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ATSC Candidate Standard: Part 2 of Proposed Doc. A/72, "AVC Video Transport Subsystem Characteristics"

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The Advanced Television Systems Committee, Inc., is an international, non-profit organization developing voluntary standards for digital television. The ATSC member organizations represent the broadcast, broadcast equipment, motion picture, consumer electronics, computer, cable, satellite, and semiconductor industries.

Specifically, ATSC is working to coordinate television standards among different communications media focusing on digital television, interactive systems, and broadband multimedia communications. ATSC is also developing digital television implementation strategies and presenting educational seminars on the ATSC standards.

ATSC was formed in 1982 by the member organizations of the Joint Committee on InterSociety Coordination (JCIC): the Electronic Industries Association (EIA), the Institute of Electrical and Electronic Engineers (IEEE), the National Association of Broadcasters (NAB), the National Cable Television Association (NCTA), and the Society of Motion Picture and Television Engineers (SMPTE). Currently, there are approximately 140 members representing the broadcast, broadcast equipment, motion picture, consumer electronics, computer, cable, satellite, and semiconductor industries.

ATSC Digital TV Standards include digital high definition television (HDTV), standard definition television (SDTV), data broadcasting, multichannel surround-sound audio, and satellite direct-to-home broadcasting.

About the Candidate Standard

This specification is being put forth as a Candidate Standard by the TSG/S8 Specialist Group on Data Multiplex and Transport. ATSC members and non-members are encouraged to review and implement this specification and return comments to cs_amend_editor@atsc.org. ATSC Members can also send comments directly to the TSG/S8 Specialist Group. The ATSC believes this specification is stable. It is expected to progress to Proposed Standard within a period of time ending 31 December 2008.

Advisory Notice

In issuing this standard, the ATSC recognizes that it includes encoding and decoding techniques for digital television transmission which are not backwards compatible with existing MPEG-2-based ATSC DTV deployments. Transitional issues associated with continuing service to existing receivers, how and when to deploy advanced-capability receivers, allocation of channel bit capacity, and related issues should be considered. ATSC recognizes that this standard will be utilized more readily in countries that have not yet implemented digital terrestrial television broadcasting systems, or in countries that have achieved internal agreement on a transition plan.

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1. SCOPE

This Part describes the transport of ATSC A/73-1 ("AVC") video in the ATSC Digital Television System. The syntax and semantics of this specification conform to ATSC A/53-3 [2], with additional constraints specified in this standard. "AVC" in this Part 2 refers to the constrained version of ITU-T Rec. H.264 | ISO/IEC 14496-10 [5] as defined in Part 1 of this Standard.

2. REFERENCES

At the time of publication, the editions indicated were valid. All standards are subject to revision and amendment, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

2.1 Normative References

The following documents contain provisions that in whole or in part, through reference in this text, constitute provisions of this standard.

[1] ATSC: A/53 Part 1:2007, "ATSC Digital Television Standard, Part 1 – Digital Television System," Advanced Television Systems Committee, Washington, D.C., 3 January 2007.

[2] ATSC: A/53 Part 4:2007, "ATSC Digital Television Standard, Service Multiplex and Transport Subsystem Characteristics," Advanced Television Systems Committee, Washington, D.C., 3 January 2007.

[3] ISO/IEC 13818-1:2000 (E), International Standard, Information technology – Generic coding of moving pictures and associated audio information: Systems.

[4] ISO/IEC 13818-1:2000/Amd.3:2004(E) Information technology – Generic coding of moving pictures and associated audio information: Systems - Amendment 3.

[5] ITU-T Rec. H.264 | ISO/IEC 14496-10:2005(E) - AVC – International Standard for Advanced Video Coding.

[6] SCTE xxx-2008 (formerly DVS/683r3) [in progress], AVC Video Systems and Transport Constraints for Cable Television.

[7] ATSC: "Program and System Information Protocol for Terrestrial Broadcast and Cable, with Amendment No. 1," Doc. A/65C, Advanced Television Systems Committee, Washington, D.C., 9 May 2006.

[8] ATSC: "ATSC Parameterized Services Standard," Doc. A/71, Advanced Television Systems Committee, 26 March 2007.

[9] ATSC: A/72 Part 1:200x, "Video System Characteristics of AVC in the ATSC Digital Television System," Advanced Television Systems Committee, Washington, D.C. (in process).

2.2 Informative References

[10] ATSC: "Data Broadcast Standard," Doc. A/90, Advanced Television Systems Committee, Washington, D.C., 26 July 2000.

[11] ETSI TS 101 154 V1.8.1 (5-2007): DVB: Implementation Guidelines for the use of video and audio coding in Broadcast applications based on the MPEG-2 transport stream.

[12] ATSC: A/53 Part 2:2007, "ATSC Digital Television Standard, RF/Transmission System Characteristics," Advanced Television Systems Committee, Washington, D.C., 3 January 2007.

[13] CEA: CEA-708-C, "Digital Television (DTV) Closed Captioning," Consumer Electronics Association, Arlington, VA, 30 July 2006.

3. COMPLIANCE NOTATION

As used in this document, "shall" denotes a mandatory provision of the standard. "Should" denotes a provision that is recommended but not mandatory. "May" denotes a feature whose presence does not preclude compliance that may or may not be present at the option of the implementer.

4. DEFINITIONS

All the provisions of A/53, Part 1 [1], Section 3 shall apply when any such provisions or definitions are used in this Part.

5. SYSTEM OVERVIEW (INFORMATIVE)

The transport format and protocol for the ATSC Digital Television Standard is a compatible subset of the MPEG-2 Systems specification defined in ISO/IEC 13818-1 [3]. It is based on a fixed-length packet Transport Stream approach which has been defined and optimized for digital television delivery applications.

The reader is referred to Section 5 of A/53-3 [2] for additional information on the System Overview.

Not shown explicitly in A/53-2 Figure 5.1 [2], but essential to the practical implementation of this Standard, is a control system that manages the transfer and processing of the elementary streams from the application encoders. The rules followed by this control system are not a part of this Standard. The output of the control system implementation shall conform to the MPEG-2 Transport Stream coding as specified in ISO/IEC 13818-1 [3] with the additional constraints specified in this Standard.

6. SPECIFICATION

This section of the standard describes the coding constraints that apply to the use of the MPEG-2 systems specification [3] in the digital television system.

6.1 MPEG-2 Systems Standard Usage

The transport subsystem shall comply with the Transport Stream definition of the MPEG-2 Systems standard as specified in ISO/IEC 13818-1 [3] and shall be further constrained as specified in ATSC A/53-3 [2] and herein. Program shall mean the collection of all elements

within the emission that have the same value of MPEG-2 program_number, independent of the methods used to propagate the program elements.

The stream_type value for AVC video program elements shall be as defined in Amendment 3 to ISO/IEC 13818-1:2000 [4] which is 0x1B. The video T-STD for AVC shall be as defined in Section 2.14.3.1 of ISO/IEC Amendment 3 to 13818-1:2000 [4] and shall follow the constraints for the profile and level encoded in the video elementary stream in Appendix A of ISO/IEC 14496-10 [5].

An AVC Access Point, as defined in Section 6.1.3 of ATSC A/72-1 [9], shall occur at least once per second. See also SCTE xxx [6] Section 6.4.1 for additional background.

Video streams of stream_type 0x1B shall be identified and constrained as described hereinafter.

6.2 Constraints on PSI

All program elements in the Transport Stream are described in the PSI and shall conform to the requirements of ATSC A/53-3 [2] and the following:

- When the video elementary stream_type is equal to 0x1B the descriptor loop immediately following ES_info_length in the TS_program_map_section() shall contain the AVC video_descriptor() described in Section 2.6.54 of ISO/IEC 13818-1 [4] with the AVC_24_hour_picture_flag set to '0'. For video sequences that contain AVC still pictures, the AVC_still_present field shall be set to '1' in this descriptor; otherwise this flag shall be set to '0'.
- When the video elementary stream_type is equal to 0x1B, the data_stream_alignment_descriptor is not required, except as specified in Section 6.4.
- When private data bytes of the adaptation field of the TS packets are in use, with tag, length, and data structures as defined in Section 6.4.2 of SCTE xxx [6], the descriptor loop immediately following ES_info_length in the TS_program_map_section() shall contain the SCTE_adaptation_field_data_descriptor as described in Section 6.3.2.3 of SCTE xxx [6]. In the absence of such adaptation field private data, the descriptor shall not be included in the corresponding ES_info_loop of the PMT.

6.3 Virtual Channels and Parameterized Services

Any virtual channel referencing an MPEG-2 program carrying a video component of stream_type 0x1B shall identify such channel within all transmitted VCTs (TVCT and/or CVCT per A/65 [7]). The service_type value for all such virtual channels shall be set to 0x07. Such virtual channels (including their signaling) shall comply with the ATSC A/71 Parameterized Services Standard [8].

For Virtual Channels signaled as being service_type 0x07, as required by A/71 [8] there is a component_list_descriptor() present in the descriptor loop following the descriptors_length field in the virtual channel descriptor loop of any terrestrial_virtual_channel_table_section() or cable_virtual_channel_table_section(). For each stream_type present in inner loop of the component_list_descriptor(), there shall be a stream_info_details() present.

The contents of the stream_info_details() for stream_type 0x1B shall be structured as shown in Table 6.1.

Table 6.1 Stream Information Details Syntax for AVC video

Syntax	No. of Bits	Format
stream_info_details() {		
AVC_profile	2	uimsbf
level_idc	6	uimsbf
caption_data_rate	3	uimsbf
reserved	5	uimsbf
}		

Note: This structure may be extended in the future. Such extensions will be added by either defining uses for the reserved bits or adding new bytes to the end of the structure. Readers should also consult the list maintained by the ATSC Code Points Registrar.

AVC_profile — This is a two-bit unsigned integer field encoding a range of values for profile_idc from Table 6.3 of ATSC A/72-1 [9]. Values shall indicate the AVC Profile in use: '01' = Baseline (for the value of profile_idc = 66); '10' = Main (for the value of profile_idc = 77); and '11' = High (for the value of profile_idc = 100). As specified in Section 6, all receiving devices that support a higher binary-numbered profile must support all lower numbered profiles. The highest profile that will be used for the virtual channel associated with the component_list_descriptor() carrying this stream_info_details() shall be sent.

level_idc — This is a six-bit unsigned integer field. Values shall be as defined in Table 6.3 of ATSC A/72-1 [9]. As specified in A/72-1, all receiving devices that support a higher binary-numbered level must also support a lower numbered level. The highest level that will be used for the virtual channel associated with the component_list_descriptor() carrying this stream_info_details() shall be sent.

caption_data_rate — This is a three-bit unsigned integer field specifying the transport rate for CEA-708 [13] caption data. The values shall be per Table 6.2 below. Non-zero values shall indicate rates less than 9600 bps when defined.

Table 6.2 CEA-708 Caption Data Rate Values

CEA-708 transport bitrate	caption_data_rate values
9600 bps	'000'
reserved	'001'-'111'

6.4 PES Constraints

Packetized Elementary Stream syntax and semantics shall conform to the requirements of ATSC A/53-3 [2]. For streams of stream_type 0x1B, each PES packet shall contain only one AVC access unit start, as defined in Sections 2.1.3 and 2.14.1 of ISO/IEC 13818-1:2000 with Amendment 3 [4], unless multiple access units fit into the payload of a single transport packet. Section 6.4.1 specifies the constraints for the case when multiple access units are placed in a PES packet. The access unit start code is not required to be aligned with the PES packet header (to avoid overhead for low bit rate and SDTV resolutions) and alignment of the access unit to PES packet header shall be signaled using the data_alignment_descriptor in the PMT (see Section 6.2). Each PES header

shall contain a PTS and DTS if DTS differs from the PTS. The PES packet shall be void of video picture data only when transmitted in conjunction with the discontinuity_indicator to signal that the continuity_counter may be discontinuous.

Within the PES packet header, the following restrictions apply:

- The PES_packet_length shall be coded as '0x0000'.
- If the data_stream_alignment_descriptor is present in the PMT, then the data_alignment_indicator shall be set to '1'

6.4.1 Multiple Access Units in a PES Packet

When a PES packet contains multiple access unit starts, for any access unit starts following the first access unit start in the same PES packet, the ISO/IEC 14496-10 [5] syntax elements num_units_in_tick, time_scale, pic_struct (if present), and the value of syntax variables TopFieldOrderCnt and BottomFieldOrderCnt of the access unit shall allow the derivation of PTS and DTS for that access unit.

6.4.2 Adaptation Field Private Data

As defined in Section 6.4.2 and Appendix A of SCTE xxx [6], the AU_information() structure may be placed into the Adaptation Field Private Data of the TS packet carrying PES data. When this structure is placed in the TS packet, the SCTE_adaptation_field_data_descriptor shall appear in the PMT as specified in Section 6.2.

6.5 Support for Still Pictures

AVC still pictures may be used and when used shall be constrained as follows:

- The still picture coding shall comply with the definitions in AMD-3 to ISO/IEC 13818-1:2000 [4] section 2.1.5 and 2.14.3.1.
- low_delay_hrd_flag (as defined in ISO/IEC 14496-10 [5]) can be either set to '0' or '1'. For still picture applications, it is recommended that the low_delay_hrd_flag be set to '0'.
- If a PES packet contains any part of a still picture, it shall contain the complete access unit with the still picture, and no part of any other access unit. This access unit shall be aligned to the PES packet header, which shall contain a coded PTS value[1].
- The time interval between successive still pictures shall be less than or equal to 60 seconds.
- The PMT for this program element shall include the AVC_video_descriptor with the AVC_still_present flag set to '1'.

-- End of document --

[1] As in MPEG-2 based systems, even though the PTS values between successive still pictures increase monotonically, this may not be true near the rollover period of system clock.