ITU Telecommunication Standardization Sector
Study Group 15
Experts Group for Video Coding and System
in ATM and Other Network Environments

Document AVC-595

October 21, 1993

Source : **NTT**

Title : **Video and Audio Communication System for CSMA/CD LAN**

Purpose : **Information**

---

1. Introduction

NTT has developed a realtime video and audio communications system for 10 Mbps CSMA/CD LAN. This system consists of an audio-video realtime communication adapter and ISDN visual telephone gateway. This adapter establishes connection by TCP protocol, and transmits audio and video data with 16-208 kbps by UDP. ITU-T Rec. H.261 and G.728 coding algorithms are used for coding/decoding video and audio respectively. For real-time audio-video communication over LANs, congestion control and video frame refresh controls are implemented. The ISDN visual telephone gateway realizes interconnection between the audio-video real-time communication adapter and ISDN visual telephone terminal based on ITU-T rec. H.320 terminal.

2. Service concepts

Fig.1 shows the audio-video tele-conference system. PCs, WSs and the audio-video real-time communication adapters are connected with 10 Mbps CSMA/CD LANs, LAN-to-LAN connections can be made via basic- or primary-rate ISDN circuits. ISDN visual telephone gateway is for interconnection between the adapter and ISDN visual-telephone based on ITU-T H-series Recommendations.

(1) Audio-Video real-time communication over LANs and WANs

The adapter can establish a connection with another adapter over LANs or WANs. Transmission rates of audio and video are 16 kbps, and 16-192 kbps variable, respectively. The maximum transmission rate of the pair is 208 kbps. When 5 pairs of adapters with 208 kbps transmission rate are communicated at the same time, it occupies about 2.1 Mbps of 10 Mbps CSMA/CD LAN capacity. If these terminals are set at 144 kbps (128 kbps for video and 16 kbps for audio), total bitrate of audio-video communication is about 1.4 Mbps.

(2) Interconnection between audio-video real-time communication adapter and ISDN visual telephone

The ISDN visual telephone gateway realizes interconnection between the audio-video realtime communication adapter and ISDN visual telephone based on ITU-T Recommendations. The

gateway converts communication protocol and video-audio data frame format only, because these both equipments implement ITU-T Rec. H.261 video coding scheme and G.728 audio coding scheme. However when an ISDN visual telephone has only G.711 audio coding scheme, the gateway transcodes these coding schemes mutually.

3. Communication protocols and congestion control

3.1 Communication protocols

Figure 3 shows a call setup and release sequence over LAN. TCP protocol is used for these connection establishment sequence, and UDP datagram transmission is used for realtime transmission of coded audio and video data.

(1) Call setup

The adapter initiates a call when the adapter gets 'call' command with IP address parameter from PC/WS. The adapter transmits call setup commands to a destination adapter in TCP. The destination adapter responds with call setup accept command when the adapter establishes the call. These commands, call setup and call setup accept, have some parameters which indicate audio data length, video encoder transmission capability, video decoder mode request, etc.

(2) Coded audio and video data transmission

The adapters send and receive audio/video coded data with UDP. The audio data and video data are combined in a packet to decrease the number of packets, and transmitted at regular intervals. This is to achieve better transmission efficiency. The packet structure is shown in Figure 4. A packet consists of a control command, a sequence number, an audio data length, a video data length, coded audio data and coded video data. The control command indicates fast update request, loop back request and, transmission and reception bit rates. The sequence number shows the packet number and is used for detecting packet loss by checking it continuity. The audio data is fixed at 0, 70, 110 or 150 bytes in a packet. The video data is filled with variable length coded data at regular intervals in a packet.

(3) Call release

The adapter releases a call when the adapter gets 'release' command from PC/WS. The adapter transmits release command to the destination adapter by TCP, then stops audio-video data transmission through UDP data packets.

3.2 Congestion control

The UDP is very simple and easy to process, so it can suit realtime data transmission. However, when LAN traffic becomes heavy, UDP packets are discarded. The adapter can detect a packet discard by checking the sequence number in the data packet, then lowers video throughput by one step automatically to relieve congestion and sets the encoder in fast update mode to clear decoded video. When congestion persists, it adjusts rate one step further. Transmission rates retum

to their original speed once congestion is cleared. If some audio data is lost, it is replaced with silence data to maintain audio-video synchronization.

3.3 Interconnection with ISDN visual telephone

Figure 4 shows an interconnection sequence between LAN terminals and ISDN equipments.

(1) Call setup

When a connection is established, the gateway converts communication protocols mutually. Video and audio transmission modes of both LAN and ISDN terminals are set in this step.

(2) Audio-video communication

The gateway converts data frame format and audio coding schemes. The video codec of the adapter is based on ITU-T rec. H.261, but has no BCH forward error code scheme. The gateway adds BCH forward error codes. Since the audio codec of the adapter has only G.728, the gateway transcodes it to G.711 coding scheme if G.728 is not supported by the ISDN terminal. When a visual telephone has G.728, the gateway simply transfers the audio data. Then the gateway multiplexes coded audio and video data in H.221 frame for an ISDN visual telephone.

To avoid overflow of coded video data from the adapter to the ISDN terminal, the gateway sets video data transmission rate of the LAN terminal lower than the one for LAN-to-LAN communication. For example, if 2B is the ISDN rate with G.728, LAN video rate is set to 77 kbps. When video buffer is in under flow, fill bits are buried in BCH frames.

4. Design concept and terminals

Hardware architecture of audio-video real-time communication adapter and ISDN visual telephone gateway are described here.

4.1 Audio-video real-time communication adapter

Figure 5 shows a block diagram of the adapter. LAN IF has 10 Mbps CSMA/CD LAN (ISO 802-3 10BASE5) interface, treats TCP/IP protocol, and communicates control data in TCP and coded audio-video data in UDP. PAD packs coded audio and video data in a packet. VIDEO CODEC encodes and decodes video signals based on ITU-T Rec. H.261. However, the video codec has no BCH forward error correction framing pattern. This is because the UDP packet has checksum and detects bit error.

Frame rate is 15 f/s in CIF and 30 f/s in QCIF. Data rate is 192 kbps at maximum. AUDIO CODEC encodes and decodes audio signal based according to ITU-T Rec. G.728. Data rate is 16 kbps fixed.

Audio-video real-time communication adapter is shown in Figure 6, and the specifications are summarized in table 1.

4.2 ISDN video-phone gateway

Figure 7 shows a block diagram of the gateway. LAN IF has 10 Mbps CSMA/CD LAN (ISO 802-3 10BASE5) interface, and communicates with an audio-video real-time communication adapter. PAD packs/separates coded audio and video data in/from a packet. ACC transcodes audio data when a visual telephone has only G.711 audio codec. When a visual telephone has G.728 audio codec, the ACC transfers it. The video codec of the adapter has no BCH forward error code scheme, ECF codes and decodes BCH. MUX multiplexes/demultiplexes coded audio and video data in/from H.221 frame. NIF has an interface of basic-rate ISDN circuits, and communicates with an ISDN visual telephone.

Table 2 summarizes the specifications of the gateway.

5. Conclusion

Information on an implementation of video and audio communication system for LAN has been provided to facilitate making a standardization program.

Table 1. Specification of audio-video real-time communication adopter

Item		Specification
LAN interface	LAN IF	10 Mbps CSMA/CD LAN (ISO 802.3 10BASE5)
	Comm. protocol	TCP/IP protocol
	Audio-video data packet	audio-video combined 70-1430 bytes/packet 13-29 packets/sec
	Transmission rate	16-208 kbps
Video interface	Coding algorithm	ITU-T Rec. H.261 (w/o BCH frame)
	Resolution	352x288 pixels (CIF) 176x144 pixels (QCIF)
	Data rate	16, 37, 77, 128, 192 kbps
	Input/Output signal	NTSC composite
Audio interface	Coding algorithm	ITU-T Rec. G.728
	Data rate	16 kbps
	Input/Output signal	Analog
Control interface	Interface	RS-232C
	Transmission rate	1.2, 2.4, 4.8, 9.6 kbps
Size		110(W)x340(H)x400(D) mm

Table 2. Specification of ISDN visual telephone gateway

Item		Specification
LAN interface	LAN IF	10 Mbps CSMA/CD LAN (ISO 802.3 10BASE5)
	Comm. protocol	TCP/IP protocol
	Data format	UDP datagram packet
	Transmission rate	16-208 kbps
ISDN interface	ISDN IF	Basic-rate IF (2xB)
	Comm. protocol	ITU-T Rec. H.242
	Data format	ITU-T Rec. H.221
	Transmission rate	64, 128 kbps
Control interface	Interface	RS-232C
	Transmission rate	1.2, 2.4, 4.8, 9.6 kbps
Size		110(W)x340(H)x400(D) mm

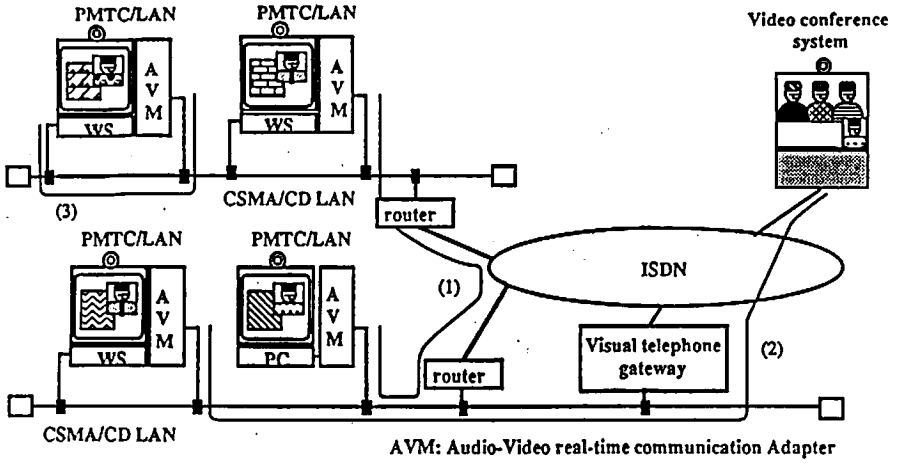

Fig.1 Multimedia Communication System for CSMA/CD LAN

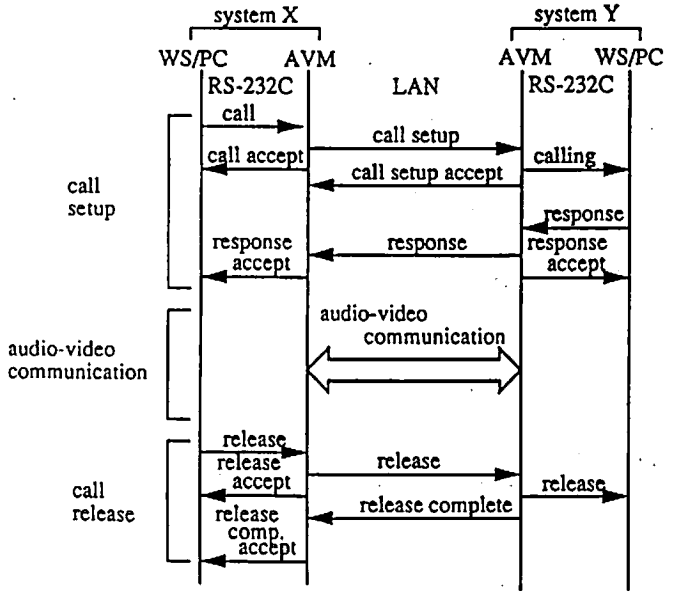

Figure 2. Call setup and release sequence

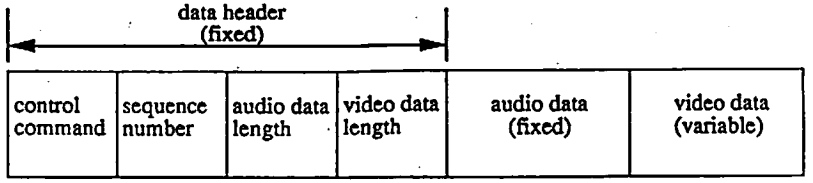

Figure 3. Audio-video data packet structure

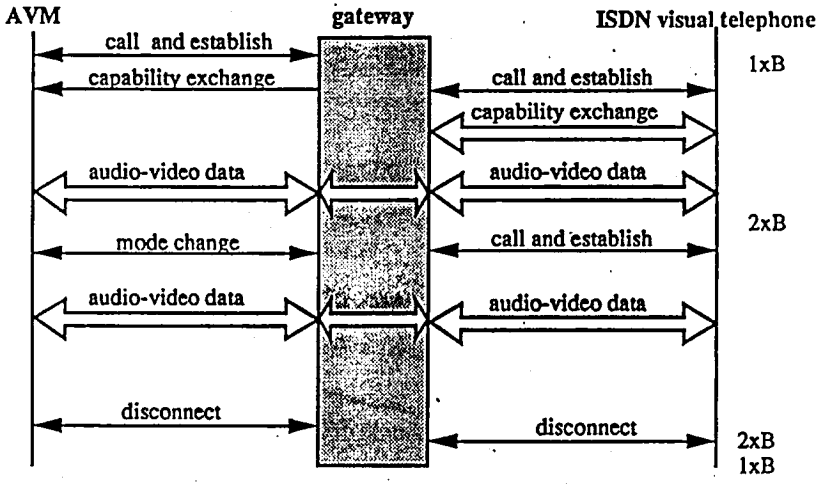

Figure 4. Call setup and release sequence

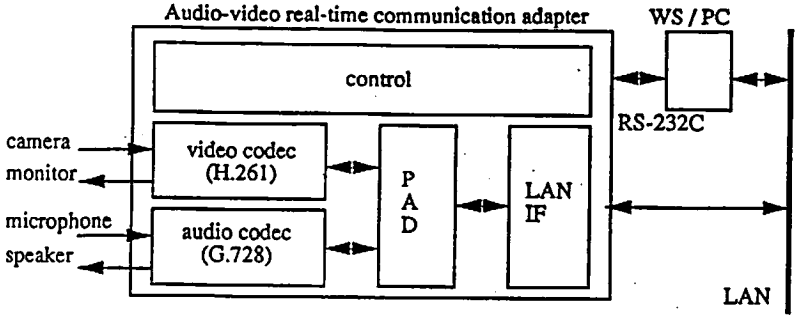

Figure 5. Block diagram of an audio-video real-time communication adapter

Figure 6. An external view of audio-video real-time communication adapter

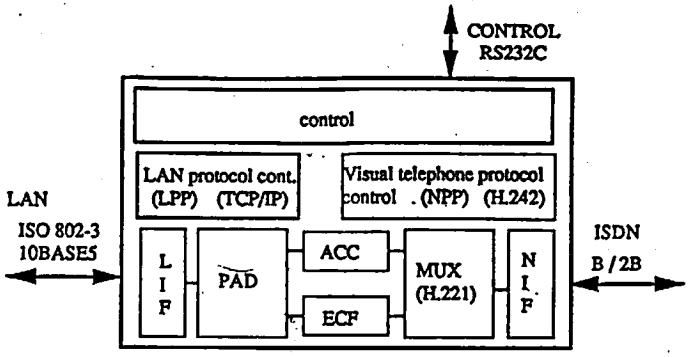

Figure 7. Block diagram of visual telephone gateway

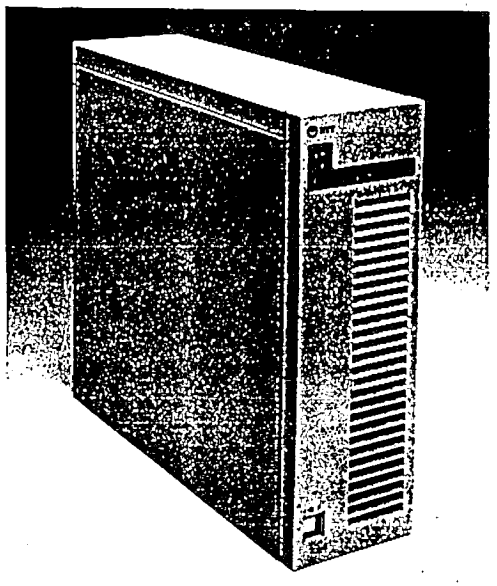

Figure 8. An external view of audio-video communication gateway