STATUS OF STANDARDS FOR TELECONFERENCING & MULTIMEDIA COMMUNICATION

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ABSTRACT

Video TeleConferencing (VTC) is being successfully employed throughout the Department of Defense (DoD), in both strategic and tactical environments. It is also being deployed in a wide range of communication network infrastructures: mobile, circuit switched, ISDN, ATM, LAN, Internet, DCTN, and FTS2000. Fortunately commercial VTC standards are being employed in most of these applications thereby contributing to interoperability between these diverse terminals and networks.

This paper reviews the status of VTC standards and some of the key applications throughout the DoD. Standards which will be reviewed include H.320 (N-ISDN), H.323 (LAN and Internet), H.324 (POTS), H.324M (mobile), H.310 (B-ISDN), and T.120 (desktop collaboration).

INTRODUCTION

Standards have been, and are continuing to be, defined for the transmission of multimedia signals (audio, video, text, still pictures, graphics, data file) over a wide range of communication networks -- N-ISDN, telephone network, B-ISDN/ATM, LAN, mobile, Internet, DCTN, FTS2000. The DoD has widely employed these standards in both the tactical and strategic environments. Applications include video teleconferencing between conference rooms in a strategic environment, video transmission from unmanned airborne platforms, remote training, transmission of audio/imagery/coordinate data from a forward observer, missile guidance, collaboration/screen sharing between remote work stations, access of information from a remote multimedia database, VTC between tactical commanders in the field.

In the increasingly austere DoD environment, the use of digital video and audio (e.g. VTC, remote training) is sharply increasing the effectiveness and productivity of limited personnel and facilities. In addition, the use of new digital video/audio compression technology permits the acquisition and efficient transmission of sensory/computer data from locations and platforms which was previously not feasible. For example, commanders in the tactical environment now have access to recently acquired strategic imagery. And in the future, man-in-the-loop missile guidance may become feasible. The impact of the digital multimedia revolution on the DoD has already been large but will rapidly accelerate in the future.

STANDARDS OVERVIEW

This paper summarizes the status of the new standards which define the procedures for VTC and videophone (VP) multimedia communications. Figure 1 and Table 1 illustrate the key ITU Recommendations which have been, and are being, developed for VTC/VP. H.320, designed for operation over the N-ISDN, is the most mature standard [established in 1990] and forms the cornerstone of all video conferencing systems--room based as well as desktop. H.320 is available from all vendors and guarantees interoperability between systems from different manufacturers.

Recommendations H.324, H.321, H.310, and H.322 were "frozen" by the ITU in February, 1995 achieving final approval in 1996. H.324 defines a multimedia terminal which communicates speech, data, and video signals over the public switched telephone network. As part of the H.324 terminal, new standards have been established for speech coding, video coding, control, and multiplex--G.723.1, H.263, H.245, and H.223 respectively.

H.321 and H.310 are new Recommendations defining videoconferencing terminals for transmission via the B-ISDN/ATM network. H.321 merely converts the H.320 standard from N-ISDN operation to B-ISDN transmission; all of the H.320 infrastructure [H.261, H.221, H.242] remain intact to maximize interoperability between the two networks. H.310 is a new Recommendation which adapts the ISO MPEG-2 standards for communication over the B-ISDN/ATM network. H.262 and H.222.0 are common text standards with ISO MPEG-2.

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H.322 adapts the H.320 standard for those LAN networks that guarantee the bandwidth--e.g. ISO Ethernet. H.323 is a new standard designed to provide videoconferencing over non-guaranteed-bandwidth LANS such as Ethernet and Token Ring. The H.323 standard was fully approved in 1996. The H.323 standard is now forming the basis for multimedia communication over the internet.

The reader should note the H.261 video coding standard is mandatory for all the Recommendations listed in Figure 1. This greatly enhances interoperability between networks. A great deal of commonality also exists in the audio, multiplex, and control standards.

All the Recommendations described above, and listed in Figure 1, define multimedia terminals which provide for the transmission of audio, data, and video signals. In many applications, particularly those for the desktop, data originating on the PC/workstation platform is the most important information to be transmitted. The ITU is developing the T.120 series of Recommendations for the communication of this data. T.120 defines a protocol stack which can be used for data-only transmission; in addition, the T.120 protocol is used for the data component in the multimedia terminals such as H.320, H.324, H.321, and H.322.

H.320: MULTIMEDIA COMMUNICATION VIA N-ISDN

H.320 is the overview ITU Recommendation which specifies a multimedia terminal for transmission over the N-ISDN network. The entire set of five standards which fully defines the H.320 terminal is listed in Table 2. Since the five H.320 Recommendations were finalized by the ITU in December, 1990, the standard is extremely mature and forms the cornerstone of the video conferencing business. Figure 2 illustrates the interrelationship of the five H.320 standards and also shows the connections of the H.320 terminal with external components.

H.324: TERMINAL FOR LOW-BIT RATE MULTIMEDIA COMMUNICATION

Recommendation H.324, fully approved in May 1996, describes terminals for low bitrate multimedia communication, utilizing V.34 modems operating over the telephone network. H.324 terminals may carry real-time voice, data, and video, or any combination.

H.324 terminals may be integrated into personal computers or implemented in stand-alone devices such as videotelephones. Support for each media type (voice, data, video) is optional, but if supported, the ability to use a specified common mode of operation is required, so that all terminals supporting that media type can interwork. H.324 allows more than one channel of each type to be in use.

The H.324 standard refers to four other ITU Recommendations, illustrated in Figure 3, which collectively define the complete terminal. The four new companion Recommendations are: H.263 (Video Coding for Low Bitrate Communication), G.723 (Speech Coder for Multimedia Telecommunications Transmitting at 5.3/6.3 kbit/s), H.223(Multiplexing Protocol for Low Bitrate Multimedia Terminals), H.245 (Control of Communications between Multimedia Terminals). H.324 specifies use of the V.34 modem, which operates up to 28.8 kbit/s, and the V.8 (or V.8bis) procedure to start and stop digital transmission. An optional data channel is defined to provide for the exchange of computer data in the workstation/PC environment. H.324 specifies the use of the T.120 protocol as one possible means for this data exchange.

H.323: VISUAL TELEPHONE SYSTEM FOR LOCAL AREA NETWORKS WHICH PROVIDE A NON-GUARANTEED QUALITY OF SERVICE

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

- Ethernet (IEEE 802.3)
- Fast Ethernet (IEEE 802.10)
- FDDI (non-guaranteed quality of service mode)
- Token Ring (IEEE 802.5)

H.323 terminals may be used in multipoint configurations, and may interwork with H.310 terminals on B-ISDN, H.320 terminals on N-ISDN, H.321 terminals on B-ISDN, H.322 terminals on Guaranteed Quality of Service LANs, H.324 terminals on GSTN and wireless networks, and V.70 terminals on GSTN. See Figure 4.

The scope of H.323 does not include the LAN itself, or the transport layer which may be used to connect various LANs. Only elements needed for interaction

with the Switched Circuit Network (SCN) are within the scope of H.323. The combination of the H.323 Gateway, the H.323 terminal, and the out-of-scope LAN appears on the SCN as an H.320, H.310, H.324, or V.70 terminal.

This Recommendation describes the components of an H.323 system. This includes Terminals, Gateways, Gatekeepers, Multipoint Controllers, Multipoint Processors, and Multipoint Control Units. Control messages and procedures within this Recommendation define how these components communicate.

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

H.324M: AUDIOVISUAL TELEPHONY VIA MOBILE RADIO

Figure 5 illustrates the general structure of the H.324M mobile multimedia terminal which is now under investigation. Work toward the H.324M Recommendation has been divided into the following areas of study; [1] speech error protection, [2] video error protection, [3] communications control [adjustments to H.245], [4] multiplex/error control of the multiplexed signal, [5] system.

The general principles and underlying assumptions upon which the H.324M Recommendations are to be based. Several of the key assumptions are listed below.

- H.324M Recommendations should be based upon H.324 as much as possible.
- The technical requirements and objectives for H.324M are essentially the same as they are for H.324.
- Since the vast majority of mobile terminal calls are with terminals in fixed networks, it is very important that H.32M Recommendations be developed which maximize interoperability with these fixed terminals.
- It is assumed that the H.324M terminal has access to a transparent/ synchronous bit stream from the mobile network.
- It is proposed to provide the manufacturer of mobile multimedia terminals with a number of optional error protection tools to address a wide range of mobile networks; regional and global, present and future, cordless and cellular. Consequently H.324M tools should be flexible, bitrate scaleable, and extensible to the maximum degree possible. 6. Like H.324, non-conversational services are an important application for H.324M.

Considerable progress has been made toward video error protection for H.324M. Technology which appears particularly promising, includes ARQ, forward error control, and error concealment. Two different approaches for the H.324M multiplexer are being planned. The first merely applies error protection to the H.223 multiplexed signal. The second employs a completely new multiplex structure designed specifically for transmission over mobile networks. A scalable channel coder has been defined to adapt the G.723.1 to mobile channels. It was approved in May, 1996.

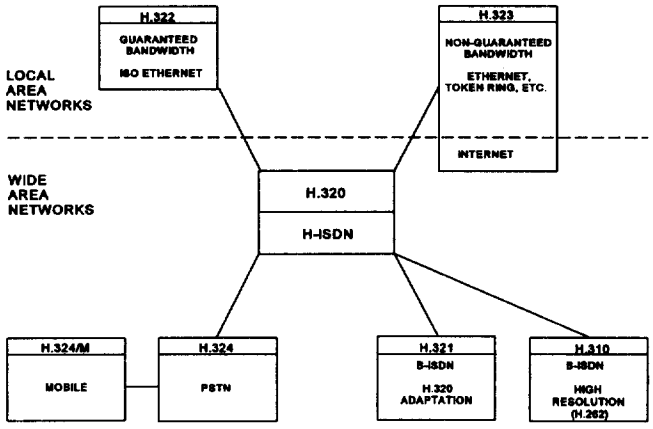

Figure 1 Multimedia Communication Standards

NETWORK		TERMINAL STANDARD					
		Overall	Video	Mux	Control/ Signaling	Audio	Comm. Interface
WAN	PSTN	H.324	H.261/H.263	H.223	H.245	G.723.1	V.34 MODEM
	MOBILE RADIO	H.324 ©	H.261/H.263	H.223 (A)	H.245	G.723.1 ©	MOBILE RADIO
	N-ISDN	H.320	H.261	H.221	H.242	G.711 (M) G.722 (O) G.728 (O)	I.400
	B-ISDN/ATM	H.321	H.261	H.221	Q.2931	G.711 (M) G.722 (O) G.728 (O)	AAL I.363 AJM I.361 PHY I.400
		H.310	H.261/ H.262*	H.222.0*/ H.222.1	H.245	G.711 (M) G.722 (O) G.728 (O) MPEG 1,2	AAL I.363 AJM I.361 PHY I.432
LAN	ISO ETHERNET	H.322	H.261	H.221	H.242	G.711 (M) G.722 (O) G.728 (O)	I.400 & TCP IP
	ETHERNET, TOKEN RING	H.323	H.261	H.225.0	H.245	G.711 (M) G.722 (O) G.728 (O)	TCP IP

* common text with ISO MPEG 2

Table 1 ITU Audiovisual Recommendations

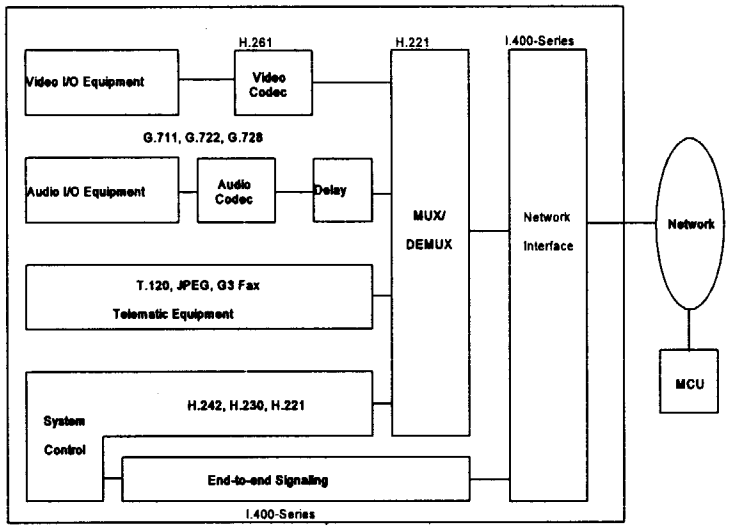

Figure 2 Visual telephone systems (H.320)

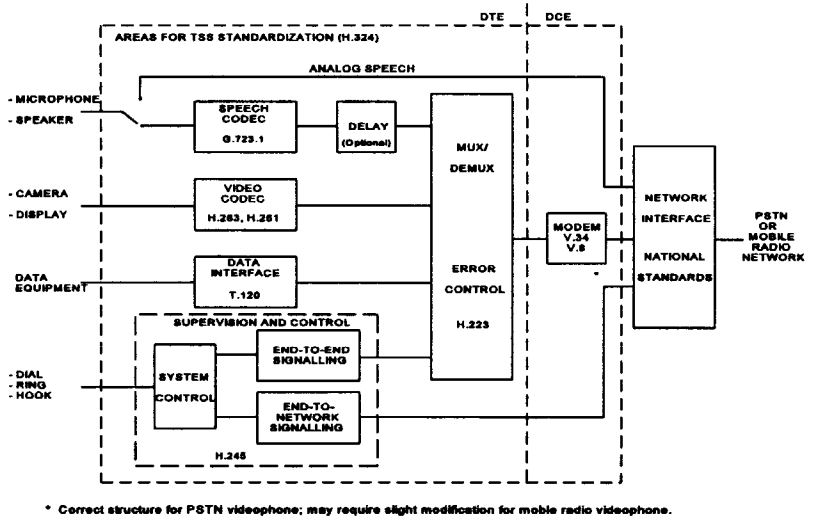

Figure 3 Functional block diagram for very low bitrate videophone

DESIGNATION	TITLE	PURPOSE
H.320	Narrow-band visual telephone systems and terminal equipment.	This standard defines the interrelationship of all of the five H.320 Recommendations.
H.261	Video codec for audiovisual services at P x 64 kbit/s.	This Recommendation specifies the video coding algorithm, the picture format, and forward error correction techniques for the audiovisual terminal.
H.221	Frame structure for a 64 to 1920 kbit/s channel in audio visual teleservices.	The purpose of this recommendation is to define a frame structure for audiovisual teleservices in single or multiple B or HO channels or a single H11 or H12 channel.
H.242	System for establishing communication between audiovisual terminals using digital channels up to 2 Mbit/s.	Recommendation H.242 defines the detailed "handshake" protocol and procedures which are employed by H.320 terminals in the preliminary phases of a call.
H.230	Frame synchronous control and indication (C&I) signals for audiovisual systems.	Recommendation H.230 has two primary elements. First, it defines the C&I symbols related to video, audio, maintenance, and multipoint. Second, it contains a table of BAS escape codes which clarifies the circumstances under which some C&I functions are mandatory and others optional.

Table 2 H.320 Recommendation Series

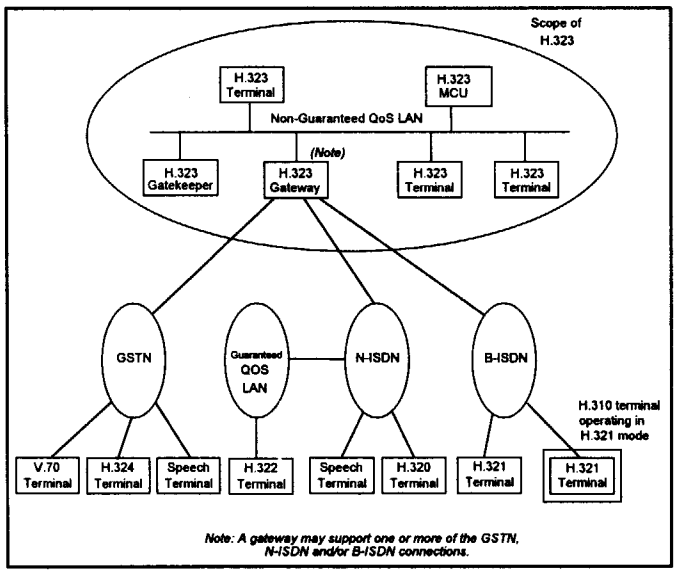

Figure 4 Interoperability of H.323 terminals. (Note: A gateway may support one or more of the GSTN, N-ISDN, and/or B-ISDN connections.)

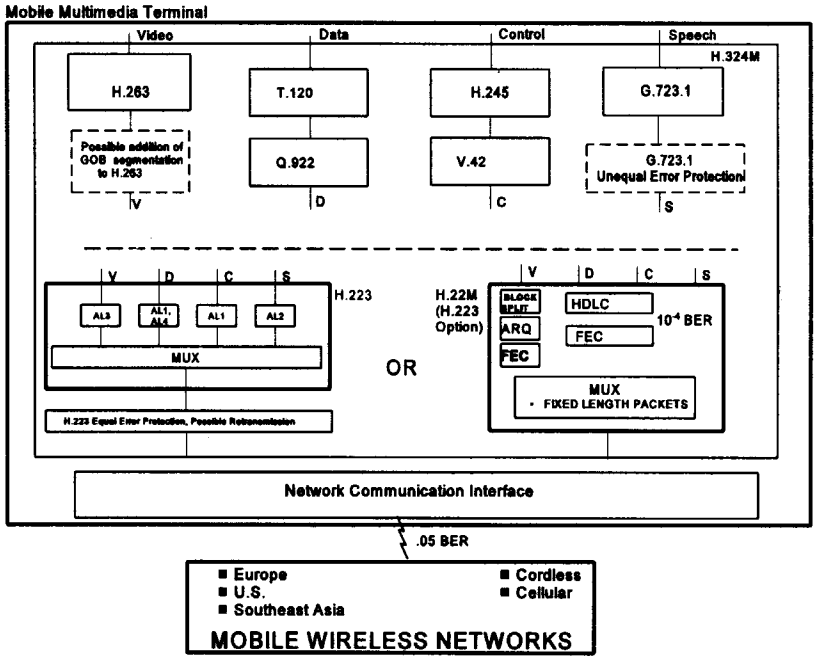

Figure 5 Mobile multimedia terminal