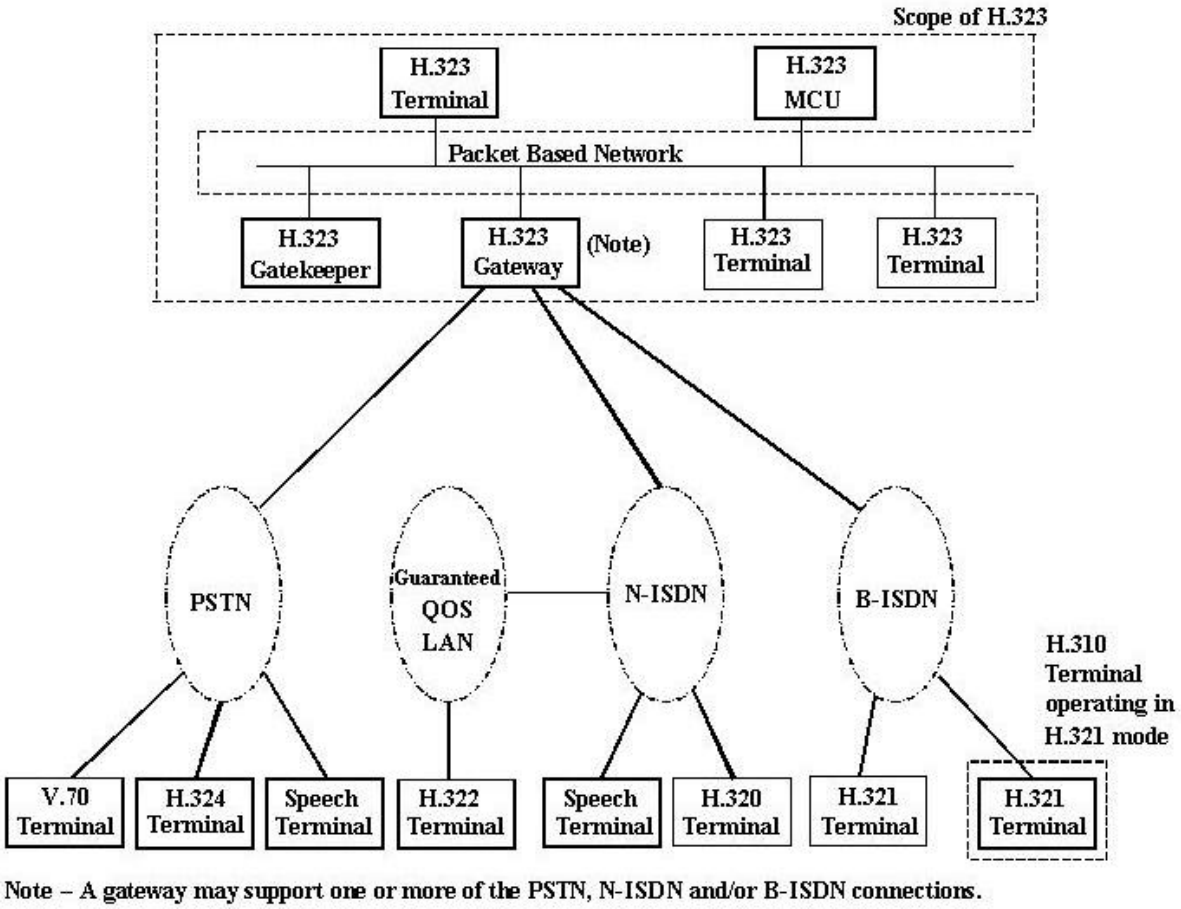


Figure 6.1-3. H.323 Interoperability with H.320 and Other Standards

6.1.3 Gatekeeper Characteristics

H.323 Gatekeepers act as control points for all calls within its zone and provide call control services to registered users. Gatekeepers act as virtual switches for H.323 conferences. A Zone *(see Figure 6.1.4)* is the collection of all terminals, Gateways, and Multipoint Control Units (MCU) managed by a single Gatekeeper. A Zone includes at least one terminal, and may or may not include Gateways or MCUs. A Zone has one and only one Gatekeeper. A Zone may be independent of network topology and may be comprised of multiple network segments, which are connected using routers or other devices.

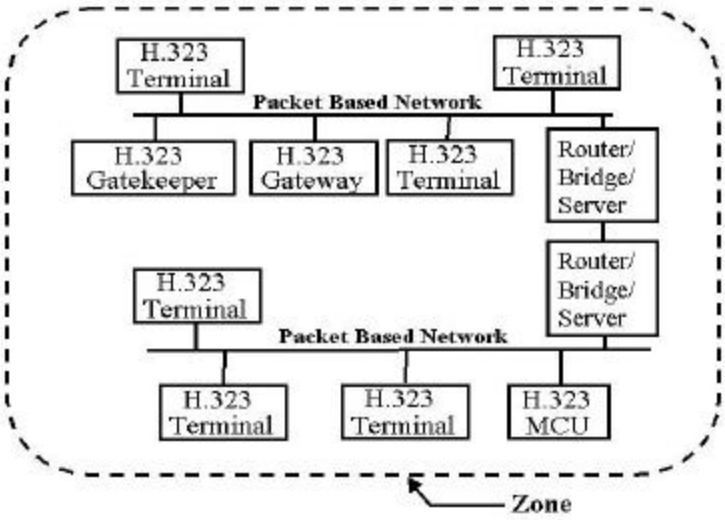


Figure 6.1-4. H.323 – Zone

6.1.3.1 Mandatory Gatekeeper Functions

The following Gatekeeper functions are as mandated by the H.323 standard.

Table 6.1-1. Mandatory Gatekeeper Functions

Address Translation	Translation of alias* address to Transport Address.
Admissions Control	Authorization of LAN access using Admission Request, Confirm and Reject messages. This may be a null function, which admits all requests.
Bandwidth Control	Supports Bandwidth Request, Confirm and Reject messages. This may be a null function, which accepts all bandwidth requests.

*Alias – an alternate name or field used for identification of real name.

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

- Address Translation – The Gatekeeper shall perform alias address to Transport Address translation. This may be done using a translation table, which is updated using the Registration messages of H.225. Other methods of updating the translation table are also allowed.
- Admissions Control – The Gatekeeper shall authorize network 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 of H.225. This may be based on bandwidth management. It may also be a null function, which accepts all requests for bandwidth changes.
- Zone Management – The Gatekeeper shall provide the above functions for terminals, MCUs, and Gateways, which have registered with it.

6.1.3.2 Other Gatekeeper Functions

The Gatekeeper may perform other optional functions such as:

- Call Control Signaling – The Gatekeeper may choose to complete the call signaling with the endpoints and may process the call signaling itself. Alternatively, the Gatekeeper may direct the endpoints to connect the Call Signaling Channel directly to each other. In this manner, the Gatekeeper can avoid handling the H.225.0 call control signals. The Gatekeeper may have to act as the network as defined in Recommendation Q.931 in order to support supplementary services. This operation is beyond the current scope of the Profile.
- 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 Gateways, and restricted access during certain periods of time. The criteria for determining if authorization passes or fails is outside the scope of this Profile.
- Bandwidth Management – Control of the number of H.323 terminals permitted simultaneous access to the network. 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 Profile. *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. The Gatekeeper may also provide speed matching or dictating through its bandwidth management function to control of the number of H.323 terminals permitted simultaneous access to the network. Through the use of the H.225.0 signaling, the Gatekeeper may request that an endpoint raise or lower the bandwidth. If the request is to raise the rate, the endpoint may either confirm bandwidth change or reject the bandwidth change. If the request is for a lower rate, the endpoint shall reply with a confirmation if the lower rate is supported, otherwise the endpoint rejects the bandwidth change.
- 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 – Beyond the current scope of the Profile.
- Bandwidth reservation for terminals not capable of this function – Beyond the current scope of the Profile.
- Directory services – Beyond the current scope of the Profile.

In order to support ad hoc Multipoint Conferences, the Gatekeeper may choose to receive the H.245 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 Channel to a Multipoint Controller (MC) *(See Section 6.1.4 for details on MCs)*. The Gatekeeper need not process the H.245 signaling; it only needs to pass the signals between the terminals or the terminals and the MC.

While the Gatekeeper is required to respond to the messages in Section 6.1.3.1, the policy used to determine admission criteria or bandwidth allocation is not subject to standardization. This provides a wide spectrum of capabilities that vendors can use to discriminate their products from their competitors.

The admission policy determines how an endpoint gets access to the network for making or receiving a multimedia call. A very simple policy may allow only a fixed number of calls at a time. The next endpoint requesting admission would then be rejected. Alternatively, the policy could be very extensive, taking into account the following: which endpoint is calling, do they have permission to make that call, and is there is enough bandwidth available for them to make the call. For example, some terminals may not be allowed to access the Gateway for a long distance call during certain hours. Or any number of calls can be placed as long as the total requested bandwidth does not exceed some pre-determined level.

Bandwidth control policy can be handled in a similar manner. Very simple policies may limit all calls to a fixed bandwidth. More complex calls may allow the bandwidth to change dynamically during the call as more or fewer calls are in progress.

It is important to look at the admission and bandwidth control policies of the products being considered, and assure that the policy is consistent with the desired operational environment.

In addition to the admission and bandwidth policies, the Gatekeeper may optionally provide other PBX like functions. This is accomplished by routing the call signaling and control channel information through the Gatekeeper. This operation is transparent to the terminals and other endpoints, which do not need to know that a call is being routed through the Gatekeeper. These PBX like functions include supplementary services such as call transfer and forwarding, and routing calls to multipoint control units for gatekeeper controlled ad hoc multipoint conferencing.

The Gatekeeper may also offer other optional capabilities, which are not subject to standardization. These include accounting and management functions, such as logging call times and durations, call source and destination, network/bandwidth utilization, and other statistics and reports. This is possible since the Gatekeeper is involved in the establishment and disconnect of every call.

6.1.4 Multipoint Control Unit (MCU) Characteristics

The Multipoint Control Unit (MCU) supports multipoint conferences. An MCU consists of a Multipoint Controller (MC), which is required, and optionally, one or more Multipoint Processors (MP). The required MC handles the common capability negotiations for audio and video processing, and also controls audio and video multicasting. The optional MP provides the mixing, switching and processing of audio, video and/or data. The MC and MP capabilities may exist in other H.323 components.

The Multipoint Controller (MC) may optionally have the capability to rate (speed) match between VTUs operating at different bit rates. If the VTUs on each link in a multipoint configuration attempt to operate at different bit rates, the MC shall limit the bit rates from the transmitting VTUs, per H.245, to match the bit rate of the least capable receiving VTU.

6.2 H.323 Requirements

The audio, video, data and control requirements are summarized below.

6.2.1 Audio Requirements

H.323 terminals shall support G.711 A-law and μ-law speech compression. The terminal may optionally support G.722, G.728, G.729, MPEG 1 audio, and G.723.1 encoders. If G.723.1 is supported, then both 5.3 kb/s and 6.3 kb/s modes shall be supported.

When it is known that the communications path will include a low bitrate link (< 56 kb/s), the endpoint shall also support G.723.1 audio coding. The H.323 standard does not mandate G.723.1, however, the industry has unofficially selected it as the low bit rate codec. It is highly recommended that all endpoints support G.723.1. Since it is difficult to know ahead of time what communications links will be traversed, it is recommended that all endpoints support both G.711 and G.723.1.

The use of the other audio codecs may provide better quality audio at the expense of reduced video performance. The availability of other audio codecs may also improve the quality of the call when going through a Gateway, since the Gateway will not need to transcode the audio.

Terminals which support ad hoc or distributed multipoint conferencing will need to be able to receive multiple audio channels and perform mixing of those channels. An ad hoc multipoint conference is a point-to-point conference that has been expanded into a multipoint conference at some time during the call. This can be done if one or more of the terminals in the initial point-to-point conference contains a Multipoint Controller (MC). This applies if the call is made using a Gatekeeper that includes MC functionality, or if the initial call is made through an MCU as a multipoint call between only two terminals. In a distributed multipoint conference, the control function may be distributed between several MCs.

6.2.2 Video Requirements

If the H.323 terminal supports video then it shall support H.261 QCIF mode. It shall also support H.263 QCIF mode and H.263 sub-QCIF mode. It may also support other optional modes as summarized in the following table.

Table 6.2-1. H.323 Picture Format Requirements

Videoconferencing Picture Format	Image Size In Pixels	H.261	H.263
Sub-QCIF	128x96	N/A	mandatory
QCIF	176x144	mandatory	mandatory
FCIF	352x288	optional	optional
4FCIF	702x576	N/A	optional
16FCIF	1408x1152	N/A	optional

6.2.3 Data Conferencing Requirements

One or more data channels may optionally be supported. T.120 is the default data capability. When supported, T.120 data conferencing enables shared whiteboards, application sharing and file transfer *(see Section 8 for detailed descriptions and guidance)*.

6.2.4 Control Functions

The H.245 Control Function uses the H.245 Control Channel to carry end-to-end control messages governing operation of the H.323 entity, 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 endpoints: an endpoint and a Multipoint Controller, or an endpoint and a Gatekeeper. The endpoint shall establish exactly one H.245 Control Channel for each call in which the endpoint is participating. This channel shall use the messages and procedures of H.245. *Note that a terminal, MCU, Gateway, or Gatekeeper may support many calls, and thus many H.245 Control Channels.*

H.245 specifies a number of independent protocol entities, which support endpoint-to-endpoint signaling. A protocol entity is specified by its syntax (messages), semantics, and a set of procedures which specify the exchange of messages and the interaction with the user. H.323 endpoints shall support the syntax, semantics, and procedures of the following protocol entities:

- Master/slave determination;
- Capability Exchange;
- Logical Channel Signaling;
- Bi-directional Logical Channel Signaling;

- Close Logical Channel Signaling;
- Mode Request;
- Round Trip Delay Determination; and,
- Maintenance Loop Signaling.

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. H.245 messages fall into four categories: Request, Response, Command, and Indication. Request and Response messages are used by the protocol entities. 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 of H.323, and shall transmit indications reflecting the state of the terminal.

6.2.5 Multipoint Capabilities

H.323 provides for centralized, decentralized and hybrid multipoint operation. All endpoints shall support centralized multipoint capability. Distributed audio and distributed video control messages are to be used to specify the optional decentralized and hybrid modes of operation.

6.2.5.1 Multicast

In multicast transfers, data is transferred from a single source to multiple network destinations. The actual mechanism (i.e. IP multicast, multi-unicast, etc.) for this process may be different for different network technologies. Multicast, in contrast to unicast or broadcast, handles streaming audio and video over the network with RTP. Unicast, on the other hand, sends multiple point-to-point transmissions. *see Figure 6.2-1*. Multicast is significantly more efficient in use of bandwidth than unicast, as packets are not replicated for transmission throughout the network.

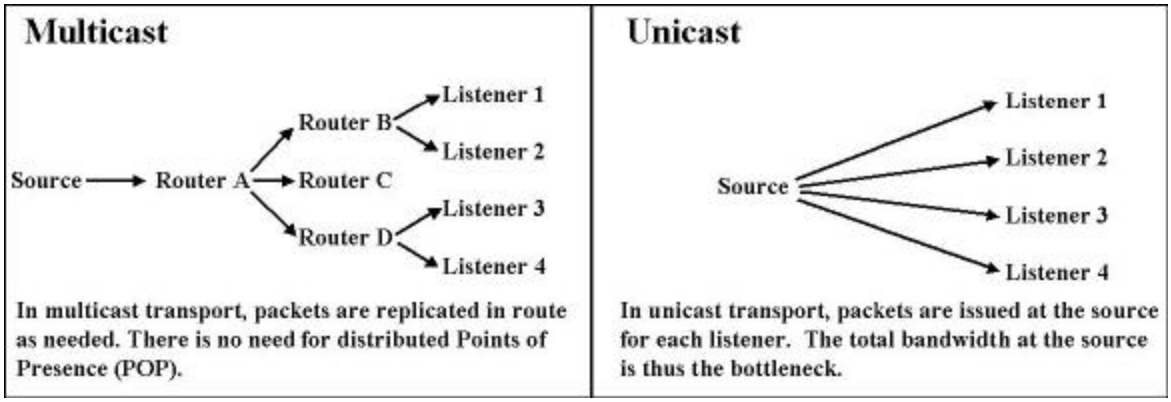


Figure 6.2-1. Packet Transport Diagrams

6.2.6 Layered Video Codecs

Annex B of H.323 defines the use of the optional layered video coding procedures. Layered video coding is a technique that allows the video information to be transmitted in multiple data streams in order to achieve video scalability. These may provide bandwidth scalability, temporal scalability, Signal to Noise Ratio (SNR) scalability, and/or spatial scalability. Scalability implies that a bitstream is composed of a base layer and associated enhancement layers. The base layer is a separately decodable bitstream. The enhancement layers can be decoded in conjunction with the base layer to increase perceived quality by either increasing the picture rate, increasing the picture quality, or increasing the picture size. SNR scalability refers to enhancement information to increase the picture quality without increasing picture resolution. Spatial scalability refers to enhancement information to increase the picture quality by increasing picture resolution. There is also support for temporal scalability by the use of B pictures. A B picture is a scalability enhancement containing pictures that can be bi-directionally predicted from two pictures in a reference layer, one temporally previous to the current picture and one temporally subsequent. B pictures allow enhancement layer information to be used to increase perceived quality by increasing the picture rate of the displayed enhanced video sequence. This mode can be useful for heterogeneous networks with varying bandwidth capacity and also in conjunction with error correction schemes. H.263 Annex O describes the use of layered coding within H.263.

Conferences can take advantage of this feature to service connected users that have different capabilities (i.e., computing power or bandwidth limitations) using one bitstream that can be decoded in part. This will allow more efficient use of network bandwidth.

The layered coding capability will be signaled using the H.245 capabilities exchange methods. Codepoints within H.245 exist which clearly identify what layering methods are supported by the endpoints. The endpoints shall use these capabilities in order to signal the exact layering methods they support.

6.2.7 Control Protocol for Far-end Camera Control

The capability for an H.323 endpoint to control one or more far-end cameras, and allow far-end control of local cameras is an emerging standard. H.282 and H.283 define the protocols used for far end camera control. Capability details may be found in the objective standards section of the Profile, Section 10.4.4. H.281 and H.224 do not apply to H.323 systems.

6.2.8 Real Time Facsimile over H.323

The optional Annex D of H.323 defines the functional interface between a Group 3 facsimile terminal on an IP network and a H.323 Gateway.

6.2.9 Signaling over UDP

Annex E of H.323 defines an optional UDP-based procedure, which improves call-signaling setup time.

6.2.10 Single Use Devices

Annex F defines Single Use Audio Devices (Audio SUDs) that operate using a well-defined subset of H.323 protocols. These devices are well suited for IP Telephony applications while retaining interoperability with regular H.323 version 2 devices. Examples of Single Use Audio Devices with fixed and limited capabilities are telephones, text telephones, and cellular IP phones.

6.2.11 Quality of Service

ITU-T I.350 describes general aspects of quality of service and network performance, including the definition of primary quality of service parameters and derived quality of service parameters.

A primary parameter is determined on the basis of direct observations of events at service access points or connection portion boundaries. A derived parameter is determined on the basis of observed values of one or more relevant primary parameters.

Some primary parameters are applicable to many multimedia teleservices, while others depend on the specific type of multimedia application. The following tables summarize the performance parameters of interest at the user and network interfaces.

Table 6.2-2. Quality of Service Parameters - User Interface

	Quality Criteria		
Communications Function	**Speed**	**Accuracy**	**Availability and Reliability**
Connection Establishment	Set-up Time, Transfer Time	Misdirected	Accessibility Ratio (among media), Connection Failure
User Information Transfer	Delay (Spontaneity), Delay Variation, Contention Resolution	Media Quality, Media Synchronization	Dropped Connection
Connection Release	Take-down Time		

Table 6.2-3. Quality of Service Parameters - End-to-End Network Interface

	Quality Criteria		
Communications Function	**Speed**	**Accuracy**	**Availability and Reliability**
Connection Establishment	Set-up Time, Transfer Time	Misdirected	Accessibility Ratio, Connection Failure
User Information (Packet) Transfer	Delay (Network Latency), Delay Variation (within a single media stream and between streams), Information Bit Rate (Sustainable Info Rate Minimum Info Rate)	Lost Transport Packet Ratio (combines IP Packet defects, such as Errored, Lost Packets)	Dropped Connection (IP Availability)
Connection Release	Take-down Time		

Table 6.2-4. Mapping between Interfaces

Network	**User**
Latency	Spontaneity
Delay Variation	Spontaneity, Media Quality, Media Sync
Info Rate	Media Quality, Media Sync
Loss Ratio	Media Quality, Media Sync

6.3 Supplementary Services

The H.450-Series of standards describes optional methods for providing Supplementary Services in the H.323 environment. The below supplementary services, Call Transfer and Call Diversion (Forward) are currently available from several manufacturers of VTC equipment. Additional, objective supplementary services are described in Section 10.4.7.

6.3.1 Generic Functional Protocol for the Support of Supplementary Services - H.450.1

H.450.1 defines the signaling protocol between H.323 entities for the control of supplementary services. Detailed procedures applicable to individual supplementary services are specified by other H.450.x series and by individual manufacturers for proprietary services using the capabilities defined in this standard. The procedures of H.450.1 are derived from the generic functional protocol specified in ISO/IEC 11582 for private integrated services networks (PISN).
The generic functional protocol provides the means to exchange signaling information for the control of supplementary services over a LAN. It does not by itself control any supplementary service, but rather provides generic services to specific supplementary services control entities. The generic functional protocol operates in conjunction with the call signaling protocol defined in H.225.0. The generic functional protocol provides mechanisms for the support of supplementary services, which relate to existing H.323 calls. Supplementary service operations require an association between the respective peer supplementary services control entities. This association is achieved implicitly by the transport connection used for call signaling. Supplementary services control entities use the services of the

Remote Operations Service, which for H.323 is defined in H.450.1 paragraph 8.3 and based on ITU-T X.880.

6.3.2 Call Transfer - H.450.2

Call Transfer is a supplementary service which enables endpoint A (or transferring endpoint) to transform an existing call between endpoints A and B (primary call) into a new call between endpoint B and an endpoint C selected by A. Endpoint A may or may not have a call established with endpoint C (secondary call) prior to transfer. Each call can either be an incoming call to or an outgoing call from endpoint A. On successful completion of Call Transfer, endpoints B and C can communicate with each other and endpoint A will no longer be able to communicate with either endpoints B or C.

The initial call between endpoints A and B (primary call) must be answered, before transfer can be initiated. On initiation of Call Transfer, if a call between endpoints A and C exists (secondary call), the transferred-to endpoint (C) is informed of the pending call transfer, and transfer only proceeds if this endpoint is able to participate.

The transferring endpoint (A) requests the transferred endpoint (B) to call the transferred-to endpoint (C). The transferred endpoint then establishes a call to the transferred-to endpoint (transfer by rerouting) and includes the temporary identifier for the secondary call if this call exists. Endpoint B's Gatekeeper may establish the call if it is handling the Call Transfer.

The primary call is retained until the first acknowledgment has been received from the transferred-to endpoint (C), and is then released. This means that the primary call remains in place if call transfer fails before that stage. If the secondary call exists it is retained until the new call request arrives at the transferred-to endpoint and is then released.

Upon answer from endpoint C (if no secondary call exists) or successful association of endpoint C with the new call (if C was already involved in the secondary call), endpoints B and C can communicate with each other. The media exchange capabilities of the new call should be equal to those of the primary call as far as possible.

Transferring only a subset of H.323 media streams or T.120 calls is not a currently available with the Call Transfer supplementary service, but may be a future capability.

H.450.2 Call Transfer is based on the equivalent supplementary service for Private Integrated Services Networks (PISN) specified in ISO/IEC 13865 and 13869.

6.3.3 Call Diversion - H.450.3

H.450.3 specifies the diversion supplementary services, which includes the services Call Forwarding Unconditional, Call Forwarding Busy, Call Forwarding No Reply and Call Deflection, all of which are applicable to various basic services supported by H.323 endpoints.

H.450.3 supplementary services apply during call establishment providing a diversion of an incoming call to another destination endpoint and apply to point-to-point calls. An incoming call via multicasting may be subject to call diversion. The maximum number of diversions to a single call is a manufacturer‘s implementation option. When counting the number of diversions, all types of diversions shall be included.

H.450.3 Call diversion supplementary service is based on ISO/IEC13872 and 13873.

6.3.3.1 Call Forwarding Unconditional

Call Forwarding Unconditional permits an endpoint to have incoming calls redirected to another number. The endpoint’s ability to originate calls is unaffected by Call Forwarding Unconditional. After Call Forwarding Unconditional has been activated, calls are forwarded independently of the status of the endpoint. Call Forwarding Unconditional is provided on a per number basis.

6.3.3.2 Call Forwarding Busy

Call Forwarding Busy enables an endpoint to have calls addressed to its number and meet busy, redirected to another endpoint. Call Forwarding Busy may operate on all calls, or just those fulfilling specific conditions. Specific conditions, if applicable, are a manufacturer‘s implementation matter. The endpoint’s ability to originate calls is unaffected by Call Forwarding Busy. Call Forwarding Busy is provided on a per number basis.

The selective operation of Call Forwarding Busy on calls associated with a specific basic service, (i.e., Transferring only a subset of H.323 media streams or T.120 calls) is not a currently available, but may be a future capability.

6.3.3.3 Call Forwarding No Reply

Call Forwarding No Reply enables an endpoint to have calls which are addressed to the endpoint’s number and for which the connection is not established within a defined period of time, redirected to another endpoint. Call Forwarding No Reply may operate on all calls, or just those fulfilling specific conditions. Specific conditions, if applicable, are a manufacturer‘s implementation matter. The endpoint’s ability to originate calls is unaffected by Call Forwarding No Reply. Call Forwarding No Reply is provided on a per number basis.

The selective operation of Call Forwarding No Reply on calls associated with a specific basic service (i.e., Transferring only a subset of H.323 media streams or T.120 calls) is not a currently available, but may be a future capability.

6.3.3.4 Call Deflection

Call Deflection permits an endpoint to respond to an incoming call by requesting diversion of that call to another number specified in the response. This request is only allowed before the called endpoint has answered the call. The endpoint´s ability to originate calls is unaffected. Call Deflection is invoked on a call by call basis, whereas Call Forwardng Unconditional deflects all calls to a given number.

6.4 H.323 Security and Confidentiality

This section is currently under study and will be addressed in a future update to the VTC Profile.

6.5 Wide Area Networks (WANs)

H.323 operation over WANs may be achieved in many ways. Details of the network design are beyond the scope of this Profile. The following sampling of basic methods is for information only. In the implementation any of these solutions, careful consideration should be given to the network parameters relating to Quality of Service as listed in Section 6.2.11, especially network latency.

One basic method is shown in Figure 6.5-1. In this setup, the connection goes directly from local LAN to a WAN or Metropolitan Area Network (MAN) such as the NIPRNET, SIPRNET or Internet via a router, bridge, or server and back to a LAN at the remote site. However, the end-to-end delays (latency) and traffic congestion are frequently problems in this setup, which may prevent it from being a feasible solution.

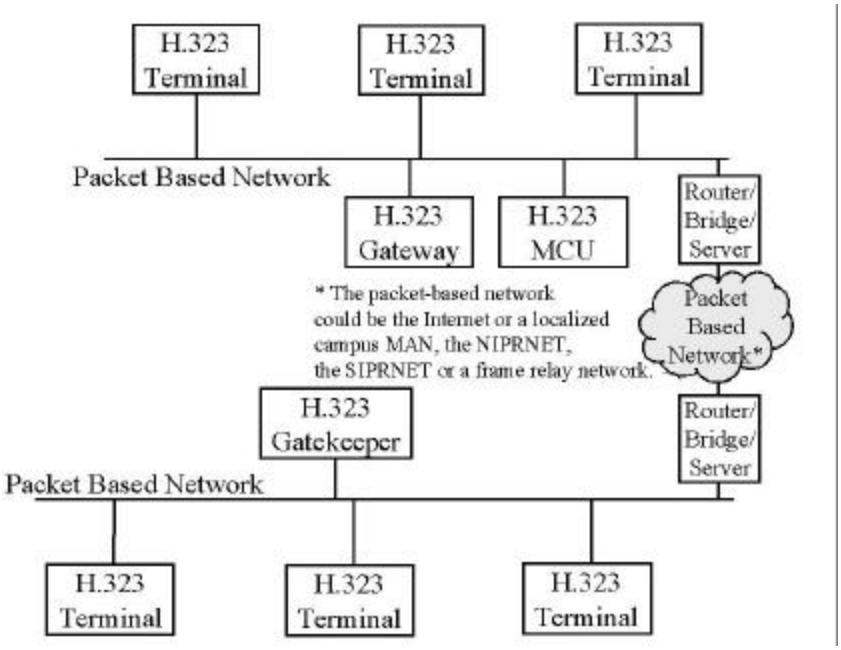


Figure 6.5-1. H.323 LAN to H.323 LAN via Router, Bridge or Server

Another method uses H.323 over a high speed WAN such as ATM or Frame Relay. This is shown in Figure 6.5-2. A third method uses the H.323 gateway to convert to an H.320 switched long-haul circuit, which is converted back to H.323 at the remote LAN. This is shown in Figure 6.5-3. More generally, the H.323 gateway could connect to a number of different networks as shown in Figure 6.5-4.

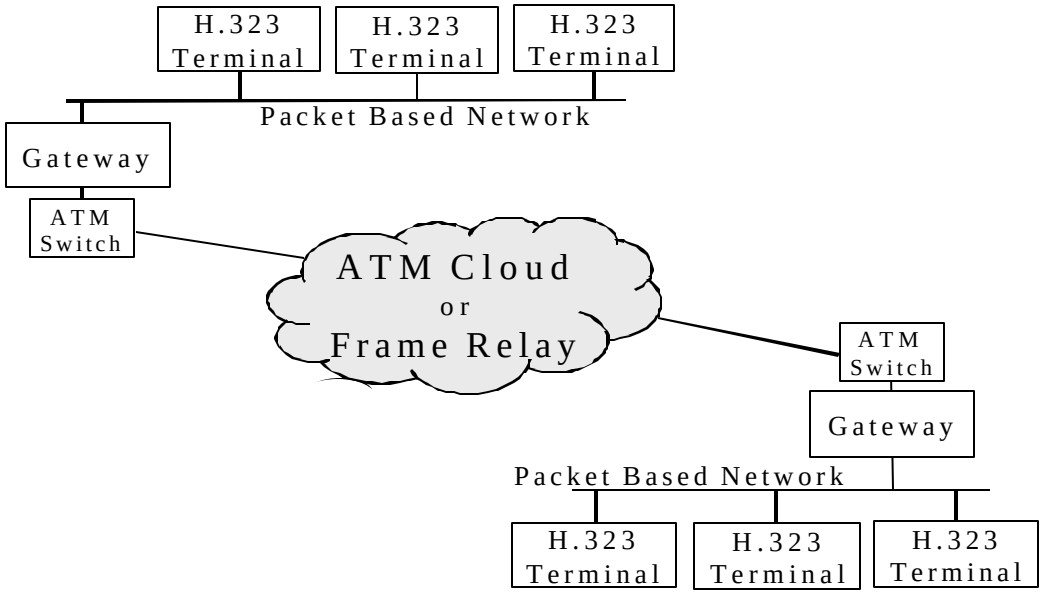


Figure 6.5-2. H.323 LAN to H.323 LAN via ATM or Frame Relay

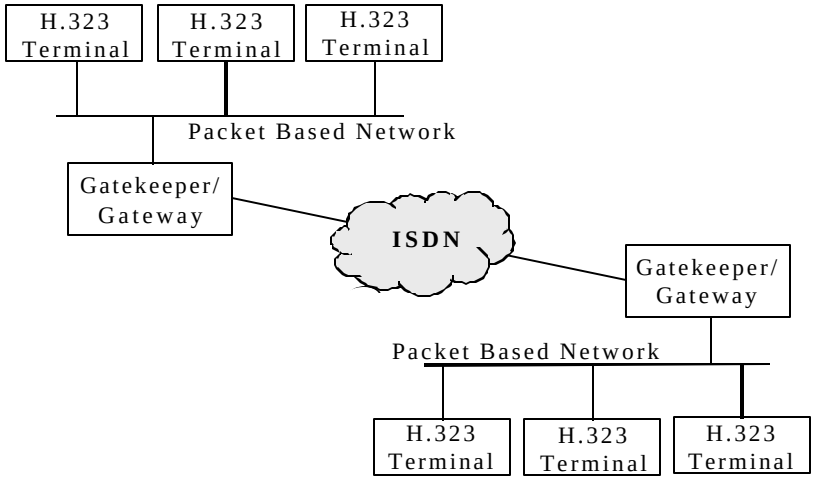
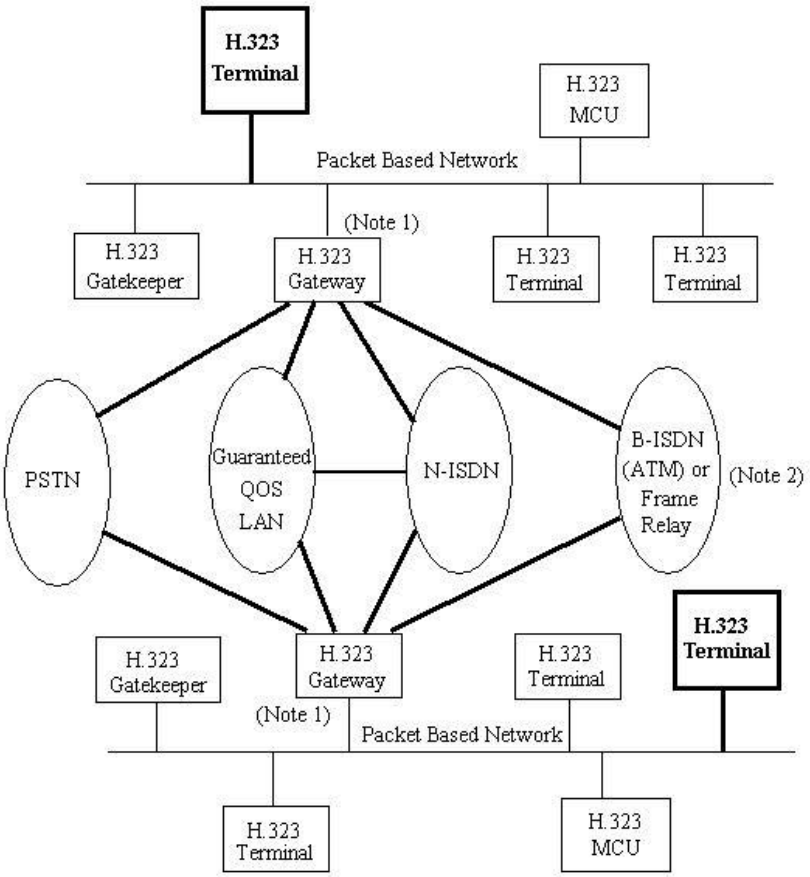


Figure 6.5-3. H.323 LAN to H.323 LAN via ISDN



Note 1 - A gateway may support one or more of the PSTN, N-ISDN and/or B-ISDN connections.
Note 2 - VTC over B-ISDN (ATM) is an objective standard. See Section 10.4.1.

Figure 6.5-4. H.323 LAN to H.323 LAN Gateway Options

7 VTC OVER PUBLIC SWITCHED TELEPHONE NETWORK (PSTN)

The requirements for operating VTC over PSTN or Plain Old Telephone System (POTS) are defined in ITU-T H.324, "Terminal for Low Bitrate Multimedia Communication," umbrella standard. DOD requirements for the implementation of this standard are under study, and will be addressed in a future revision to the Profile.

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8 MULTIMEDIA TELECONFERENCING APPLICATIONS

Multimedia applications such as audiographic conferencing, facsimile, still image transfer, annotation, pointing, shared whiteboard, file transfer, and audio-visual control are optional. If any of these applications are required in the VTU or MCU, it shall comply with the T.120 series of standards listed in Table 8.1. This includes the mandatory portions of T.120, T.122, T.123, T.124, and T.125, which define the basic protocols. It also includes the mandatory portions of T.126, T.127 and T.128 depending on the applications that are implemented. This will provide for interoperability of the application between different vendors' products.

Table 8-1 T.120 Series of Standards

Rec.	TITLE
T.120	Transmission Protocols for Multimedia Data
T.122	Multipoint Communications Service for Audiographic and Audio Visual Conferencing Service Definition
T.123	Network-specific Data Protocol Stacks for Multimedia Conferencing
T.124	Generic Conference Control for Audiographic and Audio Visual Terminals and Multipoint Control Units
T.125	Multipoint Communications Service Protocol Specification
T.126	Multipoint Still Image and Annotation Conferencing Protocol Specification
T.127	Multipoint Binary File Transfer Protocol
T.128	Multipoint Application Sharing

T.120 is the umbrella standard which provides an overview of the T.120 series. The T.120 standards consist of protocols and applications that utilize those protocols. These are described in the following sections.

T.120 also allows for non-standard applications, such as application sharing, within the T.120 framework. These non-standard applications also use the T.120 protocol stack and procedures.

T.137 is a recently approved emerging standard, part of the T.120-family. Entitled *Meeting Room Management (MRM): Services and Protocol*, it defines the functionality required to implement shared virtual spaces. It is described in Section 10.4.3 for informational purposes only and is not mandatory.

8.1 Protocols

The T.120 Protocol Suite consists of four standards: T.123 Network Specific Data Protocol Stack, T.122 Multipoint Communications Service - Service Definitions, T.124 Generic Conference Control for Terminals and Multipoint Control Units, and T.125 Multipoint Communications Service - Protocol Definition. These standards define a communications infrastructure, which supports point-to-point and multipoint data communications within the MultiLayer Protocol (MLP) and/or High Speed MLP (H-MLP) data channels.

All VTUs that implement T.120 shall implement the mandatory requirements of T.122, T.123, T.124 and T.125.

T.122 and T.125 together, define the services, messages, and procedures available within the T.120 Multipoint Communications Services.

T.123 specifies the Network Specific Data Protocol Stack for Multimedia Conferencing. A VTU supporting T.120 applications shall follow the recommendations of T.123 for the ISDN Basic Mode Profile using the physical sublayer formed by H.221 MLP channels. The Circuit Switched Digital Network Basic Mode Profile shall be used for non-ISDN circuit switched networks such as Switched-56.

T.124 provides mechanisms for the creation, control and the termination of conferences. It also makes provisions for the building and distributing the conference and application databases.

8.1.1 Multi-layer Protocol (MLP) Data Channels

A VTU implementing the T.120 series of standards shall use the MLP and/or the H-MLP data channels as described in H.242. These channels provide data rates from 4 kb/s up to 448 kb/s. MLP at 4 kb/s is insufficient bandwidth for T.120 and shall not be used. All VTUs providing T.120 applications shall support the common MLP rate of 6.4 kb/s. This data rate provides a common point of interoperability for VTUs using T.120. If higher data rates are provided, it is recommended that all lower data rates (down to 6.4 kb/s), as specified in H.221, also be provided. This will allow VTUs to interoperate at the higher data rates. For example, if one VTU can provide a data channel at 32 kb/s and 6.4 kb/s, and the other VTU can provide a data channel at 64 kb/s and 6.4 kb/s. The two VTUs will only interoperate at 6.4 kb/s. However, if the VTUs could provide data channels at all lower data rates, then the two VTUs could interoperate at 32 kb/s. Higher data rates may provide higher speed operation for T.120 applications such as file transfer, whiteboarding, and screen sharing.

VTUs, which implement T.120, may use either the MLP data channel, the H-MLP data channel or both channels for T.120 data. It is recommended that VTUs operating at 2B or lower, use the MLP data channel, while VTUs operating at higher than 2B, use the H-MLP data channel.

8.2 Conference Control

All VTUs that implement T.120 shall implement the mandatory requirements of T.124 Generic Conference Control (GCC) as per 8.2.1. A VTU may also implement any of the optional capabilities of T.124, which are described in Sections 8.2.2, 8.2.3, and 8.2.4.

T.124 defines Generic Conference Control functions. It provides for conference management and control functions such as:

- Conference Establishment and Termination: Provides the capability to start a new conference, invite someone into an existing conference, join an existing conference, leave a conference, or terminate the entire conference. It also provides the capability to obtain a list of the currently active conferences.

- Manage the Conference Roster: Maintains a list of all VTUs in a conference. VTUs can then request copies of this list.

- Manage the Application Roster: Maintains a list of the T.120 applications (file transfer, Image transfer, whiteboard, etc.) that each VTU in a conference has the capability to run.

- Remote Actuation: Allows an application on one VTU to start the same applications on other VTUs in the conference.

- Conference Conductorship: A conference can have a conductor (chairman) which provides for the orderly control of the conference.

- Application Registry Services: Allows an application to access a central database for information, which will aid in establishing communications with applications on other VTUs.

These functions are described in detail in Sections 8.2.1 through 8.2.4.

A T.120 conference can be created (started) in point-to-point mode between two VTUs or in multipoint mode between several VTUs and an MCU.

8.2.1 Mandatory Conference Control Capabilities

A VTU having T.120 capability shall have the following mandatory capabilities defined in T.124 (specific command names are shown in *italics*):

- Start a new conference, specifying the characteristics of that conference (*GCC-Conference-Create*). The VTU that creates a new conference, is the convener of that conference.
- Determine what conferences are currently in progress and the information needed to join them (*GCC Conference-Query*).
- Join an existing conference (*GCC-Conference-Join*).
- Leave an existing conference (*GCC-Conference-Disconnect*).
- Announce its presence in the conference *(GCC-Conference-Announce-Presence, GCC-Conference-Roster-Report*).
- Enroll its applications with the conference (*GCC-Application-Permission-To-Enroll, GCC-Application-Enroll, GCC-Application-Roster-Report*).
- To be invited to Join a Conference (*GCC-Conference Invite*).

- Receive notification of Conference termination (*GCC-Conference Terminate*).
- To be ejected from a conference and receive notification of an ejection (*GCC-Conference-Eject-User*).
- Receive notification that selected nodes in a conference have been transferred (*GCC-Conference-Transfer*).

8.2.2 Optional Conference Control Capabilities

A VTU having T.120 capability may have the following optional capabilities defined in T.124:

- Invite another VTU to join the conference (*GCC-Conference-Invite*).
- Ask how much time is remaining (*GCC-Conference-Time-Inquire*).
- Ask that the conference be extended beyond the allocated time (*GCC-Conference-Extend*).
- Request the list of all VTUs in a conference (*GCC-Conference-Roster-Inquire*).
- Request the list of VTUs that have the capability to run a particular application, group of applications, or any application (*GCC-Application-Roster-Inquire*).
- Request that a specific application be invoked in selected VTUs (*GCC-Application-Invoke*).
- Determine if the conference is in conductor mode (*GCC-Conductor-Inquire*).
- Request permission from the conference conductor to take certain actions within a T.120 Application (*GCC-Conductor-Permission-Ask*).
- Become the conference conductor (*GCC-Conductor-Please*, *GCC-Conductor-Assign*).

8.2.3 Optional Conference Convener Capabilities

The VTU that created the conference is the convener. A VTU that has convened a T.120 conference has the following additional optional capabilities defined in T.124:

- Dial-out to add another VTU to the conference (*GCC-Conference-Add*).
- Prevent other VTUs from joining, or allow other VTUs to join the conference without being explicitly added by the convener (*GCC-Conference-Lock*, *GCC-Conference-Unlock*, *GCC-Conference-Lock-Report*).
- Terminate the entire conference (*GCC-Conference-Terminate*).
- Eject another VTU from the conference (*GCC-Conference-Eject-User*).
- Transfer VTUs to another conference (*GCC-Conference-Transfer*).
- Notify the other VTUs of the time remaining in the conference (*GCC-Conference-Time-Remaining*).

8.2.4 Optional Conference Conductor Capabilities

A VTU, which has become the conference conductor, may be granted the same capabilities as the convener, at the discretion of the convener. The conductor may also have the following optional capabilities defined in T.124:

- Give up Conductorship. (*GCC-Conductor-Release*)
- Give Conductorship to another VTU. (*GCC-Conductor-Give*)
- Give approval to other VTUs to take certain actions within a T.120 application. (*GCC-Conductor-Permission-Grant*)

8.3 Still Image Applications

T.126 specifies the requirements for facsimile, still image, annotation, and shared whiteboard applications within T.120. This standard provides for five optional groups of features, called T.126 profiles. If the acquisition calls for still image transmission capability, then profile 1 is mandatory. If the acquisition calls for still image transmission capability, other than freeze-frame, then at least one of profiles 2 and 3 are mandatory. If the acquisition calls for shared whiteboard, then profile 4 is mandatory. If the acquisition calls for image annotation, then profile 5 is mandatory.

A VTU conforms to a T.126 Profile if its capabilities are greater than or equal to the minimum mandatory requirements indicated below. Optional capabilities, which are applicable to all T.126 profiles, are listed in Table 8.2. Most of the T.126 Profiles provide both compressed and uncompressed image formats. Compressed formats reduce redundant information within the image, thereby reducing the transmission time and storage space required. *See Sections 8.3.1 and 8.3.2 for a discussion of image formats, including T.4 (Group 3 facsimile), T.6 (Group 4 facsimile), T.81 (JPEG), and T.82 (JBIG).* The T.126 profiles are:

(1) Facsimile: Using the T.126 *Hard-Copy-0* Profile. This T.126 Profile provides for the exchange of black and white images bound directly for hard copy devices such as facsimile machines or printers. This type of image is referred to as a hardcopy image.

It shall support pixel counts of up to 1728 (wide) by 2300 (high) which are sufficient for A (8.5" x 11") size and A4 (8.27" x 11.69") size paper. Pixel counts up to 21845 in each direction are optional (Items 2 and 3 in Table 8.2). These optional larger pixel counts could be used for other paper sizes such as legal or B size.

The uncompressed and T.4 (Group 3 facsimile) compressed image formats are mandatory. Typical T.4 facsimile resolution is 200 pixels per inch (width) and 100 pixels per inch (height). Other allowable resolutions are 200(w) x 200(h), 300 x 300, and 400 x 400. The T.6 (Group 4 facsimile) and T.82 (JBIG) compressed image formats are optional (Item 5 and 6 in Table 8.2). Typical T.6 facsimile resolution is 200 pixels per inch (width) and 200 pixels per inch (height) with optional resolutions of 300 x 300, and 400 x 400. Typical T.82 facsimile resolution is 400 pixels per inch (width) and 400 pixels per inch (height).

(2) Still Image Transfer: Using the T.126 *Soft-Copy-Image-0* Profile. This T.126 Profile provides for the exchange of monochrome or color images for display. This type of image is referred to as a softcopy image.

It supports a mandatory workspace size of 384(w) x 288(h) pixels and at least one image plane which shall support images having pixel counts of up to 384 (w) and 288 (h). Additional image planes and workspace and image pixel counts of up to 21845 in each direction are optional (Items 8, 9, 10, 15 and 16 in Table 8.2).

The uncompressed, T.82 (JBIG) compressed, and T.81 (JPEG) compressed image formats are mandatory. These formats have many options which affect image quality and transmission time (Items 18, 19, and 20 in Table 8.2).

(3) High Resolution Still Image Transfer: Using the T.126 *Soft-Copy-Image-1* Profile. This T.126 Profile provides the same capability as Still Image Transfer (*Soft-Copy-Image-0* Profile) except that it shall support pixel counts up to 768 (w) and 576 (h).

(4) Whiteboard: Using the T.126 *Soft-Copy-Whiteboard-0* Profile. This T.126 Profile provides an electronic whiteboard for annotations such as drawings, notes, or sketches. Annotation drawing elements consist of point lines, poly lines, rectangles, and ellipses. Line color, style, thickness, and fill color are selectable. Annotations may be deleted or edited.

It supports a mandatory workspace size of 384(h) x 288(v) pixels and at least one annotation plane. The annotation plane keeps the annotations separate from any underlying image planes or other annotation planes. For example, an annotation plane can be used for each participant in a conference, keeping their annotations independent. The annotation plane supports annotation bitmaps having pixel counts of up to 384 (w) and 288 (h).

The uncompressed format is mandatory for the annotation bitmap. T.82 (JBIG) compressed image format is optional for the annotation bitmap *(See Item 29 in Table 8.2)*.

(5) Image Annotation: Using the T.126 *Soft-Copy-Annotated-Image-0* Profile. Provides the combined capabilities of High Resolution Still Image Transfer (*Soft-Copy-Image-1* Profile) and

Whiteboard (*Soft-Copy-Whiteboard-0* Profile) with the addition of pointing capability. This provides the ability to overlay annotation on images, and provides a movable pointer.

It supports a mandatory workspace size of 768(w) x 576(h) pixels, at least one image plane, at least one annotation plane, and a pointer plane. This supports annotation bitmaps and images having pixel counts of up to 768 (w) and 576 (h), and pointer bitmaps of up to 32 (w) x 32 (h) pixels.

The uncompressed format is mandatory for the pointer bitmap. T.82 (JBIG) compressed image format is optional for the annotation bitmap *(See Items 18 and 33 in Table 8.2)*.

As part of the T.126 initialization procedure, each VTU indicates its capabilities. Table 8.2 shows the wide range of optional capabilities that are available in the T.126 standard. The column "VALUES" indicates the range of options to choose from, "Yes, No" indicates that a manufacturer can choose to implement that feature or not to implement it. The column "REQ. CAP." indicates the item number of other capabilities that are required to be implemented, in order to implement this capability. The column "REQ. BY PROFILE" indicates that the capability is required by one of the five T.126 Profiles. The number refers to paragraph numbers (1 - 5) from the section above.

8.3.1 Hard Copy Image Format Options

Hard copy images can be represented in a variety of selectable formats. These include T.4 (Group 3 fax), T.6 (Group 4 fax), T.82 (JBIG) and uncompressed formats. T.4 has two formats, one-dimensional coding and two-dimensional coding. The two T.4 formats and the uncompressed format are mandatory; the T.6 and the T.82 formats are optional.

All hardcopy images are bilevel; that is, they consist of only full white and full black pixels. They do not provide color or shades of gray. All of the hardcopy image formats provide lossless image compression. This allows the image to be received exactly as it is scanned in, except for the losses due to limited pixel resolution.

The T.4 format is the standard Group 3 facsimile format used in most fax machines today. The two-dimensional coding format provides more compression than the one-dimensional format. The T.6 format is a two-dimensional coding algorithm and provides better compression than either of the T.4 formats.

Table 8-2 Still Image Optional Capabilities

ITEM	CAPABILITY	DESCRIPTION	VALUES	REQ. CAP.	REQ. BY PROFILE
1	Hard-Copy-Image	Capability to exchange hard copy images	Yes, No	None	1
2	Hard-Copy-Image-Bitmap-Max-Width	Maximum hardcopy image width	1,728 to 21,845 pixels	1	

ITEM	CAPABILITY	DESCRIPTION	VALUES	REQ. CAP.	REQ. BY PROFILE
3	Hard-Copy-Image-Bitmap-Max-Height	Maximum hardcopy image height	2,301 to 21,845 pixels	1	
4	Hard-Copy-Image-Bitmap-Any-Aspect-Ratio	Capability to handle any arbitrary pixel aspect ratios	Yes, no	1	
5	Hard-Copy-Image-Bitmap-Format-T.6	Capability to handle T.6 compressed image formats	Yes, no	1	
6	Hard-Copy-Image-Bitmap-Format-T.82	Capability to handle T.82 compressed image formats	Yes, no	1	
7	Soft-Copy-Workspace	Capability to have a workspace for soft copy images	Yes, No	None	2, 3, 4, 5
8	Soft-Copy-Workspace-Max-Width	Maximum softcopy workspace width	385 to 21845 pixels	7	3*, 5*
9	Soft-Copy-Workspace-Max-Height	Maximum softcopy workspace height	289 to 21845 pixels	7	3*, 5*
10	Soft-Copy-Workspace-Max-Planes	Maximum number of planes allowed in the workspace	2 to 256 planes	7	
11	Soft-Copy-Color-16, Soft-Copy-Color-202, Soft-Copy-Color-True	Capability to use a color palette in the workspace	16 colors, 202 colors, 24-bit true color (16 million colors)	7	
12	Soft-Copy-Plane-Editing	Capability to declare a workspace plane to be editable	Yes, no	7	
13	Soft-Copy-Scaling	Capability to scale softcopy images	Yes, no	7	
14	Soft-Copy-Image	Capability to exchange softcopy images	Yes, No	7	2, 3, 5
15	Soft-Copy-Image-Bitmap-Max-Width	Maximum softcopy image width	385 to 21845 pixels	7, 14	3*, 5*
16	Soft-Copy-Image-Bitmap-Max-Height	Maximum softcopy image height	289 to 21845 pixels	7, 14	3*, 5*
17	Soft-Copy-Image-Bitmap-Any-Aspect-Ratio	Capability to handle any arbitrary pixel aspect ratios	Yes, no	7, 14	
18	Soft-Copy-Image-Bitmap-Format-T.82-	Capability to handle T.82 compressed image formats	Various parameters, See 8.3.1	7, 14	
19	Soft-Copy-Image-Bitmap-Format-T.81-	Capability to handle T.81 compressed image formats	Various parameters, See 8.3.1	7, 14	

ITEM	CAPABILITY	DESCRIPTION	VALUES	REQ. CAP.	REQ. BY PROFILE
20	Soft-Copy-Image-Bitmap-Format-Uncompressed-	Capability to handle uncompressed image formats	Various parameters, See 8.3.1	7, 14	
21	Soft-Copy-Annotation	Capability to use annotation on softcopy workspaces	Yes, No	7	4, 5
22	Soft-Copy-Annotation-Bitmap-Max-Width	Maximum annotation image width	385 to 21845 pixels	7, 21	
23	Soft-Copy-Annotation-Bitmap-Max-Height	Maximum annotation image height	289 to 21845 pixels	7, 21	
24	Soft-Copy-Annotation-Drawing-Pen-Min-Thickness	Minimum thickness of the annotation pen	1 to 2 pixels	7, 21	
25	Soft-Copy-Annotation-Drawing-Pen-Max-Thickness	Maximum thickness of the annotation pen	17 to 255 pixels	7, 21	
26	Soft-Copy-Annotation-Drawing-Ellipse	Capability to use ellipse drawing types	Yes, no	7, 21	
27	Soft-Copy-Annotation-Drawing-Pen-Square-Nib	Capability to use a square nib shape when drawing lines	Yes, no	7, 21	
28	Soft-Copy-Annotation-Drawing-Highlight	Capability to use a highlight line style	Yes, no	7, 21	
29	Soft-Copy-Annotation-Bitmap-Format-T.82	Capability to handle T.82 compressed annotation image formats	Yes, no	7, 21	
30	Soft-Copy-Pointing	Capability to use pointer bitmaps	Yes, No	7	5
31	Soft-Copy-Pointing-Bitmap-Max-Width	Maximum pointer bitmap width	33 to 21845 pixels	7, 30	
32	Soft-Copy-Pointing-Bitmap-Max-Height	Maximum pointer bitmap height	33 to 21845 pixels	7, 30	
33	Soft-Copy-Pointer-Bitmap-Format-T.82	Capability to handle T.82 compressed pointer image formats	Yes, no	7, 30	
* - Indicates required values are specified in Section 8.3.					

The uncompressed format provides no compression and thus represents an image with the most amount of data. These images will require more storage capacity, and take longer to transmit. This format may be appropriate for small images (i.e. 64 x 64) where the transmission time may not be significant. With this format, delays for compression and decompression are avoided.

On dithered or halftone images, the T.4 and T.6 formats perform poorly, and may even result in negative compression. In this case, the T.4 one-dimensional format may be better than the others. Also providing better performance for these types of images is T.82 (JBIG). The T.82 format is usually better for all image types including text and line drawings, but is significantly better for dithered and halftone images. The T.82 hardcopy format uses the bilevel image format on a single bitplane and prediction with no resolution reduction. See Section 8.3.2 for more details on T.82.

8.3.2 Soft Copy Image Format Options

Soft copy images can be represented in a variety of selectable formats. These include uncompressed, T.82, and T.81 formats. All three formats are mandatory for soft copy images; however, each format has several options.

8.3.2.1 Uncompressed Format

The uncompressed format represents each pixel in the image with between one bit and 24 bits depending on the color space used. This format may be appropriate for small images (i.e. 64 x 64) where the transmission time may not be significant, and delays for compression and decompression are avoided. A VTU with softcopy capability shall be able to transmit and receive uncompressed images in 8-bit grayscale, RGB 4:4:4, YCbCr 4:2:2, or palletized 1, 4, or 8 bit per pixel formats. Optionally it may also handle YCbCr 4:2:0, YCbCr 4:4:4, CIElab 4:2:0, CIElab 4:2:2, or CIElab 4:4:4 formats. These are described in detail at the end of Sections 8.3.2.4 and 8.3.2.5.

8.3.2.2 T.82 Joint Bi-level Image Experts Group (JBIG)

T.82 (JBIG) is designed to compress bilevel images, grayscale images, and palletized color images. A VTU with softcopy capability shall transmit and receive T.82 images in bilevel, 8-bit grayscale, RGB 4:4:4, YCbCr 4:2:2, and palletized 1, 4, and 8 bit per pixel formats. Optionally, it may also handle 12-bit grayscale, YCbCr 4:2:0, YCbCr 4:4:4, CIElab 4:2:0, CIElab 4:2:2, or CIElab 4:4:4 formats. The 12-bit grayscale mode could be used for high detail medical or military images. It allows for 4096 shades of gray as opposed to only 256 shades for 8-bit grayscale. The T.82 algorithm uses three types of pixel prediction: prediction with no resolution reduction, differential prediction with resolution reduction, and deterministic differential prediction with resolution reduction. Prediction with no resolution reduction is the default. The other modes increase the compression that can be achieved, and also allow for progressive transmission. In progressive transmission, a lower resolution image appears quickly and is then progressively refined with detail until the full resolution image is transmitted.

8.3.2.3 T.81 Joint Photographic Experts Group (JPEG)

T.81 (JPEG) is designed to compress color images. It usually offers better performance than JBIG for color images. A VTU with softcopy capability shall transmit and receive T.81 images in 8-bit grayscale, and YCbCr 4:2:2 formats. Optionally it may also handle 12-bit grayscale, RGB 4:4:4, YCbCr 4:2:0, YCbCr 4:4:4, CIElab 4:2:0, CIElab 4:2:2, or CIElab 4:4:4 formats. As a default, the color components are interleaved, optionally, they can be non-interleaved.

The T.81 algorithm has several compression modes: DPCM, Sequential DCT, and Progressive DCT. Lossless compression can be selected using DPCM modes. Lossy compression is selected using DCT modes. Lossy compression may be visually lossless, providing useful images at increased compression. Sequential DCT mode compresses and transmits the entire image in a single pass. This is the default mode. Progressive DCT mode compresses the image and transmits the low frequency components of the entire image first, followed by lower frequency components. This allows the image to be transmitted and decoded progressively.

The T.81 algorithm allows two different entropy coding techniques: Huffman and arithmetic. The default is Huffman coding. The arithmetic coding mode may provide improved compression over the standard Huffman encoding. The T.81 algorithm allows prediction techniques called differential modes, which produce difference images for coding. Differential modes offer improved compression over the standard non-differential modes when there is large areas of special similarity in the images. These compression improvements may not be significant; however, they may increase the complexity and delay of the compression/decompression process.

T.81 makes use of quantization tables, which must be defined by the manufacturer or user in order to compress and decompress the images. In T.126, the tables are always transmitted along with the image data. The contents of these tables are not addressed in T.126; rather it is left to the manufacturer to determine the manner in which they are defined.

8.3.2.4 Color Mapping

The next option for all uncompressed, T.82 and T.81 formats is color mapping, which is how color is represented. There are three types of color mapping: grayscale, palletized, and color component. Grayscale formats represent an image in 256 shades of gray, with no other colors being represented. This format provides more detail than bilevel (black and white) images and requires less data than color images. Palletized formats represent color using lookup tables. Each entry of the table represents a color. Only the index of the color within the table is coded and transmitted. This index may be a 1-bit, 4-bit, or 8-bit value. Palletized formats are more efficient than the color component formats, however, the actual number of colors that can be represented is limited to a small number (2, 16, or 256). For the third type of color mapping, there are three color component formats: RGB, YCbCr, and CIElab. These formats use three 8-bit values to represent each pixel. The RGB formats are typical for computer generated pictures, while the YCbCr formats are typical for video capture devices and cameras. The

YCbCr format is more efficient than RGB because the chroma components (Cb and Cr) can be sampled at a lower resolution than the luminance component (Y) without a significant perceptual loss. This is called subsampling. The CIElab format can also be subsampled, but it provides better color quality than YCbCr in the presence of the quantization errors that may result from the compression algorithm.

8.3.2.5 Chroma Sampling

An option for the RGB, YCbCr, and CIElab color mappings is chroma sampling. This option applies to the uncompressed, T.82 and T.81 image formats. RGB can only be sampled in 4:4:4 format where each Red, Green, and Blue component is sampled at the same resolution. YCbCr can be sampled in:

- 4:4:4 format where all components are sampled at the same resolution;
- 4:2:2 format where the Cb and Cr components are sampled at half the horizontal resolution of the Y component; and,
- 4:2:0 format where the Cb and Cr components are sampled at half the horizontal and half the vertical resolution of the Y component.

This subsampling usually results in imperceptible errors in the color of the image while increasing the compression of the image. Subsampled formats may not be appropriate for images, which require precise color detail, such as high-resolution medical images. The same subsampling formats are available for the CIElab format. In this case, L is the luminance component with A and B being the chroma components.

8.3.3 Still Images

ITU-T T.126 provides a mechanism for transmitting still images within a video teleconference, as per Section 8.3. The T.126 Soft-Copy-Image-0 Profile (option 2 in Section 8.3) is recommended as a minimum to send and receive still images. It provides a capability similar to the NITFS JPEG capability specified in MIL-STD-188-198A. The T.126 profile provides the capability to receive and transmit 384 pixels (wide) x 288 pixels (high) 8-bit grayscale and 24-bit YCbCr color images using sequential DCT with Huffman encoding. This includes the MIL-STD-188-198A Type 1 (8-bit gray scale) and Type 2 (24-bit color) compression modes.

For many applications, higher resolution is required, and in this case the T.126 Soft-Copy-Image-1 Profile (option 3 in Section 8.3) is recommended. This is the same as the Soft-Copy-Image-0 Profile except that the resolution capability is increased to 768 pixels (wide) x 576 pixels(high). This resolution is sufficient to handle full-scale images digitized from NTSC broadcast quality video sources. For other resolutions, the options Soft-Copy-Image-Bitmap-Max-Width and Soft-Copy-Image-Bitmap-Max-Height can be used to specify any resolution up to 21,845.

The following options are not addressed by T.126. The capability to use the default quantization tables defined in MIL-STD-188-198A is optional. As per T.126, the tables are always transmitted along with the image data. They allow images to be coded at five different levels of quality, which results in different degrees of compression. Higher quality typically results in lower compression. The capability for the user to define custom T.81 quantization tables in order to maximize compression for special types of images is another option. *See MIL-STD-188-198A and DISA/JIEO Circular 9008, NITFS Certification Test and Evaluation Program Plan, for more details.*

Note that T.126 does not provide the same file formats, security labeling symbology, graphics meta language and text description that NITFS provides. However, the T.126 Image Annotation Profile (option 5 in Section 8.3) does provide an annotation capability, which may be used to annotate images with security information, symbols, graphics, and text. Also note that the still image cameras and the display devices must be of the same or higher resolution in order to obtain the desired overall still image resolution. *See Section 10.1.8.2.*

8.4 File Transfer

T.127 specifies the requirements for Multipoint Binary File Transfer applications within T.120. T.127 defines three profiles for binary file transfer. These are *File Receive Only*, *File Transmit Only*, and *File Transmit/Receive.* A VTU having file transfer capability shall comply with the mandatory requirements of any one of these T.127 Profiles.

The *File Receive Only* profile provides the capability to accept files transmitted from other VTUs and to request that files from other VTUs be transmitted to it.

The *File Transmit Only* profile provides the capability to initiate transmission of files to all other VTUs and to respond to requests that it transmits files to all other VTUs.

The *File Transmit/Receive* profile provides the capability of both the *File Receive Only* and *File Transmit Only* profiles.

A VTU that is a T.127 transmitter, shall be capable of transferring a file to all receivers. A transmitter may have the optional capability to concurrently transfer multiple files. A transmitter shall be capable of broadcasting a file to all receivers in the conference. A transmitter may have the optional capability to transfer files to a subset of the receivers in a conference. This capability allows private file transfers within the conference.

A VTU may have the optional capability to request a directory listing of the remote VTU. A VTU receiving a request to provide a directory listing, shall respond to that request, however, it may decline to provide the listing.

A VTU shall be capable of transmitting and/or receiving files in uncompressed format. A VTU may have the optional capability to transmit and/or receive files in V.42bis data compressed format. The compressed format may reduce the amount of data required to represent the file, which will result in reduced transmission time. If the file already contains compressed information, the V.42bis compressed format may not result in a significant reduction in data.

8.5 Multipoint Application Sharing

The T.128 Multipoint Application Sharing is an optional protocol that supports multipoint computer application sharing. It allows a view onto a computer application, such as a word processing or a spreadsheet, executing at one site to be simultaneously viewed at other sites within a conference. Each site can, under specified conditions, take control of the shared computer application by sending remote keyboard and pointing device information. This style of application sharing does not require and does not make provision for synchronizing multiple instances of the same computer application running at multiple sites. Instead, it enables remote viewing and control of a single application instance to provide the illusion that the application is running locally.

Recommendation T.128 uses services provided by Recommendations T.122 (MCS) and T.124 (GCC). Further details may be provided in future versions of the Profile.

9 VTC PROTOCOL IMPLEMENTATION CONFORMANCE STATEMENTS (PICS)

9.1 Introduction

The PICS specify requirements for implementations of this Profile. They are used to determine areas where interoperability testing may be carried out and as a screening device to determine if a VTU or MCU meets all mandatory requirements. The PICS are also recommended for use by purchasers of video teleconferencing systems to determine which features have been implemented. This section is to be used in conjunction with Sections 5, 6 and 8 of the Profile. If there is any disagreement between this section and Sections 5, 6 and 8, then Sections 5, 6 and 8 take precedence.

The columns of the PICS are as follows:

- *Protocol Feature* refers to the features of the protocol in question;
- *Std. Clause* indicates the clause of the standard where the feature is described;
- *Std. Status* indicates whether the feature is mandatory, optional, etc.; and,
- *Implemented* has two ballot boxes where the manufacturer may indicate support or non-support for a feature.

9.1.1 Symbols and Conventions used in Std. Status Column

M = Mandatory. In those cases where the entire standard is optional "Mandatory" indicates those portions of the standard that shall be implemented to meet the minimum requirements associated with that standard.

O = Optional.

O <n> = Optional, but support of at least one of the group of options labeled by the same numeral <n> is required.

C = Conditional.

CM = Conditionally Mandatory, i.e., if the terminal or MCU is capable of entering the given state, then it shall transmit the given code and, when leaving that state, the complementary code. If it has no such capability it can ignore both.

NS = Not within scope of this profile.

Y = Supported.

N = Not supported.

9.2 Identification

If using the PICS to determine specific manufacturer compliance, suggest including the following product information as applicable: Product Name; Model Number; Revision Number; Software Version Number; and, any other device identification information.

9.3 H.221 PICS

H.221 PICS			
Protocol Feature	**Std. Clause**	**Std. Status**	**Implemented?**
Frame Alignment Signal	1.1	M	Y[ ] N[ ]
Bit-rate Allocation Signal	1.2	M	Y[ ] N[ ]
Encryption Control Signal	1.3	O	Y[ ] N[ ]
Remaining capacity	1.4	M	Y[ ] N[ ]
Frame Alignment - General	2.1	M	Y[ ] N[ ]
Multiframe structure	2.2	M	Y[ ] N[ ]
Loss & recovery of frame alignment.	2.3	M	Y[ ] N[ ]
Loss & recovery of multiframe align	2.4	M	Y[ ] N[ ]
Timing recovery	2.5	O	Y[ ] N[ ]
Description of the CRC-4 procedure	2.6	O	Y[ ] N[ ]
Computation of the CRC-4 bits	2.6.1	O	Y[ ] N[ ]
Frame alignment monitoring	2.6.2.2	O	Y[ ] N[ ]
Error rate monitoring	2.6.2.3	O	Y[ ] N[ ]
Multiple B-connections	2.7.1	O	Y[ ] N[ ]
Multiple H0-connections	2.7.2	O	Y[ ] N[ ]
Encoding of the BAS	3.1	M	Y[ ] N[ ]
Values of the BAS	3.2	M	Y[ ] N[ ]
Procedures for use of the BAS	3.3	M	Y[ ] N[ ]
Trans. of generic SBE characters	3.4	O	Y[ ] N[ ]
Audio command - neutral	Annex A.1	O	Y[ ] N[ ]
Audio command - Au-off, U	Annex A.1	NS	
Audio command - Au off, F	Annex A.1	O (1)	Y[ ] N[ ]
Audio command - A-law, OU	Annex A.1	NS	
Audio command - A-law, OF	Annex A.1	O (1)	Y[ ] N[ ]
Audio command - μ-law, OU	Annex A.1	NS	
Audio command - μ-law, OF	Annex A.1	M	Y[ ] N[ ]
Audio command - G.722, m1	Annex A.1	O	Y[ ] N[ ]
Audio command - G.722, m2	Annex A.1	O	Y[ ] N[ ]
Audio command - G.722, m3	Annex A.1	O	Y[ ] N[ ]
Audio command - Au-40k	Annex A.1	NS	
Audio command – G.722.1-32k	Annex A.1	O	
Audio command – G.722.1-24k	Annex A.1	O	
Audio command - G.728	Annex A.1	M	Y[ ] N[ ]
Audio command - Au -<16k	Annex A.1	NS	
Audio command - Au-ISO-64 to 256	Annex A.1	NS	
Audio command - Au-ISO-384	Annex A.1	NS	
Xfer rate command - 64	Annex A.2	M	Y[ ] N[ ]
Xfer rate command - 2 x 64	Annex A.2	M	Y[ ] N[ ]
Xfer rate command - 3 x 64	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 4 x 64	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 5 x 64	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 6 x 64	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 384	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 2 x 384	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 3 x 384	Annex A.2	O	Y[ ] N[ ]

H.221 PICS			
Protocol Feature	**Std. Clause**	**Std. Status**	**Implemented?**
Xfer rate command - 4 x 384	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 5 x 384	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 1536	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 1920	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 128k	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 192k	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 256k	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 512k	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 768k	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 1152k	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - 1472k	Annex A.2	O	Y[ ] N[ ]
Xfer rate command - Loss-i.c.	Annex A.2	O	Y[ ] N[ ]
Channel No. 2-6	Annex A.2	O	Y[ ] N[ ]
Video, etc. cmd - Video-off	Annex A.3	O	Y[ ] N[ ]
Video, etc. cmd - H.261, H.263	Annex A.3	O	Y[ ] N[ ]
Video, etc. cmd - Video-imp.(R)	Annex A.3	NS	
Video, etc. cmd - Video-ISO	Annex A.3	NS	
Video, etc. cmd - AV-ISO	Annex A.3	NS	
Video, etc. cmd - Freeze-picture.	Annex A.3	M	Y[ ] N[ ]
Video, etc. cmd - Fast-update	Annex A.3	M	Y[ ] N[ ]
Video, etc. cmd - Encrypt-on	Annex A.3	O	Y[ ] N[ ]
Video, etc. cmd - Encrypt-off	Annex A.3	O	Y[ ] N[ ]
Video, etc. cmd - Au-loop	Annex A.3	O	Y[ ] N[ ]
Video, etc. cmd - Video-loop	Annex A.3	O	Y[ ] N[ ]
Video, etc. cmd - Dig-loop	Annex A.3	O	Y[ ] N[ ]
Video, etc. cmd - Loop-off	Annex A.3	O	Y[ ] N[ ]
Video, etc. cmd - SM-comp	Annex A.3	O	Y[ ] N[ ]
Video, etc. cmd - Cancel SM-comp	Annex A.3	O	Y[ ] N[ ]
Video, etc. cmd - 6B-H0-comp	Annex A.3	O	Y[ ] N[ ]
Video, etc. cmd - Not-6B-H0-comp	Annex A.3	O	Y[ ] N[ ]
Video, etc. cmd - Restrict	Annex A.3	M	Y[ ] N[ ]
Video, etc. cmd - Derestrict	Annex A.3	M	Y[ ] N[ ]
LSD/MLP cmd - LSD off	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - 300	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - 1200	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - 4800	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - 6400	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - 8000	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - 9600	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - 14400	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - 16k	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - 24k	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - 32k	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - 40k	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - 48k	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - 56k	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - 62.4k	Annex A.4	O	Y[ ] N[ ]

H.221 PICS			
Protocol Feature	**Std. Clause**	**Std. Status**	**Implemented?**
LSD/MLP cmd - 64k	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - Var-LSD	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - DTI(r)	Annex A.4	NS	
LSD/MLP cmd - MLP-off	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - MLP-4k	Annex A.4	O	Y[ ] N[ ]
LSD/MLP cmd - MLP-6.4k	Annex A.4	O	Y[ ] N[ ]
Audio cap - G.722-64	Annex A.5	O	Y[ ] N[ ]
Audio cap - G.722-48	Annex A.5	O	Y[ ] N[ ]
Audio cap - G.722.1-32	Annex A.5	O	Y[ ] N[ ]
Audio cap - G.722.1-24	Annex A.5	O	Y[ ] N[ ]
Audio cap - G.728	Annex A.5	M	Y[ ] N[ ]
Audio cap - Au-ISO	Annex A.5	O	Y[ ] N[ ]
Video etc. cap - QCIF	Annex A.6	M	Y[ ] N[ ]
Video etc. cap - FCIF	Annex A.6	O	Y[ ] N[ ]
Video etc. cap - 1/29.97	Annex A.6	O	Y[ ] N[ ]
Video etc. cap - 2/29.97	Annex A.6	O	Y[ ] N[ ]
Video etc. cap - 3/29.97	Annex A.6	O	Y[ ] N[ ]
Video etc. cap - 4/29.97	Annex A.6	M	Y[ ] N[ ]
Video etc. cap - Video-imp(R)	Annex A.6	NS	
Video etc. cap - Video-ISO	Annex A.6	NS	
Video etc. cap - AV-ISO	Annex A.6	NS	
Video etc. cap - MBE-cap	Annex A.6	O	Y[ ] N[ ]
Video etc. cap - Esc-CF(R)	Annex A.6	NS	
Video etc. cap - Encrypt	Annex A.6	O	Y[ ] N[ ]
Trans rate cap - B, H_0	Annex A.7	O (2)	Y[ ] N[ ]
Trans rate cap - 2B	Annex A.7	M	Y[ ] N[ ]
Trans rate cap - 6B	Annex A.7	O	Y[ ] N[ ]
Trans rate cap - 2 x H_0	Annex A.7	O	Y[ ] N[ ]
Trans rate cap - 5 x H_0	Annex A.7	O	Y[ ] N[ ]
Trans rate cap - H11/H12	Annex A.7	O	Y[ ] N[ ]
Trans rate cap - Restrict	Annex A.7	M	Y[ ] N[ ]
Trans rate cap - 6B-H_0-comp	Annex A.7	O	Y[ ] N[ ]
Trans rate cap - 128k	Annex A.7	O	Y[ ] N[ ]
Trans rate cap - 192k	Annex A.7	O	Y[ ] N[ ]
Trans rate cap - 256k	Annex A.7	O	Y[ ] N[ ]
Trans rate cap - 512k	Annex A.7	O	Y[ ] N[ ]
Trans rate cap - 768k	Annex A.7	O	Y[ ] N[ ]
Trans rate cap - 1152k	Annex A.7	O	Y[ ] N[ ]
Trans rate cap - 1472k	Annex A.7	O	Y[ ] N[ ]
LSD/MLP cap - 300(to 64k)	Annex A.8	O	Y[ ] N[ ]
LSD/MLP cap - Var-LSD	Annex A.8	O	Y[ ] N[ ]
LSD/MLP cap - MLP-4k	Annex A.8	O	Y[ ] N[ ]
LSD/MLP cap - MLP-6.4k	Annex A.8	O	Y[ ] N[ ]
LSD/MLP cap - Var-MLP	Annex A.8	O	Y[ ] N[ ]
Escape table values - HSD	Annex A.9	O	Y[ ] N[ ]
Escape table values - H.230	Annex A.9	O	Y[ ] N[ ]
Escape table values - Start-MBE	Annex A.9	O	Y[ ] N[ ]

H.221 PICS			
Protocol Feature	**Std. Clause**	**Std. Status**	**Implemented?**
Escape table values - NS-cap	Annex A.9	O	Y[ ] N[ ]
Escape table values - NS-comm.	Annex A.9	O	Y[ ] N[ ]
Escape table values - Cap-mark	Annex A.9	O	Y[ ] N[ ]
Escape table values - Data-apps	Annex A.9	O	Y[ ] N[ ]
HSD/H-MLP values - 64k to 1536k	Annex A.10	O	Y[ ] N[ ]
HSD/H-MLP values - HSD-other	Annex A.10	O	Y[ ] N[ ]
HSD/H-MLP values - Var-HSD	Annex A.10	O	Y[ ] N[ ]
HSD/H-MLP values - H-MLP-62.4k	Annex A.10	O	Y[ ] N[ ]
HSD/H-MLP cmds - 192k	Annex A.11	O	Y[ ] N[ ]
HSD/H-MLP cmds - 256k	Annex A.11	O	Y[ ] N[ ]
HSD/H-MLP cmds - 320k	Annex A.11	O	Y[ ] N[ ]
HSD/H-MLP cmds - 384k	Annex A.11	O	Y[ ] N[ ]
HSD/H-MLP cmds - HSD-other	Annex A.11	O	Y[ ] N[ ]
HSD/H-MLP cmds - H-MLP-off	Annex A.11	O	Y[ ] N[ ]
HSD/H-MLP cmds - H-MLP-62.4k	Annex A.11	O	Y[ ] N[ ]
HSD/H-MLP cmds - H-MLP-64k	Annex A.11	O	Y[ ] N[ ]
HSD/H-MLP cmds - H-MLP-128k	Annex A.11	O	Y[ ] N[ ]
HSD/H-MLP cmds - H-MLP-192k	Annex A.11	O	Y[ ] N[ ]
HSD/H-MLP cmds - H-MLP-256k	Annex A.11	O	Y[ ] N[ ]
HSD/H-MLP cmds - H-MLP-320k	Annex A.11	O	Y[ ] N[ ]
HSD/H-MLP cmds - H-MLP-384k	Annex A.11	O	Y[ ] N[ ]
HSD/H-MLP cmds - Var-H-MLP	Annex A.11	O	Y[ ] N[ ]
LSD/HSD appl. - Still image H.261	Annex A.12	O	Y[ ] N[ ]
LSD/HSD appl. - V.120 LSD	Annex A.12	O	Y[ ] N[ ]
LSD/HSD appl. - V.120 HSD	Annex A.12	O	Y[ ] N[ ]
LSD/HSD appl. - ISO-SP on LSD	Annex A.12	NS	
LSD/HSD appl. - ISO-SP on HSD	Annex A.12	NS	
LSD/HSD appl. - ISO-SP spatial	Annex A.12	NS	
LSD/HSD appl. - ISO-SP progressive	Annex A.12	NS	
LSD/HSD appl. - ISO-SP arithmetic	Annex A.12	NS	
LSD/HSD appl. - Graphics cursor	Annex A.12	NS	
LSD/HSD appl. - Group 3 fax	Annex A.12	NS	
LSD/HSD appl. - Group 4 fax	Annex A.12	NS	
LSD/HSD appl. - ISO-SP on in LSD	Annex A.13	NS	
LSD/HSD appl. - ISO-SP on in HSD	Annex A.13	NS	
LSD/HSD appl. - Cursor data LSD	Annex A.13	NS	
LSD/HSD appl. - Fax on in LSD	Annex A.13	NS	
LSD/HSD appl. - Fax on in HSD	Annex A.13	NS	
LSD/HSD appl. - V.120 LSD	Annex A.13	O	Y[ ] N[ ]
LSD/HSD appl. - V.120 HSD	Annex A.13	O	Y[ ] N[ ]

Note 1: A-law audio is not mandatory but is strongly recommended.

Note 2: The transmission rate capability for one B-channel is mandatory, the capability for 384 kb/s H_0 is optional.

9.4 H.230 PICS

The following tables summarize some requirements for H.230 compliance. The Transmit and Receive columns indicate that the Protocol Feature is transmitted or received by the VTU or MCU. The Notes column provides other information related to the requirements. The numbers in the table headers refer to sections in this profile that are related to the group of protocol features in that table.

9.4.1. MCU General Capability

5.1.6 MCU (also see 5.1.5.1.1 and 5.1.5.1.2)						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
MCC	3.5	M	X	Note 2		Y[ ] N[ ]
CANCEL-MCC	3.5	M	X	Note 2		Y[ ] N[ ]
MCS	3.5	CM	X	Note 2	Mandatory if MCU has Data Channel Capability	Y[ ] N[ ]
MCN	3.5	CM	X	Note 2	"	Y[ ] N[ ]
MMS	3.5	CM	X	Note 2	Mandatory if H.263 is supported	Y[ ] N[ ]
CANCEL MMS	3.5	CM	X	Note 2	Mandatory if H.263 is supported	Y[ ] N[ ]
MIZ	3.5	O	X	Note 2	Indication only	Y[ ] N[ ]
CANCEL-MIZ	3.5	O	X	Note 2	"	Y[ ] N[ ]
MIV	3.5	O	X		"	Y[ ] N[ ]
CANCEL-MIV	3.5	O	X		"	Y[ ] N[ ]
MIL	3.5	O	X	X		Y[ ] N[ ]
TIC	3.5	O	X	X	Related to Call Association	Y[ ] N[ ]
TIX*	3.5	O		X	"	Y[ ] N[ ]
TIA*	3.5	O	X		Related to Call Association and Terminal Numbering	Y[ ] N[ ]
TIN*	3.5	O	X	Note 2	Related to Terminal Numbering	Y[ ] N[ ]
TIL*	3.5	O	X	Note 2	"	Y[ ] N[ ]
TID*	3.5	O	X	Note 2	"	Y[ ] N[ ]
TCU	3.5	O	Note 1	X	"	Y[ ] N[ ]
VIN*	3.5	O	X		"	Y[ ] N[ ]

Note 1: This code may have to be transmitted by the MCU in the cascaded case.
Note 2: This code may have to be received by the MCU in the cascaded case.
* - These features require the use of terminal numbers.

9.4.2. MCU Voice Activation

5.1.6.1.2.1 MCU Voice Activated Switching						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
Voice Activated	H.243 5.2	M	X	X		Y[ ] N[ ]
VCF	3.1	M	X	X		Y[ ] N[ ]
VCU	3.1	M	X	X		Y[ ] N[ ]

9.4.3. MCU User Broadcast Control

5.1.6.1.2.2 MCU User Broadcast Control						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
MCV	3.5	M	Note 1	X		Y[ ] N[ ]
CANCEL-MCV	3.5	M	Note 1	X		Y[ ] N[ ]
VCR	3.5	M	X	Note 2		Y[ ] N[ ]

Note 1: This code may have to be transmitted by the MCU in the cascaded case.
Note 2: This code may have to be received by the MCU in the cascaded case.

9.4.4. MCU User Select Control

5.1.6.1.2.3 MCU User Select Control						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
VCS*	3.5	CM		X	Mandatory if MCU has User Select Control	Y[ ] N[ ]
CANCEL-VCS	3.5	CM		X	"	Y[ ] N[ ]
VCR	3.5	CM	X		“	Y[ ] N[ ]

* - This features require the use of terminal numbers.

9.4.5. MCU Chair Control Capability

5.1.6.1.2.4 MCU Chair Control Capability (also see 5.1.5.1.2)						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
CIC	3.5	CM	X	X	Mandatory if MCU has Chair Control	Y[ ] N[ ]
CCA	3.5	CM	Note 1	X	"	Y[ ] N[ ]
CIS	3.5	CM	Note 1	X	"	Y[ ] N[ ]
CIR	3.5	CM	X	Note 2	"	Y[ ] N[ ]
CIT	3.5	CM	X	Note 2	"	Y[ ] N[ ]
CCR	3.5	CM	X	Note 2	"	Y[ ] N[ ]
VCB*	3.5	CM	Note 1	X	"	Y[ ] N[ ]
CANCEL-VCB	3.5	CM	Note 1	X	"	Y[ ] N[ ]
VCR	3.5	CM	X	Note 2	"	Y[ ] N[ ]
CCD*	3.5	CM	Note 1	X	"	Y[ ] N[ ]
CCK	3.5	CM	Note 3	X	"	Y[ ] N[ ]
TIF*	3.5	CM	X	Note 2	"	Y[ ] N[ ]
TCU	3.5	CM		X	"	Y[ ] N[ ]
TIA*	3.5	CM	X		"	Y[ ] N[ ]
TIL*	3.5	CM	X		"	Y[ ] N[ ]
TIN*	3.5	CM	X		"	Y[ ] N[ ]
TID*	3.5	CM	X		"	Y[ ] N[ ]
VIN*	3.5	CM	X		"	Y[ ] N[ ]
VCS	3.5	O		X		Y[ ] N[ ]
CANCEL-VCS	3.5	O		X		Y[ ] N[ ]

Note 1: This code may have to be transmitted by the MCU in the cascaded case.
Note 2: This code may have to be transmitted by the MCU in the cascaded case.
Note 3: CCK in a cascaded environment is for further study in ITU-T H.243.
* - These features require the use of terminal numbers.

9.4.6. MCU Terminal Identifiers

5.1.6.1.2.6 MCU Terminal Identifiers						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
TCI	3.5	O	X	Note 2		Y[ ] N[ ]
TII	3.5	O	Note 1	X	Related to TCI	Y[ ] N[ ]
TIS	3.5	O	Note 1	X	"	Y[ ] N[ ]
TCS	3.5	O	X	Note 2		Y[ ] N[ ]
IIS	3.5	O	Note 1	X	Related to TCS	Y[ ] N[ ]
TCP*	3.5	O	Note 1	X		Y[ ] N[ ]
TIP	3.5	O	X	Note 2	Related to TCP	Y[ ] N[ ]

Note 1: This code may have to be transmitted by the MCU in the cascaded case.
Note 2: This code may have to be received by the MCU in the cascaded case.
*- This features require the use of terminal numbers.

9.4.7. MCU Selection of SCM

5.1.6.1.4 MCU Selection of SCM (also see 5.1.5.1.2.c)						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
Minimum SCM	H.243 4.0	M				Y[ ] N[ ]
Secondary VTUs	H.243 4.0	O				Y[ ] N[ ]
MIS	3.5	O	X	X	Indication only	Y[ ] N[ ]
CANCEL-MIS	3.5	O	X	X	"	Y[ ] N[ ]

9.4.8. MCU Audio General

5.1.6.2 MCU Audio						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
G.711 μ-law	G.711	M	X	X		Y[ ] N[ ]
G.711 A-law	G.711	M	X	X		Y[ ] N[ ]
G.722	G.722	O	X	X	Highly recommended	Y[ ] N[ ]
G.722.1	G.722.1	O	X	X	Highly recommended	Y[ ] N[ ]
G.728	G.728	M	X	X	Highly recommended	Y[ ] N[ ]
Audio Mixing	H.243	M	X	X		Y[ ] N[ ]
Voice Activated Switching	H.243	M	X	X		Y[ ] N[ ]

9.4.9. MCU Data Communications

5.1.6.3 MCU Data Communications						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
DCA-L	3.5	O	X	X		Y[ ] N[ ]
DIT-L	3.5	O	X	X		Y[ ] N[ ]
DIS-L	3.5	O	X	X		Y[ ] N[ ]
DCR-L	3.5	O	X	X		Y[ ] N[ ]
DCC-L	3.5	O	X	X		Y[ ] N[ ]
DCA-H	3.5	O	X	X		Y[ ] N[ ]
DIT-H	3.5	O	X	X		Y[ ] N[ ]
DIS-H	3.5	O	X	X		Y[ ] N[ ]
DCR-H	3.5	O	X	X		Y[ ] N[ ]
DCC-H	3.5	O	X	X		Y[ ] N[ ]
T.120	---	O	X	X		Y[ ] N[ ]

9.4.10. MCU Cascading

5.1.6.5 MCU Cascading						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
Simple Cascading	H.243	O	X	X		Y[ ] N[ ]
Principle/ Satellite Cascading	H.243	O	X	X		Y[ ] N[ ]
MIM	3.5	CM	X	X	Mandatory for Principle/Satellite Cascading	Y[ ] N[ ]
RAN	3.5	CM	X	X	Mandatory for MCUs without administered P/S status	Y[ ] N[ ]

9.4.11. MCU Simultaneous Conference Operation

5.1.6.7 MCU Simultaneous Conference Operation						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
Simultaneous Conferences	H.243	O	X	X		Y[ ] N[ ]

9.4.12. MCU Value Added Services

10.1.9 MCU Value Added Services						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
SBE Characters	3.4	O		X		Y[ ] N[ ]

9.4.13. Other MCU Capabilities

Other MCU Capability						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
AIM	3.2	O	X	X	Indication only	Y[ ] N[ ]
AIA	3.2	O	X	X	"	Y[ ] N[ ]
VIS	3.1	O	X	X	"	Y[ ] N[ ]
VIA	3.1	O	X	X	"	Y[ ] N[ ]
VIA2	3.1	O	X	X	"	Y[ ] N[ ]
VIA3	3.1	O	X	X	"	Y[ ] N[ ]
VIR	3.1	O	X	X	"	Y[ ] N[ ]
LCV	3.3	O	X	X		Y[ ] N[ ]
LCA	3.3	O	X	X		Y[ ] N[ ]
LCD	3.3	O	X	X		Y[ ] N[ ]
LCO	3.3	O	X	X		Y[ ] N[ ]

9.4.14. Normal VTU Basic Multipoint Capability

5.1.5.1.1 Normal VTU Basic Multipoint Capability						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
VCF	3.1	M		X		Y[ ] N[ ]
VCU	3.1	M		X		Y[ ] N[ ]
Freeze Picture Release	H.261 H.263	M	X		In H.261 or H.263Picture Header	Y[ ] N[ ]
MCC	3.5	M		X		Y[ ] N[ ]
Cancel-MCC	3.5	M		X		Y[ ] N[ ]
MCS	3.5	CM		X	Mandatory if VTU has Data Channel Capability	Y[ ] N[ ]
MCN	3.5	CM		X	"	Y[ ] N[ ]

9.4.15. Normal VTU Optional Multipoint Capability

5.1.5.1.2 Normal VTU Optional Multipoint Capability						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
TIC	3.5	O	X			Y[ ] N[ ]
TIA*	3.5	O		X	Related to TIC	Y[ ] N[ ]
TIX*	3.5	O	X		"	Y[ ] N[ ]
MIV	3.5	O		X	Indication only	Y[ ] N[ ]
Cancel-MIV	3.5	O		X	"	Y[ ] N[ ]
MIZ	3.5	O		X	"	Y[ ] N[ ]
Cancel-MIZ	3.5	O		X	"	Y[ ] N[ ]
MIS	3.5	O		X	"	Y[ ] N[ ]
Cancel-MIS	3.5	O		X	"	Y[ ] N[ ]
TCU	3.5	O	X		Related to Terminal Numbering	Y[ ] N[ ]
TIA*	3.5	O		X	"	Y[ ] N[ ]
TIL*	3.5	O		X	"	Y[ ] N[ ]
TIN*	3.5	O		X	"	Y[ ] N[ ]
TID*	3.5	O		X	"	Y[ ] N[ ]
VIN*	3.5	O		X	"	Y[ ] N[ ]
TIF*	3.5	O	X			Y[ ] N[ ]
TCI	3.5	O		X		Y[ ] N[ ]
TII	3.5	O	X		Related to TCI	Y[ ] N[ ]
TIS	3.5	O	X		"	Y[ ] N[ ]
TCS	3.5	O		X		Y[ ] N[ ]
IIS	3.5	O	X		Related to TCS	Y[ ] N[ ]
TCP*	3.5	O	X			Y[ ] N[ ]
TIP	3.5	O		X	Related to TCP	Y[ ] N[ ]
SBE	3.4	O	X			Y[ ] N[ ]

*- These features require the use of terminal numbers.

9.4.16. VTU User Broadcast Control Capability

5.1.5.2.1 User Broadcast Control VTU Capability						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
MCV	3.5	CM	X		Mandatory if VTU has User Broadcast Control	Y[ ] N[ ]
CANCEL-MCV	3.5	CM	X		"	Y[ ] N[ ]

9.4.17. VTU User Select Control Capabilities

5.1.5.2.2 User Select Control VTU Capability						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
VCS*	3.5	CM	X		Mandatory if VTU has User Select Control	Y[ ] N[ ]
CANCEL-VCS	3.5	CM	X		"	Y[ ] N[ ]
VCR	3.5	CM		X	"	Y[ ] N[ ]
TCU	3.5	O	X		“	Y[ ] N[ ]
TIN*	3.5	O.1		X	“	Y[ ] N[ ]
TID*	3.5	O.1		X	“	Y[ ] N[ ]
TIL*	3.5	O.1		X	“	Y[ ] N[ ]
VIN*	3.5	O.1		X	“	Y[ ] N[ ]

* - These features require the use of terminal numbers.

9.4.18. VTU Chair Control Basic Capability

5.1.5.3.1 VTU Chair Control Basic Capability						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
CIC	3.5	CM		X	Mandatory if VTU has Chair Control Capability	Y[ ] N[ ]
CCA	3.5	CM	X		"	Y[ ] N[ ]
CIS	3.5	CM	X		"	Y[ ] N[ ]
CIR	3.5	CM		X	"	Y[ ] N[ ]
CIT	3.5	CM		X	"	Y[ ] N[ ]
CCR	3.5	CM		X	"	Y[ ] N[ ]
CCD*	3.5	CM	X		“	Y[ ] N[ ]
CCK	3.5	CM	X		“	Y[ ] N[ ]
VCB*	3.5	CM	X		"	Y[ ] N[ ]
CANCEL VCB	3.5	CM	X		"	Y[ ] N[ ]
VCR	3.5	CM		X	"	Y[ ] N[ ]
TIF*	3.5	CM		X	“	Y[ ] N[ ]
TCU	3.5	CM	X		“	Y[ ] N[ ]
TIN*	3.5	CM		X	“	Y[ ] N[ ]
TID*	3.5	CM		X	“	Y[ ] N[ ]
TIL*	3.5	CM		X	“	Y[ ] N[ ]
VIN*	3.5	CM		X	“	Y[ ] N[ ]

*- These features require the use of terminal numbers.

9.4.19. VTU Chair Control Optional Capability

5.1.5.3.2 VTU Chair Control Optional Capability						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
VCS*	3.5	O	X			Y[ ] N[ ]
Cancel VCS	3.5	O	X			Y[ ] N[ ]

* - These features require the use of terminal numbers.

9.4.20. VTU Data Communications

8.1.1 MLP Data Channels						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
DCA-L	3.5	O	X	X		Y[ ] N[ ]
DIT-L	3.5	O	X	X		Y[ ] N[ ]
DIS-L	3.5	O	X	X		Y[ ] N[ ]
DCR-L	3.5	O	X	X		Y[ ] N[ ]
DCC-L	3.5	O	X	X		Y[ ] N[ ]
DCA-H	3.5	O	X	X		Y[ ] N[ ]
DIT-H	3.5	O	X	X		Y[ ] N[ ]
DIS-H	3.5	O	X	X		Y[ ] N[ ]
DCR-H	3.5	O	X	X		Y[ ] N[ ]
DCC-H	3.5	O	X	X		Y[ ] N[ ]
T.120	---	O	X	X		Y[ ] N[ ]

9.4.21. Other VTU Capability

Other VTU Capability						
Protocol Feature	**Std. Clause**	**Std. Status**	**Transmit**	**Receive**	**Notes**	**Implemented?**
AIM	3.2	CM	X	X	Mandatory if the VTU has audio mute capability, indication only for the receive VTU	Y[ ] N[ ]
AIA	3.2	CM	X	X	"	Y[ ] N[ ]
VIS	3.1	CM	X	X	Mandatory if the VTU has video mute capability, indication only for the receive VTU	Y[ ] N[ ]
VIA	3.1	CM	X	X	"	Y[ ] N[ ]
VIA2	3.1	CM	X	X	"	Y[ ] N[ ]
VIA3	3.1	CM	X	X	"	Y[ ] N[ ]
VIR	3.1	O	X	X	Indication only	Y[ ] N[ ]
LCV	3.3	O		X		Y[ ] N[ ]
LCA	3.3	O		X		Y[ ] N[ ]
LCD	3.3	M		X		Y[ ] N[ ]
LCO	3.3	M		X		Y[ ] N[ ]

9.5. H.224 PICS

Real-Time Control Protocol for Simplex Applications Using the H.221 LSD/HSD/MLP Channels

Protocol Feature	Std. Clause	Std. Status	Implemented?
H.224 Capabilities	6.1.1	M	Y [ ] N [ ]
H.224 Commands	6.1.2	M	Y [ ] N [ ]
Operation	6.1.3	M	Y [ ] N [ ]
Relationship to T.120 Protocols	6.2	M	Y [ ] N [ ]
Major Features	7	M	Y [ ] N [ ]
Physical Layer Transmission Over H.221	7.1	M	Y [ ] N [ ]
Client Bata Block Segmentation	7.2	M	Y [ ] N [ ]
Maximum Information Field Size	7.2.1	M	Y [ ] N [ ]
Maximum Transmission Time	7.2.2	M	Y [ ] N [ ]
Segment Numbering	7.2.3	M	Y [ ] N [ ]
Terminal Address Resolution	7.3	M	Y [ ] N [ ]
Client ID Assignments	7.4	M	Y [ ] N [ ]
Data Layer Protocol Frame Structure	7.5	M	Y [ ] N [ ]
Field Descriptions	8	M	Y [ ] N [ ]
Client Management Entity	9	M	Y [ ] N [ ]
CME Client List Message	9.1	M	Y [ ] N [ ]
CME Extra Capabilities Message	9.2	O	Y [ ] N [ ]
CME Client List Command	9.3	O	Y [ ] N [ ]
CME Extra Capabilities Command	9.4	O	Y [ ] N [ ]
CME Standard Command Codes	9.5	M	Y [ ] N [ ]
CME Standard Response Codes	9.6	M	Y [ ] N [ ]
List of Standard Client IDs	10	M	Y [ ] N [ ]
Extended Client IDs	10.1	M	Y [ ] N [ ]
Non-Standard Client IDs	10.2	O	Y [ ] N [ ]

9.6. H.231 PICS

Multipoint Control Units for Audiovisual Systems Using Digital Channels up to 2 Mb/s

Protocol Feature	Std. Clause	Std. Status	Implemented?
Audio mixing MCU	4.3a	O.1	Y[ ] N[ ]
Audio switching MCU	4.3a	O.1	Y[ ] N[ ]
Video	4.3b	O	Y[ ] N[ ]
Transfer rate (see H.221)	4.3c	O(1)	Y[ ] N[ ]
Restricted-network capability	4.3d	M	Y[ ] N[ ]
Data	4.3e	O	Y[ ] N[ ]
MLP - highest rates	4.3f	O	Y[ ] N[ ]
Encryption	4.3g	O	Y[ ] N[ ]
MBE capability	4.3h	CM	Y[ ] N[ ]
Non-MLP chair control	4.3i	O	Y[ ] N[ ]
Ports and configurability	4.4a	O	Y[ ] N[ ]
Network aspect	4.4b	O	Y[ ] N[ ]
Communication mode selection	4.4c	O	Y[ ] N[ ]
Terminal identification	4.4d	O	Y[ ] N[ ]

Note 1 - H.231 stipulates that an MCU may provide any of the transfer rates specified in H.221. In the case of this Profile *p=1* and *p=2* are mandatory.

9.7. H.242 PICS

System for Establishing Communications Between Audiovisual Terminals Using Digital Channels up to 2 Mb/s

Protocol Feature	Std. Clause	Std. Status	Implemented?
Audio capabilities	2.1	M	Y[ ] N[ ]
Video capabilities	2.2	M	Y[ ] N[ ]
Transfer rate capabilities	2.3	M	Y[ ] N[ ]
Data capabilities	2.4	O	Y[ ] N[ ]
Terminals on restricted ntwks capab.	2.5	M	Y[ ] N[ ]
Capability exchange - Sequence A	5.1	M	Y[ ] N[ ]
Mode switching - Sequence B	5.2	M	Y[ ] N[ ]
Frame reinstatement Sequence C	5.3	M	Y[ ] N[ ]
Mode initialization - $p = 1$	6.1.1	M	Y[ ] N[ ]
Mode initialization - $p > 1$	6.1.2	M	Y[ ] N[ ]
Dynamic switching - F to F	6.2.1	M	Y[ ] N[ ]
Dynamic switching - F to U	6.2.2	O	Y[ ] N[ ]
Dynamic switching - U to F/U	6.2.3	O	Y[ ] N[ ]
Mode 0 forcing - single channel	6.3.1	M	Y[ ] N[ ]
Mode 0 forcing - two or more chans.	6.3.2	M	Y[ ] N[ ]
Mode mismatch recovery	6.4	M	Y[ ] N[ ]
Frame alignment loss	7.1.1	M	Y[ ] N[ ]
Frame synchronization loss	7.1.2	M	Y[ ] N[ ]
Channel renum. - loss of 1 channel	7.2.1	O	Y[ ] N[ ]
Channel renum - loss of add'l chan.	7.2.2	O	Y[ ] N[ ]
Channel renum - loss of initial chan.	7.2.3	O	Y[ ] N[ ]
Initial channel	8.1.1	M	Y[ ] N[ ]
Additional channels	8.1.2	M	Y[ ] N[ ]
Terminal disconnection	8.2	M	Y[ ] N[ ]
Call transfer	8.3	O	Y[ ] N[ ]
Conferencing	8.4	O	Y[ ] N[ ]
PCM Format conversion	8.5	O	Y[ ] N[ ]
Act/deact data channels	9.1	O	Y[ ] N[ ]
MLP	9.2	O	Y[ ] N[ ]
Simultaneous LSD and MLP	9.3	O	Y[ ] N[ ]
Restricted networks	10	M	Y[ ] N[ ]
56 to 64 kb/s interworking	10.2.6	M(1)	Y[ ] N[ ]
Framing signal (56 kb/s)	10.3.1	M	Y[ ] N[ ]
Transmission formats (56 kb/s)	10.3.2	M	Y[ ] N[ ]
n x 56 kb/s operation	10.3.3	O	Y[ ] N[ ]
n x H_0 operation	10.3.4	O	Y[ ] N[ ]
Procedures for use of BAS codes	11	M	Y[ ] N[ ]
Bit occupancy and BAS codes	12	M	Y[ ] N[ ]
6B-H_0 interconnect	13	NS	
Encryption control signal channel	14	O	Y[ ] N[ ]

Note 1 - But see Section 6.5.

9.8. H.243 PICS

Procedures for Establishing Communications Between Three or More Audiovisual Terminals Using Digital Channels up to 2 Mb/s

Protocol Feature	Std. Clause	Std. Status	Implemented?
SCM - permanent	2.1	O.1	Y[ ] N[ ]
SCM - Per call selection	2.2	O.1	Y[ ] N[ ]
SCM - automatic	2.3	O.1	Y[ ] N[ ]
SCM - selected using MLP	2.4	O.1	Y[ ] N[ ]
First terminal capabilities	3.1	M	Y[ ] N[ ]
Second terminal capabilities (A/V)	3.2	M	Y[ ] N[ ]
Third terminal capabilities (A/V)	3.3	M	Y[ ] N[ ]
Fourth and subsequent terminals	3.4	M	Y[ ] N[ ]
Multiple channels	3.5	M	Y[ ] N[ ]
MCU-MCU initialization - G.722/56	3.6.1a	O.2	Y[ ] N[ ]
MCU-MCU initialization - G.722/48	3.6.1b	O.2	Y[ ] N[ ]
MCU-MCU initialization - G.722.1/32	TBD	TBD	Y[ ] N[ ]
MCU-MCU initialization - G.722.1/24	TBD	TBD	Y[ ] N[ ]
MCU-MCU initialization - G.728	3.6.1c	M	Y[ ] N[ ]
Designation of Master - prior to call	3.6.2.1	O.3	Y[ ] N[ ]
Designation of Master - negotiated	3.6.2.2	O.3	Y[ ] N[ ]
Closure of conference	3.7	O	Y[ ] N[ ]
Video switching - no video procs'ng	4.1.1	M	Y[ ] N[ ]
Video switching - errored frames	4.1.2	NS	
Automatic switching	4.2	M	Y[ ] N[ ]
Multipoint cmd visualization	4.2.2	O	Y[ ] N[ ]
Video cmd select	4.2.3	O	Y[ ] N[ ]
Numbering of terminals	5	O	Y[ ] N[ ]
Numbering method	5.1	CM	Y[ ] N[ ]
Term.-MCU interconn. w/o assoc.	5.21	CM	Y[ ] N[ ]
Term.-MCU interconn. with assoc.	5.22	O	Y[ ] N[ ]
MCU interconnection	5.3	O	Y[ ] N[ ]
Assignment of MCU numbers	5.3.1.1	CM	Y[ ] N[ ]
Fwd No. of term. added or dropped	5.3.1.2	CM	Y[ ] N[ ]
Storage and dissem. of term. Nos.	5.3.1.3	CM	Y[ ] N[ ]
Identity information	5.4	O	Y[ ] N[ ]
General mode switching	6.1	M	Y[ ] N[ ]
Bit rate symmetry	6.1.1	M	Y[ ] N[ ]
Changing the video rate	6.1.2	M	Y[ ] N[ ]
Mode changes in multi MCU calls	6.1.3	M	Y[ ] N[ ]
Mode switching for data distribution	6.2	CM	Y[ ] N[ ]
Range of data channel provisions	6.2.1.1	CM	Y[ ] N[ ]
Idle bits	6.2.1.2	CM	Y[ ] N[ ]
Terminals w/o data capability	6.2.1.3	CM	Y[ ] N[ ]
Data tokens - assignment	6.2.2.1	CM	Y[ ] N[ ]
Data tokens - release & reassign.	6.2.2.2	CM	Y[ ] N[ ]
Data tokens - withdrawal	6.2.2.3	CM	Y[ ] N[ ]
Opening, etc. of data channel	6.2.3	CM	Y[ ] N[ ]

Protocol Feature	Std. Clause	Std. Status	Implemented?
Chair-control procedures BAS codes	7	O	Y[ ] N[ ]
Chair-control token - assignment	7.2.1	CM	Y[ ] N[ ]
Chair-control token - release	7.2.2	CM	Y[ ] N[ ]
Chair-control token - withdrawal	7.2.3	CM	Y[ ] N[ ]
Info available to Chair-ctl term.	7.3	CM	Y[ ] N[ ]
Chair-control of broadcast video	7.4.1	CM	Y[ ] N[ ]
Term. dropping by Chair-control	7.5	CM	Y[ ] N[ ]
Withdrawal of data token by C-ctl.	7.6	CM	Y[ ] N[ ]
Request for floor	7.7	CM	Y[ ] N[ ]
Dropping entire conference	7.8	CM	Y[ ] N[ ]
Dial-out facility	7.9	O	Y[ ] N[ ]
Identification of token assignment	7.10	CM	Y[ ] N[ ]
BAS sequencing	8	O(1)	Y[ ] N[ ]
Capability exchange during a call	9	M	Y[ ] N[ ]
Procedure for loop detect at MCU	10	O	Y[ ] N[ ]
Term. does not indicate SCM cap.	11.1	M	Y[ ] N[ ]
Contention resolution principle	11.2	O	Y[ ] N[ ]

Note 1 – It is recommended that the procedures of H.242 clause 12 be followed.

9.9. H.261 PICS

Video CODEC for Audiovisual Services at *p*x64 kb/s.

Protocol Feature	Std. Clause	Std. Status	Implemented?
Source format - FCIF	3.1	O	Y[ ] N[ ]
Source format - QCIF	3.1	M	Y[ ] N[ ]
Prediction	3.2.1	O	Y[ ] N[ ]
Motion compensation - encoder	3.2.2	O	Y[ ] N[ ]
Motion compensation - decoder	3.2.2	M	Y[ ] N[ ]
Loop filter - encoder	3.2.3	O	Y[ ] N[ ]
Loop filter - decoder	3.2.3	M	Y[ ] N[ ]
Transformer	3.2.4	M	Y[ ] N[ ]
Quantization	3.2.5	M	Y[ ] N[ ]
Clipping	3.2.6	M	Y[ ] N[ ]
Forced updating	3.4	M	Y[ ] N[ ]
Data structure	4.1	M	Y[ ] N[ ]
Video multiplex arrangement	4.2	M	Y[ ] N[ ]
Multipoint considerations	4.3	M	Y[ ] N[ ]
Transmission coder	5	M	Y[ ] N[ ]
Inverse transform accuracy spec.	Annex A	M	Y[ ] N[ ]
Hypothetical Reference Decoder	Annex B	M	Y[ ] N[ ]
Codec delay measurement method	Annex C	-	-
Still Image Transmission	Annex D	O	Y[ ] N[ ]

9.10. H.263 PICS

Video Coding for Low Bitrate Communications.

Protocol Feature	Std. Clause	Std. Status	Implemented?
Source format – sub-QCIF	4.1	M	Y[ ] N[ ]
Source format - QCIF	4.1	M	Y[ ] N[ ]
Source format - FCIF	4.1	O	Y[ ] N[ ]
Source format – 4FCIF	4.1	O	Y[ ] N[ ]
Source format – 16FCIF	4.1	O	Y[ ] N[ ]
Prediction	4.2.2	O	Y[ ] N[ ]
Motion compensation - encoder	4.2.3	O	Y[ ] N[ ]
Motion compensation - decoder	4.2.3	M	Y[ ] N[ ]
Transformer	6.2.4	M	Y[ ] N[ ]
Quantization	4.2.4	M	Y[ ] N[ ]
Clipping	6.3.1	M	Y[ ] N[ ]
Forced updating	4.4	M	Y[ ] N[ ]
Data structure	5.1.1	M	Y[ ] N[ ]
Video multiplex arrangement	5	M	Y[ ] N[ ]
Multipoint considerations	Annex C	M	Y[ ] N[ ]
Transmission coder	Annex H	M	Y[ ] N[ ]
Inverse transform accuracy spec.	Annex A	M	Y[ ] N[ ]
Hypothetical Reference Decoder	Annex B	M	Y[ ] N[ ]

9.11 H.281 PICS

Far-End Camera Control Protocol for Video Conferences Using H.224

Protocol Feature	Std. Clause	Std. Status	Implemented?
Elements of Procedure	5	O	Y [ ] N [ ]
Action Messages	5.1	O	Y [ ] N [ ]
Action Message Examples	5.2	O	Y [ ] N [ ]
Select Video Source	5.3	O	Y [ ] N [ ]
Select Video Source Examples	5.4	O	Y [ ] N [ ]
Store Preset	5.5	O	Y [ ] N [ ]
Activate Preset	5.6	O	Y [ ] N [ ]
General	5.7	O	Y [ ] N [ ]
FECC Message Structure	6	M	Y [ ] N [ ]
FECC Capability Fields	6.2	M	Y [ ] N [ ]

9.12 G.711 PICS

Pulse Code Modulation (PCM) of Voice Frequencies.

Protocol Feature	Std. Clause	Std. Status	Implemented?
64 kb/s - A-law	3.1	O	Y[ ] N[ ]
64 kb/s - μ-law	3.1	O	Y[ ] N[ ]
56 kb/s - A-law	H.221 Annex A.1	O	Y[ ] N[ ]
56 kb/s - μ-law	H.221 Annex A.1	M	Y[ ] N[ ]

9.13 G.722 PICS

7 KHz Audio-coding within 64 kb/s.

Protocol Feature	Std. Clause	Std. Status	Implemented?
64 kb/s	1.3	O	Y[ ] N[ ]
56 kb/s	1.3	O	Y[ ] N[ ]
48 kb/s	1.3	O	Y[ ] N[ ]

9.14 G.722.1

7 KHz Audio-coding within 24 and 32 kb/s.

Protocol Feature	Std. Clause	Std. Status	Implemented?
24 kb/s	G.722.1	O	Y[ ] N[ ]
32 kb/s	G.722.1	O	Y[ ] N[ ]

9.15 G.723.1 PICS

Speech coders: Dual Rate Speech Coder for Multimedia Communications Transmitting at 5.3 and 6.3 kb/s.

Protocol Feature	Std. Clause	Std. Status	Implemented?
Transmit Low Rate Audio (5.3 kb/s)	G.723.1	O	Y [ ] N [ ]
Receive Low Rate Audio (5.3 kb/s)	G.723.1	M	Y [ ] N [ ]
Transmit High Rate Audio (6.3 kb/s)	G.723.1	O	Y [ ] N [ ]
Receive High Rate Audio (6.3 kb/s)	G.723.1	M	Y [ ] N [ ]
Transmit Silence Frames	G.723.1	O	Y [ ] N [ ]
Receive Silence Frames	G.723.1	M	Y [ ] N [ ]

9.16 G.728 PICS

Coding of Speech at 16 kb/s using Low-Delay Code Excited Linear Prediction (LD-CELP).

Protocol Feature	Std. Clause	Std. Status	Implemented?
16 kb/s	All	M	Y[ ] N[ ]

9.17 T.122 PICS

Multipoint Communication Service for Audiographics and Audiovisual Conferencing Service Definition.

Protocol Feature	Std. Clause	Std. Status	Implemented?
Establishing Connections and binding them to the Domain	7.1	M	Y [ ] N [ ]
Attaching Application Users to a Domain	7.2	M	Y [ ] N [ ]
MCS Domain Parameters	7.3	M	Y [ ] N [ ]
MCS Channels	8	M	Y [ ] N [ ]
Multicast Channels	8.1	M	Y [ ] N [ ]
Single-Member Channels	8.2	M	Y [ ] N [ ]
Private Channels	8.3	M	Y [ ] N [ ]
Channel Id Numbering	8.4	M	Y [ ] N [ ]
MCS Data Transfer	9	M	Y [ ] N [ ]
Simple Send	9.1	M	Y [ ] N [ ]
Uniformly Sequenced data transfer	9.2	M	Y [ ] N [ ]
Send Data with Responses (For Further Study)	9.3	O	Y [ ] N [ ]
Token Management	10	O	Y [ ] N [ ]
Exclusive Event Control and Transfer	10.1	O	Y [ ] N [ ]
Event Coordination	10.2	O	Y [ ] N [ ]
Token Id Numbering	10.3	O	Y [ ] N [ ]
MCS Connect Provider	12.1	M	Y [ ] N [ ]
MCS Disconnect Provider	12.2	M	Y [ ] N [ ]
MCS Attach User	12.3	M	Y [ ] N [ ]
MCS Detach User	12.4	M	Y [ ] N [ ]
MCS Channel Join	13.1	M	Y [ ] N [ ]
MCS Channel Leave	13.2	M	Y [ ] N [ ]
MCS Channel Convene	13.3	M	Y [ ] N [ ]
MCS Channel Disband	13.4	M	Y [ ] N [ ]
MCS Channel Admit	13.5	M	Y [ ] N [ ]
MCS Channel Expel	13.6	M	Y [ ] N [ ]
MCS Send Data	14.1	M	Y [ ] N [ ]
MCS Uniformly Sequenced Send Data	14.2	M	Y [ ] N [ ]
MCS Token Grab	15.1	O	Y [ ] N [ ]
MCS Token Inhibit	15.2	O	Y [ ] N [ ]
MCS Token Give	15.3	O	Y [ ] N [ ]
MCS Token Please	15.4	O	Y [ ] N [ ]
MCS Token Release	15.5	O	Y [ ] N [ ]
MCS Token Test	15.6	O	Y [ ] N [ ]
MCS Domain Establishment phase	A.1	M	Y [ ] N [ ]
MCS Data Transfer phase	A.2	M	Y [ ] N [ ]
MCS Connection Release phase	A.3	M	Y [ ] N [ ]

9.18 T.123 PICS

Protocol Stacks for Audiographic and Audiovisual Teleconferencing Applications.

Protocol Feature	Std. Clause	Std. Status	Implemented?
ISDN call setup	1.3	O	Y [ ] N [ ]
Multipoint configuration	5	O	Y [ ] N [ ]
Profile overview	6	M	Y [ ] N [ ]
ISDN basic mode profile	7.1	M	Y [ ] N [ ]
CSDN basic mode profile	7.2	O	Y [ ] N [ ]
PSDN basic mode profile	7.3	O	Y [ ] N [ ]
PSTN basic mode profile	7.4	O	Y [ ] N [ ]
B-ISDN basic mode profile	7.5	O	Y [ ] N [ ]
LAN basic mode profile	7.6	O	Y [ ] N [ ]
Extended Transport Connections	Annex B	O	Y [ ] N [ ]
SCF overview	9.1	M	Y [ ] N [ ]
SCF procedures	9.2	M	Y [ ] N [ ]
SCF messages	9.3	M	Y [ ] N [ ]
Quality of service parameters	9.4	M	Y [ ] N [ ]
Q.922 protocol parameters and options	10	M	Y [ ] N [ ]
Data link frame structure transparency for start-stop transmission	11	O	Y [ ] N [ ]
Physical sublayer formed by H.221 MLP channels	12	M	Y [ ] N [ ]
Alternative profiles	13	O	Y [ ] N [ ]
Alternative: ISDN based on Q.922	13.1	O	Y [ ] N [ ]
Alternative: ISDN based on T.90	13.2	O	Y [ ] N [ ]
Alternative: ISDN based on V.120	13.3	O	Y [ ] N [ ]
Alternative: PSTN based on H.324	13.4	O	Y [ ] N [ ]
Alternative: B-ISDN based on H.222	13.5	O	Y [ ] N [ ]
Alternative: LAN based on data unit transfer	13.6	O	Y [ ] N [ ]
Integration of multimedia signals framed according to H.221	ANNEX A	M	Y [ ] N [ ]
Multimedia conference call setup in the ISDN	APPENDIX I	O	Y [ ] N [ ]

9.19 T.124 PICS

Generic Conference Control for Audiographic and Audiovisual Terminals and Multipoint Control Units.

Protocol Feature	Std. Clause	Std. Status	Implemented?
System Model For a Conference Node	6.1	M	Y [ ] N [ ]
Conference Establishment and Termination	6.2	M	Y [ ] N [ ]
The Conference Roster	6.3	M	Y [ ] N [ ]
The Application Roster	6.4	M	Y [ ] N [ ]
The Application Registry	6.5	M	Y [ ] N [ ]
Conference Conductorship	6.6	O	Y [ ] N [ ]
Miscellaneous Functions	6.7	O	Y [ ] N [ ]
Summary of GCC Abstract Services	6.8	M	Y [ ] N [ ]
Conference Establishment and Termination	7.1	M	Y [ ] N [ ]

Protocol Feature	Std. Clause	Std. Status	Implemented?
The Conference Profile	7.1.1	M	Y [ ] N [ ]
Conference Establishment Requirements	7.1.3	M	Y [ ] N [ ]
Examples of Conference Establishment Procedures	7.1.4	O	Y [ ] N [ ]
Meet-me Conference Establishment	7.1.4.1	M	Y [ ] N [ ]
Call-out Conference Establishment	7.1.4.2	O	Y [ ] N [ ]
Call-through Conference Establishment	7.1.4.3	O	Y [ ] N [ ]
Point-to-Point Conference Establishment	7.1.4.4	M	Y [ ] N [ ]
Conference Establishment among Multiport Terminals	7.1.4.5	O	Y [ ] N [ ]
The Conference Roster	7.2	M	Y [ ] N [ ]
The Application Roster	7.3	M	Y [ ] N [ ]
Contents of the Application Roster	7.3.1	M	Y [ ] N [ ]
Description of the Application Roster Exchange Procedure	7.3.2	M	Y [ ] N [ ]
The Application Registry	7.4	M	Y [ ] N [ ]
Registry Keys	7.4.1	M	Y [ ] N [ ]
Ownership and Persistence	7.4.2	M	Y [ ] N [ ]
Dynamic Allocation	7.4.3	M	Y [ ] N [ ]
Conference Conductorship	7.5	O	Y [ ] N [ ]
Miscellaneous Functions	7.6	O	Y [ ] N [ ]
General Operation	8.1	M	Y [ ] N [ ]
Conference Establishment and Termination	8.2	M	Y [ ] N [ ]
Conference Creation	8.2.1	M	Y [ ] N [ ]
Querying Conferences	8.2.2	M	Y [ ] N [ ]
Joining a Conference	8.2.3	M	Y [ ] N [ ]
Inviting a Node to a Conference	8.2.4	O	Y [ ] N [ ]
Requesting to Add a Node to a Conference	8.2.5	O	Y [ ] N [ ]
Locking a Conference	8.2.6	O	Y [ ] N [ ]
Unlocking a Conference	8.2.7	O	Y [ ] N [ ]
Disconnecting from a Conference	8.2.8	O	Y [ ] N [ ]
Terminating a Conference	8.2.9	M	Y [ ] N [ ]
Ejecting a Node from a Conference	8.2.10	O	Y [ ] N [ ]
Transferring Nodes Between Conferences	8.2.11	O	Y [ ] N [ ]
The Conference and Application Rosters	8.3	M	Y [ ] N [ ]
Overview	8.3.1	M	Y [ ] N [ ]
Nodes Entering a Conference	8.3.2	M	Y [ ] N [ ]
Enrolling Application Protocol Entities	8.3.3	M	Y [ ] N [ ]
Updating a Conference Roster Entry	8.3.4	M	Y [ ] N [ ]
Propagation of Roster Updates to the Top GCC Provider	8.3.5	M	Y [ ] N [ ]
Distribution of the Conference and Application Rosters	8.3.6	M	Y [ ] N [ ]
Nodes Leaving a Conference	8.3.7	M	Y [ ] N [ ]
Collapsing Application Capabilities Lists	8.3.8	M	Y [ ] N [ ]
Application and Conference Roster Inquiry	8.3.9	M	Y [ ] N [ ]
An Example of a Roster Update	8.3.10	O	Y [ ] N [ ]

Protocol Feature	**Std. Clause**	**Std. Status**	**Implemented?**
Remotely Invoking an Application Protocol Entity	8.3.11	O	Y [ ] N [ ]
The Application Registry	8.4	M	Y [ ] N [ ]
Registering a Channel	8.4.1	M	Y [ ] N [ ]
Assigning a Token	8.4.2	M	Y [ ] N [ ]
Setting a Parameter	8.4.3	M	Y [ ] N [ ]
Retrieving an Entry	8.4.4	M	Y [ ] N [ ]
Deleting an Entry	8.4.5	M	Y [ ] N [ ]
Monitoring an Entry	8.4.6	M	Y [ ] N [ ]
Allocation of Unique Handles	8.4.7	M	Y [ ] N [ ]
Changes in Ownership and Registry Cleanup	8.4.8	M	Y [ ] N [ ]
Conference Conductorship	8.5	O	Y [ ] N [ ]
Grabbing Conductorship	8.5.1	O	Y [ ] N [ ]
Releasing Conductorship	8.5.2	O	Y [ ] N [ ]
Conductor Assignment and Release Indications	8.5.3	O	Y [ ] N [ ]
Asking to Be Given Conductorship	8.5.4	O	Y [ ] N [ ]
Giving Conductorship	8.5.5	O	Y [ ] N [ ]
Getting Conductorship Status	8.5.6	O	Y [ ] N [ ]
Conductorship Announcement When New Nodes Enter a Conference	8.5.7	O	Y [ ] N [ ]
Unexpected Disconnection of the Conductor	8.5.8	O	Y [ ] N [ ]
Asking to Be Given Conducted-Mode Permission	8.5.9	O	Y [ ] N [ ]
Granting Conducted-Mode Permission	8.5.10	O	Y [ ] N [ ]
Miscellaneous Functions	8.6	O	Y [ ] N [ ]
Timed Conferences	8.6.1	O	Y [ ] N [ ]
Requesting Conference Assistance	8.6.2	O	Y [ ] N [ ]
Broadcasting a Text Message	8.6.3	O	Y [ ] N [ ]
GCCPDU Definitions	8.7	M	Y [ ] N [ ]
Use of the Multipoint Communication Service	9	M	Y [ ] N [ ]
MCS Services	9.1	M	Y [ ] N [ ]
Channel Allocation	9.2	M	Y [ ] N [ ]
Token Allocation	9.3	M	Y [ ] N [ ]
Use of MCS Data Transmission Services	9.4	M	Y [ ] N [ ]
Encoding of PDUs in MCS Primitives	9.5	M	Y [ ] N [ ]
Format of User Data Parameter of MCS-Connect-Provider	9.6	M	Y [ ] N [ ]
Interpretation of the MCS Domain Selector	9.7	M	Y [ ] N [ ]
Static Channel ID Assignments	Annex A.1	M	Y [ ] N [ ]
Static Token ID Assignments	Annex A.2	M	Y [ ] N [ ]
Object Identifier Assignment	Annex B	M	Y [ ] N [ ]

9.20 T.125 PICS

Multipoint Communications Service Protocol Specification

Protocol Feature	Std. Clause	Std. Status	Implemented?
Overview of the MCS protocol	5	M	Y [ ] N [ ]
Model of the MCS layer	5.1	M	Y [ ] N [ ]
Services provided by the MCS layer	5.2	M	Y [ ] N [ ]
Services assumed from the transport layer	5.3	M	Y [ ] N [ ]
Functions of the MCS layer	5.4	M	Y [ ] N [ ]
Domain management	5.4.1	M	Y [ ] N [ ]
Channel management	5.4.2	M	Y [ ] N [ ]
Data transfer	5.4.3	M	Y [ ] N [ ]
Token management	5.4.4	M	Y [ ] N [ ]
Hierarchical processing	5.5	M	Y [ ] N [ ]
Domain parameters	5.6	M	Y [ ] N [ ]
Use of the transport service	6	M	Y [ ] N [ ]
Model of the transport service	6.1	M	Y [ ] N [ ]
Use of multiple connections	6.2	M	Y [ ] N [ ]
Transport connection release	6.3	M	Y [ ] N [ ]
Structure of Version 2 MCSPDUs	7	M	Y [ ] N [ ]
Structure of Version 3 MCSPDUs	8	O	Y [ ] N [ ]
Encoding of MCSPDUs	9	M	Y [ ] N [ ]
Routing of MCSPDUs	10	M	Y [ ] N [ ]
Connect and extended parameters MCSPDUs	10.1	M	Y [ ] N [ ]
Domain MCSPDUs	10.2	M	Y [ ] N [ ]
Meaning of MCSPDUs	11	M	Y [ ] N [ ]
MCS provider information base	12	M	Y [ ] N [ ]
Hierarchical replication	12.1	M	Y [ ] N [ ]
Channel information	12.2	M	Y [ ] N [ ]
Token information	12.3	M	Y [ ] N [ ]
Elements of procedure	13	M	Y [ ] N [ ]
MCSPDU sequencing	13.1	M	Y [ ] N [ ]
Input flow control	13.2	O	Y [ ] N [ ]
Throughput enforcement	13.3	O	Y [ ] N [ ]
Domain configuration	13.4	M	Y [ ] N [ ]
Domain merger	13.5	M	Y [ ] N [ ]
Domain disconnection	13.6	M	Y [ ] N [ ]
Channel id allocation	13.7	M	Y [ ] N [ ]
Token status	13.8	M	Y [ ] N [ ]
Capabilities Notification	13.9	O	Y [ ] N [ ]
Protocol version arbitration	13.10	M	Y [ ] N [ ]
Protocol version interoperability	13.11	M	Y [ ] N [ ]
Multicast adaptation protocol	Annex A	O	Y [ ] N [ ]

9.21 T.126 PICS

Multipoint Still Image and Annotation Conferencing Protocol Specification.

Protocol Feature	Std. Clause	Std. Status	Implemented?
SI Application Enrollment	5.1	M	Y [ ] N [ ]
Capabilities and Profiles	5.2	M	Y [ ] N [ ]
Workspaces	5.3	M	Y [ ] N [ ]
Hard Copy Devices	5.4	O	Y [ ] N [ ]
Bitmaps	5.5	M	Y [ ] N [ ]
Annotations	5.6	O	Y [ ] N [ ]
Drawing and Erasing Basic Shapes	5.6.1	O	Y [ ] N [ ]
Drawing and Erasing Custom Shapes	5.6.2	O	Y [ ] N [ ]
Text	5.6.3	O	Y [ ] N [ ]
Pointers	5.7	O	Y [ ] N [ ]
Remote Events	5.8	O	Y [ ] N [ ]
Archives	5.9	O	Y [ ] N [ ]
Conducted Mode Behavior	5.10	O	Y [ ] N [ ]
Use of MCS	6.	M	Y[ ] N [ ]
MCS Token and Channel Usage	6.1	M	Y [ ] N [ ]
Use of MCS Data Services	6.2	M	Y [ ] N [ ]
Use of GCC	7.	M	Y [ ] N [ ]
GCC Unique Handles	7.1	M	Y [ ] N [ ]
SI Protocol Parameters	8.1	M	Y [ ] N [ ]
SI Application Enrollment and Initialization	8.2	M	Y [ ] N [ ]
Static Mode	8.2.1	M	Y [ ] N [ ]
Multicast Mode	8.2.2	M	Y [ ] N [ ]
Private Mode	8.2.3	M	Y [ ] N [ ]
Forming Registry Keys	8.2.4	M	Y [ ] N [ ]
Establishing Dynamic Tokens	8.2.5	M	Y [ ] N [ ]
SI Capabilities	8.2.6	M	Y [ ] N [ ]
Workspaces	8.3	O	Y [ ] N [ ]
Workspace Structure	8.3.1	O	Y [ ] N [ ]
Plane Stacking	8.3.1.1	O	Y [ ] N [ ]
Plane Coordinate System	8.3.1.2	O	Y [ ] N [ ]
Workspace Views	8.3.1.3	O	Y [ ] N [ ]
Drawing Color Palette	8.3.1.4	O	Y [ ] N [ ]
Workspace Attributes	8.3.1.5	O	Y [ ] N [ ]
Workspace Synchronization	8.3.1.5.1	O	Y [ ] N [ ]
Acceptance of Keyboard and Pointing Device Events	8.3.1.5.2	O	Y [ ] N [ ]
Preference to Preserve the Workspace	8.3.1.5.3	O	Y [ ] N [ ]
Background Color	8.3.1.5.4	O	Y [ ] N [ ]
Workspace Plane Parameters	8.3.1.6	O	Y [ ] N [ ]
Plane Editability	8.3.1.6.1	O	Y [ ] N [ ]
Plane Usage	8.3.1.6.2	O	Y [ ] N [ ]
Plane Protection	8.3.1.6.3	O	Y [ ] N [ ]
Workspace View Parameters	8.3.1.7	O	Y [ ] N [ ]
View Region	8.3.1.7.1	O	Y [ ] N [ ]
View State	8.3.1.7.2	O	Y [ ] N [ ]

Protocol Feature	Std. Clause	Std. Status	Implemented?
Update Enable Flag	8.3.1.7.3	O	Y [ ] N [ ]
Source Display Indicator	8.3.1.7.4	O	Y [ ] N [ ]
Creating a Workspace	8.3.2	O	Y [ ] N [ ]
Deleting a Workspace	8.3.3	O	Y [ ] N [ ]
Editing Workspace, Plane, and View Attributes	8.3.4	O	Y [ ] N [ ]
Copying Workspace Contents	8.3.5	O	Y [ ] N [ ]
Workspace Refreshing for Late Arrivers	8.3.6	O	Y [ ] N [ ]
The Effect of Changes to the Application Roster	8.3.7	O	Y [ ] N [ ]
Workspace Caching	8.3.8	O	Y [ ] N [ ]
Bitmaps	8.4	M	Y [ ] N [ ]
Creating Bitmaps	8.4.1	M	Y [ ] N [ ]
Deleting Bitmaps	8.4.2	O	Y [ ] N [ ]
Editing Bitmaps	8.4.3	O	Y [ ] N [ ]
Bitmap Color Definition	8.4.4	O	Y [ ] N [ ]
Bitmap Color Component Sampling Ratios	8.4.5	O	Y [ ] N [ ]
Bitmap Formats	8.4.6	O	Y [ ] N [ ]
Uncompressed	8.4.6.1	M	Y [ ] N [ ]
ITU-T T.4 (G3)	8.4.6.2	CM	Y [ ] N [ ]
ITU-T T.6 (G4)	8.4.6.3	CM	Y [ ] N [ ]
ITU-T T.81 (JPEG)	8.4.6.4	O	Y [ ] N [ ]
ITU-T T.82 (JBIG)	8.4.6.5	O	Y [ ] N [ ]
Non-Standard Bitmap Format	8.4.6.6	O	Y [ ] N [ ]
Pointers	8.5	O	Y [ ] N [ ]
Drawing	8.6	O	Y [ ] N [ ]
Drawing Shapes	8.6.1	O	Y [ ] N [ ]
Point	8.6.1.1	O	Y [ ] N [ ]
Open Polyline	8.6.1.2	O	Y [ ] N [ ]
Closed Polyline	8.6.1.3	O	Y [ ] N [ ]
Rectangle	8.6.1.4	O	Y [ ] N [ ]
Ellipse	8.6.1.5	O	Y [ ] N [ ]
Non-Standard	8.6.1.6	O	Y [ ] N [ ]
Drawing Element Attributes and Parameters	8.6.2	O	Y [ ] N [ ]
Sample Rate	8.6.2.1	O	Y [ ] N [ ]
Rotation	8.6.2.2	O	Y [ ] N [ ]
Bounding Rectangle	8.6.2.3	O	Y [ ] N [ ]
Pen Color	8.6.2.4	O	Y [ ] N [ ]
Pen Thickness	8.6.2.5	O	Y [ ] N [ ]
Pen Nib	8.6.2.6	O	Y [ ] N [ ]
Line Style	8.6.2.7	O	Y [ ] N [ ]
Fill Color	8.6.2.8	O	Y [ ] N [ ]
Highlighting	8.6.2.9	O	Y [ ] N [ ]
View State	8.6.2.10	O	Y [ ] N [ ]
Depth Order	8.6.2.11	O	Y [ ] N [ ]
Creating Drawing Elements	8.6.3	O	Y [ ] N [ ]
Deleting Drawing Elements	8.6.4	O	Y [ ] N [ ]
Editing Drawing Elements	8.6.5	O	Y [ ] N [ ]

Protocol Feature	**Std. Clause**	**Std. Status**	**Implemented?**
Remote Events	8.7	O	Y [ ] N [ ]
Remote Keyboard Events	8.7.1	O	Y [ ] N [ ]
Remote Pointing Device Events	8.7.2	O	Y [ ] N [ ]
Remote Printing Events	8.7.3	O	Y [ ] N [ ]
Archives	8.8	O	Y [ ] N [ ]
Conducted Mode Operation	8.9	O	Y [ ] N [ ]
SIPDU Definitions	9.	M	Y [ ] N [ ]
SI Profiles	Annex A	O	Y [ ] N [ ]
Static Channel and Token ID Assignments	Annex B	M	Y [ ] N [ ]
Static Channel ID Assignments	1.1	M	Y [ ] N [ ]
Static Token ID Assignments	1.2	M	Y [ ] N [ ]
Object Identifier Assignments	Annex C	M	Y [ ] N [ ]
Deriving Intermediate Palettes for Bitplane Progressive Transmission of Palletized Images	Appendix I	O	Y [ ] N [ ]

9.22 T.127 PICS

Multipoint Binary File Transfer Protocol

Protocol Feature	Std. Clause	Std. Status	Implemented?
Multipoint Transfer of Data - An Overview	6	M	Y [ ] N [ ]
T.127 System Model	6.1	M	Y [ ] N [ ]
Compression	6.2	O	Y [ ] N [ ]
Priority	6.3	O	Y [ ] N [ ]
File Preshipping	6.4	O	Y [ ] N [ ]
Baseline MBFT Application	7	M	Y [ ] N [ ]
Description of Operation	8	M	Y [ ] N [ ]
File Transfer User Application	8.1	O	Y [ ] N [ ]
File Transfer Application Resource Manager	8.2	M	Y [ ] N [ ]
File Transfer Application Service Element	8.3	M	Y [ ] N [ ]
MBFT Resources	8.4	M	Y [ ] N [ ]
MBFT Initialization	8.4.1	M	Y [ ] N [ ]
Static Mode	8.4.2	M	Y [ ] N [ ]
Multicast Mode	8.4.3	M	Y [ ] N [ ]
Private Mode	8.4.4	M	Y [ ] N [ ]
Forming Registry Keys	8.4.5	M	Y [ ] N [ ]
MBFT Capabilities	8.5	M	Y [ ] N [ ]
Support of Additional Concurrent File Transfers	8.6	O	Y [ ] N [ ]
Multicast Channels	8.6.1	O	Y [ ] N [ ]
Private Channels	8.6.2	O	Y [ ] N [ ]
Selective File Transfer	8.7	O	Y [ ] N [ ]
Leaving an MBFT Session	8.8	M	Y [ ] N [ ]
File Exchange	8.9	M	Y [ ] N [ ]
Transmitter Invoked Operation	8.9.1	M	Y [ ] N [ ]
Receiver Invoked Operation	8.9.2	O	Y [ ] N [ ]
Remote Directory Listing	8.10	O	Y [ ] N [ ]
Conducted Mode Behavior	8.11	M	Y [ ] N [ ]
Peer File APE Present at Conducting Node	8.11.1	M	Y [ ] N [ ]
Peer File APE Absent at Conducting Node	8.11.2	M	Y [ ] N [ ]
Aborting a File Transfer	8.12	M	Y [ ] N [ ]
Diagnostics	8.13	O	Y [ ] N [ ]
NonStandard Operations	8.14	O	Y [ ] N [ ]
MBFT PDU Definitions	9	M	Y [ ] N [ ]
Use of the Multipoint Communication Service	10	M	Y [ ] N [ ]
Use of MCS Data Transmission Services	10.1	M	Y [ ] N [ ]
Channel Allocation	10.2	M	Y [ ] N [ ]
Token Allocation	10.3	M	Y [ ] N [ ]
MCS services	10.4	M	Y [ ] N [ ]
Use of Generic Conference Control	11	M	Y [ ] N [ ]
Resource IDs	11.1	M	Y [ ] N [ ]
Static Channel and Token Assignment	Annex A	M	Y [ ] N [ ]
Object Identifier Assignments	Annex B	M	Y [ ] N [ ]
File Transfer Examples	Appendix I	O	Y [ ] N [ ]
MBFT Attributes	Appendix II	O	Y [ ] N [ ]

9.23 H.320 Classified Security PICS

(Normative for Department of Defense)

Protocol Feature	Std. Section	Std. Status	Implemented?
FTR 1080B-2002	5.1.1.1	M	Y[ ] N[ ]
Transmission data rates: *p*=1, *p*=2	5.1.1.3	M	Y[ ] N[ ]
Proprietary codec	5.1.1.4	O	Y[ ] N[ ]
Motion rendition	5.1.1.6	M	Y[ ] N[ ]
VTU Network interface	5.2.2	O	Y[ ] N[ ]
Graphics-MIL-STD quantization tables	8.3.3	O	Y[ ] N[ ]
Graphics - Custom quantization tables	8.3.3	O	Y[ ] N[ ]
Security - interoperate with KG-194	5.1.4.3	CM	Y[ ] N[ ]
Security - KG-194 resync capability	5.1.4.3.2	CM	Y[ ] N[ ]
Security - interoperate with KIV-7/KIV-7HS	5.1.4.4	CM	Y[ ] N[ ]
Security - KIV-7/KIV-7HS resync	5.1.4.4.2	O	Y[ ] N[ ]
ISDN BRI	5.2.3.1.2	O	Y[ ] N[ ]
Secure ISDN BRI	5.2.3.1.3	O	Y[ ] N[ ]

9.24 H.323 PICS

9.24.1 H.323 Endpoint PICS

Gatekeeper Communication

Protocol Feature	Std. Clause	Trans. Std. Status	Rcv. Std. Status	Implemented?
Gatekeeper Location (GRQ)	H.225	O	-	Y [ ] N [ ]
Gatekeeper Location (GCF/GRJ)	H.225	-	M	Y [ ] N [ ]
Registration (RRQ)	H.225	M	-	Y [ ] N [ ]
Registration (RCF/RRJ)	H.225	-	M	Y [ ] N [ ]
Unregistration (URQ)	H.225	O	M	Y [ ] N [ ]
Unregistration (UCF/URJ)	H.225	M	O	Y [ ] N [ ]
Admission (ARQ)	H.225	M	-	Y [ ] N [ ]
Admission (ACF/ARJ)	H.225	-	M	Y [ ] N [ ]
Bandwidth Change (BRQ)	H.225	O	CM Note 1	Y [ ] N [ ]
Bandwidth Change (BCF/BRJ)	H.225	M	M	Y [ ] N [ ]
Disengage (DRQ)	H.225	O	M	Y [ ] N [ ]
Disengage (DCF/DRJ)	H.225	O	M	Y [ ] N [ ]
Information (IRQ)	H.225	-	M	Y [ ] N [ ]
Information (IRR)	H.225	M	-	Y [ ] N [ ]
Information (IACK/INAK)	H.225	-	O	Y [ ] N [ ]

Note 1 - Mandatory for endpoint to comply with bandwidth reduction BRQ from Gatekeeper.

Call Signaling

Protocol Feature	Std. Clause	Trans. Std. Status	Rcv. Std. Status	Implemented?
Setup	H.225	M	M	Y [ ] N [ ]
Setup Acknowledge	H.225	O	O	Y [ ] N [ ]
Alerting	H.225	M	M	Y [ ] N [ ]
Call Proceeding	H.225	O	M	Y [ ] N [ ]
Connect	H.225	M	M	Y [ ] N [ ]
Progress	H.225	O	O	Y [ ] N [ ]
Release Complete	H.225	CM Note 1	M	Y [ ] N [ ]
User Information	H.225	O	O	Y [ ] N [ ]
Information	H.225	O	O	Y [ ] N [ ]
Notify	H.225	O	O	Y [ ] N [ ]
Status	H.225	M	M	Y [ ] N [ ]
Status Inquiry	H.225	O	M	Y [ ] N [ ]
Facility	H.225	M	M	Y [ ] N [ ]
Fast Connect	H.323	O	O	Y [ ] N [ ]

Note 1 - Mandatory if Call Signaling Channel is open.

Control Function

Protocol Feature	Std. Clause	Std. Status	Implemented?
Master/Slave Determination	H.245	M	Y [ ] N [ ]
Capability Exchange	H.245	M	Y [ ] N [ ]
Logical Channel Signaling	H.245	M	Y [ ] N [ ]
Bi-directional Logical Channel Signaling	H.245	M	Y [ ] N [ ]
Close Logical Channel Signaling	H.245	M	Y [ ] N [ ]
Mode Request	H.245	M	Y [ ] N [ ]
Round Trip Delay Determination	H.245	M	Y [ ] N [ ]
Maintenance Loop Signaling	H.245	M	Y [ ] N [ ]

Motion Video

Protocol Feature	Std. Clause	Std. Status	Implemented?
Encode H.261 QCIF (176x144)	H.261	M	Y [ ] N [ ]
Encode H.263	H.263	O	Y [ ] N [ ]
Decode H.261 QCIF (176x144)	H.261	M	Y [ ] N [ ]
Decode H.263	H.263	O	Y [ ] N [ ]
Multiple Video Stream Transmission Capability	H.323	O	Y [ ] N [ ]
Multi-Unicast Video Transmission Capability	H.323	O	Y [ ] N [ ]
Multicast Video Transmission Capability	H.323	O	Y [ ] N [ ]
Multiple Video Stream Reception Capability	H.323	O	Y [ ] N [ ]
Video Switching Capability	H.323	O	Y [ ] N [ ]
Video Mixing Capability	H.323	O	Y [ ] N [ ]

Audio

Protocol Feature	Std. Clause	Std. Status	Implemented?
Transmit Audio (64 kb/s) (Note 1)	G.711	M	Y [ ] N [ ]
Receive Audio (64 kb/s) (Note 1)	G.711	M	Y [ ] N [ ]
Transmit Low Rate Audio	G.723.1	O	Y [ ] N [ ]
Receive Low Rate Audio	G.723.1	O	Y [ ] N [ ]
Transmit Low Delay Audio	G.729	O	Y [ ] N [ ]
Receive Low Delay Audio	G.729	O	Y [ ] N [ ]
Asymmetric Capability	H.323	M	Y [ ] N [ ]
Multiple Audio Stream Transmission Capability	H.323	O	Y [ ] N [ ]
Multi-Unicast Audio Transmission Capability	H.323	O	Y [ ] N [ ]
Multicast Audio Transmission Capability	H.323	O	Y [ ] N [ ]
Multiple Audio Stream Reception Capability	H.323	O	Y [ ] N [ ]
Audio Mixing Capability	H.323	O	Y [ ] N [ ]
Receive Path Delay Capability	H.323	O	Y [ ] N [ ]

Note 1 - Only 64 kb/s mode is allowed.

Data Applications

Protocol Feature	Std. Clause	Std. Status	Implemented?
Multimedia Teleconferencing Applications	T.120 series	O	Y [ ] N [ ]
Far End Camera Control	H.282/H.283	O	Y [ ] N [ ]

Multipoint Controller Features

Protocol Feature	Std. Clause	Std. Status	Implemented?
Multipoint Controller Capability Included (Note 1)	H.323	O	Y [ ] N [ ]
Conference out of Consultation	H.323	O	Y [ ] N [ ]

Note 1 - Support conferences between three or more endpoints in a multipoint conference.

Multipoint Capability

Protocol Feature	Std. Clause	Std. Status	Implemented?
Centralized Multipoint Audio Capability	H.323	M	Y [ ] N [ ]
Centralized Multipoint Video Capability	H.323	CM (Note 1)	Y [ ] N [ ]
Centralized Multipoint Data Capability	H.323	CM (Note 2)	Y [ ] N [ ]
Decentralized Multipoint Audio Capability	H.323	O	Y [ ] N [ ]
Decentralized Multipoint Video Capability	H.323	O	Y [ ] N [ ]
Decentralized Multipoint Data Capability	H.323	O	Y [ ] N [ ]

Note 1 - Mandatory if endpoint supports video.
Note 2 - Mandatory if endpoint supports data.

9.24.2 H.323 Gateway Specific PICS

Gateway Features (Note 1)

Protocol Feature	Std. Clause	Std. Status	Implemented?
Supports H.310 Gateway Conversions	H.323	O	Y [ ] N [ ]
Supports H.320 Gateway Conversions	H.323	O	Y [ ] N [ ]
Supports H.321 Gateway Conversions	H.323	O	Y [ ] N [ ]
Supports H.322 Gateway Conversions	H.323	O	Y [ ] N [ ]
Supports H.324 Gateway Conversions	H.323	O	Y [ ] N [ ]
Supports V.70 Gateway Conversions	H.323	O	Y [ ] N [ ]
Supports PSTN Voice Gateway Conversions	H.323	O	Y [ ] N [ ]
Supports ISDN Voice Gateway Conversions	H.323	O	Y [ ] N [ ]
Supports Video (Note 2)	H.323	O	Y [ ] N [ ]
Supports Video Transcoding	H.323	O	Y [ ] N [ ]
Supports Audio (Note 3)	H.323	M	Y [ ] N [ ]
Supports Audio Transcoding	H.323	O	Y [ ] N [ ]
Supports Data	H.323	O	Y [ ] N [ ]
T.120 MCU Included	T.120	O	Y [ ] N [ ]
H.323 MCU Included (Note 4)	H.323	O	Y [ ] N [ ]
H.323 Gatekeeper Included (Note 5)	H.323	O	Y [ ] N [ ]

Note 1 - The Gateway appears to the other H.323 terminals on the network as one or more H.323 terminals, or an H.323 MCU.

Note 2 - Per Motion Video PICS of 9.24.1.

Note 3 - Per Audio PICS of 9.24.1.

Note 4 - If the Gateway includes an MCU function on the network side, that function shall be an H.323 MCU

Note 5 - Independent function that may be co-exist with the Gateway.

9.24.3 H.323 Multipoint Processor Specific PICS

Multipoint Processor Features (Note 1)

Protocol Feature	Std. Clause	Std. Status	Implemented?
Supports Video (Note 2)	H.323	O	Y [ ] N [ ]
Supports Video Transcoding	H.323	O	Y [ ] N [ ]
Supports Voice Activated Video Switching	H.323	O	Y [ ] N [ ]
Supports Audio (Note 3)	H.323	O	Y [ ] N [ ]
Supports Audio Transcoding	H.323	O	Y [ ] N [ ]
Supports Audio Mixing	H.323	O	Y [ ] N [ ]
Supports Data	H.323	O	Y [ ] N [ ]
T.120 MCU Included	T.120	O	Y [ ] N [ ]
H.323 Multipoint Controller Included (Note 4)	H.323	CM	Y [ ] N [ ]
H.323 Gatekeeper Included (Note 5)	H.323	O	Y [ ] N [ ]
H.323 Gateway Included (Note 6)	H.323	O	Y [ ] N [ ]
Chair Control	H.323	O	Y [ ] N [ ]
User Broadcast Control Control	H.323	O	Y [ ] N [ ]
User Select Control	H.323	O	Y [ ] N [ ]
Multipoint Lip Synchronization	H.323	O	Y [ ] N [ ]

Note 1 - The MP is not callable as an endpoint, the MCU, which it is a part of, is callable as an endpoint.
Note 2 - Per Motion Video PICS of 9.24.1.
Note 3 - Per Audio PICS of 9.24.1.
Note 4 - Mandatory if the MP is implemented .
Note 5 - Independent function, which may be co-located with the Gatekeeper
Note 6 - Independent function, which may be co-located with the Gateway.

9.24.4 H.323 Gatekeeper Specific PICS

Gatekeeper Features

Protocol Feature	Std. Clause	Std. Status	Implemented?
Address Translation	H.323	M	Y [ ] N [ ]
Admissions Control (Note 1)	H.323	M	Y [ ] N [ ]
Bandwidth Control (Note 2)	H.323	M	Y [ ] N [ ]
Route Call Control Signaling	H.323	O	Y [ ] N [ ]
Support Adhoc multipoint (route call to MCU)	H.323	O	Y [ ] N [ ]
Enhanced services (Note 3)	H.323	O	Y [ ] N [ ]

Note 1 - See Section 6.1.3.1 for admission policy.
Note 2 - See Section 6.1.3.1 for bandwidth management policy.
Note 3 - See Section 6.1.3.1 for description of other Enhanced Services.

INTERTENTIONALLY BLANK

10 NOTES

(This section contains information of a general or explanatory nature that may be helpful; however, the section is not mandatory.)

10.1 Acquisition Guidance

10.1.1 Non-Developmental Items

The selected minimum essential (mandatory) requirements identified in this Profile should allow maximum flexibility by permitting non-developmental item (NDI) or commercial off-the-shelf (COTS) acquisition.

10.1.2 Tailoring

New DOD acquisitions should meet the mandatory requirements of this Profile, but it is up to the acquisition activity to decide which options should be acquired.

10.1.3 Mandatory Optional

The term *mandatory optional* for a given feature is not used in this Profile but is sometimes used in acquisition documents. Care must be taken to distinguish between the language of the Profile and the language of the acquisition documents, since they serve different purposes. A feature that is optional in the Profile could be mandatory, mandatory optional, optional, or omitted entirely from the acquisition documents, depending on the user's needs.

10.1.4 Software Upgrades

It is recommended that procurement officials add language to their contracts to mandate that upgrades or enhancements to the VTU or MCU be implemented in software as much as possible. Having upgrades in software instead of hardware will usually allow for more cost-effective changes.

10.1.5 Overseas Conferences

The A-law audio coding option, as specified in Section 5.1.3.2.1, is recommended if it is anticipated that overseas conferences with non-DOD sites will be held.

10.1.6 Electrical and Mechanical Interfaces

For classified operation with KG-194 cryptographic devices, it is recommended that the electrical and mechanical interfaces of the cables connecting the KG-194 be specified at both the network interface and the VTU or MCU. For ISDN TAs an EIA-449 to TIA/EIA-530 adapter cable may be required since TAs typically do not have EIA-449 interfaces.

10.1.7 Audio

10.1.7.1 Audio Subsystem

It is the responsibility of the room audio subsystem to provide the specified electrical input level to the VTU or MCU, and to amplify the specified output electrical level from the VTU or MCU to the proper acoustic level. In addition, it may cancel or suppress echoes, mix various microphones, and distribute signals to loudspeakers.

10.1.7.2 Narrowband Speech Mode

The 0F (framed) modes are for audio data rates of 56 kb/s (unrestricted network) and 48 kb/s (restricted network).

10.1.7.3 Audio at $p = 1$

For operation at $p = 1$ use of G.711, G.722 or G.722.1 will result in an audio-only connection. To obtain audio and video at $p = 1$, use G.728 audio.

10.1.8 Video

10.1.8.1 Video Picture-Quality Definition

Four ANSI standards relate to the measurement of video picture quality for VTC. Since methods presented by these standards are new, commercial test equipment for conducting these measurements is not known to be available as of the date of the Profile.

The first is ANSI T1.801.01-1995 (Rev. 2001) "Digital Transport of Video Teleconferencing/Video Telephony Signals - Video Test Scenes for Subjective and Objective Performance Assessment". This standard specifies a collection of video test scenes that have been approved for use in subjective and objective performance assessment. Scenes are divided by content categories that are chosen to be representative of typical VTC applications. The measured video performance of a VTC system may be strongly dependent on the type of input video transmitted by the VTC system. Scenes with more motion and/or more spatial detail may produce lower subjective quality ratings than scenes with less motion and/or less spatial detail. Therefore, the user should take special care to select a subset of test scenes from ANSI T1.801.01-1995 that adequately characterize the intended application. *Note: The accompanying video test tape to this ANSI standard is available from the Alliance for Telecommunications Industry Solutions, 1200 G Street, NW, Suite 500, Washington, DC 20005.*

The second is ANSI T1.801.02-1996 (Rev. 2001) "Digital Transport of Video Teleconferencing/Video Telephony Signals - Performance Terms, Definitions, and Examples". This standard provides a dictionary of digital video performance terms and impairments and includes videotape that illustrates common digital video impairments such as tiling, smearing, edge busyness, error blocks, and jerkiness. Thus, this standard gives end-users and service providers a common language for discussing digital video impairments.

The third is ANSI T1.801.03-1996 "Digital Transport of One-Way Video Signals - Parameters for Objective Performance Assessment". This standard specifies methods of measurement for objective video performance parameters (the standard does not cover audio) for end-to-end transmission quality between the video input interface of one VTU and the video output interface of another VTU. The performance metrics in ANSI T1.801.03 have been approved for in-service or out-of-service use for detecting the continued operational readiness of one-way, 525-line video systems utilizing digital transport facilities (e.g., maintenance, fault detection, and quality monitoring).

The fourth is ANSI T1.801.04-1997 "Multimedia Communications Delay, Synchronization, and Frame Rate Measurement." This standard specifies ANSI approved methods of measurement for end-to-end audio and video delay, and audio-visual synchronization. Transmission frame rate can be measured using this standard or ANSI T1.801.03.

Acquisition authorities should take measures to ensure levels of video quality necessary for their applications, especially when acquiring a variety of products from different sources. Video quality should be tested while interoperating not only with the same manufacturer's equipment, but also with different manufacturer's equipment, because this can drastically affect the video quality. At present, the most accurate method of assessing video quality is subjective testing (the test scenes in ANSI T1.801.01 have been approved for subjective testing of VTC systems).

Although incomplete, the objective testing methods presented by the above ANSI standards can provide useful indicators of quality. The ultimate goal is to refine and extend the objective measurement technology to produce objective methods that can replace subjective experiments for a wide range of applications. This work is continuing on a national as well as an international level so that the user of this document is encouraged to determine the status of these investigations.

10.1.8.2 Freeze-Frame Picture Quality

The limiting factors in freeze-frame video quality are often the cameras and monitors. Typically, the resolution of the cameras and monitors is designed for the motion video resolution and may not provide the desired freeze-frame picture quality. For example, the freeze-frame resolution of 4 x FCIF (704 x 576 = 405,504 pixels) exceeds the specifications of NTSC cameras and monitors (maximum 480 horizontal lines). To make full use of the 4 x FCIF resolution, special cameras and monitors have to be procured.

10.1.8.3 Picture Format (resolution)

If the user requires the VTU or MCU to operate at a rate equal to or greater than $p = 6$, then it is recommended that the VTU or MCU also have the capability for FCIF resolution at rates equal to and above $p = 2$.

10.1.9 Multipoint Control Unit (MCU)

In addition to the operations described in Section 5.1.6, there are several other options, which are not ITU Recommendations issues, but still should be identified in an acquisition document. These options include:

- Network interface. The network interface selected is heavily dependent on the type of network to which the MCU will be connected. This decision requires close coordination with the network provider. If the network is a digital public switched network, such as narrow-band ISDN, a single PRI is recommended for unclassified MCUs. This interface will allow multiple VTUs to be connected through a single network interface. For classified MCUs, a separate EIA-449:TIA/EIA-422-B interface is required for each VTU or MCU connection.

- Number of VTUs in a conference. This can typically range from 4 to 24. It should be possible to increase the number of VTUs supported by the MCU by adding cards and/or software without returning the equipment to the factory.

- Number of simultaneous conferences (Segmentable operation). The number of simultaneous conferences is usually related to the number of VTUs that can be supported. For example, if the MCU can support 16 VTUs, then it can usually support up to 8 simultaneous conferences (8 conferences of 2 VTUs each.). The number of VTUs supported by an MCU is manufacturer dependent.

- Cascading. Does the MCU support cascading to other MCUs in a standards compliant manner? This will allow increasing the number of VTUs in a conference beyond the number supported by a single MCU. It will also allow more efficient communications. For example, if an East Coast MCU connects to 4 East Coast VTUs and a West Coast MCU connects to 4 West Coast VTUs, only a single coast-to-coast connection is required between the two MCUs. Otherwise the four VTUs on one coast will require individual coast-to-coast connections to the MCU on the other coast.

- Audio. MCU support of the G.722, G.722.1 and G.728 audio algorithms will allow conferences to operate at a higher level of capability. Support of G.722 or G.722.1 will provide better quality audio. Support of G.728 will provide better quality video because it makes more bandwidth available for video. If audio switching is desired, the method of control should be understood since it is not within the ITU Recommendations.

- Video. Some MCUs provide video mixing capability where more than one VTU's video can be seen simultaneously. A typical implementation divides the video screen into four rectangles, with each rectangle showing a different VTU site.

- Secondary VTUs. It is recommended that the MCU support secondary VTUs. This will allow less capable VTUs or audio only terminals to still participate in the conference at least in an audio only mode.

- Terminal numbering. It is recommended that the MCU support H.243 terminal numbering.

- Value added services. An MCU may optionally offer value-added services that are not within the scope of the ITU-T H.320 Recommendations. Some of these services may be activated by the VTU using SBE characters. Value added services offer additional capability to the conference that are accessed by the VTU. These services might include conference access codes (passwords), request an operator, dial out capability, access the reservation system, add another party, etc. These services would be accessed by character sequences such as #0 (# and zero on the keypad) for the conference operator. The appropriate character sequences may be obtained by audio prompt or other means. These character sequences are currently not standardized. Other value-added services are also possible. In selecting these features, care should be taken in assuring that they are compatible with common VTUs and do not require proprietary VTU functionality. If proprietary VTU functionality is required, these features can only be accessed by those manufacturers VTUs and may not be usable in most conferences.

10.2 Security

10.2.1 TEMPEST

10.2.1.1 General

The following are recommendations only (not mandatory). TEMPEST requirements for secure VTC systems should be applied case by case, in accordance with MILDEP or DOD TEMPEST requirements. TEMPEST protection must be considered if the VTU is being used for the processing of classified information.

Any equipment certified under NACSIM 5100A is still acceptable for use under NSTISSAM TEMPEST/1-92 (see 10.2.3). There are both facility and equipment TEMPEST zones. A facility

TEMPEST zone is a defined area within a facility where equipment with appropriate TEMPEST characteristics (TEMPEST zone assignment) may be operated without emanating electromagnetic radiation beyond the controlled space boundary of the facility. *NOTE: Facility TEMPEST zones are determined by measuring electromagnetic attenuation provided by a building's properties and the free space loss to the controlled space boundary. Equipment TEMPEST zone assignments are based on the level of compromising emanations produced by the equipment.*

10.2.1.2 TEMPEST Requirements

TEMPEST requirements should be referred to the individual MILDEPs as follows:

- Air Force - Information Warfare Center
- Army - Intelligence Security Command
- Navy and Marine Corps - Naval Electronic Systems Security Command
- NSA - NSA TEMPEST Advisory Group

Below are the addresses of the commands:

Air Force:	Commander Air Force Information Warfare Center/EAC San Antonio, TX 78243-5000
Army:	Commander TEMPEST Det 902 MI GP ATTN: IAGPA-A-VH Vint Hill Farms Station Warrenton, VA 22186-5126
Navy/ Marine Corps:	Naval Electronic Systems Security Engineering Center ATTN: INFOSEC Department 3801 Nebraska Avenue, NW Washington, DC 20393-5270
NSA:	Department of Defense National Security Agency TEMPEST Advisory Group, ATTN: C9 Fort George G. Meade, MD 20755-6000

For DOD agencies not listed above, contact the NSA office for information.

10.2.1.3 TEMPEST Documents

TEMPEST requirements are stated in the following documents or their latest revision:

NACSIM 5100A	*Compromising Emanations Laboratory Test Requirements, Electromagnetics. National Security Telecommunications and Information System Security (NSTISS)*
NTISSI 7000	*National Telecommunications and Information Systems Security Instruction, TEMPEST Countermeasures for Facilities, 7 October 1988*
NTISSP 300	*National Telecommunications and Information Systems Security Policy, National Policy on the Control of Compromising Emanations, 3 October 1988*
NSTISSAM TEMPEST/1-92	*Compromising Emanations Laboratory Test Requirements, Electromagnetics. National Security Telecommunications and Information System Security (NSTISS)*
	Commercial COMSEC Endorsement Program Procedures, 31 August 1987, National Security Agency
	INFOSEC System Security Products & Services Catalog, October 1990, National Security Agency

The above documents can be obtained from:

National Telecommunications & Information
Systems Security Committee
Director, NSA
Fort George G. Meade, MD 20755-6000

OPNAVINST C5510.93E	*Navy Implementation of National Policy on Control of Compromising Emanations, 22 February 1988, with OPNAVNOTE C 5510 of 13 October 1990*
AR 380-19-1	*Control of Compromising Emanations, September 1990 (Army)*

10.2.2 Automated Information Security

10.2.2.1 General

The following are recommendations only (not mandatory). Automated Information Security requirements for VTC systems should be applied on a case by case, in accordance with MILDEP or DOD security requirements. Security protection must be considered if the VTU is being used for the processing of classified information.

10.2.2.2 Automated Information Security Requirements

DOD Directive 5200.28, reference (b), mandates the accreditation of automated information systems (IS), to include stand-alone personal computers, connected systems, and networks. The interpretation and implementation of this Directive varies across Service and Agency boundaries.

The DOD Information Technology Security Certification and Accreditation Process (DITSCAP) establishes a standard process, set of activities, general tasks, and a management structure to certify and accredit IS that will maintain the information assurance (IA) and security posture of the Defense Information Infrastructure (DII). This process supports an infrastructure-centric approach, with a focus on the mission, environment, and architecture. For a system in development, the intent is to identify appropriate security requirements, design to meet those requirements, test the design against the same requirements, and then monitor the accredited system for changes or reaccredidation as necessary.

10.2.2.2.1 DOD Security Requirements Documents

DODD 5200.28	*Security Requirements for Automatic Data Processing (ADP) Systems, revised April 1978.*
DOD 5200.28-STD	*Department of Defense Trusted Computer System Evaluation Criteria, December 26, 1985.*
DOD 5200.28-M	*ADP Security Manual, June 1979.*
DODI 5200.40	*DOD Information Technology Security Certification and Accreditation (C&A) Process (DITSCAP), December 30, 1997.*
DOD 8510.1-M	*DOD Information Technology Security Certification and Accreditation Process (DITSCAP), July 31, 2000.*

The above documents can be obtained from the U.S. Department of Defense, Washington Headquarters Service, Correspondence and Directives Directorate.

WHS/C&D Directives and Records Branch
Attn: Directives Section
Suite 501, Crystal Gateway North
1111 Jefferson Davis Highway
Arlington, VA 22202
http://web7.whs.osd.mil/

10.2.2.2.2 Selected Automated Information Security Definitions

Accreditation. A formal declaration by the DAA that the AIS is approved to operate in a particular security mode using a prescribed set of safeguards at an acceptable level of risk. Accreditation is the official management authorization for the operation of AIS and is based on the certification process as well as other management considerations. The accreditation statement affixes security responsibility with the DAA and shows that due care has been taken for security.

Automated Information Systems (AISs). An assembly of computer hardware, software, and/or firmware configured to collect, create, communicate, compute, disseminate, process, store, and/ or control data or information.

AIS Security. Measures and controls that safeguard or protect an AIS against unauthorized (accidental or intentional) disclosure, modification, or destruction of AISs and data, and denial of service. AIS security includes consideration of all hardware and/or software functions, characteristics, and/or features; operational procedures, accountability procedures, and access controls at the central computer facility, remote computer, and terminal facilities; management constraints; physical structures and devices; and personnel and communication controls needed to provide an acceptable level of risk for the AIS, and for the data and information contained in the AIS. It includes the totality of security safeguards needed to provide an acceptable protection level for AIS and for data handled by AIS.

Certification Authority (Certifier) Responsibilities. The Certifier supports the DAA as the technical expert in the certification process. The Certifier initiates the vulnerability and risk assessments, reviews the threat definition, identifies the security requirements, tailors the DITSCAP, determines the appropriate certification level, and develops the DITSCAP plan and SSAA.

Designated Approving Authority (DAA). The official who has the authority to decide on accepting the security safeguards prescribed for an AIS or the official who may be responsible for issuing an accreditation statement that records the decision to accept those safeguards. The DAA must be at an organizational level, have authority to evaluate the overall mission requirements of the AIS, and to provide definitive directions to AIS developers or owners relative to the risk in the security posture of the AIS. This term is synonymous with the designated accrediting authority and delegated accrediting authority.

DOD Information Technology Security Certification and Accreditation Process (DITSCAP). The standard DOD process for identifying information security requirements, providing security solutions, and managing IS security activities.

Information System Security Officer (ISSO). The person responsible to the DAA for ensuring the security of an IS throughout its life cycle, from design through disposal. Synonymous with system security officer.

System Security Authorization Agreement (SSAA). The SSAA is a formal agreement among the DAA(s), the Certifier, user representative, and program manager. It is used throughout the entire DITSCAP to guide actions, document decisions, specify IA requirements, document certification tailoring and level-of-effort, identify potential solutions, and maintain operational systems security.

10.2.2.3 Automated Information Security of PC-Based CODECs

When changing from a classified to an unclassified conference, non-PC-Based CODECs are powered off to assure no residual classified information remains. PC-based CODECs do not provide the same assurance due to the possible storage of classified data and/or images on the hard drive. One possible alternative is to require the use of two removable hard drives, one for unclassified conferences and one for classified conferences.

10.2.3 Type 3 Cryptographic Equipment - Export Restrictions

Type 3 is for transmission of unclassified sensitive information. Use of the DES algorithm and the Advanced Encryption Standard (AES), outside the DOD community is beyond the scope of this Profile. DES and AES are export-controlled algorithms. Export of the DES or AES algorithm is handled on a case by case basis through licensing by the Bureau of Export Administration of the U.S. Department of Commerce *(See FIPS PUB 140-2 and FIPS PUB 197)*.

10.2.4 Classified Operation over Restricted Networks

Type 1 data encryption from a VTU or MCU operating on an unrestricted network, in restricted mode, will result in encryption of the bit 8 sub-channel. A gateway between the unrestricted network and a restricted network will remove the bit 8 sub-channel. This results in corruption of the encrypted data, such that the far-end cryptographic equipment is not able to properly decrypt the data back into the original bit pattern.

For operation of VTU or MCUs using Type 1 security over an unrestricted network connected to a restricted network, the following procedure should be used: Each VTU or MCU is connected through a cryptographic device to a network interface device (that is, an inverse multiplexer (IMUX), or a terminal adapter). The network interface device at the unrestricted network must interface to the cryptographic device at multiples of 56 kb/s and perform the bit 8 sub-channel stuffing/stripping for the unrestricted network. The cryptographic device and the VTU or MCU at both ends of the network receive network timing at 56 kb/s. This approach puts the encrypted data in bits 1 to 7 only. These bits will not be affected by the gateway, and the encrypted data will not be corrupted.

10.3 Network Access Alternatives

Network interfaces, except for those specified in Sections 5.2.3.1 and 5.2.4 are outside the scope of this Profile. The following is for information only.

10.3.1 ISDN Access Alternatives

Sections 5.2.3.1 and 5.2.4 of the Profile specify several options for connecting to ISDN, but do not preclude the use of other alternatives. This section and its subparagraphs describe various methods of basic rate interface (BRI) ISDN connectivity. VTU or MCU manufacturers may have some of this equipment integrated into their Profile-compliant designs. Section 10.3.1.3 addresses Type 1 classified operation. Sections 10.3.1.1, 10.3.1.2, 10.3.1.4, and 10.3.1.5 address unclassified and unclassified sensitive operation. For unclassified sensitive operation, the VTU or MCU and the Type 3 cryptographic equipment are typically integrated into a single physical unit.

Three physical interfaces are associated with ISDN: the R interface, the S/T interface, and the U interface. It is recommended that if the S/T interface is provided, it be in accordance with ANSI T1.605, *ISDN Basic Access Interface for S and T Reference Points* (Layer 1 Specification). It is recommended that if the U interface is provided, it be in accordance with ANSI T1.601, *ISDN Basic Access Interface for Use on Metallic Loops for Application on the Network Side of the NT* (Layer 1 Specification).

10.3.1.1 External Terminal Adapter

Figure 10.3-1 shows a typical configuration, including the interface between the VTU or MCU and the separate terminal adapter, which is the R interface.

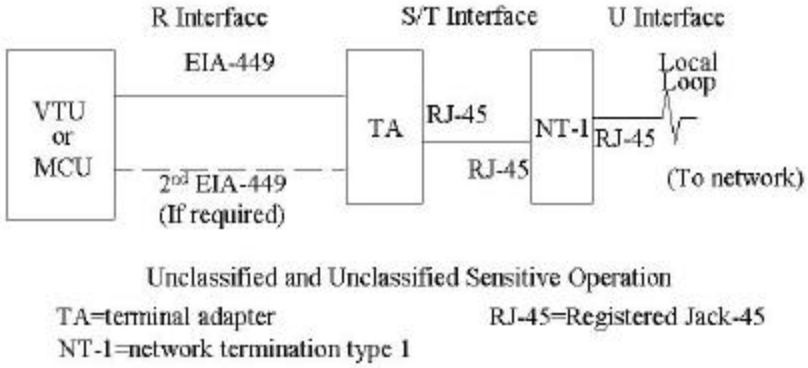

Figure 10.3-1. Network Configuration for External Terminal Adapter.

The R interface of the VTU or MCU consists of two 56/64 kb/s EIA-449 ports, or one 112/128 kb/s EIA-449 port. Section 5.2.3.1.1 also makes use of this configuration. If the VTU or MCU has one port, the external terminal adapter will have to include an inverse multiplexing function to create the two B channels from the one VTU or MCU port and vice versa. This version is for unclassified or Type 3 unclassified, sensitive operation.

10.3.1.2 External Terminal Adapter with Dialing Interface

Figure 10.3-2 shows a typical configuration, including the interface between the VTU or MCU and the separate terminal adapter, which is the R interface.

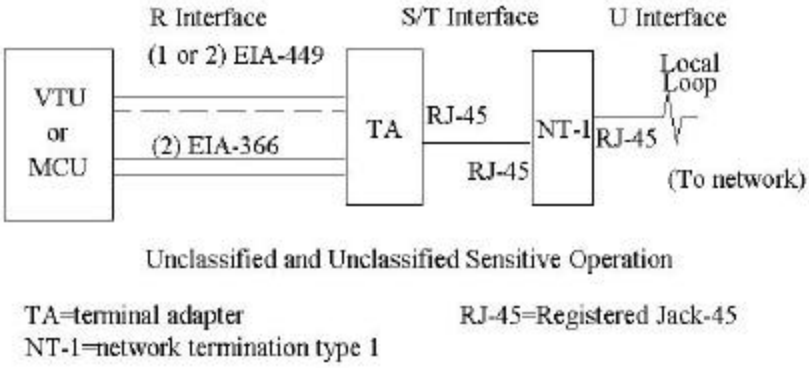

Figure 10.3-2. Network Configuration for External Terminal Adapter with EIA-366 Dialing Interface.

The R interface of the VTU or MCU consists of two 56/64 kb/s EIA-449 ports, or one 112/128 kb/s EIA-449 port. The R interface also includes two EIA-366-A dialing interfaces: one for each B channel. Section 5.2.3.1.2 also makes use of this configuration. If the VTU or MCU has one port, the external terminal adapter will have to include an inverse multiplexing function to create the two B channels from the one VTU or MCU port and vice versa. This configuration is for unclassified or Type 3 unclassified, sensitive operation. Type 1 classified operation is not permitted.

10.3.1.3 Classified Operation

For Type 1 classified operation, the cryptographic equipment is added at the R interface, as shown in Figure 10.3-3.

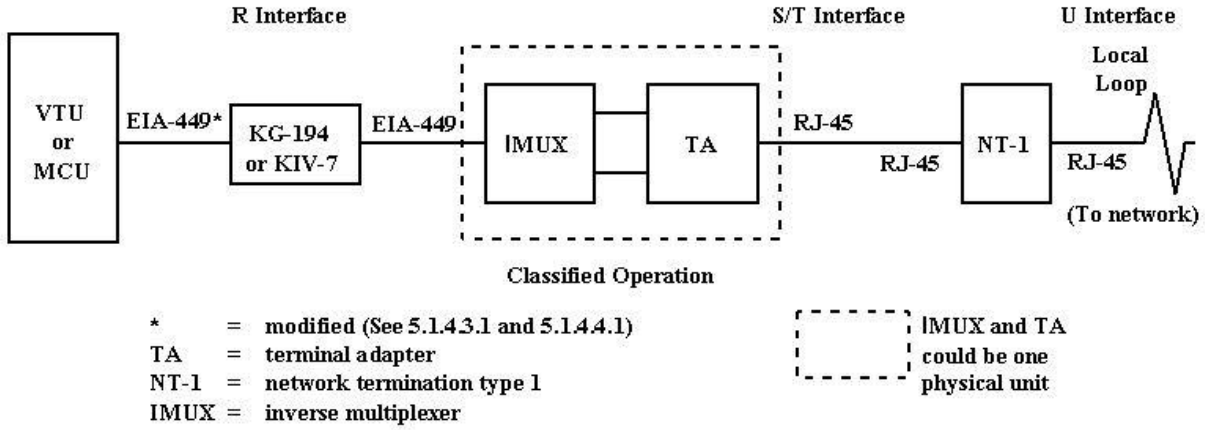

Figure 10.3-3. Network Configuration for Classified Operation.

If the VTU or MCU has the EIA-366 port, there can be nothing physically connected to it during a classified conference.

10.3.1.4 Integrated Terminal Adapter

The terminal adapter is integrated with the VTU or MCU into a single physical unit. The NT-1 is physically separate *(see Figure 10.3-4)*. This is only for unclassified and unclassified, sensitive operation. In this case, the integrated unit will provide the S/T interface to the Type 1 network termination. The connector at the S/T interface is a RJ-45. Type 1 classified conferencing is not permitted with this configuration.

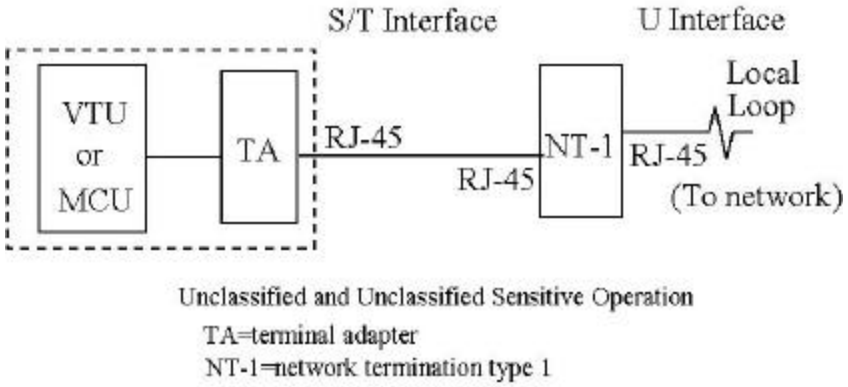

Figure 10.3-4. Network Configuration for Integrated Terminal Adapter.

10.3.1.5 Integrated Terminal Adapter and Network Termination

This is only for unclassified and unclassified, sensitive operation. The VTU or MCU, TA and NT-1 are integrated into a single physical unit (see Figure 10.3-5). The integrated unit will now provide the U interface for the network. Type 1 classified conferencing is not permitted with this configuration. Much of the newer video teleconferencing equipment uses this configuration.

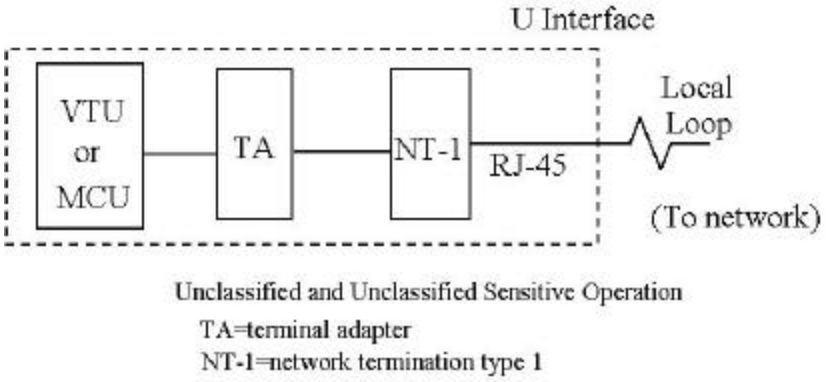

Figure 10.3-5. Network Configuration for Integrated TA and NT1.

10.3.2 Aggregation using Inverse Multiplexers

To provide interoperability between inverse multiplexers, the following is recommended.

10.3.2.1 Unclassified Operation

An aggregator or inverse multiplexer (IMUX) is used to connect a single-channel VTU or MCU to another single-channel VTU or MCU through a multiple-channel network. The VTU or MCU is connected to an IMUX. The IMUX-Network-IMUX connection provides a clear data channel at a specified data rate, e.g., 384 kb/s. At the other end, another IMUX is connected to the other VTU or MCU. *(See Figure 10.3-6.)*

The IMUX operates in Mode B1, as defined in H.244. In this mode, the IMUX-Network-IMUX connection initially operates in a framed mode to achieve channel synchronization. When synchronization is achieved, the framing is dropped and the entire channel capacity is used for transmitting the data stream.

The IMUX-VTU or MCU interface is at the same data rate, e.g., 384 kb/s, as the total data rate (in this case, 3 x BRI) of the IMUX-Network interface. This is because the IMUX-Network data streams do not contain framing information.

Setup and control of the IMUX can be done manually or automatically. Loss of synchronization between the network channels must be detected and reset manually by initializing the IMUX to a framed mode, as described above. Note that the IMUX may be integrated or external to the VTU or MCU.

10.3.2.2 Classified Operation

A VTU or MCU used for classified operation and connected to a multiple - channel network must use an aggregator or inverse multiplexer (IMUX). The VTU or MCU must be a single-channel VTU or MCU having the interface described in Section 5.1.4.3.1. The VTU or MCU is connected to a cryptographic device (KIV-7/KIV-7HS or KG-194). The cryptographic device is then connected to an IMUX or a dedicated network. The IMUX-Network-IMUX connection provides a clear data channel at a specified data rate, e.g., 384 kb/s. At the other end, another IMUX is connected to the appropriate interoperable cryptographic device, which is then connected to a VTU or MCU. *(See Figure 10.3-7.)*

Interoperability between the KG-194 and the KIV-7/KIV-7Hs is achieved through the MCU. For example, KG-194 encrypted information is decrypted by the KG-194 cryptographic devices located at the MCU, and then may be re-encrypted by a KIV-7/KIV-7HS to communicate with a KIV-7/KIV-7HS encrypted VTU. *(See Figure 10.3-7.)*

The IMUX operates in Mode 1, as defined in TIA/EIA-619. In this mode, the IMUX-Network-IMUX connection initially operates in a framed mode to achieve channel synchronization. When synchronization is achieved, the framing is dropped and the entire channel capacity is used for transmitting the encrypted data stream. Since the framing information is encrypted, no capabilities can be communicated between the terminal and the IMUX.

The IMUX-Cryptographic interface is at the same data rate, e.g., 384 kb/s, as the total data rate (in this case, 3 x BRI) of the IMUX-Network interface. This is because the IMUX-Network data streams do not contain framing information.

Setup and control of the IMUX must be done manually, or with proper isolation, to ensure RED-BLACK separation. No VTU or MCU-to-IMUX communication or electrical connection is allowed unless the RS-366 dial-up disconnect procedures and/or isolation configuration is approved by NSA. Loss of synchronization between the network channels must be detected and reset manually by initializing the IMUX to a framed mode, as described above.

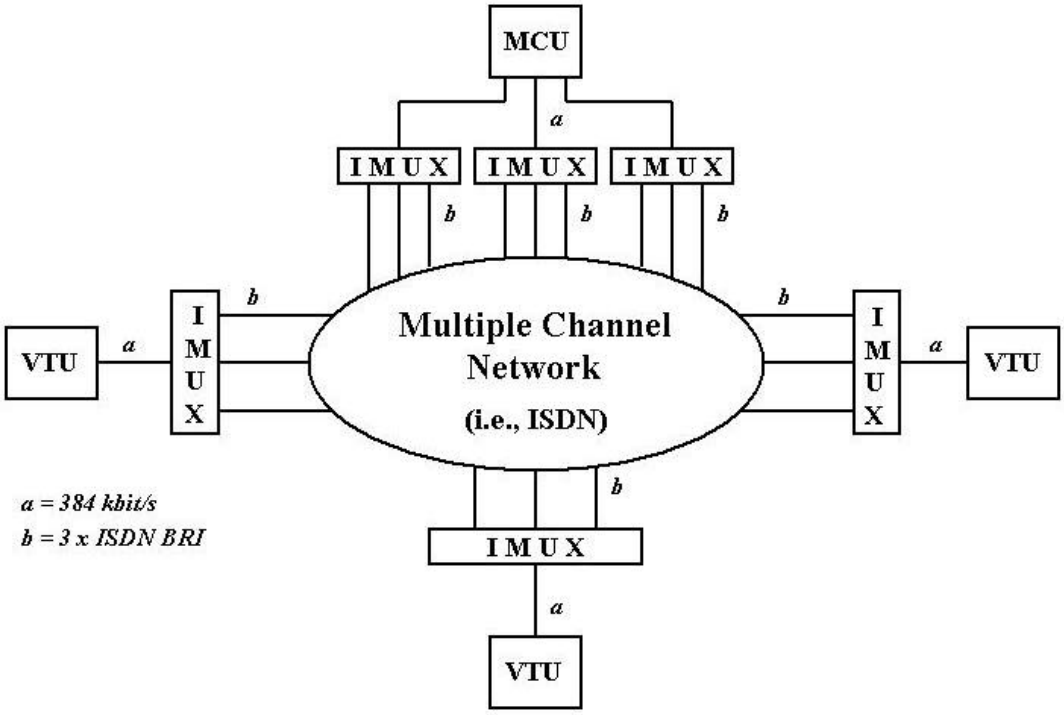

Figure 10.3-6. Examples of MCU/IMUX Unclassified or Unclassified/Sensitive Operation with Single-Channel VTUs.

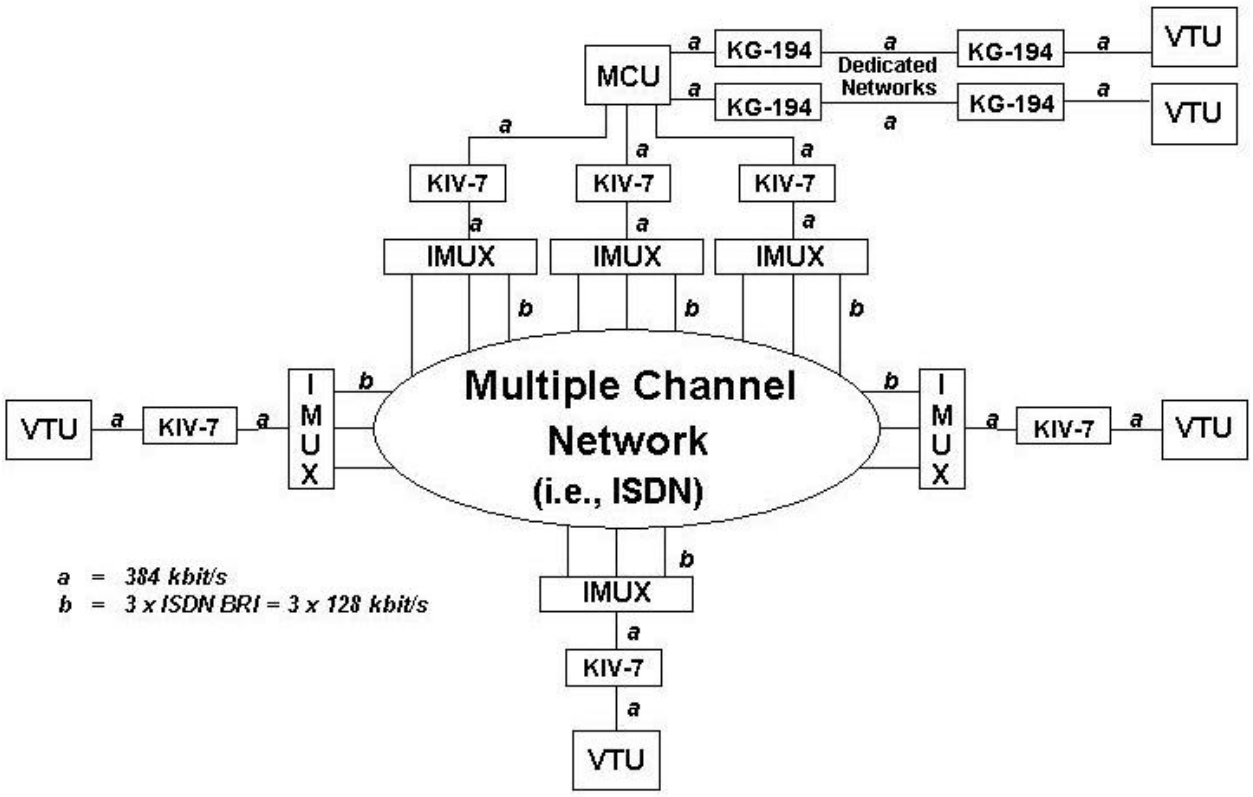

Figure 10.3-7. Example of MCU/IMUX Operation - Classified Conference

10.3.3 Other Network Interfaces

The VTU may also support direct network interfaces, which are outside the scope of this Profile. Below are some examples of direct network interfaces:

- Primary rate ISDN interface
- North America T1 interface
- 2-wire switched 56-kb/s interface
- 4-wire switched 56-kb/s interface.

10.4 Objective Standards

It is DOD's objective to include the following standards as mandatory components in future versions of the Profile, subject to DOD and Federal approval, and subject to continued industry availability of interoperable products implementing these standards. Each of these standards is also designed to work in conjunction with the T.120 family of standards. Interoperability between various types of these objective networks usually requires gateways, which will be addressed in future revisions to the profile.

10.4.1 Asynchronous Transfer Mode (ATM)

There are three ITU umbrella standards that could be used for operation over ATM: H.310, H.321, and H.323. H.323 is the objective mandate for VTC over ATM. H.310 is meant for high quality VTC typically using greater than 2 Mb/s bandwidth, but is relatively expensive to implement, and does not at this writing have a great deal of industry support. H.321 is basically H.320 over ATM. It is relatively straightforward to implement, but also lacks widespread industry support at this time. H.323 provides for two modes of operation over ATM:

- Internet Protocol (IP) over ATM media stream transport; and,
- Real Time Protocol (RTP) over ATM media stream transport (Annex C of H.323).

The first of these modes is widely supported by industry, but the second mode is not widely supported by industry at this time. If the second of these two modes is implemented, then the first must also be implemented as the common interoperable mode. Table 10.4-1 shows the functional standards, which are called out by the H.321 and H.323 umbrella standards.

It is not completely clear which of the three standards (H.310, H.321, and H.323) will become the dominant standard for ATM in the future, but since H.323 currently has the most support from industry, this standard has been chosen as the objective mandate for ATM. H.310 may be added at a later time when there is more industry support, since it provides a high level of quality unavailable from any of the other VTC standards.

10.4.2 Public Switched Telephone Network (PSTN)

H.324, which describes terminals for low bit rate multimedia communication, is the objective mandate standard. This umbrella standard operates at low bit-rates of between 9.6 and 28.8 kb/s over ordinary telephone lines (POTS). The low bit rate also makes it valuable for tactical applications. It may carry real time voice, data, or video, or any combination of these. Table 10.4-1 shows the functional standards that are called out by the H.324 umbrella standard.

By virtue of its inclusion in the Joint Technical Architecture, this standard is currently mandatory for DOD for VTC operation at data rates between 9.6 and 28.8 kbps. This will be reflected in future versions of the Profile.

Table 10.4-1. Relationships between Selected Umbrella Standards and the Functional Standards.

Umbrella Standard	H.321 (H.320 over ATM)	H.323	H.324
Network Type	Switched Digital (B-ISDN, ATM, LAN)	Packet-based networks (LANs, ATM)	PSTN or POTS (the analog phone system)
Video	H.261 H.263	H.261 H.263	H.261 H.263
Audio	G.711 G.722 G.722.1 G.728 G.723.1 G.729	G.711 G.722 G.722.1 G.728 G.723.1 G.729	G.722.1 G.723.1
Multiplexing	H.221	H.225.0	H.223
Control	H.242	H.245	H.245
Multipoint	H.231 H.243	H.323	None
Data	T.120	T.120	T.120
Network Protocols	AAL I.363 ATM I.361 I.400	TCP/IP IEEE 802.X ATM I.361 I.400 V.34 Modem	V.34 Modem Cellular Radio

10.4.3 Meeting Room Management (MRM), Virtual Meeting Room Collaboration

T.137 is an emerging standard, part of the T.120-family of standards. The recently approved T.137, Meeting Room Management (MRM): Services and Protocol, defines the functionality required to implement shared virtual spaces. As part of the T.120 architecture (Figure 10.4-1), it is designed to deliver such services using generic and extensible mechanisms that are independent of the underlying transports used for delivering the real time media streams. In future revisions of T.137, this scope is expected to broaden to cover all media services used within a conference. The objective of standardizing this functionality is to provide a basis for interoperability between client applications and conferencing services.

T.137 extends T.124, the Generic Conference Control, adding the capability to define and manage virtual meeting room spaces within the GCC conference. It provides a means to seamlessly integrate all of the media components, meeting rooms, lobby, conference framework, rosters and services, being used within a meeting. These virtual meeting spaces can be regarded as representing meeting rooms where audio, video and data communication can take place. The functionality provides support for a number of virtual meeting scenarios including round table meetings, informal meeting spaces and conferences with audiences. The T.137 protocol provides inherent support for multi-room scenarios. The protocol will find application in support of enhanced audio conferencing and audiographics conferencing services with the aim to provide an holistic approach to the management of

the meeting room involving multiple media, while providing the flexibility to adapt individual meeting rooms in response to user requirements.

Meeting rooms can be public, controlled or private, and dynamically created or destroyed as needed during the conference or at any other time. The room creator can invite any desired participants. Controlled rooms can be accessed via a password or key. Registration and validation procedures can be defined to gain access to a private room. Private reception rooms for participants awaiting entry into a private room can be created. Meeting rooms can be permanent, defined by the conference framework, dynamic, created and destroyed as required, or persistent, a special type of dynamic room. Persistent rooms can exist even if no participants are present. Private side conversations or breakout groups are allowed without having to establish a separate conference.

The lobby is a virtual space inside the MRM session, but outside of any MRM meeting room. It contains the conference roster and the room list.

The conference framework consists of the conference configuration, and the Room and Service Constructors. The conference configuration defines the conference-wide parameters such as relationship, name, purpose, maximum number of nodes and rooms, and reporting parameters requirements. The Room Constructor defines room types, access rights and permitted roles of the participants. Permitted roles include Observer, a non-active member, GCC anonymous node participant, a conventional T.120 node which may fully participate and interact within GCC conference, and Administrator, that may be external manager. The Administrator cannot be muted. The Service Constructor manages services such as audio, mixing and floor control.

Rosters include the conference roster and the room roster. The conference roster contains the conference framework, reconfiguration and list of active rooms. The room roster is room specific data, which includes room state, mode and access requirements.

Services are primarily audio bridging parameters, such as the maximum number of participants (nodes), maximum number of mixer ports, and mixer management.

The standard defines procedures for arbitrating use of real time media services such as telephony and video streaming, for advertising those services to participating nodes and for managing and controlling those services once activated. T.137 specifies mechanisms for multimedia capability reporting at the start of and during communications and defines procedures for arbitrating access to and configuring the infrastructure in support of the services.

T.137 defines a Conference Server that takes responsibility for the running of the MRM conference and a service access channel for communication between the clients and server. The MRM protocol places minimal implementation burden on client terminals with most of the complexity being concentrated at the Server. This provides centralized management of the real time infrastructure. A single server node is assigned to be the Conference Manager and MRM Top Provider. However, communication from

clients to the MRM Top Provider is always directed to the conference management channel, allowing other Network Elements to also join

this channel and to co-operate in delivering the conference. These other Network Elements may shadow the MRM Top Provider, allowing the possibility of one of them taking on the Top Provider role in the event of a failure condition. This provision also allows the possibility of a distributed management mode in future versions of this protocol enabling it to more readily scale to support large conference environments. T.MRM requires the services of MCS and GCC.

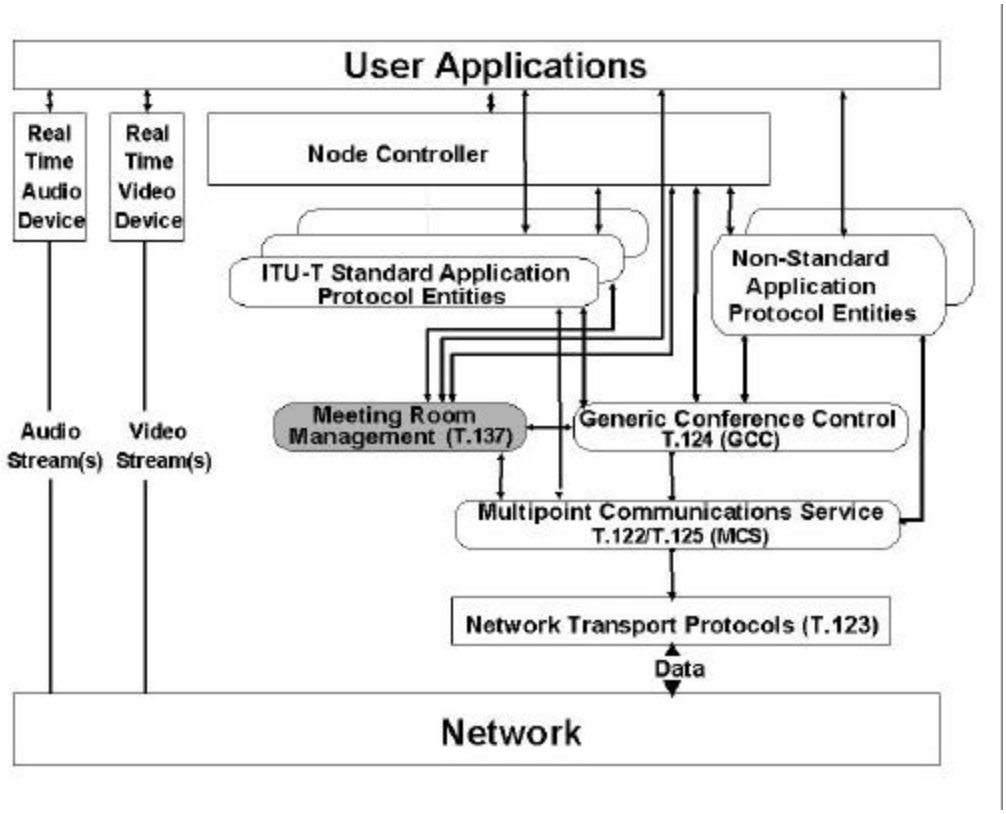

Figure 10.4-1. T.137 Meeting Room Management, Audio-Visual Control Architecture

10.4.4 H.323 Control Protocol for Far-end Camera Control

The capability for an H.323 endpoint to control one or more far-end cameras, and allow far-end control of local cameras is an emerging standard. Far-end camera control requires that both endpoints have the far-end camera control capability. H.282 and H.283 define the protocols used for far end camera control. H.281 and H.224 do not apply to H.323 systems.

10.4.4.1 Control Protocols

H.323 endpoints support far-end camera control through the H.282 Remote Control Protocol for Multimedia Applications. The H.282 protocol is supported in an H.245 logical channel according to H.283. H.283 describes logical channel transport for the H.282 protocol in an H.323 conference.

H.282 addresses nodes and devices in a conference. A node is a distinct entity participating in a point to point or multipoint conference. A device is normally a physical entity, such as a camera, but may also be a software process and will typically reside at a Terminal node and function as the devices host node.

H.282 Remote Device Control allows the remote activation and control of devices within a conference environment. A number of standard device classes and a library of standard device attributes are defined by H.282 Annex A. These aim to address mandatory or commonly required functionality for use in support of multipoint multimedia communication and in particular conferencing.

H.282 defines the default owner of a given device as the host node, which has responsibility for servicing remote device requests from other Terminal nodes in the conference. It is not necessary for a host node to be co-located with the device it is hosting.

H.282 Remote Device Control provides the following facilities to the conference:

- A conference participant can determine the profile of a device attached to a remote node.
- A participant can request exclusive access to a remote device in order to perform device control or configuration.
- A participant can control, configure, receive event notification and obtain the status of a remote device.
- A participant can select a set of remote devices through the use of the Source Combiner device capability. The outputs (video or audio) of the selected remote devices can be combined together to form a single output stream. *(Note: The Source Combiner device is a separate device class from the camera device class. It can be used to remotely combine the outputs of two or more cameras, or one camera and one or more other remote devices.)*

H.282 defined standard device classes are Camera, Microphone, Stream Player Recorder, Slide Projector, Light Source, and Source Combiner. Only the H.282 Camera device class for far-end camera control is within the scope of this Profile. Other device classes may be added in future revisions.

H.283 provides services to the H.282 Remote Control Protocol for Multimedia Applications. H.283 provides the means for the upper layer H.282 protocol to communicate with its peer nodes in a point to point or multipoint conference. The H.283 Logical Channel Transport runs in bi-directional unreliable H.245 logical channels. It provides an unreliable and a reliable service. The reliable service is intended for the low bandwidth traffic of H.282, not high bandwidth streaming data.

An H.282 session within a conference consists of all the nodes in a conference with active H.282 connections. The H.282 connections can be set up between nodes in a conference, depending on centralized, decentralized, and multicast capability. Each node may have more than one H.282 connection, but in any case all the connections are part of the same session. Control of multiple devices and multiple device types is handled within a single instance of the H.282 Protocol.

10.4.4.2 Camera Device Class

The camera device class provides a comprehensive remote control capability allowing control over the camera position and viewing angle as well as the ability to manipulate parameters relating to the image as described in Table 10.4-2. The following provides a brief description of each of the camera control and event attribute types.

Device control and event attributes are general attributes for use by any device class as appropriate.

Camera control attributes may be used for controlling a camera. Camera control movement parameters may be specified relative to the current position or as an absolute value.

Camera control attributes used for start-stop movement start a continuous movement and have a maximum time out as part of the attribute. The continuous movement is started in the selected direction until the time-out expires. A camera that supports pan, tilt, zoom, or focus control must support it with the continuous movement control attributes. Optionally, such devices may support the fixed range or spatial positioning or relative field of view control attributes.

Camera control attributes using fixed range positioning use a position mechanism with fixed ranges. The receiving remote device control application must map this fixed positioning to the actual positioning system used by the camera.

Camera control attributes using spatial positioning use a positioning mechanism where the positioning system represents the absolute camera position in degrees. The receiving remote device control application must map these absolute degree positions to the camera positioning system. These parameter values express the angle in degrees to which the camera is to be positioned assuming that the mid-point of the camera pan and tilt range is 0°. For spatial positioning, a camera that supports the fixed-range Zoom Position attribute must also support the current field of view Zoom Magnification attribute. If the Pan Position attribute is supported, the camera must also support the Pan View attribute. If the Tilt Position attribute is supported, the camera must also support the Tilt View attribute.

Camera control attributes using the current field of view allow a camera to be moved relative to the current field of view. A camera that supports the Zoom Magnification attribute must also support the Zoom Position attribute. If the camera supports the Pan View attribute, it must also support the Pan Position attribute. If the camera supports the Tilt View attribute, it must also support the Tilt Position attribute.

Table 10.4-2. Far-End Camera Control and Event Attributes

Control Attribute	Features
Device Control	
Device State	Set a device to an active or inactive state or read the current device state.
Device Pre-set	Select or store a particular device pre-set
Device Date	Set or read the current device date
Device Time	Set or read the current device time
Camera Control	
Iris Mode	Set or read the camera iris mode (Manual/Auto/ Unknown)
Focus Mode	Set or read camera focusing mode (Manual/Auto/ Unknown)
Pointing Mode	Set or read camera pointing mode (Manual/Auto/ Unknown)
Camera Lens	Select a particular camera lens where the camera has more than one lens available
Camera Filter	Select a particular camera filter where the camera has more than one filter available
Go To Camera Home Position	Command the camera to move to its default home position
External Camera Light	Control an external light source that is associated with a camera
Clear Camera Lens	Command the camera to clear the lens
Camera Pan Speed	Configure the speed of camera movement used when panning
Camera Tilt Speed	Configure the speed of camera movement used when tilting
Camera Back Light Mode	Set or read the camera back light mode
Camera Back light Setting	Set or read the camera back light setting
Camera White Balance Alignment	Set or read the camera white balance alignment
Camera White Balance Alignment Mode	Set or read the camera white balance alignment mode
Calibrate White Balance Alignment	Instruct the camera to calibrate the white balance alignment
Focus Image	Instruct the camera to bring the current image into focus
Capture Image	Instruct the camera to capture the current image and transmit it
Camera Control Used For Start Stop Movement	
Pan Continuous	Start or stop continuous horizontal panning movement with a maximum time-out

Control Attribute	Features
Tilt Continuous	Start or stop continuous vertical tilting movement with a maximum time-out
Zoom Continuous	Start or stop continuous zoom movement with a maximum time-out
Focus Continuous	Start or stop continuous focus movement with a maximum time-out
Iris Continuous	Start or stop continuous iris movement with a maximum time-out
Camera Control Using Fixed Range Positioning	
Zoom Position	Set or read the camera zoom position
Focus Position	Set or read the camera focus position
Iris Position	Set or read the camera iris position
Camera Control Using Spatial Positioning	
Pan Position	Set or read the camera pan position
Tilt Position	Set or read the camera tilt position
Camera Control Using the Current Field of View	
Zoom Magnification	Set the camera zoom position relative to the current field of view
Pan View	Set the camera tilt position relative to the current field of view
Tilt View	Set the camera tilt position relative to the current field of view
Events	
Device Lock State Changed	Signals a change in the device lock state
Device Availability Changed	Signals a temporary change in the availability of the device
Camera Panned to Limit	Signals the camera reached the limit of the available pan range
Camera Tilted to Limit	Signals the camera reached the limit of the available tilt range
Camera Zoomed to Limit	Signals the camera reached the limit of the available zoom range
Camera Focused to Limit	Signals the camera reached the limit of the available focus range

10.4.4.3 Interoperability with H.281 Far-End Camera Control

A terminal that supports H.282 may interoperate with a terminal that only supports H.281 via a gateway that performs the relevant transcoding between the two protocols. In order to allow the H.281 terminal to perform remote camera source selection, it is recommended that H.282 terminals be assigned the device identifiers in the same way as described by the H.281 recommendation, as per table 10.4-3 below.

Table 10.4-3. Remote Camera Source Selection

Device	Device ID
Main Camera	1
Auxiliary Camera	2
Document Camera	3
Auxiliary Document Camera	4

10.4.5 H.323 Versions 3 and 4 Packet-Based Multimedia Communications Systems

H.323 version 3 was approved in September 1999 and makes modest improvements to the H.323 version 2 of February 1998. New features in Version 3 are:

- Maintaining and Reusing Connections;
- Conference out of Consultation;
- Caller ID;
- Language Preference;
- Annex E/H.323 Gatekeepers ability to mandate the usage of Annex E for call signaling to endpoints;
- Remote Device Control;
- Generic Capabilities added to H.245 (1999);
- Annex G/H.225.0 - Communication between Administrative Domains;
- Annex E/H.323 - Protocol for Multiplexed Call Signaling Transport;
- Annex F/H.323 - Simple Endpoint Type;
- H.341 - H.323 Series Management Information Base (MIB) for SNMP-based management of H.323 equipment; and,
- Supplementary Services.

H.323 Version 4 was approved in November 2000 and contains enhancements in a number of important areas, including reliability, scalability, and flexibility. New features will help facilitate more scalable Gateway and MCU solutions to meet the growing market requirements. New features and solutions in Version 4 are:

- Gateway decomposition (H.248, which describes the protocol between the Media Gateway Controller (MGC) and the Media Gateway (MG));
- Multiplexed stream transmission;
- Supplementary services;
- HTTP-based control (Annex K/H.323);
- "Stimulus-based" control mechanism (Annex L/H.323);
- Name identification service (H.450.8);
- Call completion (H.450.9);
- Alternate Gatekeepers;
- Usage information reporting by endpoints;
- Endpoint capacity indicator;
- Caller identification service;
- In-band tones and announcements, such as incorrect or unreachable destination number;
- IP Alias Mapping;
- Indicating desired protocol for special services (i.e., FAX);
- Bandwidth management;
- Reporting call status;

- Ability to initiate a voice call and then switch to fax at some point (Annex D-Real-time FAX);
- Call linkage, which is a unique identifier that can be used to identify a call with multiple segments from end to end;
- QSIG and ISUP may be tunneled without translation;
- Allow for RSVP when not using Fast Connect to improve QoS;
- H.245 to be started in parallel to Fast Connect;
- Generic extensibility framework;
- H.323 URL;
- Call Credit-Related Capabilities; and,
- H.323 version 4 now allows an endpoint to utilize RFC 2833 to send and receive DTMF digits.

10.4.6 Session Initiation Protocol (SIP) RFC 2543

The Session Initiation Protocol (SIP) is being developed by the IETF as an alternate approach to H.323 for providing signaling functions. H.323 is based more on a monolithic bloc derived from H.320 for traditional of the traditional circuit-switched ISDN multimedia, and SIP favors a more lightweight approach based on HTTP.

The SIP is an application-layer control protocol that can establish, modify and terminate multimedia sessions or calls. These multimedia sessions include multimedia conferences, distance learning, Internet telephony and similar applications. SIP can invite both persons and "robots", such as a media storage service. SIP can invite parties to both unicast and multicast sessions; the initiator does not necessarily have to be a member of the session to which it is inviting. Media and participants can be added to an existing session.

SIP supports five facets of establishing and terminating multimedia communications:

- User location: determination of the end system to be used for communication;
- User capabilities: determination of the media and media parameters to be used;
- User availability: determination of the willingness of the called party to engage in communications;
- Call setup: "ringing", establishment of call parameters at both called and calling party; and,
- Call handling: including transfer and termination of calls.

SIP can also initiate multi-party calls using a multipoint control unit (MCU) or fully meshed interconnection instead of multicast. Internet telephony gateways that connect Public Switched Telephone Network (PSTN) parties can also use SIP to set up calls between them.
The IETF Internet Draft RFC of July 13, 2001 titled “SIP-H.323 Interworking,” describes the logical entity known as the interworking function (IWF) that will allow the interworking between the SIP

(Session Initiation Protocol) and H.323 networks. This Internet-Draft RFC is being developed as a cooperative effort between the IETF and ITU.

10.4.7 Supplementary Services

The H.450-Series of standards describes optional methods for providing Supplementary Services in the H.323 environment. The following supplementary services are optional objective services, which may be available with future H.323 version 3 or version 4 VTC equipment implementations, and make use of the "Generic functional protocol for the support of supplementary services in H.323" as defined in H.450.1 *(See Section 6.3.1)*.

10.4.7.1 Call Hold – H.450.4

H.450.4 describes the procedures and the signaling protocol for the Call Hold supplementary service in H.323. Call Hold allows a VTU, which may have originated the call or has been called, to interrupt the existing call and then subsequently, if desired, re-establish communications with the held VTU. Call Hold applies to the complete H.323 call (i.e., audio and video). Putting on hold only a subset of the media streams as well as putting on hold a T.120 call is not a currently available, but may be a future capability.

10.4.7.2 Call Park and Call Pickup - H.450.5

H.450.5 describes the procedures and the signaling protocol scenarios for the Call Park and Call Pickup supplementary services in H.323.

Call Park is a supplementary service, similar to Call Hold, in a call between two Users A and B. It allows User A to put the call on hold and User B may be connected to another channel, such as music or announcements, and User B may see a video or still image.

Call Pickup allows another User C, to pickup the parked call to connect to User B. This differs from call hold in that User C does not have to be at the same endpoint as User A.

10.4.7.3 Call Waiting - H.450.6

H.450.6 describes the procedures and the signaling protocol for the Call Waiting supplementary service in H.323 networks. The Call Waiting supplementary service permits a busy user to be informed of an incoming call while being engaged with one or more other calls (i.e., Call Waiting operates in case of an incoming call when a busy condition within the endpoint is encountered). As an option, a busy condition may also be encountered if the user is busy with workflow applications (e.g., writing e-mails).

10.4.7.4 Message Waiting Indication - H.450.7

H.450.7 proposes the procedures and signaling protocol for the Message Waiting Indication supplementary service in H.323 networks. The Message Waiting Indication supplementary service provides a general-purpose mechanism by which a user can be advised that messages (e.g., voice mail, fax, and teletex) are available. The procedures and the signaling protocol of H.450.7 are derived from the Message Waiting Indication supplementary service as specified in ISO/IEC 15505 and ISO/IEC 15506.

10.4.7.5 Name Identification Supplementary Services - H.450.8

Calling Party Name Presentation is a feature that provides the name of the calling party to the called party. The calling party name could be, for example, the name of a person or organization, a phone number or room number, a network address or other pre-programmed information. The calling party name may be provided by the calling VTU or by the gatekeeper for gatekeeper routed calls that originate in the packet-based network. When a call originates in the switched circuit network and enters the packet-based network through a gateway, the gateway will pass to the packet-based network the calling party name information provided from the switched circuit network.

10.4.7.6 Call Completion Supplementary Service - H.450.9

Completion of Calls to Busy Subscribers is a supplementary service that is offered to a calling User A. On encountering a busy called User B, it allows User A to request that User B's endpoint monitor User B and notify User A's endpoint when User B becomes free. On response by User A to that notification, User A's endpoint must attempt to complete the call to User B.

Completion of Calls on No Reply is a supplementary service that is offered to a calling User A. On encountering a called User B that does not answer, it allows User A to request that User B's endpoint monitors User B and notifies User A when User B becomes free after a subsequent period of activity. On response by User A to that notification, User A's endpoint must attempt to complete the call to User B.

10.4.7.7 Call Offer Supplementary Service - H.450.10

Call Offer is a supplementary service which, on request from the calling user (or on that user's behalf), enables a call to be offered to a busy called user and to wait for that called user to accept the call, after the necessary resources have become available.

10.4.7.8 Call Intrusion Supplementary Service - H.450.11

Call Intrusion is a supplementary service which, on request from the served user, enables the served user to establish communication with a busy called user (user B) by breaking into an established call between user B and a third user (user C).

10.4.7.9 Common Information Additional Network Feature for H.323 - H.450.12

The Additional Network Feature Common Information enables the exchange of Common Information between endpoints that support this supplementary service. This Common Information is a collection of miscellaneous information that relates to the endpoint or equipment at one end of a connection and includes one or more of the following: Feature Identifiers, Party Category. This information, when received by an Additional Network Feature Common Information endpoint, can be used for any purpose (e.g., as the basis for indications to the local user or to another network or in order to filter feature requests).

11 DOD VTC POLICY

The Joint Technical Architecture (JTA) and the VTC Profile are the official VTC standards documents to be used by DOD per ASD-C3I direction.

11.1 ASD-C3I Memorandum

The ASD-C3I memorandum (see next page) on VTC standards guidance establishes OSD policy requiring conformance to this Appendix and is the implementing policy of this Profile. *(See attached copy of the memorandum.)*

11.2 JTA Memorandum

The Profile is also cited as mandatory in the Joint Technical Architecture (JTA) as per the OSD memorandum, which follows the ASD-C3I memorandum. *(See attached copy of the JTA memorandum.)*

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OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
6000 DEFENSE PENTAGON
WASHINGTON, DC 203016000

March 30, 1998

COMMAND, CONTROL,

COMMUNICATIONS, AND INTELLIGENCE

MEMORANDUM FOR DIRECTORS OF THE DEFENSE AGENCIES
DIRECTOR, INFORMATION SYSTEMS FOR COMMAND, CONTROL, COMMUNICATIONS AND COMPUTERS, U.S. ARMY
DIRECTOR, SPACE INFORMATION WARFARE, COMMAND AND CONTROL, U.S. NAVY
ASSISTANT CHIEF OF STAFF, SYSTEMS FOR COMMAND, CONTROL, COMMUNICATIONS AND COMPUTERS, U.S. AIR FORCE
DIRECTOR, COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS AND INTELLIGENCE, U.S. MARINE CORPS
DIRECTOR, COMMAND, CONTROL, COMMUNICATIONS, AND COMPUTER SYSTEMS, JOINT STAFF
DIRECTOR, JOINT STAFF
DIRECTOR, DEFENSE TELECOMMUNICATIONS SERVICE—WASHINGTON

SUBJECT: Video Teleconferencing (VTC) Standards Guidance

To improve interoperability and standardization of Video Teleconferencing (VTC) in the Department of Defense (DoD), the Office of the Assistant Secretary of Defense, Command, Control, Communications, and Intelligence (C3I), issued specific policy guidance on October 31, 1994, to use the Corporation for Open Systems (COS) Video Teleconferencing Profile (also known as the Industry Profile for VTC) for acquisition of VTC equipment. Corporation for Open Systems has ceased its business operations, thus requiring DoD to seek a new sponsor for the VTC standard.

Department of Defense successfully solicited the Federal Telecommunications Standards Committee (FTSC) to accept the Profile as a document applicable to the entire Federal Government. An accord was reached and the new Federal standard, Federal Telecommunications Recommendation (FTR) 1080-1997, was approved October 30, 1997. It contains the original COS VTC Profile as an Appendix. The Appendix will be mandatory for DoD and optional for the rest of the Federal community. The Profile is fully compatible with, and interoperable with, the main body of FTR 1080B-2001. However, it contains much more detail, including additional requirements like security, that

are not in the main body and are, therefore, optional for the rest of the Federal community.

Effective immediately, all new procurements for VTC that operate between transmission data rates of 56 to 1,920 kb/s shall conform to the requirements of FTR 1080B-2001, including the requirements of the latest approved version of Appendix A. This supersedes the October 31, 1994, mandate to conform to the COS VTC Profile.

The Joint Technical Architecture is also being updated to reflect this guidance. It applies to all C3I systems and all systems that interface with C3I systems.

The DISA Center for Standards point of contact for VTC standards is Mr. Klaus Rittenbach, IN42, DSN 987-6864, Commercial (732)427-6864, E-mail: RITTENBK@FTM.DISA.MIL. Paper and electronic copies of FTR 1080B-2001 and of Appendix A are available from Mr. Rittenbach. Before using the FTR, contact IN42 to determine the latest version of Appendix A.

Request Director, Joint Staff, provide this guidance to the Commanders-in-Chief. My point of contact for this action is Mr. Richard Colver, who is assigned to my Communications Directorate, DSN 225-3137, Commercial (703) 695-3137, E-mail: COLVERR@OSD.PENTAGON.MIL.

/S/
Stanley E. Gontarek
Deputy Assistant Secretary of Defense
(Command, Control and Communications)
(Acting)

November 29, 1999

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS
UNDER SECRETARIES OF DEFENSE
ASSISTANT SECRETARIES OF DEFENSE
GENERAL COUNSEL OF THE DEPARTMENT OF DEFENSE
DIRECTOR, OPERATIONAL TEST AND EVALUATION
ASSISTANTS TO THE SECRETARIES OF DEFENSE
DIRECTORS OF DEFENSE AGENCIES
DIRECTOR, JOINT STAFF

SUBJECT: DoD Joint Technical Architecture (JTA) Version 3.0

This memorandum makes JTA Version 3.0 effective for use immediately superseding Version 2.0. However, paragraphs 2, 3, and 4 of Version 2.0 cover memorandum dated 30 Nov 1998 (attached) continue to apply. Each DoD Component and cognizant OSD authority is required to have on file a current or new implementation plan with the USD(A,T and L) and the ASD(C3I)(DoD CIO). If an implementation plan needs revision, it is due within 60 days while a new plan is due within 180 days from the date of this memorandum.

The JTA and related information can be found at URL http://www-jta.itsi.disa.mil. If access to the World Wide Web is not available, a copy or the JTA on CD ROM can be obtained by calling (703) 735-3552.

Addressees should assure the widest distribution of this memorandum. Request Director, Joint Staff forward this memorandum to Unified Combatant Commands.

/s/	/s/	/s/
Jacques S. Gardner Under Secretary of Defense (Acquisition, Technology and Logistics)	Arthur L. Money Assistant Secretary of Defense (Command, Control, Communications & Intelligence)	John L. Woodward, Jr. Lieutenant General, USAF Director, Command, Control, Communications and Computer Systems

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OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION
AND TECHNLOGY

30 NOV 1998

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
UNDER SECRETARIES OF DEFENSE
DIRECTOR, DEFENSE RESEARCH AND ENGINEERING
ASSISTANT SECRETARIES OF DEFENSE
GENERAL COUNSEL OF THE DEPARTMENT OF DEFENSE
DIRECTOR, OPERATIONAL TEST AND EVALUATION
ASSISTANTS TO THE SECRETARIES OF DEFENSE
DIRECTORS OF THE DEFENSE AGENCIES
DIRECTORS OF DEFENSE FIELD ACTIVITIES

SUBJECT: DoD Joint Technical architecture (JTA) Version 2.0

JTA Version 2.0 was approved by the Architecture Coordination Council on May 28, 1998 and has been posted to the JTA Home Page with a notice that formal authorization for use will be provided separately. This memorandum makes the JTA Version 2.0 effective for use immediately, superceding version 1.0. In addition, this memorandum updates the portion of Paragraph 4.3.9 of DoD 5000.2-R (with Change 3) covering the JTA applicability and waiver process, pending a formal revision of DoD 5000.2-R and other DoD Directives and Instructions.

Implementation of JTA, that is the use of applicable JTA mandated standards, is required for all emerging, or changes to an existing capability that produces, uses, or exchanges information in any form electronically; crosses a functional or DoD Component boundary; and gives the warfighter or DoD decision maker and operational capability. Use of an applicable JTA mandated standard must consider the cost, schedule, or performance impacts, and if warranted a waiver from use granted as described below. Hence, implementation of the JTA is required for all DoD Acquisition categories, and all other non-traditional (e.g., Defense Information Infrastructure (DII) Common Operating Environment (COE)), systemic (e.g., Joint Airborne SIGINT Architecture (JASA)), or non-DoD 5000 series acquisitions (e.g., procurement of information technology services, CINC Initiatives) that meet these criteria. In addition, implementation of the JTA is required for pre-acquisition programs such as: Advanced Concept Technology Demonstration (ACTDs), Advanced Technology Demonstrations (ATDs), Joint Warrior Interoperability Demonstrations (JWIDs), 'Exploitation-year', and Battle Laboratory projects that meet these criteria.

Each DoD Component and cognizant OSD authority is responsible for implementation to include compliance assurance, programming and budgeting or resources, and scheduling. Only the Component Acquisition Executive, or cognizant OSD authority can grant a waiver from the use of an applicable JTA mandated standard. All waivers shall be submitted to the USD (A&T) and ASD(C3I) (the DoD chief Information Officer (CIO)) for concurrence. Both USD(A&T) and ASD(C3I) (DoD CIO) concurrence can be assumed if no response is received two weeks after the date of receipt. To assure proper and timely consideration, all waivers must be accompanied by the identification of cost, schedule, and performance impacts that will occur if waiver is not granted and acknowledgement of any resulting operational limitations.

To preclude the granting of duplicate wavers, caused by implementing this and other OSD mandates, the organization responsible for systemic implementation of the JTA (e.g., DISA for DII COE; NSA for the JASA; BMDO for the standards in the Missile Defense) will administratively coordinate through the establish mechanism and grant the waiver and forward to USD(A&T) and ASD(C3I) (DoD CIO) for concurrence. Lastly, all waivers of the standards contained in the Modeling & Simulation Domain Annex must be submitted through the M&S management office of the responsible DoD component of the Defense Modeling and Simulation Office (DMSO). DMSO will then coordinate and administratively process a recommended disposition to the Executive Council for Modeling & Simulation (EXCIMS). EXCIMS will submit their recommendations to the USD(A&T) for approval with the concurrence of the DoD CIO.

Each DoD Component and cognizant OSD authority is requested to provide a new or revised implementation plan to the USD(A&T) and the ASD(C3I)(DoD CIO). Revision of an existing plan is due within 60 days while a new plan is due within 90 days from the date of this memorandum. These plans must include consideration of JTA implementation for existing capabilities meeting the criteria provided in the second paragraph.

The JTA is a living document and will continue to evolve with the technologies, marketplace, and associated standards upon which it is based. The JTA is the minimum set of performance based primary non-governmental standards needed to maximize interoperability and affordability within DoD and hence is entirely consistent with Acquisition Reform principles and practices. Tests and exercises will be used to evaluate the JTA implementation progress.

Addressees are requested to assure the widest distribution of this memorandum. Request Director, Joint Staff forward this memorandum to Unified Combatant Commands.

/s/	/s/	/s/
Jacques S. Gansler	Arthur L. Money	DOUGLAS D. BUCHHOLZ
Under Secretary of Defense	Senior Civilian Official	Lieutenant General, USA
(Acquisition and Technology)		Director for C4 Systems

The Joint Staff