

Source : Japan
Title : Consideration of H.222.0 Transport System as multimedia multiplexing
for audiovisual communications
Purpose : Discussion

1.Introduction

It is our objective that one integrated H.32X audiovisual terminal can be used for not only conversational services but also retrieval and broadcasting services via ATM networks. This paper describes a case study for applying H.222.0 Transport Stream to the H.32X terminal. In this paper stream_id and stream_type codes are based on Annex 2 to AVC-673R [1].

2.Case Study for applying H.222.0 Transport System

A case study has been carried out for a 5 Mbit/s high quality videoconferencing service in which H.222.0 Transport Stream is used for multiplexing video, audio, data and control information. Packets are allocated to video and audio so that the multiplexing delay becomes less than 10 ms. The control signal is sent as soon as a C&I event or transfer mode changing occurs. In addition, it is sent ten times per second to facilitate recovery from transmission error, switched video multipoint conferencing, and channel hopping. Furthermore, it is assumed that the PES packet format is commonly applied to both Program and Transport Streams, thus the PES packet rate complies with the value for the CSPS (constrained system parameter stream): 300 packets per second at maximum.

2.1 Elementary streams and their bit rate values

Medium	Bit rate (kbit/s)	Coding law	Note
Audio	64	G.722	
Video	4575	H.262 ISO/IEC 13818-2	-Synchronous with audio
Data	64	JPEG high resolution still pictures	-Asynchronous with audio -Data channel is assumed to be always open
Control	16	H.24X H.23X	-ITU-T auxiliary data -Synchronous with audio -For in-channel negotiation, control, indication, transfer mode change

2.2 Network

- CBR at 5 Mbit/s

2.3 Packetization delay

We are concerned with packetization delay due to the packet multiplex of audio, video and other signals. Since the audio bit rate is much lower than the video rate and the PES packet rate is restricted, audio determines the packetization delay.

2.4 Packet assignment in PES layer

Medium	Bit rate (kbit/s)	Number of PES packets per second	Packet length(byte) *
Audio***	64	125	64 + 14
Video***	4575	130.1	4397 + 19
Data***	64	10	800 + 9
Control	16	16	125 + 14
Overhead**	36.287 (0.8 %)		
Total	4755.29	281.1	

* The packet length indicates (data bytes) + (overhead bytes).

** Overhead includes header bytes and stuffing bytes.

*** In order to simplify packetization, Audio, Video and Data packet lengths are fixed.

2.5 Packet assignment in TS layer

Medium	Bit rate (kbit/s)	Number of TS packets per second	Average rate (kbit/s)
Audio	64	125	188.000 (125*188*8)
Video	4575	3121.4	4694.655 (3121.4*188*8)
Data	64	50	75.200 (50*188*8)
Control	16	16	24.064 (16*188*8)
PAT, PMT		4	6.016 (2*2*188*8)
Null Packet		8.1	12.065 (8.1*188*8)
Total	4719 (94.38 %)	3324.5	5000

2.6 PID assignment in TS layer

Contents	PID	Note
Program Association Table	0000 h	fixed
Program Map Table	0010 h	user defined
Video ES	0011 h	user defined
Audio ES	0012 h	user defined
Control ES	0013 h	user defined
Data ES	0014 h	user defined

2.7 Descriptors in the Program Map Table

See the companion contribution AVC-692 [2].

3 Packetization algorithm

- 1) As soon as 64 bytes of the audio signal are stored in the buffer, an Audio TS packet is sent.
- 2) When a C&I event occurs, a Control TS packet is sent just after the earliest available Audio TS packet.
- 3) When 182 bytes of the data signal are stored in the buffer, a Data TS packet is sent just after the earliest available Audio TS packet. If a Control TS packet is also available at that time, the Data TS packet is sent just after the Control TS packet.

- 4) Video signal is sent by forming TS packets occupying between the end of Control or Data TS packet and the beginning of Audio TS packet.
- 5) If the whole payload of a TS packet is not available at the time of its transmission, stuffing bytes are inserted.
- 6) If the multiplex buffer approaches underflow, a Null TS packet is sent.

4 Discussion points

- 1) What kind of descriptor in the program is necessary for H.32X terminals? e.g. terminal type information.
- 2) What kind of descriptor in the data elementary stream is necessary for H.32X terminals? e.g. Fax or JPEG etc.

Note) In this paper we assume that the data such as Fax and JPEG is sent via the multiplexed MPEG Transport stream. It is an open issue through what channel the data such as Fax and JPEG is sent.

- 3) What kind of mechanism for synchronization between audiovisual signal and control signal is necessary for H.32X terminals? Presentation Time Stamp in PES or Control data with Presentation Time Stamp? See the companion contribution AVC-693, 694.
- 4) What protocol should be used for ITU-T Auxiliary Data? e.g. T.120 series.
- 5) What kinds of coding law in audio program are applicable for H.32X terminals? e.g. MPEG Audio.

5 Conclusion

A case study has been carried out when H.222.0 Transport Stream is used as a possible multimedia multiplexing method for high quality videoconferencing service. Transmission efficiency of 94 % and packetization delay of 10 ms have been obtained. Several discussion points have also been raised. They should be urgently discussed and decided what functions we should require to H.222.1.

Reference

- [1] AVC-673R Report of the sixteenth experts group meeting in Grimstad - Part 1 and Part 2, July 1994, Grimstad
- [2] AVC-692 Proposal for ITU-T_stream_descriptors (Japan), Nov. 1994, Singapore

Table 1 Video packet in Transport layer

Syntax	No. of Bits	Codeword bin/hex/dec	Note
sync_byte	8	47 h	Video ES
transport_error_indicator	1	0 b	
payload_unit_start_indicator	1	0 b	
transport_priority	1	0 b	
PID	13	0011 h	
transport_scrambling_control	2	00 b	
adaptation_field_control	2	01 b	
continuity_counter	4	x h	
data_byte	8*184		sequential increment

Table 2 Audio packet in Transport layer

Syntax	No. of Bits	Codeword bin/hex/dec	Note
sync_byte	8	47 h	Audio ES
transport_error_indicator	1	0 b	
payload_unit_start_indicator	1	1 b	
transport_priority	1	0 b	
PID	13	0012 h	
transport_scrambling_control	2	00 b	
adaptation_field_control	2	11 b	
continuity_counter	4	x h	
adaptation_field_length	8	69 h	105
discontinuity_indicator	1	0 b	
random_access_indicator	1	0 b	
elementary_stream_priority_indicator	1	0 b	
PCR_flag	1	1 b	
OPCR_flag	1	0 b	
splicing_point_flag	1	0 b	
transport_private_data_flag	1	0 b	
adaptation_field_extension_flag	1	0 b	
program_clock_reference_base	33	xxxxxxxx h	
reserved	6	111111 b	
program_clock_reference_extension	9	xxx h	
stuffing_byte	98*8	FF h	
data_byte	78*8		

Table 3 Data packet in Transport layer

Syntax	No. of Bits	Codeword bin/hex/dec	Note
sync_byte	8	47 h	Data ES
transport_error_indicator	1	0 b	
payload_unit_start_indicator	1	1 b	
transport_priority	1	0 b	
PID	13	0014 h	
transport_scrambling_control	2	00 b	
adaptation_field_control	2	11 b	
continuity_counter	4	x h	
adaptation_field_length	8	1,66 h	1 or 102
discontinuity_indicator	1	0 b	
random_access_indicator	1	0 b	
elementary_stream_priority_indicator	1	0 b	
PCR_flag	1	1 b	
OPCR_flag	1	0 b	
splicing_point_flag	1	0 b	
transport_private_data_flag	1	0 b	
adaptation_field_extension_flag	1	0 b	
stuffing_byte	0, 101*8	FF h	
data_byte	182,81*8		81 ; last TS packet in PES packet

Table 4 ITU-T auxiliary data packet in Transport layer

Syntax	No. of Bits	Codeword bin/hex/dec	Note
sync_byte	8	47 h	Control ES
transport_error_indicator	1	0 b	
payload_unit_start_indicator	1	0 b	
transport_priority	1	0 b	
PID	13	0013 h	
transport_scrambling_control	2	00 b	
adaptation_field_control	2	11 b	
continuity_counter	4	x h	
adaptation_field_length	8	xx h	181-M
discontinuity_indicator	1	0 b	
random_access_indicator	1	0 b	
elementary_stream_priority_indicator	1	0 b	
PCR_flag	1	0 b	
OPCR_flag	1	0 b	
splicing_point_flag	1	0 b	
transport_private_data_flag	1	0 b	
adaptation_field_extension_flag	1	0 b	
stuffing_byte	(182-M)*8	FF h	
data_byte	M*8		variable length information

Table 5 Program Association Table in Transport layer

Syntax	No. of Bits	Codeword bin/hex/dec	Note
sync_byte	8	47 h	PAT
transport_error_indicator	1	0 b	
payload_unit_start_indicator	1	1 b	
transport_priority	1	0 b	
PID	13	0000 h	
transport_scrambling_control	2	00 b	
adaptation_field_control	2	11 b	
continuity_counter	4	x h	
adaptation_field_length	8	A6 h	
discontinuity_indicator	1	0 b	
random_access_indicator	1	0 b	
elementary_stream_priority_indicator	1	0 b	
PCR_flag	1	0 b	
OPCR_flag	1	0 b	Program_association _section
splicing_point_flag	1	0 b	
transport_private_data_flag	1	0 b	
adaptation_field_extension_flag	1	0 b	
stuffing_byte	165*8	FF h	
pointer	8	00 h	
table_id	8	00 h	
section_syntax_indicator	1	1 b	13 User defined
'0'	1	0 b	
reserved	2	11 b	
section_length	12	00D h	
transport_stream_id	16	0000 h	
reserved	2	11 b	
version_number	5	00 h	
current_next_indicator	1	x b	
section_number	8	00 h	
last_section_number	8	00 h	
program_number	16	0001 h	User defined
reserved	3	111 b	
program_map_PID	13	0010 h	
CRC_32	32	xxxxxxx h	PMT

Table 6 Program Map Table in Transport layer

Syntax	No. of Bits	Codeword bin/hex/dec	Note
sync_byte	8	47 h	PMT
transport_error_indicator	1	0 b	
payload_unit_start_indicator	1	1 b	
transport_priority	1	0 b	
PID	13	0010 h	
transport_scrambling_control	2	00 b	
adaptation_field_control	2	11 b	
continuity_counter	4	x h	129
adaptation_field_length	8	81 h	
discontinuity_indicator	1	0 b	
random_access_indicator	1	0 b	
elementary_stream_priority_indicator	1	0 b	
PCR_flag	1	0 b	
OPCR_flag	1	0 b	
splicing_point_flag	1	0 b	
transport_private_data_flag	1	0 b	
adaptation_field_extension_flag	1	0 b	
stuffing_byte	128*8	FF h	128
pointer	8	00 h	program_map_section
table_id	8	02 h	
section_syntax_indicator	1	1 b	13
'0'	1	0 b	
reserved	2	11 b	
section_length	12	00D h	
program_number	16	0001 h	
reserved	2	11 b	
version_number	5	xx h	
current_next_indicator	1	x b	for the renewal of this table
section_number	8	00 h	for the renewal of this table
last_section_number	8	00 h	
reserved	3	111 b	
PCR_PID	13	0012 h	Audio Packet
reserved	4	1111 b	
program_info_length	12	000 h	Nothing for Now
stream_type	8	02 h	H.262
reserved	3	111 b	
elementary_PID	13	0011 h	Video Packet
reserved	4	1111 b	
ES_info_length	12	005 h	
descriptor_tag	8	02 h	video_stream_descriptor
descriptor_length	8	03 h	
multiple_frame_rate_flag	1	0 b	single frame rate
frame_rate_code	4	4 h	29.97 Hz
MPEG_2_flag	1	1 b	MPEG2
constrained_parameter_flag	1	0 b	
still_picture_flag	1	0 b	
profile_and_level_indication	8	58 h	SP@ML
chroma_format	2	01 b	4:2:0

frame_rate_extension_flag	1	0 b	
reserved	5	11111 b	
stream_type	8	09 h	ITU-T Auxiliary
reserved	3	111 b	
elementary_PID	13	0012 h	Audio Packet
reserved	4	1111 b	
ES_info_length	12	004 h	
descriptor_tag	8	65 h	ITU-T Audio tag (New)
descriptor_length	8	02 h	
coding_algorithm	8	04 h	G.722 Mode 1 (New)
reserved	8	FF h	(New)
stream_type	8	09 h	ITU-T auxiliary
reserved	3	111 b	
elementary_PID	13	0013 h	Control Packet
reserved	4	1111 b	
ES_info_length	12	004 h	
descriptor_tag	8	67 h	ITU-T Control (New)
descriptor_length	8	02 h	
protocol	8	01 h	H.24X, H.23X (New)
reserved	8	FF h	(New)
stream_type	8	09 h	ITU-T auxiliary
reserved	3	111 b	
elementary_PID	13	0014 h	Data Packet
reserved	4	1111 b	
ES_info_length	12	004 h	
descriptor_tag	8	66 h	ITU-T Data (New)
descriptor_length	8	02 h	
reserved	16	FFFF h	(New)
CRC_32	32	xxxxxxxx h	

Table 7 Video packet in PES layer

Syntax	No. of Bits	Codeword bin/hex/dec	Note
packet_start_code_prefix	24	000001 h	
stream_id	8	E0 h	H.262
PES_packet_length	16	1135 h	4405
'10'	2	10 b	
PES_scrambling_control	2	00 b	
PES_priority	1	0 b	
data_alignment_indicator	1	0 or 1 b	
copyright	1	0 b	
original_or_copy	1	1 b	
PTS_DTS_flags	2	00 / 10 b	10 b; with PTS
ESCR_flag	1	0 b	
ES_rate_flag	1	0 b	
DSM_trick_mode_flag	1	0 b	
additonal_copy_info_flag	1	0 b	
PES_CRC_flag	1	0 b	
PES_extension_flag	1	0 b	
PES_header_data_length	8	0A h	

data_alignment_indicator	1	0 b	no PTS/DTS
copyright	1	0 b	
original_or_copy	1	1 b	
PTS_DTS_flags	2	00 b	
ESCR_flag	1	0 b	
ES_rate_flag	1	0 b	
DSM_trick_mode_flag	1	0 b	
additonal_copy_info_flag	1	0 b	
PES_CRC_flag	1	0 b	
PES_extension_flag	1	0 b	
PES_header_data_length	8	0 h	
PES_packet_data_byte	800*8		

Table 10 ITU-T auxiliary data in PES layer

Syntax	No. of Bits	Codeword bin/hex/dec	Note
packet_start_code_prefix	24	000001 h	ITU-T auxiliary data 128
stream_id	8	F4 h	
PES_packet_length	16	0080 h	
'10'	2	10 b	
PES_scrambling_control	2	00 b	
PES_priority	1	0 b	
data_alignment_indicator	1	0 b	
copyright	1	0 b	
original_or_copy	1	1 b	
PTS_DTS_flags	2	00 / 10 b	
ESCR_flag	1	0 b	
ES_rate_flag	1	0 b	
DSM_trick_mode_flag	1	0 b	10 b; with PTS
additonal_copy_info_flag	1	0 b	
PES_CRC_flag	1	0 b	
PES_extension_flag	1	0 b	
PES_header_data_length	8	0A h	
'0010' *	4	0010 b	
PTS [32..30] *	3	x h	
marker_bit *	1	1 b	
PTS [29..15] *	15	xxxx h	
marker_bit *	1	1 b	
PTS [14..0] *	15	xxxx h	
marker_bit *	1	1 b	
stuffing_byte	0,5*8	FF h	0; with PTS
PES_packet_data_byte	64*8		

* When PTS_DTS_flags is '00 b', these fields don't exist.