MIL-STD-188-331
29 March 1994

MILITARY STANDARD

INTEROPERABILITY AND PERFORMANCE STANDARD FOR VIDEO TELECONFERENCING

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FOREWORD

1. This military standard (MIL-STD) is approved and mandatory for use by all departments and agencies of the Department of Defense (DOD) in accordance with DOD Instruction 5000.2, dated 15 May 1991, and Office of the Assistant Secretary of Defense - Command, Control, Communications, and Intelligence (ASD-C3I) policy memorandum titled *Department of Defense Policy for Video Teleconferencing (VTC) Management, Acquisition, and Standards*, dated 26 October 1993. See Appendix A for the text of this policy memorandum.

2. Beneficial comments (recommendations, additions, and deletions) and any pertinent data that may be of use in improving this MIL-STD should be addressed to the Defense Information Systems Agency (DISA), Joint Interoperability and Engineering Organization (JIEO), TBBC (ATTN: Mr. Rittenbach), Fort Monmouth, NJ 07703-5613.

3. The selected minimum essential requirements identified in this MIL-STD should allow maximum flexibility by permitting DOD to acquire nondevelopmental items (NDI) or commercial off-the-shelf (COTS) items.

4. For specific VTC applications, some or all requirements of this MIL-STD may not be appropriate. If a waiver to any of the requirements is desired for inter-DOD component systems and equipment, a request with detailed justification must be forwarded to DISA/JIEO, ATTN: Standards Management Division, TBBF, Fort Monmouth, NJ 07703-5613. For intra-DOD component systems and equipment, the waiver justification must be sent to the head of the DOD component, with a copy sent to DISA/JIEO.

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Concluded)

1. SCOPE

1.1 Purpose. The purpose of this MIL-STD is to provide DOD with interoperability between video teleconferencing (VTC) terminal equipment. The MIL-STD includes the VTC unit (VTU), as defined in 3.1. It also addresses cryptographic devices, but not input/output (I/O) equipment such as cameras, monitors, microphones, and speakers. Use of this MIL-STD assumes a network is operational to support communications between VTC terminal equipment. This MIL-STD will be revised to include other VTC-related requirements, such as multipoint. The technical parameters of this MIL-STD may be exceeded to satisfy certain specific requirements, provided that the minimum mandatory requirements are met and that interoperability is maintained.

1.1.1 Demarcation. The intent of the initial release of this MIL-STD is to address primarily the VTU and the interfaces to the cryptographic devices. On the network side, the MIL-STD addresses the interface between network interface equipment and the VTU or cryptographic device, but not the network interface equipment itself. On the I/O side, it addresses the interfaces between the VTU and the I/O devices, but not the I/O devices themselves. The interface between the VTU and the room control unit is beyond the scope of this MIL-STD. See 4.3, Figures 1 and 2.

1.2 Content. This MIL-STD specifies the minimum requirements for DOD interoperability. It also specifies optional features. Mandatory features are listed in 4.1 and optional features are listed in 4.2. This MIL-STD does not address the following areas:

- Analog videoconferencing
- Transmission data rates below 56 kbps
- Transmission data rates above 1920 kbps
- Network considerations
- Conference dialing and hookup
- Conference scheduling
- Multipoint
- Operational security procedures
- Simplex and broadcast modes of operation
- Key management

1.3 Application. This MIL-STD applies to all procurements initiated for DOD VTC and videophone equipment operating between 56 and 1920 kbps after the effective date of the MIL-STD. 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. This MIL-STD is mandatory for use by all DOD departments and agencies in accordance with DOD Instruction 5000.2, dated 15 May 1991. Any exceptions to this require a written waiver from the Defense Information Systems Agency (DISA), formerly the Defense Communications Agency (DCA). Existing and replacement systems must migrate to this MIL-STD in accordance with the ASD-C3I policy memorandum titled *DOD Policy for Video Teleconferencing Management, Acquisition, and Standards*. See the Foreword and Appendix A. This MIL-STD does not preclude the procurement of proprietary features as long as the corresponding standard features are also procured. See the definitions of *mandatory* and *optional* features for further explanation. This MIL-STD is also recommended for DOD contractors and anyone else who needs to communicate with DOD by way of VTC. The MIL-STD can be used in the design and installation of new VTC equipment and subsystems, and in authorized upgrading of existing VTC subsystems and equipment. Technical advances will be reviewed by the MIL-STD-188-331 Working Group for developing revisions.

2. APPLICABLE DOCUMENTS

(Numbers in parentheses indicate the paragraphs of this MIL-STD in which the associated document is referenced.)

2.1 Government Documents

2.1.1 Specifications, Standards, and Handbooks. The following specifications, standards, and handbooks form a part of this MIL-STD to the extent specified herein. 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 (see 6.2.1).

2.1.1.1 Federal Standards

FED-STD-1037B	Glossary of Telecommunication Terms (3.1, 3.2, 6.5)

2.1.1.2 Federal Information Processing Standards (FIPS)

FIPS PUB 46-1	Data Encryption Standard (5.5.4.2.1)
FIPS PUB 81	Data Encryption Standard Modes of Operation (5.5.4.2.2)
FIPS PUB 140-1	Security Requirements for Equipment Using Data Encryption Standard (5.5.4.4)
FIPS PUB 178	Video Teleconferencing Services at 56 to 1920 Kb/s (4.2.1, 4.2.2, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.4.1, 5.1.4.3, 5.1.4.6, 5.1.5, 5.1.6, 5.1.7, 5.2.2.1, 5.2.2.2, 5.6)

Copies of FIPS are available to DOD activities from

Commanding Officer
Naval Publications and Forms Center
(ATTN: NPODS)
5801 Tabor Avenue
Philadelphia, PA 19120-5099

Others must request copies of FIPS from

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161-2171
Telephone: 703-487-4650

2.1.1.3 Military Standards

MIL-STD-188-113	Interoperability and Performance Standards for Analog to Digital Conversion Techniques (5.2.3)
MIL-STD-188-114A	Electrical Characteristics of Digital Interface Circuits (5.5.3.1)
MIL-STD-188-198	Joint Photographic Experts Group (JPEG) Image Compression for the National Imagery Transmission Format Standard (Approved for U.S. release only) (5.3.2, 5.3.2.1)
MIL-STD-2500	National Imagery Transmission Format (Version 2.0) for the National Imagery Transmission Format Standard (5.3.1, 5.3.2, 5.3.2.2, 5.3.2.3). (Approved for U.S. release only.)
MIL-STD-2045-14500	Reliable End-System Transport for DOD Communications (5.3.2.4, 5.4.3.3, 5.4.4.3)
MIL-STD-2045-44500	Tactical Communications Protocol 2 (TACO2) for the National Imagery Transmission Format Standard (5.3.2.4)

Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from

Commanding Officer
Naval Publications and Forms Center
(ATTN: NPODS)
5801 Tabor Avenue
Philadelphia, PA 19120-5099

Federal standards are also available from

General Services Administration
GSA Specification Unit (WFSIS)
Room 6039
7th & D Streets SW
Washington, DC 20407 USA
Telephone: 202-472-2205

2.1.2 Other Government Documents, Drawings, and Publications. The following Government documents, drawings, and publications also form a part of this MIL-STD to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

2.1.2.1 DOD Directives

4640.14	Base and Long-Haul Telecommunications Equipment and Services (3.1)
5040.2	Visual Information (3.1)

2.1.2.2 Other Government Documents

MIL-HDBK-1300	National Imagery Transmission Format Standard Handbook (Approved for U.S. release only) (3.1, 5.3.2)
DISA/JIEO Circular 9008	NITFS Certification Test and Evaluation Program Plan (5.3.2.4)
NSTISS 4009	National INFOSEC Glossary, National Security Telecommunications and Information Systems Security (3.3)
Warner Amendment	Public Law 97-86, 1 December 1981 (3.1, 5.5.2.2)

2.2 Non-Government Publications. The following documents form a part of this MIL-STD 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 (see 6.1.4). If not in the DODISS and not in the solicitation, then use the latest approved version of the standard.

2.2.1 ITU-T Recommendations. Non-Government standards are distributed among non-Government standards bodies, such as the T1 committees, and Federal agencies that use VTC. The ITU-T (formerly CCITT) Study Group 1 and Study Group XV, and the U.S. T1A1.5 Committee, have been involved with these standards. The address for T1 is

Standards Committee, T1 Telecommunications
5430 Grosvenor Lane
Suite 200
Bethesda, MD 20814
Telephone: 301-564-4505

2.2.1.1 Video, Communications, and Control

H.221	Frame Structure for a 64 to 1,920 K/bps Channel in Audiovisual Teleservices (3.1, 5.1.1, 5.1.3, 5.1.4.2, 5.1.5, 5.1.7, 5.2.1, 5.2.2.1, 5.2.2.2, 5.4.3.2, 5.4.3.4, 5.4.4.2, 5.4.4.4, 5.5.2.3, 5.5.3.2)
H.230	Frame-Synchronous Control and Indication Signals for Audiovisual Systems (3.1, 5.1.1, 5.1.5, 5.2.2.1, 5.2.2.2)
H.233	Confidentiality System for Audiovisual Services (5.5.2.3, 5.5.4.1, 5.5.4.2, 5.5.4.2.1)
H.242	System for Establishing Communication Between Audiovisual Terminals Using Digital Channels up to 2 Mbps (3.1, 5.1.1, 5.1.6, 5.1.7, 5.2.2.1, 5.2.2.2)
H.261	Video CODEC for Audiovisual Services at *p* x 64 K/bps (3.1, 5.1.1, 5.1.4, 5.1.4.1, 5.1.4.2, 5.1.4.3, 5.1.4.5, 5.1.4.6, 5.2.4)
H.320	Narrowband Visual Telephone Systems and Terminal Equipment (3.1, 5.1.1, 5.1.6, 5.2.2.1, 5.2.2.2)

2.2.1.2 Audio

G.711	Pulse Code Modulation (PCM) of Voice Frequencies (5.2.2.1, 5.2.3)
G.722	7 kHz Audio-coding within 64 K/bits/s (3.1, 5.2.2.2, 5.2.3)
G.728	Speech Coding at 16 kilobits per second (5.2.2.3)

2.2.1.3 Data

H.224 (draft)	A Real Time Control Protocol for Simplex Applications Using the H.221 LSD/HSD/MLP Channels (formerly H.DLL) (5.4.1, 5.4.3.1, 5.4.3.3, 5.4.3.4, 5.4.3.5, 5.4.3.7, 5.4.4.3 to 5.4.4.6, 5.6.2)
T.35	Procedure for the Allocation of ITU-T Members' Codes (5.4.3.6, 5.4.4.6)
V.24	List of Definitions for Interchange Circuits Between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) (5.4.3.8, 5.4.3.8.1, 5.4.3.8.2, 5.4.3.8.3, 5.4.3.8.4, 5.4.3.8.5)
V.42	Error-Correcting Procedures for DCEs Using Asynchronous-to-Synchronous Conversion (5.4.3.8.2, 5.4.3.8.3)

Application for copies of ITU-T recommendations should be addressed to

International Telecommunications Union
Place des Nations
CH-1211
Geneva 20, Switzerland
Telephone: +41 22 730 5111
Fax: +41 22 733 7256

ITU-T recommendations are also available from

Omnicom, Phillips Business Information Inc.
1201 Seven Locks Road
Suite 300, Potomac, MD 20854 USA
Telephone: 1-800-666-4266
Fax: 1-301-309-3847

or from

Omnicom International, Ltd.
First Floor
Forum Chambers
The Forum
Stevenage, Herts, UK SG1 1EL
Telephone: +44 438 742424
Fax: +44 438 740154

2.2.2 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 (3.1, 5.1.8.1, 5.1.8.4)
EIA-232-D	Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange (3.1, 4.1.1, 5.3.2.4, 5.3.3, 5.4.2, 5.4.3, 5.4.3.1, 5.4.3.3, 5.4.3.6, 5.4.3.7, 5.4.3.8)
EIA-366-A	Interface Between Data Terminal Equipment and Automatic Calling Equipment for Data Communications (5.1.8.3.2, 6.9.1.2)
EIA-422-A	Electrical Characteristics of Balanced Voltage Digital Interface Circuits (3.1, 4.1.2, 5.1.8.2, 5.3.3, 5.4.2, 5.4.4, 5.5.3.1, 5.5.3.2)
EIA-449	General-Purpose 37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data

Interchange (3.1, 5.1.8.2, 5.1.8.3.1, 5.1.8.3.3, 5.5.2.3, 5.5.3.1)

EIA-530 — High-Speed 25-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment (3.1, 5.3.2.4, 5.3.3, 5.4.2, 5.4.4, 5.4.4.1, 5.4.4.3, 5.4.4.6, 5.4.4.7, 5.4.4.7.2)

Copies of EIA standards can be purchased from

Electronic Industries Association
Standards Sales
2001 Pennsylvania Avenue NW
Washington, DC 20006
Telephone: 202-457-4966
Fax: 202-457-4985

2.2.3 Other Publications

NIUF Profile 940007 — NIUF Video Conferencing Application Profile, (5.1.8.3)

A Catalog of National ISDN Solutions for Selected NIUF Applications, (5.1.8.3)

Copies of ANSI, FIPS, FED-STD, EIA, ITU-T, and ECMA standards are included in *Open Systems Standards*, Volumes 1-6, edited by Harold C. Folts, McGraw Hill, Publisher.

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.

2.3 Order of Precedence. In the event of a conflict between the text of this MIL-STD and the references cited herein, the text of this MIL-STD shall take precedence, except for federal standards (including FIPS), which take precedence over this MIL-STD. Nothing in this MIL-STD, however, supersedes applicable laws and regulations, unless a specific exemption has been obtained.

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3. DEFINITIONS

3.1 **Terms.** Definitions of terms used in this MIL-STD shall be as specified in FED-STD-1037B. Those definitions unique to this MIL-STD and not defined in FED-STD-1037B, are provided in this paragraph. A list of terms used in this MIL-STD, and defined in FED-STD-1037B, is in paragraph 6.5. The numbers in parentheses at the end of the definitions indicate the sources as listed in 3.3.

Audio through VTU: The audio signal is run through the VTU and multiplexed with the video for transmission. The audio is not transmitted on a separate line. (2)

Audio: The voice or sound portion of a teleconference. (2)

Bayonet Neill-Concelman (BNC): A type of coaxial cable connector. (2)

Bit-rate allocation signal (BAS): An 8-bit word, within the frame structure of ITU-T Recommendation H.221, used to transmit commands, control and indication signals, and capabilities. (2)

Broadcast mode: See FED-STD-1037B, *broadcast operation*.

Broadcast security: The capability to broadcast to multiple receive sites in a secure (classified) mode of operation. (2)

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. (3)

Chrominance: The difference between a reproduced color and a standard reference color of the same luminous intensity. (2)

CIF: See *Full Common Intermediate Format*.

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." (2)

CODEC: Acronym for COder/DECoder. See FED-STD-1037B, definition 1. In VTC, an electronic device that converts analog signals, typically video, voice, and/or data, 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. (2)

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

Conferencing: Programs and meetings that may be for the purpose of presenting and exchanging information, comparing views, learning, planning, and decision-making. Conferences can be held in one location or conducted simultaneously at multiple locations, linked together by telecommunications systems. Conferencing includes the design and engineering of conferencing systems and telecommunications services; the creation of presentation media; and the development and promulgation of policy, procedures, and standards for the operation of conferencing activities, facilities, systems, and networks. (2)

Cryptographic resynchronization: The VTU having the capability to automatically send a signal for resynchronization to the cryptographic device whenever resynchronization is needed. (2)

Data communications port: A port used to transfer information between functional units by means of data transmission, according to a protocol. (2)

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. (2)

DB-25S: A standardized 25-pin connector used in EIA-232-D and EIA-530 data communications. (2)

Decoder: A device that decodes. (2) See FED-STD-1037B (definition 1), *decode*.

Desktop and individual workstation: An input/output display device with local computer power that allows an individual to perform some computational work and/or data-base access from a local or remote location. This device may also have videophone and/or VTC capabilities. (2)

Discrete signals: A signal composed of sample values uniformly spaced in time. The result of sampling a continuous signal. (2)

Distance learning: See *teletraining*.

Document camera indicator bit: A bit specified in the Picture header of H.261, indicating whether the image is from a fixed document camera or is motion video. (2)

Echo cancellation: The process of reducing echo electronically in the audio or transmission systems. (2)

Echo canceler: A device that electronically reduces echo in the audio or transmission systems. (2)

EIA-232-D (formerly RS-232-D): A serial interface standard for transmission of unbalanced signals between a variety of computer, media, and multimedia peripherals. EIA-232-D transmits at a maximum of 19.2 kbps for up to a distance of about 50 feet and uses a 25-pin connector. (2)

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. EIA-422 allows a maximum data rate of 10 Mbps. (2)

EIA-449 (formerly RS-449): A serial mechanical interface standard for transmission of balanced and unbalanced signals between a variety of higher-end computer, media, and multimedia peripherals. EIA-449 allows a maximum data rate of 10 Mbps and uses a 37- or 9-pin connector. (2)

EIA-530: A replacement for EIA-449 that uses a DB-25 (EIA-232-D) connector instead of a 37-pin connector, while keeping the most important electrical signals intact. EIA-530 is to be used in conjunction with EIA-422-A. (2)

Electronic classroom: See *teletraining*.

Electric Industries Association: A U.S. commercial standards organization. The acronym EIA precedes a numerical designation, such as EIA-232-D, which replaces the now obsolete RS (Recommended Standard) designation, for example, RS-232-D. (2)

Embedded encryption: Encryption integrated into the VTU box. (2)

Encoder: A device that encodes. (2) See FED-STD-1037B (definition 1), *encode*.

Encryption: The process of encrypting. See FED-STD-1037B, *encrypt*. (2)

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. (2)

Frame alignment: See FED-STD-1037B. In this MIL-STD, *frame alignment* refers to the ITU-T H.221 frame, not the image frame. (2)

Frame alignment signal (FAS): See FED-STD-1037B. In ITU-T H.221, this signal also contains additional bits for status, control, and error detection. (2)

Freeze-frame video: A frame of visual information selected from a video signal and processed through the video CODEC for transmission to remote sites. Not to be confused with *still image*. See *still image*. (2)

Full Common Intermediate Format (FCIF): A video format defined in ITU-T H.261 characterized by 352 luminance pels on each of 288 lines, with half as many chrominance pels in each direction. (2)

Full duplex: See FED-STD-1037B, *duplex operation*.

High-speed data channel: A channel for the transmission of high-speed data (48 kbps or higher), which is multiplexed into the transmitted bit stream, or demultiplexed from the received bit stream, as defined in ITU-T Recommendation H.221. (2)

High-resolution graphics: Graphics captured and displayed at a higher resolution than the NTSC standard (EIA-170-A). (2)

Huffman Coding: An entropy coding technique to compress data in which frequent events are represented by short codes, and rare events are represented by long codes. Used in Group 3 facsimile and JPEG. (2)

Inverse multiplexer: A device used to create a single, higher-speed network data channel by combining, separating, and synchronizing multiple, independent 56- or 64-kbps network data channels. Also known as an *aggregator*. (2)

ISDN: See FED-STD-1037B, *Integrated Services Digital Network*. (3) Note: Access channels include a basic rate (two 64-kbps "B" channels + one 16-kbps "D" channel) and a primary rate (twenty-three 64-kbps "B" channels and one 64-kbps "D" channel). (2)

ITU-T: See FED-STD-1037B, *CCITT*.

Lip synchronization: The relative timing of audio and video signals so that there is no noticeable lag or lead between audio and video. (2)

Low-speed data channel: A channel for the transmission of low-speed data, which is multiplexed into the transmitted bit stream or demultiplexed from the received bit stream, as defined in ITU-T Recommendation H.221. (2)

Luminance: The monochromatic component of the signal used to convey brightness information. (2)

Mandatory feature: If a given feature is mandatory in this MIL-STD, then once the standard is adopted, the feature must be included in all future military VTC procurements, unless a waiver is obtained. (2)

Microphones: Devices that convert acoustic energy (sound waves) into electrical energy, to be transmitted over wire or other communications channels. An audio transducer that converts sound pressure waves (sound energy) into electrical signals. (2)

Minimum picture interval: The minimum time between pictures selected for encoding. Allowable values are 1/29.97, 2/29.97, 3/29.97, and 4/29.97 seconds per picture. (2)

Motion compensation: A type of interframe coding used by CODECs in the compression of motion video images. The process relies on an algorithm that examines a sequence of image frames to measure the motion that occurs between frames. (2)

Mu-law: The PCM coding and companding standard used in Japan and North America. (2)

Multipoint: A telecommunications system that permits three or more locations to intercommunicate in a conference call. (2)

Near-full motion operation: A VTU capability that unconditionally provides an encoded video frame update rate of greater than or equal to 6.0 frames per second (fps). (2)

Network: See FED-STD-1037B. In this MIL-STD, *network* infers 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. (2)

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. (2)

NITF: National Imagery Transmission Format. The format for secondary imagery transmission defined in the NITFS. (2)

NITFS: National Imagery Transmission Format Standard. A set of military standards described in MIL-HDBK-1300, for secondary imagery dissemination. (2)

Nondevelopmental item (NDI). NDIs are items procured from immediately available stock, with no development costs. (2)

Optional feature: If a feature is optional in this MIL-STD, the user must decide to purchase the MIL-STD feature or not. If purchased, this feature shall meet the specifications in the MIL-STD. (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. The MIL-STD does not prevent the user from buying a particular feature implemented in a nonstandard way. However, if both standard and nonstandard modes are purchased, the feature must be easily switched back to the standard mode.

For example, if a high-resolution, still imagery mode is an optional feature in this MIL-STD, it would be the user's decision to purchase the MIL-STD high-resolution, still-image-mode or not. If purchased, the version shall meet the MIL-STD specifications for the high-resolution, still image mode. This will allow for interoperability of high-resolution, still images among those users purchasing this MIL-STD 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 paragraph 6.1.3. (2)

p: An integer that can range from 1 to 30. It relates to VTUs that operate at nominal bit rates of integer multiples of 64000 bits per second (bps), where the integer is *p*. For unrestricted channels, such as provided by ISDN, each increment of data rate may actually be 64000 bps, but in restricted channels, each increment may be only 56000 bps. (2)

***p* x 64**: A family of 5 ITU-T recommendations. These include H.221, H.230, H.242, H.261, and H.320. These standards form the basis for VTC interoperability. (2)

Pink noise: A random noise with a spectrum level having a negative slope of 10 dB per octave. (2)

Point-to-point: See FED-STD-1037B, *point-to-point transmission*.

Quarter Common Intermediate Format (QCIF): A video format defined in ITU-T H.261 that is characterized by 176 luminance pels on each of 144 lines, with half as many chrominance pels in each direction. QCIF has 1/4 as many pels as FCIF. (2)

Recommended standard: A prefix to EIA standards, such as RS-232-D. This designation is now obsolete; it has been replaced by the prefix EIA, for example, EIA-232-D. (2)

Resolution: See FED-STD-1037B, definition 3. For video equipment, often measured in terms of pels. (2)

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 common in North America, and was originally due to a one's density limitation in T1 circuits. (2)

RGB: An acronym for Red-Green-Blue. A connection that consists of three different signals used to carry the red, green, and blue elements of a color image. Since the image is unencoded, it results in higher resolution and picture clarity than that allowed by NTSC video (which contains composite, encoded color information). Three different lines are needed for connection instead of the one for NTSC signals. (2)

Registered Jack Number 11 (RJ-11): The standard modular phone jack for the U.S. (2)

Room control unit: A control box used by the operator or facilitator to control cameras, audio, and graphics. (2)

Service definition: A standards document that defines the scope of the standardization effort of commercial standards. Service definitions for VTC have been written by the ANSI T1A1.5 committee, and by ITU-T Study Group 1. (2)

Still image: Non-moving visual information such as graphs, drawings, pictures, or video frames not processed by the video CODEC portion of the VTU. This differs from freeze-frame images, which are processed by the video CODEC portion of the VTU. (2)

Sub-band adaptive differential pulse-code modulation (SB-ADPCM): A digital transmission process that splits the audio frequency band into two sub-bands (higher and lower), then uses ADPCM to encode the signals in each sub-band. (2)

Synchronization: See FED-STD-1037B. See also *lip synchronization*.

Teleconferencing activity: An organization or function established to provide teleconferencing programs and services, and authorized in accordance with DOD Directive 5040.2. (2)

Teleconferencing: The use of teleconferencing to conduct a seminar. (2)

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. (2)

Teleseminar: See *teletraining*.

Teleservices: See *telecommunications service*.

Teletraining: (Also known as distance learning, teleseminar, or electronic classroom.) The use of teleconferencing point-to-point or multi-point to provide interactive remote site training. (2)

TEMPEST-approved: See FED-STD-1037B. A TEMPEST-approved device that meets stringent 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. (2)

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 input/output (I/O) device. (2)

Toll quality: Telephone voice quality using a 3-kHz analog bandwidth. (2)

Type 1: A classified or controlled cryptographic equipment, assembly, component, or item endorsed by the National Security Agency 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. (1)

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. (1)

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. (2) This definition does not include Warner-Amendment-exempt equipment. (2)

Unclassified: Information that is not classified. (2)

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. (2)

Unrestricted channel: A digital communications channel, in which for each increment of *p*, all 64000 bits per second (bps) are available for information transfer. ISDN is an example of a network that uses 64000-bps communications channels. (2)

Video: That portion of a signal related to moving images. (2) See also FED-STD-1037B, *video signal*.

Videoconferencing: See *video teleconferencing*.

Videophone: A VTC terminal where most of the equipment is integrated into a single desktop unit. (2)
Video CODEC: See *CODEC*.

Video teleconferencing: A 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 the participants are in the same room. (3)

Video teleconferencing unit (VTU): VTC equipment that performs the following functions: coding/decoding of audio and video; and 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 MIL-STD is broader than the scope of the VTU because the scope of the MIL-STD includes cryptographic devices and other items that the VTU does not include. (2)

Video telephony: Relating to video phones and VTC. (2)

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 ADPE or services to be used for routine administrative and business applications, including payroll, finance, logistics, and personnel management applications.

The Warner Amendment has the effect of exempting the above DOD applications from the mandatory-use provisions for FTS-2000. See DOD Directive 4640.14 for detailed instructions for Warner exemption determinations. (2)

Warner-exempt: A telecommunications requirement that meets the stipulations as stated in the Warner Amendment, which thereby exempts that requirement from the mandatory-use provisions of FTS-2000. (2)

Wideband: See FED-STD-1037B, definition 4. In the case of wideband audio, G.722 specifies a bandwidth of 7 kHz. (2)

Windowing: The capability to divide a video display into two or more separate regions with displays from different sources in each region. For example, four separate 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. (2)

XLR: The industry standard for low impedance, balanced microphone connectors. (2)

XOFF: A flow control ASCII character meaning "Transmit off." (2)

XON: A flow control ASCII character meaning "Transmit on." (2)

3.2 **Abbreviations and Acronyms.** The abbreviations and acronyms used in this MIL-STD are defined below. Those that are common with the terms in FED-STD-1037B have been included for the convenience of the reader.

ADPE	automatic data processing equipment
AMSC	Acquisition Management Systems Control
ANSI	American National Standards Institute
AR	Army Regulation
ASCII	American Standard Code for Information Interchange
ASD-C3I	Office of the Assistant Secretary of Defense - Command, Control, Communications, and Intelligence
BAS	bit-rate allocation signal
BNC	bayonet Neill-Concelman
bps	bit(s) per second
BRI	Basic Rate Interface
BW	bandwidth
CCIR	International Radio Consultative Committee
CCITT	International Telegraph and Telephone Consultative Committee (now ITU-T)
CD-ROM	compact disk - read-only memory
CIF	common intermediate format
CODEC	coder-decoder
COMRAT	compression rate code
COMSEC	communications security
COS	Corporation for Open Systems, International
COTS	commercial off-the-shelf
crypto	cryptographic
CSU	channel service unit
CTS	clear to send
dBm	decibel(s) referenced to 1 milliwatt
DCD	data channel received line signal detector
DCE	data circuit-terminating equipment
DCT	discrete cosine transform
DES	data encryption standard
DIA	Defense Intelligence Agency
DISA	Defense Information Systems Agency
DOD	Department of Defense
DODISS	Department of Defense Index of Specifications and Standards
DPCM	differential pulse-code modulation
DSR	data set ready
DSU	data service unit
DTE	data terminal equipment
DTR	data terminal ready
ECS	encryption control signal
EIA	Electronic Industries Association
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
fps	frame(s) per second
FSCLAS	File Security Classification field
HDLC	high-level data link control
HSD	high-speed data
Hz	hertz
IC	Image Compression field
I/O	input/output
IMUX	inverse multiplexer
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ITU	International Telecommunications Union
ITU-R	ITU Radio Communications Sector (formerly CCIR)
ITU-T	ITU Telecommunications Sector (formerly CCITT)
JIEO	Joint Interoperability and Engineering Organization
JPEG	Joint Photographic Experts Group
JWICS	Joint Worldwide Intelligence Communications System
kbps	kilobit(s) per second
kHz	kilohertz
LOS	loss of synchronization
LSD	low-speed data
Mbps	megabit(s) per second
MHDR	message header
MILDEP	military department, such as the Air Force, Army, Navy
MIL-HDBK	military handbook
MIL-STD	military standard
MPI	minimum picture interval
ms	millisecond(s)
N/A	not applicable
NACSIM	National COMSEC Information Memorandum
NATO	North Atlantic Treaty Organization
NDI	nondevelopmental item
NIST	National Institute of Standards and Technology
NITF	National Imagery Transmission Format
NITFS	National Imagery Transmission Format Standard
NIUF	North American ISDN Users Forum
NSTISS	National Security Telecommunications and Information Systems Security
NSTISSAM	National Security Telecommunications and Information Systems Security Advisory/Information Memorandum

NTISSI	National Telecommunications and Information Systems Security Instruction
NTISSP	National Telecommunications and Information Systems Security Policy
NTSC	National Television Standards Committee
OPNAVINST	Chief of Naval Operations Instruction
OPNAVNOTE	Chief of Naval Operations Note
OSI	Open Systems Interconnect
PAL	phase alternation by line
PCM	pulse-code modulation
PUB	publication
QCIF	quarter common intermediate format
RD	Receive Data
RGB	red green blue
ROM	read-only memory
RS	recommended standard
RT	receive timing
RTS	request to send
RXD	receive data
SB-ADPCM	sub-band adaptive differential pulse-code modulation
SD	Send Data
SECAM	System electronique couleur avec memoire
ST	Send Timing
TA	Terminal Adapter
TACO2	Tactical Communications Protocol 2
TCSS	telecommunications systems standards
TEMPEST	compromising emanations
TT	terminal timing
TXD	transmit data
VTC	video teleconferencing
VTU	video teleconferencing unit

3.3 References

(1) *National INFOSEC Glossary*, National Security Telecommunications and Information Systems Security (NSTISS) No. 4009, National Security Agency, 5 June 1992. (Definitions have been slightly modified to meet the needs of MIL-STD-188-331.)

(2) MIL-STD-188-331 Working Group definitions.

(3) DIA, JSI-5C, *JWICS Definitions*.

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4. GENERAL REQUIREMENTS

VTC systems have been divided into two categories: (a) desktop and videophone applications (4.2), and (b) all other systems (4.1). Section 4 is a summary of the major mandatory and optional features for each category. The numbers in parentheses indicate the paragraphs in this MIL-STD in which the features are specified.

4.1 VTC Applications (Except Desktop and Videophones). This category applies to all VTC systems, except for desktop and videophone applications. All desktop and videophone systems shall comply with 4.2.

4.1.1 Mandatory Features. The features described below, in 4.1.1 (a) through 4.1.1 (l), shall be included. (See Section 3 for the definition of *mandatory features*.)

a. Modes of operation (5.1.2)
   - Full-duplex (5.1.2)

b. Transmission data rates (5.1.3)
   - Operation at $p = 1$ and $p = 2$ (56-128 kbps) (5.1.3)

c. Motion video (5.1.4)
   - QCIF picture quality (5.1.4.1)
   - Minimum picture update rate (5.1.4.2)

d. Freeze-frame video (5.1.4.5)
   - same resolution as motion video

e. Control and indication signals (5.1.5)

f. Call control (5.1.6)

g. Frame structure (5.1.7)

h. Electrical and mechanical interfaces (5.1.8.2, 5.2.5, 5.4.3, 5.5.3.1)

i. Audio (5.2)
   - Audio through the VTU (5.2.1)
   - Narrowband (3-kHz bandwidth) speech at 48 and 56 kbps (mu-law PCM) (5.2.2.1)
   - Encoding and decoding (5.2.3)
   - Lip synchronization (5.2.4)

j. Data transport (5.4)

- Low-speed EIA-232-D data transfer up to 4800 bps (5.4.3) See note in 5.4.1.

k. Security (5.5)
- Unencrypted mode (5.5.2.1)
- Capability to operate with KG-194 cryptographic equipment (5.5.2.3, 5.5.3)
- Resynchronization capability (5.5.3.2)

l. Concurrent operation at $p = 2$ (5.6.2)
- Video
- Audio
- Still image or Data
- Security

4.1.2 Optional Features. These features may be included. If they are included, they shall be implemented as specified in this MIL-STD. This MIL-STD does not preclude additional nonstandard modes for any given feature, as long as the standard mode is included for that feature. (See Section 3 for the definition of *optional features*.)

a. Transmission data rates (5.1.3)
- Operation at $p = 3$ through 30

b. Motion video (5.1.4)
- Full CIF picture quality (Mandatory if $p \geq 6$ is required) (5.1.4.1)
- Error correction (5.1.4.3)
- Motion compensation (5.1.4.4)

c. Freeze-frame video (5.1.4.5)
- 4 x resolution of motion video

d. Electrical and mechanical interfaces (5.1.8, 5.2.5, 5.4.3, 5.4.4, 5.5.4.6)

e. Audio (5.2)
- Narrowband (3-kHz bandwidth) speech at 48 and 56 kbps (A-law PCM) (5.2.2.1)
- Wideband (7-kHz bandwidth) speech at 48 - 56 kbps (mandatory if $p \geq 6$ is required) (5.2.2.2)
- Narrowband (3-kHz bandwidth) speech at 16 kbps (5.2.2.3)

f. Still image (5.3)
- High-resolution (NITFS-JPEG) (5.3.2.1)

g. Data transport (5.4)
   - Low-speed EIA-232-D data transfer > 4800 bps (5.4.3)
   - High-speed EIA-422-A/530 data transfer ≥64 kbps (5.4.4)

h. Security (5.5)
   - Classified mode (5.5.3)
   - Unclassified sensitive mode (5.5.4)
   - Visual security status signal for unclassified sensitive mode (5.5.4.5)

i. Concurrent operation at $p > 2$ (5.6.3)

4.2 Desktop and Videophone Applications. This category applies to all videophones and desktop applications. All other VTC systems shall comply with 4.1.

4.2.1 Mandatory Features. For these applications, the only mandatory requirements are those stated in Federal Information Processing Standard (FIPS) PUB 178 for Class 1 terminals.

4.2.2 Optional Features. Any features that may be provided in addition to those in FIPS PUB 178 are optional. If provided, they shall interoperate with the corresponding features of 4.1.1, 4.1.2, and 5. Electrical and mechanical interface compatibility is not required except in the case of classified operation, for which the requirements of 5.5.3.1 apply. It is up to the procuring agency to specify which electrical and mechanical interfaces are required, if any. Features that shall interoperate include, but are not limited to, the following:

- security (classified mode)
- security (unclassified, sensitive mode)
- still images
- freeze-frame video
- data transmission
- additional video capabilities
- additional audio capabilities

This paragraph does not preclude additional nonstandard modes for any given feature, as long as the standard mode is included for that feature.

4.3 Demarcation. Figures 1 and 2 show the line of demarcation of MIL-STD-188-331. The scope of the MIL-STD is limited to items inside the dashed line. Further details for special cases are shown in Figures 3 through 7 (see section 5).

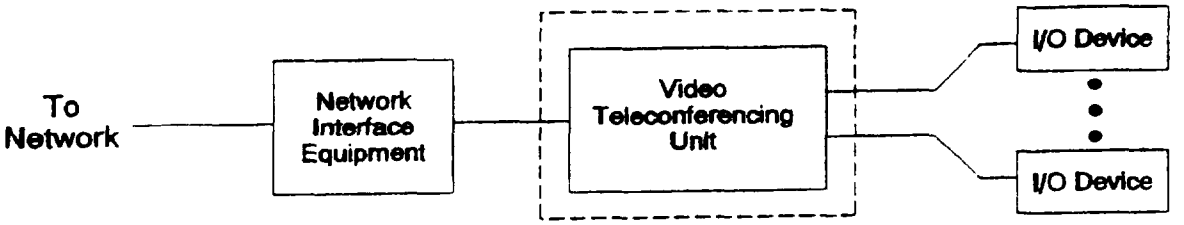


Figure 1. Line of Demarcation with No External Cryptographic Device

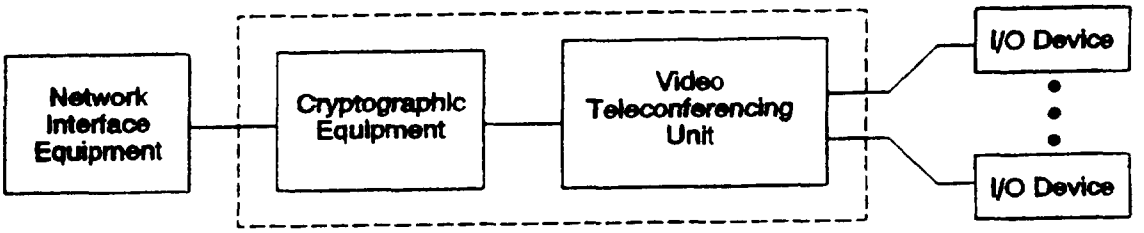


Figure 2. Line of Demarcation with External Cryptographic Device

5. DETAILED REQUIREMENTS

The requirements in this section shall apply to all VTC systems, except for desktop and videophone applications. All desktop and videophone systems shall comply with 4.2.

5.1 Video, Communications, and Control

5.1.1 General. Except as noted, the VTU shall conform to the requirements set forth in FIPS PUB 178. FIPS PUB 178 is based on the five ITU-T (formerly CCITT) *p* x 64 standards: H.221, H.230, H.242, H.261, and H.320.

5.1.2 Full-Duplex Mode. The VTU shall provide full-duplex operation, as stated in FIPS PUB 178. This applies to video, audio, still-image graphics, data communications, and security.

5.1.3 Data Transmission Rates. FIPS PUB 178 relates to VTUs that operate at nominal bit rates of *p* x 64000 bits per second (bps), where *p* is an integer that can range from 1 to 30. For unrestricted channels, such as provided by the Integrated Services Digital Network (ISDN), each increment of data rate may actually be 64000 bps, but in restricted channels, each increment may be only 56000 bps. VTUs shall be able to operate with other VTUs on unrestricted and restricted channels. VTUs operating on calls that are multiples of 56 kbps shall send the restrict capability as specified in H.221, Annex A.7, and the restrict command as specified in H.221, Annex A.3. Upon receiving the restrict capability, the called VTU shall begin using procedures of H.221, Annex B, and shall send the restrict command. VTUs operating under a restrict capability condition may respond to the derestrict command or may initiate error recovery (e.g., capability exchange). VTUs shall provide operation at least for $p = 1$ and $p = 2$. VTUs able to operate at $p = 2$ shall be able to operate with a single 128-kbps channel, and if the second port is specified, with two 64-kbps channels. See 5.1.8.2.

Operation at $p > 2$ is optional. If the procurement requires a higher *p* value, then all *p* values in the set {1, 2, 4, 6, 12, 18, 23, 24} less than or equal to the requirement shall also be provided. For other *p* values, operation only with a single channel is required.

5.1.4 Video Coding and Decoding. The video coder/decoder (CODEC) subsystem used to provide VTC services within the scope of this MIL-STD shall conform to the specifications set forth in FIPS PUB 178 (see also ITU-T H.261). The video CODEC subsystem can also provide other proprietary solutions in addition to

FIPS PUB 178 (see also ITU-T H.261). Options provided by FIPS PUB 178 (see also ITU-T H.261) shall be implemented for DOD use, as indicated in 5.1.4.1 through 5.1.4.6.

5.1.4.1 Picture Format (Resolution). The video CODEC shall provide full-color, near-full motion operation using at least the QCIF format, in accordance with FIPS PUB 178 (see also ITU-T H.261). If the procurement requires at least FCIF resolution (or equivalent) for motion video, then the standard algorithm of FIPS PUB 178 (see also ITU-T H.261) shall be available at FCIF resolution. If the user requires the VTU to operate at a rate equal to or greater than $p = 6$, then the VTU shall also have the capability for FCIF resolution at rates equal to and above $p = 2$.

5.1.4.2 Motion Rendition. The encoder shall be capable of encoding at least an average of 6 pictures per second, excluding pictures with scene changes. 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, and ITU-T H.261, paragraph 3.1.

5.1.4.3 Forward Error Correction (FEC). Using the FEC code in the decoder, as specified in FIPS PUB 178 (see also ITU-T H.261, paragraph 5.4), to correct transmission errors is optional.

5.1.4.4 Motion Compensation. The requirement for motion compensation in the encoder is optional.

5.1.4.5 Freeze-Frame Video. All VTUs shall support a freeze-frame video transmission capability. *Freeze-frame video* is a frame selected from a video signal and processed through the video CODEC for transmission to remote sites. Freeze-frame video is not the same as still-image graphics. See 5.3. Motion video transmission is suspended until freeze-frame transmission is complete.

The VTU shall be able to output video signals representing both motion video and freeze-frame video simultaneously, or provide a single video output that the user can switch between motion video and freeze-frame video. The coding of freeze-frame images shall be performed by means of the technique described in Recommendation H.261, Annex D. This technique provides an image with up to twice the resolution in each direction of the format being used for motion video, that is, 352 x 288 pels for VTUs using QCIF motion video, and 704 x 576 pels for VTUs using FCIF motion video. VTUs capable of QCIF motion video shall provide QCIF freeze-frame video capability. 4 x QCIF (FCIF) freeze-frame

video shall be optional. VTUs capable of FCIF motion video shall provide FCIF freeze-frame video capability. 4 x FCIF freeze-frame video shall be optional. Freeze-frame video having 2 x horizontal and/or 2 x vertical resolutions are also allowable, but are not specifically listed as options under this MIL-STD.

5.1.4.6 **Proprietary Video Coding.** Proprietary algorithms for video coding are allowed by FIPS PUB 178. If a certain value of p is required by the procurement, the VTU must operate at that value according to FIPS PUB 178 (see also ITU-T H.261), and not just the proprietary video algorithm.

5.1.5 **Control and Indication Signals.** The VTUs shall provide additional information needed for the system to function properly. This additional information will contain ITU-T H.221 frame-synchronous control signals and indication signals such as freeze picture, video loopback, and simple multipoint controls, as specified in FIPS PUB 178 (see also ITU-T Recommendation H.230).

5.1.6 **Call Control (Handshaking).** The VTUs shall interoperate with each other and the existing telecommunications system, as specified in FIPS PUB 178 (see also ITU-T Recommendation H.242 and H.320.)

5.1.7 **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 FIPS PUB 178 (see also 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, in accordance with ITU-T Recommendation H.221, is outside the scope of this MIL-STD.

The capability to interoperate at $p = 6$ between a VTU connected to an H0 channel and a VTU that has only B channel capability is specified in ITU-T H.221, section A.3. However, ITU-T H.242 does not yet specify the necessary end-to-end signaling procedure for handling a 6B-H0 interconnection. Therefore, the optional 6B-H0 interconnection is not yet fully defined and is for further study.

5.1.8 **Electrical and Mechanical Interfaces**

5.1.8.1 **Camera Interface.** All systems shall support the capture of motion-video and freeze-frame video images, using television cameras. For VTC equipment that has external cameras and that is

intended to be used in North America, the electrical interfaces between the cameras and the VTU shall optionally meet the NTSC (EIA-170-A) standard. The mechanical interface shall optionally be BNC, F-type, or RCA connectors.

The interfaces between the VTU and the video display devices are outside the scope of this MIL-STD, since they do not affect interoperability between VTUs.

5.1.8.2 VTU Network Interface. A minimum of one synchronous EIA-449 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 EIA-422-A for balanced voltage digital-interface circuits. At $p = 2$, if the user has a requirement for unclassified or unclassified, sensitive operation over 2 channels, then a VTU network interface to support at least 1 additional channel is mandatory. Otherwise the second network interface is optional. If optional, the interface shall be field-installable in the existing VTU. See 5.1.8.3, 6.9.1, and 6.9.3 for possible configurations of network interface ports.

The requirements of 5.5.3.1 and 5.5.3.2 shall apply to at least one of the EIA-449 network interface ports provided, to allow the VTU to interface with KG-194-compatible cryptographic equipment.

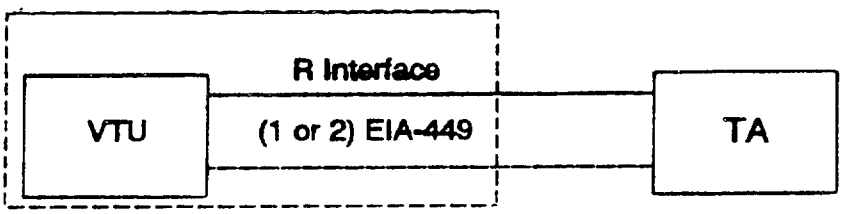
If an external inverse multiplexer is needed for networks with more than 1 channel, such as ISDN and dual-switched 56-kbps networks, see 6.9.2.

5.1.8.3 ISDN Basic Rate Interface (BRI). ISDN interfaces are optional. Three optional ISDN BRI configurations are within the scope of this MIL-STD; other network interfaces are permitted but are outside the scope of this MIL-STD. See 5.1.8.3.1, 5.1.8.3.2, and 5.1.8.3.3. Typical interconnections for other ISDN BRI configurations are discussed in 6.9.1. Other network interfaces are listed in 6.9.3. Included in the scope of this MIL-STD (section 1) are ISDN BRIs between the VTU and the terminal adapter (TA), and, for classified operation, between the Type 1 cryptographic device and the TA.

All configurations in 5.1.8.3 and 6.9.1 are in accordance with the North American ISDN Users Forum (NIUF) profile, *NIUF Video Conferencing Application Profile 940007*, and the NIUF catalog, *A Catalog of National ISDN Solutions for Selected NIUF Applications*. Any of these configurations may be chosen, depending on the user's needs. Use of D-channel signaling, as shown in 6.9.1.4 and 6.9.1.5, is permitted for unclassified and

unclassified sensitive operation, but is outside the scope of this MIL-STD. Use of D-channel signaling originating from the VTU is not permitted with classified operation. See 5.1.8.3.3 for ISDN BRI classified operation.

5.1.8.3.1 Option 1, External Terminal Adapter. Option 1 is for unclassified and Type 3 unclassified sensitive operation. The VTU shall have one or two EIA-449 ports, as described in 5.1.8.2, 5.5.3.1, and 5.5.3.2. These shall be used to connect to an external ISDN TA. See Figure 3.



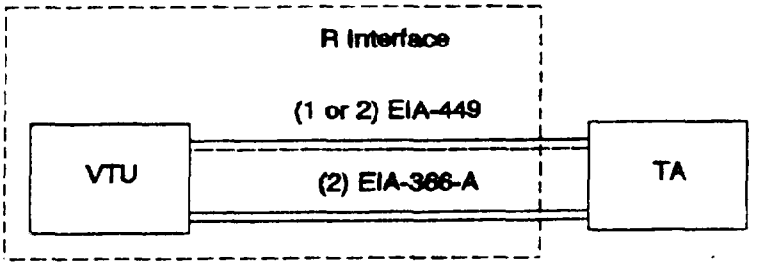
(Interior of dashed-line polygon indicates scope of MIL-STD-188-331.)

Figure 3. Option 1, External TA.

The TA is outside the scope of this MIL-STD. (See Figure 12 in 6.9.1.1 for a more detailed configuration.) Note that if the VTU user specifies the one EIA-449 port version, and two B channels are used, the necessary inverse multiplexing (IMUX) function to go from a single channel to two B channels must be performed by the TA. In the dual-port version, the IMUX function is performed within the VTU.

5.1.8.3.2 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 EIA-366-A dialing interfaces (one for each B channel) for convenient dialing through the VTU. See Figure 4.

However, the EIA-366-A dialing interface is not permitted to be physically or electrically connected during classified operation. (See Figure 13 in 6.9.1.2 for a more detailed configuration.) 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 channel to two B channels must be performed by the TA.

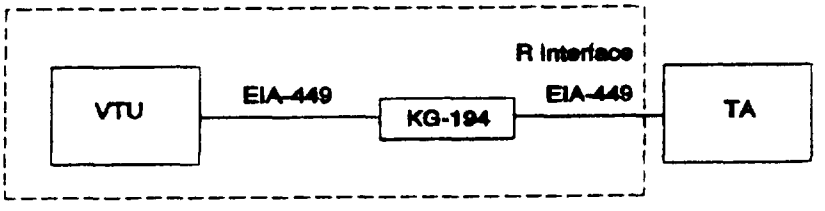


(Interior of dashed-line polygon indicates scope of MIL-STD-188-331.)

Figure 4. Option 2, External TA with Dialing Interface.

In the dual-port version, the IMUX function is performed within the VTU.

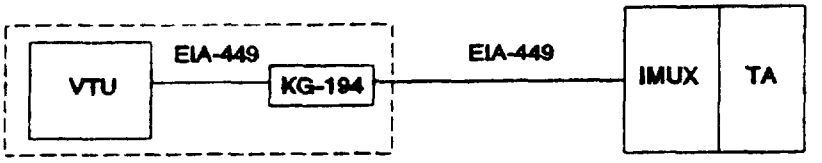
5.1.8.3.3 Option 3, Classified Operation. Option 3 is for Type 1 classified operation, in accordance with 5.5.3. The VTU shall use only one EIA-449 port, as described in 5.1.8.2, 5.5.3.1, and 5.5.3.2. See Figures 5 and 6.



(Interior of dashed-line polygon indicates scope of MIL-STD-188-331.)

Figure 5. Option 3, Classified Operation with Single Channel.

Dialing must be performed on the network side of the cryptographic device. In this option, dialing is typically done through the TA. (See Figure 14 in 6.9.1.3 for a more detailed configuration.) No physical or electrical connection between the VTU and the network or network interface is permitted other than through the cryptographic device. Note that if two B channels are used, the necessary IMUX function to go from a single channel to two B channels must be performed by the IMUX/TA, as shown in Figure 6.



(Interior of dashed-line polygon indicates scope of MIL-STD-188-331.)

Figure 6. Option 3, Classified Operation with Multiple Channels.

5.1.8.4 Monitor Interface. For VTC equipment that has external video display monitors and that is intended for use in North America, the electrical interface between the monitors and the VTU shall optionally meet the EIA-170-A (NTSC) or RGB standard. The mechanical interface shall optionally be BNC, F-type, or RCA connectors.

5.2 Audio

5.2.1 General. The audio CODEC subsystem shall be an integrated subsystem of the VTU. This means the audio signal shall be transmitted in-band, in accordance with ITU-T Recommendation H.221, and not out-of-band.

5.2.2 Speech-Quality Modes. The audio subsystem shall be able to operate in the speech modes, as specified in 5.2.2.1 through 5.2.2.3.

5.2.2.1 Narrowband Speech Mode. The 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 Recommendation G.711, FIPS PUB 178 (see also ITU-T H.221, H.230, H.242, and H.320), and additional requirements stated in 5.2.

This audio mode is known as Mode 0 (Mode zero) 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 (A-law), Mode 0F (A-law), Mode 0U (mu-law), and Mode 0F (mu-law). The 0F (framed) modes are for audio data rates of 56 kbps (unrestricted network) and 48 kbps (restricted network).

The audio subsystem shall be able to operate in Mode 0F (mu-law). Mode 0F (A-law) is optional. The use of the 0U (unframed) modes is outside the scope of this MIL-STD and is not recommended.

5.2.2.2 Wideband Speech at 48 to 56 kbps. Wideband (7-kHz analog bandwidth) speech is mandatory for all VTUs required by the user to operate at rates of $p \geq 6$; it is optional otherwise. Wideband speech shall conform to the specifications set forth in ITU-T Recommendation G.722, FIPS PUB 178 (see also ITU-T H.221, H.230, H.242, and H.320), and additional requirements stated in 5.2. G.722 is not intended for use at $p = 1$.

The audio subsystem shall be able to operate in the following two modes, as specified in ITU-T G.722 and H.221:

Mode 2: 56-kbps audio (unrestricted network)
Mode 3: 48-kbps audio (restricted or unrestricted network)

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

The audio subsystem shall be able to automatically switch over from Mode 0 (see 5.2.2.1) 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.

5.2.2.3 Narrowband Speech at 16 kbps. ITU-T Recommendation G.728 is an optional mode. If selected, it shall be available at all the data rates at which the VTU is capable of operating.

5.2.3 Encoding and Decoding. For Mode 0 narrowband speech, using the mandatory Mode 0F (mu-law), the characteristics of the pulse-code modulation (PCM) converter shall conform to the specifications set forth in MIL-STD-188-113. 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 Recommendation G.722.

5.2.4 Lip Synchronization. To conform to this MIL-STD, 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 signals shall be measured as specified in Annex C of H.261.

5.2.5 Electrical and Mechanical Interfaces. The requirements in 5.2.5.1 and 5.2.5.2 are optional if the audio system is completely integrated into the VTU (that is, videophone, PC-based desktop system, integrated rollabout systems), and mandatory otherwise. This means that if the room audio system is not physically included in or adjacent to the VTU, then the requirements of 5.2.5.1 and 5.2.5.2 are mandatory.

5.2.5.1 Electrical Specification. Input and output line-level room audio interfaces shall be provided that meet 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 6.1.8.2 for further information on the audio subsystem.

5.2.5.2 Mechanical Specification. The VTU shall provide mechanical connections for the room audio system. The room audio system connection shall provide either (a) one XLR male/female pair, or (b) 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.

5.3 Still Images

5.3.1 General. The ability to capture, exchange, and display still images is optional. In addition, the ability to output images digitally to personal computers and workstations may optionally be supported. Image-capture devices may include standard cameras and scanning devices. The actual graphic input devices such as cameras and digital scanners are outside the scope of this MIL-STD; however, the interface to cameras is specified in 5.1.8.1. This MIL-STD makes a distinction between freeze-frame video and still images. Freeze-frame video is mandatory and is addressed in 5.1.4.5. It defines a frame selected from a video signal, and processed through the video CODEC for transmission to remote sites. One optional still-image

mode, the National Imagery Transmission Format Standard (NITFS) (MIL-STD-2500), is specified in this paragraph. This mode consists of graphics or other images transmitted through the VTU HSD or LSD data channels. NITFS uses the Joint Photographic Experts Group (JPEG) algorithm for image compression. NITFS may be implemented through the high- or low-speed data ports and requires no change to the VTU hardware and software.

5.3.2 **NITFS Mode.** NITFS, specified in MIL-STD-2500, is an optional still-image mode. The purpose of adding NITFS to MIL-STD-188-331 is to tailor JPEG in a standard manner by fixing many optional parameters such as quantization tables and Huffman coding tables. NITFS also adds headers and other types of data such as computer-generated graphics, labels, and text to the resulting data file. Several items of each data type may be included in one message, yet any data types may be omitted. MIL-HDBK-1300 describes the NITFS and its components.

Version 2.0 (or later) of the software described by MIL-HDBK-1300 shall be used. Version 2.0 includes the JPEG Image Compression standard (MIL-STD-188-198). This will provide a full range of still-image capabilities ranging from low- to high-resolution for monochrome, gray-scale, and color images. Initiation and termination of NITFS file transfer is negotiable manually. No BAS codes are assigned to this file transfer.

5.3.2.1 **NITFS JPEG.** If NITFS is selected as an option, then the JPEG compression scheme specified in MIL-STD-188-198 is mandatory. If NITFS is selected as an option, operation Types 1 and 2 are mandatory. Type 1 is 8-bit sample precision gray-scale sequential DCT with Huffman coding. Type 2 is 24-bit color, 8-bit sample precision per component (3 components), sequential DCT with Huffman coding.

5.3.2.2 **NITF Header.** In the NITF File Header (Table 1, MIL-STD-2500) the File Type & Version (FHDR) field shall be set to the value "NITFnn.nn", where "nn.nn" is the software version number. In addition, the File Security Classification field (FSCLAS) shall either specify a valid classification value ("T," "S," "C," "R," or "U") or the value "N". "T" indicates Top Secret, "S" indicates Secret, "C" indicates Confidential, and "R" indicates Restricted (unclassified sensitive). "N" indicates the classification is not specified in the message. The other fields in the NITF header may be filled with zeros or user-selected values.

5.3.2.3 **Image Sub-header.** The image sub-header (Table III in MIL-STD-2500) shall specify value "C3" in the image compression

(IC field). "C3" indicates the type of image compression, in this case, JPEG. The default compression rate code (COMRAT field) shall be "00.5". The first two digits to the left of the decimal point indicate the type of image. In this case, "00" indicates a general-purpose image. The single digit to the right of the decimal point indicates the desired transmission quality level from 1 to 5. In this case, "5" indicates the highest-quality level. The higher the quality level, the less compression will take place, and the longer the transmission time per image. The other fields in the image sub-header may be filled with zeros or user-selected values.

5.3.2.4 Additional Specifications. In addition, the mandatory set of NITFS capabilities shall be provided, as specified for CLEVEL 2 in DISA/JIEO Circular 9008, *NITFS Certification Test and Evaluation Program Plan*. This provides for an image size of 64 to 1024 vertical pixels by 64 to 1024 horizontal pixels. The minimum compliant set of capabilities includes JPEG compression and decompression, using sequential DCT, Huffman entropy encoding, and an 8-bit precision mode of operation. In addition, the NITFS terminals shall be able to pack and unpack 8-bit monochrome, 8-bit color, and 24-bit color images. Circular 9008 extends JPEG to include items such as quantization tables and color space definitions.

The NITFS terminals shall implement an end-to-end protocol for communications via the low-speed EIA-232-D data or high-speed EIA-530 data ports. This protocol will provide for the guaranteed delivery of error-free data from one terminal to the other. It is recommended that the NITFS terminals communicate over the low-speed EIA-232-D or high-speed EIA-530 data ports, using MIL-STD-2045-14500, *Reliable End System Transport for DOD Communications*. Terminals that do not implement MIL-STD-2045-14500 should use the MIL-STD-2045-44500 Tactical Communications Protocol (TACO2), in accordance with Circular 9008. The terminal users must negotiate, out-of-band, the protocol to be used for the NITF transfer.

5.3.3 Electrical and Physical Interfaces. Use of NITFS JPEG assumes the following: NITFS 2.0 terminals are connected to the high-speed EIA-530/422-A data port at each VTU in the conference. (The high-speed EIA-530/422-A data port is the preferred port, if available. The low-speed EIA-232-D data port can also be used by users' mutual agreement.) The image transfer is initiated from the sending NITFS terminal. See Figure 7.

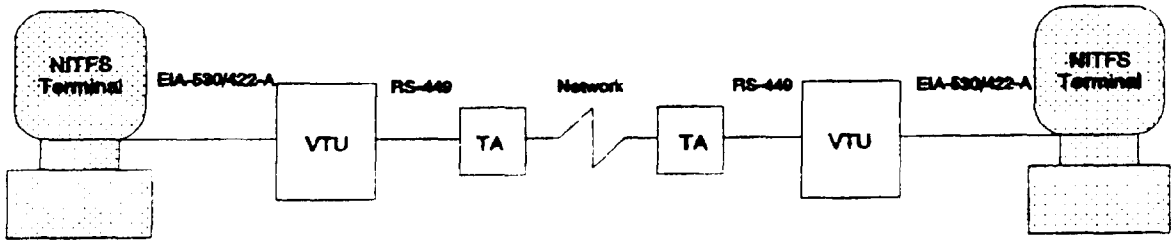


Figure 7. Typical NITFS Configuration.

5.4 Data Communications Interface

5.4.1 General. A physical and electrical data communications interface shall be provided. The purpose of the data communications interface is to support communications between data terminating equipment (DTE), where a DTE can be a computer, a workstation, or a dumb terminal connected to the VTU during a video teleconference. DTE-to-DTE communications demands physical, electrical, and procedural interfaces. These interfaces are defined between the DTE and the VTU, between the VTUs, and between the DTEs. The procedural interfaces between the DTEs are required for interoperability, but are outside the scope of this MIL-STD. The MIL-STD provides for a mandatory low-speed, and an optional high-speed, interface between the DTE and the physical realization of the VTU. The DTEs, other than the electrical and mechanical interfaces to the VTUs, are outside the scope of this MIL-STD.

NOTE: Paragraph 5.4 is based on a draft Recommendation (H.224), and is optional at this time. Should Recommendation H.224 be ratified as an ANSI standard or an ITU Recommendation *without substantial change*, the requirements of 5.4.3 shall be considered mandatory. In the interim, it offers users a workable solution for data interchange.

5.4.2 Data Transmission Modes. One low-speed EIA-232-D (formerly RS-232-D) data port shall be provided with the VTU as an I/O communications port. Up to three additional low-speed ports may be provided. One to four high-speed EIA-530/422-A data communications ports are optional.

5.4.3 Low-Speed EIA-232-D Data Port. At least one EIA-232-D asynchronous attachment port shall be provided for connection of user I/O equipment. The VTU shall provide the DCE interface; typically the I/O equipment will support the DTE interface.

5.4.3.1 Asynchronous Parameters. The low-speed port of the VTU shall support the following EIA-232-D options, and all user-selectable options shall be selectable from manual inputs to the VTU:

(a) Mode: full-duplex

(b) Class: asynchronous (start-stop)

(c) EIA-232-D data rates: 300, 1200, 2400, and 4800 bps. Other data rates, such as 9600 bps, may optionally be provided. The data rates of the EIA-232-D interface are not required to match the data rates of the LSD channel. To resolve the mismatch, H.224 (formerly H.DLL) inter-frame fill and flow-control mechanisms can be used. It is recommended that the data rates match each other at both DTEs.

(d) Data rate selection: user-selectable

(e) Parity: none

(f) Character structure: the format shall be 1 start bit, 8 data bits, and 1 stop bit.

(g) Flow control: RTS/CTS (Request to Send/Clear to Send)

(h) Connector: DB-25S (25 pins)

5.4.3.2 Logical Equivalents. Table I gives the equivalents that shall be used for asynchronous data:

TABLE I. Asynchronous Data Equivalents.

VOLTAGE	FUNCTION	SIGNAL CONDITION	DELIMITING BITS	H.221 LSD BITS LOGICAL VALUE
< -3 V	Off	Mark	Stop	1
> +3 V	On	Space	Start	0

5.4.3.3 DTE-to-DTE Communications. EIA-232-D data shall be transmitted between VTUs in the LSD channel. Asynchronous data arriving at the EIA-232-D interface shall be encapsulated in low-priority H.224 Client Data Blocks by the VTU and transferred via the H.224 protocol to the far-end EIA-232-D interface. When channel capacity is available, the time between receiving input data and transmitting the corresponding low-priority client data blocks shall be no greater than 250 milliseconds.

All communications shall be point-to-point between two VTUs, and, as a result, between the two DTEs connected to their respective VTUs.

The H.224 client application providing this function shall act as a bearer channel, transparent to the protocol executing on the DTEs. As the bits are received from the DTE interface, they shall be inserted into each client data octet from least significant to most significant bit position. For synchronous data transfer between VTUs, no start and stop bits shall be used.

This MIL-STD makes the assumption that the application executing on the communicating DTEs has the appropriate supporting OSI layers (2-4) to provide it with the necessary error detection, error recovery, session management, connection management, and syntax conversions. The user of the EIA-232-D asynchronous interface should make sure that the data-transfer application executing on the sending and receiving DTEs has compatible software that supports its data-link layer all the way up to the application layer. To accomplish compatibility for layers 2-4 of the OSI model, MIL-STD-2045-14500 is recommended. MIL-STD-2045-14500 specifies a combination of layer protocols that collectively provide the transport service for synchronous, asynchronous, full-duplex, or half-duplex dedicated links.

5.4.3.4 Low-Speed Data Capabilities Declaration. The capability of using H.224 and the LSD channel shall be indicated via BAS code exchange, in accordance with ITU-T Recommendations H.224 and H.221.

5.4.3.5 Low-Speed Data Channel Establishment. The LSD channel shall be opened and closed automatically, according to the requirements of the various H.224 client applications.

5.4.3.6 Client Identification. At least one low-speed EIA-232-D data port shall be provided. Up to three additional low-speed EIA-232-D data ports may optionally be provided. Each port shall be identified with a H.224 Nonstandard Client ID containing the following fields:

Country code:	United States	(0xB500)
Manufacturer code:	Corporation for Open Systems, International (COS)/DOD	(0x014B)
Manufacturer Client ID:	same as low-speed port number	(1 to 4)

NOTE: 0x indicates that the subsequent digits are hexadecimal. The numerical values for country codes are found in ITU-T Recommendation T.35. The United States has been assigned code 0xB500. Manufacturer codes are assigned in the United States by committee T1A1. COS/DOD has been assigned code 331 decimal (0x014B). The upper manufacturer octet, 01, is sent first. The lower manufacturer octet, 4B, is sent next.

5.4.3.7 DCE-to-DCE Flow Control. The H.224 control bit C0 shall be used to indicate DCE-to-DCE, and thus VTU-to-VTU, flow control.

Control bit C0=0 shall indicate a request to stop transmitting data bound for the low-speed EIA-232-D data port associated with the specified Client ID.

Control bit C0=1 shall indicate a request to resume transmission of data bound for the low-speed EIA-232-D data port associated with the specified Client ID.

Control bit C1 is reserved, and should be set to 1 by transmitters and ignored by receivers.

5.4.3.8 EIA-232-D Control Signals. Figure 8 illustrates the data and control signals exchanged between DTE and DCE.

Table II summarizes the function of each signal. These control signals are used to control the EIA-232-D data capabilities declaration, and local DTE/DCE flow control, following ITU-T V.24.

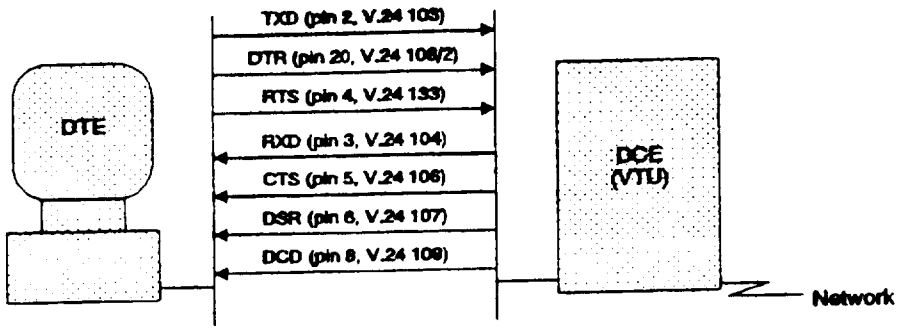


Figure 8. DTE/DCE Data and Control Leads.

TABLE II. Data and Control Lead Summary.

LEAD	EIA NOTATION	ITU-T V.24 CIRCUIT	ON (> +3 V)	OFF (< -3 V)
TXD	BA	103	Transmit logical 0	Transmit logical 1
RXD	BB	104	Receive logical 0	Receive logical 1
DTR	CD	108/2	DTE ready	DTE not ready
RTS	CA	133	DCE is flow enabled	DCE is flow disabled
CTS	CB	106	DTE is flow enabled	DTE is flow disabled
DSR	CC	107	DCE powered	DCE not powered
DCD	CF	109	DCE Far end ready	DCE Far end not ready

5.4.3.8.1 DTR, V.24 Circuit 108/2, Data Terminal Ready. DTR, ITU-T V.24 Circuit 108/2, is driven by the DTE. DTR ON indicates to the DCE that the DTE is present and ready to transfer data. When DTR is ON, the DCE should respond by sending client capabilities to the far end. DTR OFF indicates to the DCE that the DTE is not present, or does not wish to transfer data. When DTR is OFF, the DCE should respond by removing the client from the capabilities sent to the far end.

5.4.3.8.2 RTS, V.24 Circuit 133, Ready for Receiving. RTS, ITU-T V.24 Circuit 133, is driven by the DTE. It is used to flow-control the DCE, following ITU-T V.42, paragraph 7.3.1, *Flow control across the DTE/DCE interface.*

RTS ON indicates to the DCE that the DTE is ready to receive, and the DCE may transfer data to the DTE.

RTS OFF indicates to the DCE that the DTE is not ready to receive; the DCE shall stop transferring data to the DTE.

5.4.3.8.3 CTS, V.24 Circuit 106, Ready for Sending. CTS, ITU-T V.24 Circuit 106, is driven by the DCE. It is used to flow-control the DTE, following ITU-T V.42, paragraph 7.3.1, *Flow control across the DTE/DCE interface*. CTS ON indicates to the DTE that the DCE is ready to send (DCE buffers free), and the DTE may transfer data to the DCE. CTS ON is indicated only when client information from the distant end indicates that the equivalent port number has been activated. CTS OFF indicates to the DTE that the DCE is not ready to send (DCE buffers full or other cause); the DTE shall stop sending data to the DCE.

5.4.3.8.4 DSR, V.24 Circuit 107, Data Set Ready. DSR, ITU-T V.24 Circuit 107, is driven by the DCE. It indicates whether the DCE is ready to operate. The DCE should set DSR ON at all times when the DCE is powered and ready to operate.

5.4.3.8.5 DCD, V.24 Circuit 109, Data Channel Received Line Signal Detector. DCD, ITU-T V.24 Circuit 109, is driven by the DCE. It indicates whether the far-end equipment is ready to communicate. The DCE should initially set DCD OFF, and turn it ON when the far-end client capability for an equivalent port number is received. If the far-end client capability is removed, or the call is dropped, DCD shall return to the OFF state.

5.4.4 High-Speed EIA-530 Data Port. One or more synchronous EIA-530 ports may be provided as an option for connection of user I/O equipment. Note that this is distinct from the ports on the network side, as specified in 5.1.8. The electrical characteristics shall be as specified in standard EIA-422-A for balanced voltage digital interface circuits. See 6.3 for further information.

5.4.4.1 Synchronous Parameters. The high-speed data port shall support the following EIA-530 options, and all user-selectable options shall be selectable from manual inputs to the VTU:

(a) Mode: full-duplex

(b) Class: synchronous at data rates greater than 20,000 bps

(c) Data rates: for unrestricted channels - 64 kbps for $p = 2$; 64, 128, 192, or 256 kbps for $p = 3$ to p max, but not more than $(p - 2) \times 64$ kbps. Concurrent operation of HSD and video is not required at $p = 2$. Other data rates may optionally be provided. Operation of high-speed data on restricted channels is outside the scope of this MIL-STD.

(d) Data rate selection: user-selectable

(e) Flow control: CA/CB (Request to Send/Clear to Send)

(f) Connector: 25-position

(g) All Category 1 circuits shall be supported:

Circuit BA	(Transmitted Data)
Circuit BB	(Received Data)
Circuit DA	(Transmit Signal Element Timing, DTE Source)
Circuit DB	(Transmit Signal Element Timing, DCE Source)
Circuit DD	(Receiver Signal Element Timing, DCE Source)
Circuit CA	(Request to Send) (RTS)
Circuit CB	(Clear to Send) (CTS)
Circuit CC	(DCE Ready)
Circuit CD	(DTE Ready) (DTR)
Circuit CF	(Received Line Signal Detector)

5.4.4.2 Logical Equivalents. Table III gives the equivalents that shall be used for synchronous data:

TABLE III. Synchronous Data Equivalents.

VOLTAGE (X)	FUNCTION	SIGNAL CONDITION	H.221 HSD BITS LOGICAL VALUE
-2 > X > -6 V	OFF	MARK	1
+2 < X < +6 V	ON	SPACE	0

5.4.4.3 DTE-to-DTE Communications. EIA-530 data shall be transmitted between VTUs in the HSD channel. Synchronous data arriving at the EIA-530 interface shall be encapsulated in low-priority H.224 Client Data Blocks by the VTU and transferred via the H.224 protocol to the far end EIA-530 interface. As the

bits are received from the DTE interface, they shall be inserted into each client data octet from least significant to most significant bit position. The DCE shall generate transmit clocking to the DTE, adjusting the clocking rate as necessary to match the bandwidth available for encapsulated user data from the high-speed data port.

The DCE shall generate receive clocking to the DTE, adjusting the clocking rate as necessary to match the incoming data rate from the far end.

All communications shall be point-to-point between two VTUs and, as a result, between the two DTEs. The H.224 client application providing this function shall act as a bearer channel, transparent to the protocol executing on the DTEs.

This MIL-STD makes the assumption that the application executing on the communicating DTEs has the appropriate supporting OSI layers (2-4) to provide it with the necessary point-to-point flow control, error detection, error recovery, session management, connection management, and syntax conversions. The user of the EIA-530 synchronous interface should make sure that the data-transfer application executing on the sending and receiving DTEs has compatible software that supports its data-link layer all the way up to the application layer. To accomplish compatibility for layers 2-4 of the OSI model, MIL-STD 2045-14500 is recommended. This MIL-STD specifies a combination of layer protocols that collectively provide the transport service for synchronous, asynchronous, full-duplex, or half-duplex dedicated links.

H.224 control bits C0 and C1 are reserved. They shall be set to 1 by DTE transmitters and ignored by DTE receivers.

5.4.4.4 High-Speed Data Capabilities Declaration. The capability of using H.224 and the HSD channel shall be indicated via BAS code exchange, in accordance with ITU-T Recommendations H.224 and H.221.

5.4.4.5 High-Speed Data Channel Establishment. The HSD channel shall be opened and closed according to the requirements of the various H.224 client applications.

5.4.4.6 Client Identification. Up to four high-speed EIA-530 data ports may optionally be provided. Each port shall be identified with a H.224 Nonstandard Client ID containing the following fields:

Country code:	United States	(0xB500)
Manufacturer code:	COS/DOD	(0x014B)
Manufacturer Client ID:	high-speed port number + 16	(Client ID numbers range from 17 to 20)

NOTE: 0x indicates that the subsequent digits are hexadecimal. The numerical values for country codes are found in ITU-T Recommendation T.35. The United States has been assigned code 0xB500. Manufacturer codes are assigned in the United States by committee T1A1. COS/DOD has been assigned code 331 decimal (0x014B). The upper manufacturer octet, 01, is sent first. The lower manufacturer octet, 4B, is sent next.

5.4.4.7 EIA-530 Control Signals. Table IV summarizes the use of EIA-530 control signals.

TABLE IV. EIA-530 Control Lead Summary.

CONTROL LEAD	EIA NOTATION	ON	OFF
DTR	CD	DTE ready	DTE not read
RTS	CA	BW request	BW not requested
CTS	CB	BW available	BW not available
DSR	CC	DCE powered	DCE not powered
DCD	CF	Far end ready	Far end not ready

5.4.4.7.1 DTR, Data Terminal Ready. DTR, EIA circuit CD, is driven by the DTE. DTR ON indicates to the DCE that the DTE is present and ready to transfer data. When DTR is ON, the DCE shall respond by sending the client capabilities to the far end. DTR OFF indicates to the DCE that the DTE is not present, or does not wish to transfer data. When DTR is OFF, the DCE shall respond by removing the client from the capabilities sent to the far end, and de-allocating any client bandwidth.

5.4.4.7.2 RTS/CTS Flow Control. RTS/CTS handshaking signals shall be used on the EIA-530 interface between the DTE and VTU to allocate HSD bandwidth for the high-speed data port.

When the DTE places the RTS signal in the ON state, the VTU shall respond by allocating appropriate HSD bandwidth for the

high-speed data port. The CTS signal is placed in the ON state only if client information received from the distant end indicates that the equivalent port number has been activated.

When the DTE places the RTS signal in the OFF state, the VTU shall respond by de-allocating any client bandwidth, and then place the CTS signal in the OFF state.

If the DTR control signal is in the OFF state, the VTU shall ignore the RTS control signal and shall place the CTS control signal in the OFF state.

5.4.4.7.3 DSR, Data Set Ready. DSR, EIA circuit CC, is driven by the DCE. It indicates whether the DCE is ready to operate. The DCE shall set DSR ON at all times when the DCE is powered and ready to operate.

5.4.4.7.4 DCD, Data Channel Received Line Signal Detector. DCD, EIA-530 circuit CF, is driven by the DCE. It indicates whether the far-end equipment is ready to communicate. The DCE shall initially set DCD OFF, and turn it ON when the far-end client capability is received for the equivalent port number. If the far-end client capability for this port number is removed, or the call is dropped, DCD shall return to the OFF state.

5.5 Security

5.5.1 General. This paragraph specifies two standard means of securing the transmitted signals: one for classified information and one for unclassified sensitive information. Classified security is specified in 5.5.3. Unclassified sensitive security is specified in 5.5.4. The capability to interface and operate with cryptographic equipment for classified operation is mandatory. The capability to encrypt and decrypt unclassified sensitive information is optional.

The following area is briefly addressed in 6.4, but only as a recommendation, not as a mandatory or optional feature: compromising emanations (TEMPEST).

The following areas related to security are outside the scope of this MIL-STD:

- physical security, including room security
- user authorization
- key management and distribution

5.5.2 Levels of Security. This MIL-STD identifies three levels of security for the protection of the information transmitted between VTUs. The three security levels are described in the 5.5.2.1 through 5.5.2.3.

5.5.2.1 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.

5.5.2.2 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). In this MIL-STD, this information will be referred to as "Type 3."

5.5.2.3 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 MIL-STD, this information will be referred to as "Type 1." VTUs shall be able to interface with and operate with Type 1 cryptographic equipment.

VTUs shall be able to operate using the framed mode, in accordance with Recommendation H.221. Use of the unframed mode is outside the scope of this MIL-STD.

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 kbps, the VTUs shall operate in a single-channel mode (using a single EIA-449 network interface). A cryptographic device is placed between the network interface equipment and the VTU. See Figure 9 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, which are outside the scope of this MIL-STD. See 6.8 for more details.

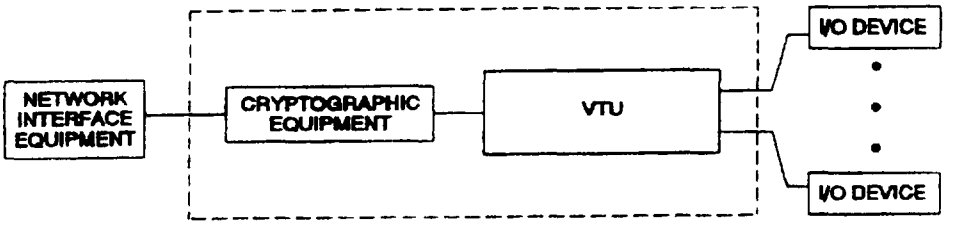


Figure 9. Line of Demarcation with External Cryptographic Device.

ITU-T H.233 recommends that the VTU service channel (which contains the FAS, BAS, and ECS signals) remain 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.

5.5.3 Type 1 Cryptographic Equipment. 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 must be compatible in terms of both encryption and key-management schemes, except that existing KG-81 equipment may continue to be used until KG-194 or compatible equipment is available.

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, as in the case of operation at $p = 2$ using ISDN or switched 56 circuits, then an IMUX shall be used to multiplex and demultiplex the two transmission channels to the single cryptographic unit.

5.5.3.1 Electrical and Mechanical Interfaces. The cryptographic equipment is compatible with MIL-STD-188-114A and EIA-422-A. 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). See Figure 10.

All of the signal lines connecting the cryptographic equipment to the VTU and the network interface equipment shall have differential balanced connections.

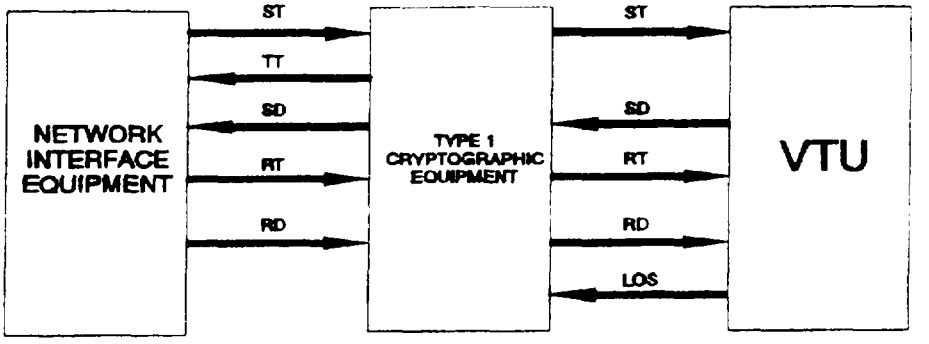


Figure 10. EIA-422-A Electrical Interface for VTU, Cryptographic Device, and Network Interface Device.

The interface between the network interface equipment and the cable to the cryptographic equipment shall include the following signals: Send Timing (ST), Terminal Timing (TT), Send Data (SD), Receive Timing (RT), and Receive Data (RD). See Table V. This interface shall conform to the specifications of EIA-449 (mechanical) and EIA-422-A (electrical). The cryptographic equipment does not generate a 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.

The interface between the VTU and the cable to the cryptographic equipment shall include, in accordance with EIA-449 and EIA-422-A, the signals ST, SD, RT, and RD. The interface shall also use a nonstandard loss of synchronization (LOS) signal. This LOS signal shall be balanced, in accordance with EIA-422-A, with pin 3 designated as the "A" lead and pin 21 as the "B" lead.

TABLE V. Type 1 Cryptographic Equipment Interface Signals.

SIGNAL	EIA-449 PINS		DESCRIPTION
	A LEAD	B LEAD	
LOS	3	21	Loss of Synchronization
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

5.5.3.2 **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 EIA-422-A, paragraph 4.1, 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 EIA-422-A, paragraph 4.1. 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 paragraph, within 30 seconds after both of the following conditions have been met:

a. the LOS line has returned to logic "1"; and

b. 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.

5.5.4 Type 3 Cryptographic Equipment

5.5.4.1 Applicability. Paragraph 5.5.4 is optional, and applies to both embedded and non-embedded encryption. To protect unclassified, sensitive data, the DES option of ITU-T H.233, *Confidentiality System for Audiovisual Services*, as stated in 5.5.4.2.1, or Type 1 encryption, as stated in 5.5.3, shall be used. See 6.7 for export restrictions.

5.5.4.2 Technical Requirements. The VTU shall conform to the specifications set forth in ITU-T H.233. ITU-T H.233 offers a choice of encryption methods, including the Data Encryption Standard (DES). Using DES, the VTU shall be able to encrypt video, audio, still images, and data. One possible implementation is shown in Figure 11.

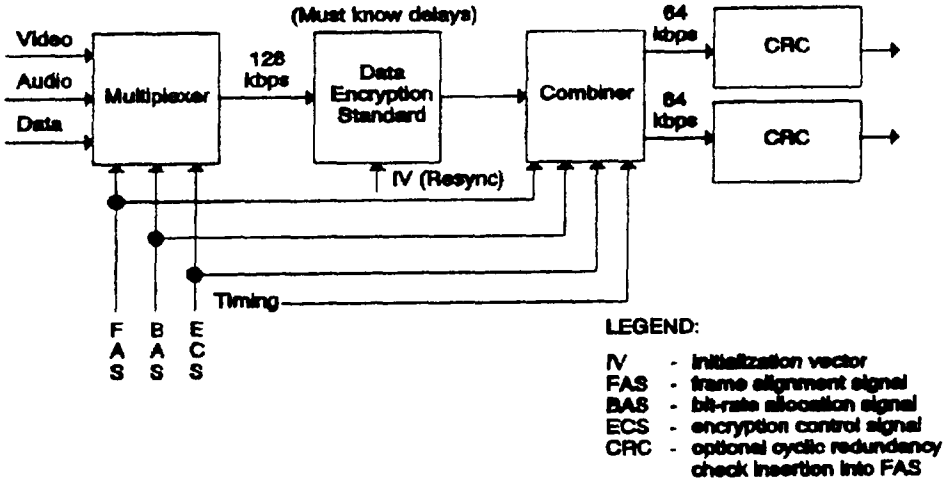


Figure 11. Block Diagram of a Sample Type 3 Encryption Implementation.

5.5.4.2.1 Data Encryption Standard. All VTUs covered by this MIL-STD, and using 5.5.4, shall be able to operate using DES. Operation using the DES algorithm is defined in FIPS PUB 46-1, *Data Encryption Standard*. A VTU may also be able to operate in any of the non-DES modes specified in ITU-T H.233.

5.5.4.2.2 Output Feedback Mode. All VTUs using the DES algorithm shall use the 64-bit Output Feedback Mode, as defined in FIPS PUB 81, *Data Encryption Standard Modes of Operation*. The initialization vector shall be 64 bits long.

5.5.4.3 Validation. All DES implementations must be validated by NIST. Software implementations (other than firmware) are not in compliance with this MIL-STD. The following firmware implementations are acceptable: Read-Only Memory (ROM); microcode; erasable programmable read-only memory (EPROM); Compact Disk - Read-Only Memory (CD-ROM); and Chip implementations.

5.5.4.4 Levels of Security Protection. All VTUs shall follow the security requirements for cryptographic modules, as defined in FIPS PUB 140-1, *Security Requirements for Equipment Using Data Encryption Standard*. FIPS PUB 140-1 describes 4 levels of protection for various aspects, including the basic design, module interfaces, authorized roles and services, and physical security. The selection of the appropriate level of protection is beyond the scope of this MIL-STD and is left to the discretion of the user. FIPS PUB 140-1 compliance shall be validated by NIST (assuming NIST has an active validation program at the time of procurement.)

5.5.4.5 Visual Indication. VTUs using this paragraph shall optionally provide an external electrical or visual security status signal that can be used by a display device to give a real-time visual indication of whether information (audio, video, still-image, and all data) transmitted across the network is Type-3-protected or in the clear.

5.5.4.6 Electrical and Mechanical Interfaces. Interface specifications for Type 3 security are beyond the scope of this MIL-STD.

5.6 Concurrent Operation. As described in FIPS PUB 178, concurrent operation can be provided by dynamically subdividing an overall transmission channel of 56 to 1920 kbps into lower rates suitable for audio, video, and data.

5.6.1 Concurrent Operation at $p = 1$. Concurrent operation at $p = 1$ is outside the scope of this MIL-STD.

5.6.2 Concurrent Operation at $p = 2$. The VTC terminal equipment, including the video (motion or freeze-frame), audio, and low-speed data channel (for data and still images), as stated in this MIL-STD, shall be able to function concurrently at $p = 2$.

With an unrestricted network (128 kbps), the VTU shall be able to operate (sending to the network and receiving from the network) at the following minimum concurrent data rates for the given components:

Video:	62.4 kbps
Audio:	56.0 kbps
Control signals:	3.2 kbps
Data channel:	6.4 kbps
Freeze-frame video:	Motion video can be frozen while freeze-frame video is being transmitted on the video channel.

With a restricted network (112 kbps), the VTU shall be able to operate (sending to the network and receiving from the network) at the following minimum concurrent data rates for the given components:

Video:	54.4 kbps
Audio:	48.0 kbps
Control signals:	3.2 kbps
Data channel:	6.4 kbps
Freeze-frame video:	Motion video can be frozen while freeze-frame video is being transmitted on the video channel.

Bandwidth not used for the transmission of audio, control signals, or the data channel shall be used for video. The data channel data rate of 6.4 kbps allows for H.224 overhead, fill, and optional ECS, while providing 4.8 kbps of still-image or data-transfer capability.

5.6.3 Concurrent Operation at $p > 2$. If the VTU is able to operate at $p > 2$, then the following features shall also be able to operate concurrently at all the data rates of video operation above $p = 2$:

Video (motion or freeze-frame)
Audio
LSD data channel (for still image or data)
HSD data channel (if the EIA-530 data port is chosen).

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful; however, the section is not mandatory.)

6.1 Acquisition Guidance

6.1.1 Nondevelopmental Items. The selected minimum essential (mandatory) requirements identified in this MIL-STD should allow maximum flexibility by permitting nondevelopmental item (NDI) or commercial off-the-shelf (COTS) acquisition.

6.1.2 Tailoring. To ensure proper application of this MIL-STD, invitations for bids, requests for proposals, and contractual statements of work should tailor the requirements in paragraphs 4 or 5 of this MIL-STD to exclude any unnecessary options. For procurement of new equipment, the mandatory portions must be included, but it is up to the individual to decide which options should be procured.

6.1.3 Mandatory Optional. The term *mandatory optional* for a given feature is not used in this MIL-STD but is sometimes used in procurement contracts to indicate that a vendor must include pricing on features that the purchaser has the option of buying under the contract. Care must be taken to distinguish between the language of the MIL-STD and the language of the procurement contract, since they serve different purposes. A feature that is optional in the MIL-STD could be mandatory, mandatory optional, optional, or omitted entirely from the procurement contract, depending on the user's needs.

6.1.4 Issue of DODISS. When this MIL-STD is used in acquisition, the applicable issue of the DODISS must be cited in the solicitation (see 2.1.1 and 2.2).

6.1.5 Software Upgrades. It is recommended that procurement officials add language to their contracts to mandate that upgrades or enhancements to the VTU be implemented in software as much as possible. Having upgrades in software instead of hardware will usually allow for more cost-effective changes. (An exception to this is encryption of unclassified, sensitive information using DES. See 5.5.4.3.)

6.1.6 Overseas Conferences. It is recommended that procurement officials require the A-law audio coding option, as specified in 5.2.4, if it is anticipated that overseas conferences with non-DOD sites will be held.

6.1.7 Desktop and Videophone Applications. The minimum requirements of this MIL-STD for desktop and videophone applications provide interoperability limited to audio and video. If interoperability in the areas of graphics, data, or security is desired, it is recommended that the appropriate additional features of this MIL-STD also be mandated in the procurement contract.

6.1.8 Audio

6.1.8.1 Restricted Channel Limitation. On restricted channels, audio may degrade or be rendered temporarily useless while data or still images are being transmitted at 9600 bps. Therefore, it is recommended that the audio be muted during transmission of large amounts of data or still images at 9600, or that a different data rate be used.

6.1.8.2 Audio Subsystem. It is the responsibility of the room audio subsystem to provide the specified electrical input level to the VTU, and to amplify the specified output electrical level from the VTU to the proper acoustic level. In addition, it may cancel or suppress echoes, mix various microphones, and distribute signals to loudspeakers. These functions are room-dependent and are outside the scope of this MIL-STD. For guidance in obtaining the proper audio levels, see ITU-T Recommendations P.30, P.34, P.50, P.51, and P.64, listed in 6.2.1.

6.1.9 Video

6.1.9.1 Video Picture-Quality Definition. Procurement officials should be aware that video picture-quality standards are not yet mature. Acquisition authorities should take measures to ensure levels of video picture-quality necessary for their applications, especially when acquiring a variety of products from different vendors. One method of doing this is by requesting demonstrations of picture quality while interoperating with different vendors.

6.1.9.2 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 pels) 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.

6.2 Referenced Documents

The numbers in parentheses indicate the paragraphs in which the document is referenced.

6.2.1 Documents Referenced in Sections 1, 2, 6, and Foreword

DOD Instruction 5000.2	Defense Acquisition Program Procedures (Foreword, 1.3)
DODISS	Department of Defense Index of Specifications and Standards (2.1.1, 2.2, 6.1.4)
ANSI T1.601	American National Standard for Telecommunications - ISDN Basic Access Interface for Use on Metallic Loops for Application on the Network Side of the NT (6.9.1)
ANSI T1.605	American National Standard for Telecommunications - ISDN Basic Access Interface for S and T Reference Points (6.9.1)
ANSI T1A-EIA-619	Aggregation of Multiple Independent 56 Kbit/s or 64 Kbit/s Channels onto a Synchronized Wideband Connection (formerly known as the BONDING standard) (6.9.2.1, 6.9.2.2)
ASD-C3I Memorandum	Department of Defense Policy for Video Teleconferencing Management, Acquisition, and Standards, 26 October 1993 (Foreword, 1.3)
ITU-T P.30	Subscribers' Lines and Sets (6.1.8.2)
ITU-T P.34	Transmission Characteristics of Hands-Free Telephones (6.1.8.2)
ITU-T P.50	Artificial Voices (6.1.8.2)
ITU-T P.51	Artificial Ear and Artificial Mouth (6.1.8.2)
ITU-T P.64	Determination of Sensitivity/ Frequency Characteristics of Local Telephone

	Systems to Permit Calculation of their Loudness Ratings (6.1.8.2)
ITU-T V.35	Data Transmission at 48 kbps Using 60-108 kHz Group Band Circuits (6.9.3)
X.21	Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Synchronous Operation on Public Data Networks (6.9.3)

6.2.2 Other Related Documents

6.2.2.1 Related Government Documents

FED-STD-1020A	Telecommunications: Electrical Characteristics of Balanced Voltage Digital Interface Circuits, Revision A (Cross-Reference: EIA-422-A, MIL-STD-188-114A)
FED-STD-1026	Telecommunication: Interoperability Requirements for Use of the Data Encryption Standard
FED-STD-1031	General-Purpose 37-Position and 9-Position Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment (Cross-Reference: EIA-449)
FIPS PUB 143	General-Purpose 37-Position and 9-Position Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment (Cross-Reference: EIA-449)
MIL-STD-188-100	System Design and Engineering Standards for Strategic and Tactical Communications
MIL-STD-962B	Preparation of Military Standards, Handbooks, and Bulletins
NCS TIB 91-3	Development of a Federal Standard for a Video CODEC Operating at *p* x 64 kbps. Office of the Manager, National

Communications System, Washington, D.C. 20305. (This document is helpful in explaining the ITU-T Recommendations H.221, H.230, H.242, H.261, and H.320.)

Application for NCS documents can be addressed to

National Communications System (NCS)
NT
701 South Court House Road
Arlington, VA 22204-2198, USA
Telephone: 703-692-2124
Fax: 703-746-5240

6.2.2.2 Related ANSI Publications

ANSI T1.306	American National Standard for Telecommunications - Digital Processing of Audio Signals - Algorithm and Line Format for Transmission of 7-kHz Audio Signals at 64/56 kbps (Cross-Reference: ITU-T G.722)

Application for copies should be addressed to

American National Standards Institute (ANSI)
1430 Broadway
New York, NY 10018, USA
Telephone: 212-642-4900
Fax: 212-302-1286

6.2.2.3 Related ITU Documents

ITU-R (formerly CCIR) Recommendation 601-1	Encoding parameters of digital television for studios. Recommendations and Reports of the ITU-R, Volume XI, Part 1
ITU-T F.710	Teleconference Service
ITU-T F.721	Basic Narrow-Band Videophone Service in the ISDN
ITU-T I.430	ISDN User-Network Interfaces: Layer 1 Recommendations
ITU-T I.431	Primary Rate User-Network Interface - Layer 1 Specification

ITU-T Q.922 — ISDN Data-Link Layer Specification for Frame Mode Bearer Services

Application for copies should be addressed to

International Telecommunications Union
Place des Nations
CH-1211 Geneva 20, Switzerland
Telephone: +41 22 730 5111
Fax: +41 22 733 7256

ITU-R recommendations are also available from

Omnicom, Phillips Business Information Inc.
1201 Seven Locks Road
Suite 300
Potomac, MD 20854 USA
Telephone: 1-800-666-4266
Fax: 1-301-309-3847

or from

Omnicom International, Ltd.
First Floor
Forum Chambers
The Forum
Stevenage, Herts, UK SG1 1EL
Telephone: +44 438 742424
Fax: +44 438 740154

6.2.2.4 Related ISO Publications

ISO/IEC 3309 — Information Processing Systems - Data Communications. High-level Data-Link Control Procedures Frame Structure

ISO/IEC Committee Draft Joint Photographic Experts Group (JPEG) 10918-1 (JPEG) Digital Compression and Coding of Continuous-Tone Still Images, Part 1: Requirements and Guidelines

ISO standards are available from

International Organization for
Standardization (ISO)
1 Rue de Varembe, Case Postale 56
CH-1211, Geneva 20, Switzerland
Telephone: +41 22 734 1240
Fax: +41 22 733 3430

ISO standards may also be obtained from

Omnicom, Phillips Business Information Inc.
1201 Seven Locks Road
Suite 300
Potomac, MD 20854 USA
Telephone: 1-800-666-4266
Fax: 1-301-309-3847

or from

Omnicom International, Ltd.
First Floor
Forum Chambers, The Forum
Stevenage, Herts, UK SG1 1EL
Telephone: +44 438 742424
Fax: +44 438 740154

6.3 Electrical and Mechanical Interfaces. For VTUs capable of operating at $p > 2$, which have a requirement for transmission of large data or still image files, a minimum of one EIA-530/422-A data interface is recommended in addition to the required EIA-232-D data interface. EIA-530 replaces EIA-449. Manufacturers using EIA-449 ports can comply with the optional requirement for EIA-530 by simply supplying an EIA-449/530 adapter cable, unless the procurement specification states otherwise.

For classified operation with KG-194 cryptographic devices, it is recommended that the procuring agency specify the electrical and mechanical interfaces of the cables connecting the KG-194 at both the network interface and the VTU.

6.4 TEMPEST Recommendations

6.4.1 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 6.4.3). 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.

6.4.2 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.

6.4.3 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)

6.5 **Definitions.** The following terms used in this MIL-STD are defined in FED-STD-1037B. In the case of multiple definitions, the applicable definition number is indicated.

Adaptive differential pulse-code modulation
A-law
Analog-to-digital (A-D) conversion
Asynchronous (definition 1)
Bandwidth (definition 1)
Bit rate
Broadcast operation
CCITT
Channel (definition 3)
Channel service unit (CSU)
Communications (definition 2)
Communications security (COMSEC)
Communications security (COMSEC) equipment
Cryptographic information
Cryptography
Customer premises equipment (CPE)
Data
Data circuit-terminating equipment (DCE)
Data compression (definition 1)
Data encryption standard (DES)
Data service unit (DSU) (definition 1)
Data terminal equipment (DTE) (definition 1)
Data transmission
Decode (definition 1)
Decrypt
Differential pulse-code modulation (DPCM)
Duplex operation
Echo (definition 1)
Echo attenuation
Encode (definition 1)
Encrypt
Firmware
Forward error correction (FEC)
Graphics
Handshaking (definition 2)
High-level data link control (HDLC)
Input/output (I/O) device (equipment)
Interoperability (definition 2)
Key
Long-haul communications (definition 1)
Multiplexer
Narrowband signal
NTSC Standard
Octet

PAL
Parity
Pel (definition 2)
Point-to-point link
Point-to-point transmission
Pulse-code modulation (PCM)
Quantization
Raster
Resolution (definition 3)
Sampling rate
SECAM
Security (definition 1)
Simplex operation (definition 1)
Software
Synchronization
Synchronous
Tactical communications
Telecommunication (definition 1)
Teleconference
Telecommunications service (definition 2)
TEMPEST
User (definition 1)
Video (see *video signal*)
Visual display unit

6.6 Service Definition. Below is the ANSI T1 committee that handles the service definition, which defines the scope of the ANSI standardization efforts for VTC:

T1A1	ANSI Accredited Technical Subcommittee on Telecommunications Performance
T1A1.5	Subworking Group of T1A1

6.7 Type 3 Cryptographic Equipment - Export Restrictions. Type 3 is for transmission of unclassified sensitive information. Use of the DES algorithm outside the DOD community is beyond the scope of this MIL-STD. DES is an export-controlled algorithm. Export of the DES algorithm is handled case by case. Commercial export is controlled by the State Department. FIPS PUB 46-1 and FIPS PUB 140-1 contain information concerning the export of DES.

6.8 Classified Operation Over Restricted Networks. Type 1 data encryption from a VTU 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.

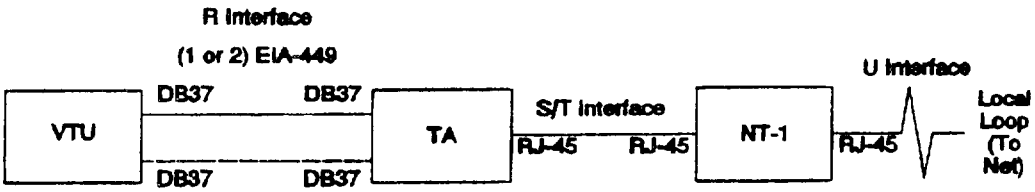
For operation of VTUs using Type 1 security over an unrestricted network connected to a restricted network, the following procedure should be used: Each VTU is connected through a cryptographic device to a network interface device [that is, an inverse multiplexer (IMUX), or a terminal adapter]. The network interface device at the unrestricted network must interface to the cryptographic device at multiples of 56 kbps and perform the bit 8 sub-channel stuffing/stripping for the unrestricted network. The cryptographic device and the VTU at both ends of the network receive network timing at 56 kbps. 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.

6.9 Network Access Alternatives. Network interfaces, except for those specified in 5.1.8.3, are outside the scope of this MIL-STD. The following is for information only.

6.9.1 ISDN Access Alternatives. Paragraph 5.1.8.3 specifies several options for connecting to ISDN, but does not preclude the use of other alternatives. This paragraph and its subparagraphs describe various methods of basic rate interface (BRI) ISDN connectivity. VTU vendors may integrate some of this equipment into their MIL-STD-188-331-compliant designs. Paragraph 6.9.1.3 addresses Type 1 classified operation. Paragraphs 6.9.1.1, 6.9.1.2, 6.9.1.4, and 6.9.1.5 address unclassified and unclassified sensitive operation. For unclassified sensitive operation, the VTU 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).

6.9.1.1 External Terminal Adapter. Figure 12 shows a typical configuration, including the interface between the VTU and the separate terminal adapter, which is the R interface.



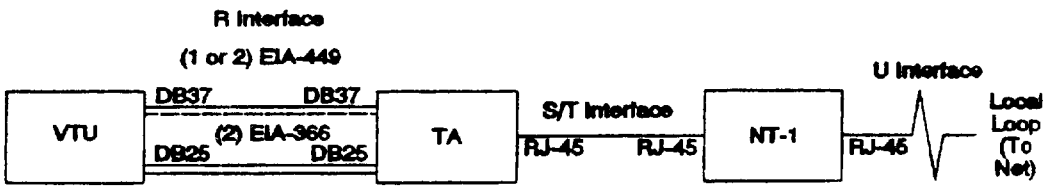
Unclassified and Unclassified Sensitive Operation

TA = terminal adapter
NT-1 = network termination Type 1

Figure 12. Network Configuration for External Terminal Adapter.

The R interface of the VTU consists of two 56/64 kbps EIA-449 ports, or one 112/128 kbps EIA-449 port. Paragraph 5.1.8.3.1 also makes use of this configuration. If the VTU 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 port and vice versa. This version is for unclassified or Type 3 unclassified, sensitive operation.

6.9.1.2 External Terminal Adapter with Dialing Interface. Figure 13 shows a typical configuration, including the interface between the VTU and the separate terminal adapter, which is the R interface.



Unclassified and Unclassified Sensitive Operation

TA = terminal adapter
NT-1 = network termination Type 1

Figure 13. Network Configuration for External Terminal Adapter with EIA-366 Dialing Interface.

The R interface of the VTU consists of two 56/64 kbps EIA-449 ports, or one 112/128 kbps EIA-449 port. The R interface also includes two EIA-366-A dialing interfaces: one for each B channel. Paragraph 5.1.8.3.2 also makes use of this configuration. If the VTU 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 port and vice versa. This configuration is for unclassified or Type 3 unclassified, sensitive operation. Type 1 classified operation is not permitted.

6.9.1.3 Classified Operation. For Type 1 classified operation, the cryptographic equipment is added at the R interface, as shown in Figure 14.

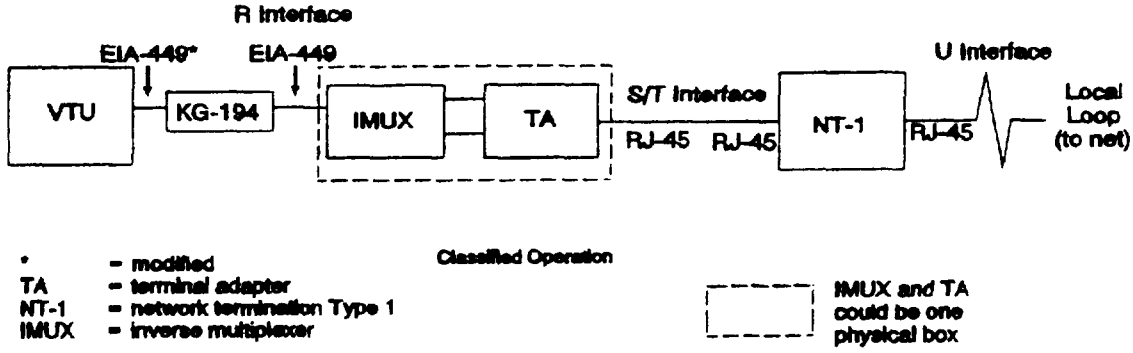


Figure 14. Network Configuration for Classified Operation.

Paragraph 5.1.8.3.3 also makes use of this configuration. If the VTU has the EIA-366 port, there can be nothing physically connected to it during a classified conference.

6.9.1.4 Integrated Terminal Adapter. Figure 15 shows a diagram of this configuration.

The terminal adapter is integrated with the VTU into a single physical unit. The NT-1 is physically separate. 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 an RJ-45. Type 1 classified conferencing is not permitted with this configuration.

6.9.1.5 Integrated Terminal Adapter and Network Termination. Figure 16 shows a diagram of this configuration.

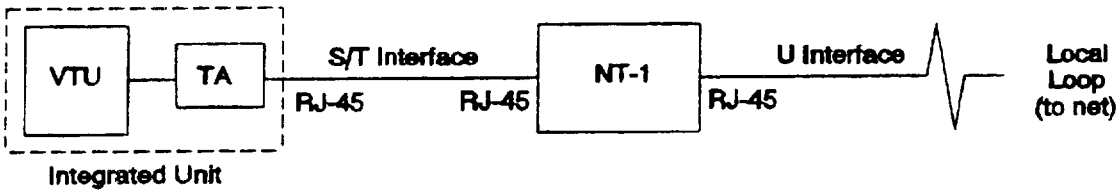


Figure 15. Network Configuration for Integrated Terminal Adapter.

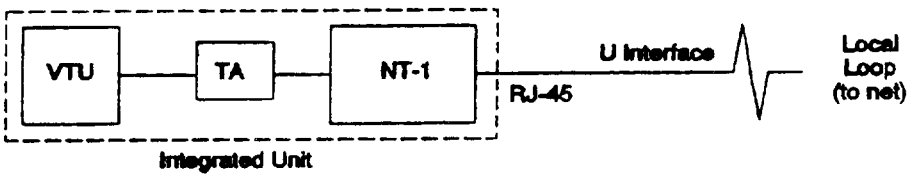


Figure 16. Network Configuration for Integrated Terminal Adapter and Network Termination.

This is only for unclassified and unclassified, sensitive operation. The VTU, terminal adapter, and network termination (NT-1) is integrated into a single physical unit. The integrated unit will now provide the U interface for the network. Type 1 classified conferencing is not permitted with this configuration.

6.9.2 Inverse Multiplexers. To provide interoperability between inverse multiplexers, the following is recommended.

6.9.2.1 Unclassified Operation. An inverse multiplexer (IMUX) is used to connect a single-channel VTU to a multiple-channel VTU through a multiple-channel network. The VTU is connected to an IMUX. The IMUX-Network-IMUX connection provides a clear data channel at a specified data rate (that is, 128 kbps). At the other end, the IMUX is connected to the other VTU.

The IMUX operates in Mode 1, as defined in ANSI T1A-EIA-619 (formerly known as the BONDING standard). In this mode, the IMUX-Network-IMUX interface 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 interface is at the same data rate (that is, 128 kbps) as the total data rate (2 x 64 kbps) 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.

6.9.2.2 Classified Operation. The VTU is connected to a cryptographic device (KG-194). The cryptographic device is then connected to an IMUX. The IMUX-Network-IMUX connection provides a clear data channel at a specified data rate (128 kbps). At the other end, the IMUX is connected to a cryptographic device (KG-194). The cryptographic device is connected to the far-end VTU.

The IMUX operates in Mode 1, as defined in ANSI T1A-EIA-619. In this mode, the IMUX-Network-IMUX interface 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-KG interface is at the same data rate (128 kbps) as the total data rate (2 x 64 kbps) 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 to ensure RED-BLACK separation. No VTU-to-IMUX communication or electrical connection is allowed. Loss of synchronization between the network channels must be detected and reset manually by initializing the IMUX to a framed mode, as described above.

6.9.2.3 Single- to Multiple-Channel Operation. This section is left for future study.

6.9.3 Other Network Interfaces. The VTU may support additional interfaces to the TA, which are outside the scope of this MIL-STD. Below are some examples of such interfaces:

- V.35
- Dual V.35
- V.35 with EIA-366-A
- Dual V.35 with dual EIA-366-A
- X.21
- Dual X.21

The VTU may also support direct network interfaces, which are outside the scope of this MIL-STD. Below are some examples of direct network interfaces:

- Primary rate ISDN interface
- North America T1 interface
- 2-wire switched 56-kbps interface
- 4-wire switched 56-kbps interface.

6.10 Subject Term (Key-Word) Listing

audio visual
CODEC
communications
data communications
freeze-frame video
H.320
motion video
multimedia
NITFS
p x 64
security
still image
teleconferencing
video
video coding and decoding
videophone
video teleconferencing (VTC)

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APPENDIX A

DOD Policy
for
Video Teleconferencing (VTC)
Management, Acquisition, and Standards

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE

WASHINGTON, DC 20301-3040
October 26, 1993

COMMAND, CONTROL,
COMMUNICATIONS
AND INTELLIGENCE

MEMORANDUM FOR DIRECTOR, INFORMATION SYSTEMS FOR COMMAND, CONTROL, COMMUNICATIONS AND COMPUTERS (ARMY)
DIRECTOR, SPACE AND ELECTRONICS WARFARE (NAVY)
DEPUTY CHIEF OF STAFF, SYSTEMS FOR COMMAND, CONTROL, COMMUNICATIONS AND COMPUTERS (AIR FORCE)
DIRECTOR, COMMAND, CONTROL, COMMUNICATIONS AND COMPUTER SYSTEMS (JOINT STAFF)
DIRECTORS, J6, UNIFIED AND SPECIFIED COMBATANT COMMANDS
DIRECTOR, DEFENSE TELECOMMUNICATIONS SERVICE-WASHINGTON
DIRECTORS OF THE DEFENSE AGENCIES

SUBJECT: Department of Defense (DoD) Policy for Videoteleconferencing (VTC) Management, Acquisition, and Standards

In order to improve interoperability and standardization of VTC within DoD, all new procurements for VTC services and equipments will comply with the attached policy guidance, effective immediately.

Point of contact in this office is Mr. Tom Dickinson, (703) 695-7181, DSN 225-7181.

Deborah R. Castleman
Deputy Assistant Secretary of Defense
(Command Control and Communications)

Attachment

Date: 26 OCT 1993

Department of Defense Policy
for
Videoteleconferencing (VTC) Management, Acquisition, and Standards

This policy applies to all DoD VTC activities and capabilities (including videophones, desktop, and PC-based devices which use an integral codec) which operate at data transmission rates between 56 Kbps and 1.92 Mbps. All DoD VTC services will be considered as value added offerings of the Defense Information System Network (DISN) and will be fully interoperable with the DISN. In order to ensure VTC interoperability within the DoD, the following policy is effective immediately:

- All new DoD procurements for VTC (including videophones) that operate between transmission rates of 56 Kbps and 1.92 Mbps shall conform to the requirements set forth in Federal Information Processing Standards Publication 178 (FIPS Pub 178), which references the five ITU-T (formerly CCITT) "p x 64" VTC standards, H.221, H.230, H.242, H.261, and H.320. An Interim Planning Standard 187-331 is expected to be issued in January, 1994, to provide initial standards until the late 1994 publication of MIL-STD-188-331 ("Interoperability and Performance Standard for Videoteleconferencing"). Existing DoD VTC capabilities will be upgraded as necessary to comply with MIL-STD-188-331 within one year of its approval.

- The above FIPS and MIL-STD are for point-to-point service only, and do not address multipoint or network issues. A follow-on to MIL-STD-188-331, (188-331-A), is expected in March, 1995, which will address multipoint issues. In the interim, all requirements for multipoint control units that operate between 56 Kbps and 1.92 Mbps will conform to the requirements in ITU-T (formerly CCITT) recommendations H.231 and H.243. Existing DoD VTC multipoint capabilities will be upgraded as necessary to comply with MIL-STD-188-331-A within one year of its approval.

- All intelligence activities requiring SCI-secure VTC capability will use the Joint Worldwide Intelligence Communications System (JWICS), currently being fielded by the Defense Intelligence Agency (DIA). DIA and DISA will ensure JWICS integration into the DISN, and will employ standards, applications, protocols and equipment which are in consonance with the DISN implementation.

- DISA will develop and maintain a list of VTC equipment certified as meeting applicable standards. When applicable, interoperability shall be consistent with the provisions of DoD Directive 4630.8, "Procedures for Compatibility, Interoperability and Integration of Command, Control, Communications and Intelligence (C3I) Systems." DISA's Joint Interoperability Test Center will conduct

product conformance and inter-product interoperability tests and certify candidate equipment before placing it on the list. DISA's Joint Interoperability Engineering Office Center for Standards has overall responsibility for VTC standards within DoD. Interoperability will be based on MIL-STD-188-331 and 188-331-A, and on commercial product testing.

- DISA will provide contract vehicle(s) for equipment and services which will be available for use by the DoD Components to satisfy VTC requirements. No deviations from this policy are permitted unless submitted to and endorsed by DISA.

CONCLUDING MATERIAL

Custodians:

Army - CR
Navy - EC
Air Force - 90

Review Activities:

Army - AC, AM, CR-1, ET, IE, PT, SC, TM
Navy - AS, CH, MC, NC, ND, NP, NV, OM, TD
Air Force - 02, 11, 13, 15, 17, 21, 29, 93
DLA - DH
DIA - DI
DMA - MP
DOT - OST
ECAC - ---
NSA - NS
OASD - DO, IQ, IR, WS

User Activities:

Army - AI, ER, MI, MT, TE
Navy - AP, CG, SH
Air Force - 05, 06, 10, 16

Preparing Activity:

DISA - DC

Agent:

N/A

(Project TCSS - 3310)

International Interest:

NATO

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER: MIL-STD-188-331	2. DOCUMENT DATE (YYMMDD) 29 March 1994

3. DOCUMENT TITLE: **Interoperability and Performance Standard for Video Teleconferencing**

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) AUTOVON *(If applicable)*	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME: Joint Interoperability and Engineering Organization (JIEO)	b. TELEPHONE *(Include Area Code)* (1) Commercial (908) 532-7720 (2) AUTOVON: 992-7720
c. ADDRESS *(Include Zip Code)* DISA/JIEO TBBC ATTN: Mr. Rittenbach Fort Monmouth, NJ 07703-5613	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340