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**Working Draft:  
Part 2 of Proposed Doc. A/73,  
“VC-1 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.

### **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, Part 1 (“VC-1”) video in the ATSC Digital Television System. The syntax and semantics of this Standard conform to A/53 Part 3. “VC-1” in this Part 2 refers to the constrained version of SMPTE 421M [9] 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 3:2007, “ATSC Digital Television Standard, Service Multiplex and Transport Subsystem Characteristics,” Advanced Television Systems Committee, Washington, D.C., 3 January 2007.
- [3] SMPTE: RP227-2007, “VC-1 Bitstream Transport Encodings,” Society of Motion Picture and Television Engineers, White Plains, N.Y., 2007.
- [4] ATSC: A/73, Part 1:2008, Proposed Doc. A/73, “Video System Characteristics of VC-1 in the ATSC Digital Television System,” Advanced Television Systems Committee, Washington, D.C. <date> [this document is at ballot].
- [5] ATSC: “ATSC Parameterized Services Standard,” Doc. A/71, Advanced Television Systems Committee, Washington, D.C., 26 March 2007.
- [6] ATSC: “Program and System Information Protocol for Terrestrial Broadcast and Cable, Rev. C., with Amendment No. 1,” Doc. A/65C, Advanced Television Systems Committee, Washington, D.C., 2 January 2006 (Amendment No. 1 dated 9 May 2006).
- [7] SCTE: SCTE 128 2007, “AVC Video Systems and Transport Constraints for Cable Television” (Public Review closes 2/11/08).
- [8] ETSI: “TS 101 154 V1.8.1 (7-2007): DVB: Implementation Guidelines for the use of video and audio coding in Broadcast applications based on the MPEG-2 transport stream.”

## 2.2 Informative References

- [9] SMPTE: 421M:2006, “VC-1 Compressed Video Bitstream Format and Decoding Process<sup>1</sup>,” Society of Motion Picture and Television Engineers, White Plains, N.Y., 2006.
- [10] ISO/IEC 13818-1:2000, International Standard, Information technology – Generic coding of moving pictures and associated audio information: Systems
- [11] 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 and the definitions of SMPTE RP227 [3], Section 3.4 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 [10]. 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, Part 3 [2] for additional information on the System Overview.

Not shown explicitly in A/53, Part 3 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.

## 6. SPECIFICATION

VC-1 shall be encoded into the ATSC Transport Stream as provided in SMPTE RP227 [3] with the additional constraints and extensions as defined herein.

An overview of the ATSC Digital Television System can be found in A/53, Part 1 [1] section 5, and an overview of the ATSC Transport Stream layer can be found in A/53, Part 3 [2] section 5.

For the ATSC Transport Stream, the audio elementary streams (e.g., AC-3) and Program System Information (PSI) are encoded according to A/53, Part 3 [2] Sections 6, 7 and 8.

Each VC-1 Program Element shall be identified by using the `stream_type` value defined in RP227 [3] wherever a VC-1 stream is signaled. RP 227 [3] defines the value 0xEA for the VC-1 `stream_type`.

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<sup>1</sup> This is normatively included through ATSC A/73, Part 1 [4] and SMPTE RP227 [3].

VC-1 video streams shall be identified and constrained as hereinafter.

## 6.1 PSI Constraints

### 6.1.1 MPEG-2 Registration Descriptor

The MPEG-2 Registration descriptor shall be used as defined by RP227 [3]. RP227 requires the MPEG-2 Registration Descriptor `format_identifier` be set to 0x56432D31 (“VC-1”) and be inserted into the PMT after the `ES_info_length` field for each VC-1 Elementary Stream. Various Registration Descriptor sub-descriptors are defined in RP227 [3]. Their use shall be further constrained as follows:

- The `sd_alignment()` subdescriptor shall be included if and only if the video stream has been encoded with one of the VC-1 alignment options, and the PES `data_alignment_indicator` is set to 1.
- The `sd_profile_level()` subdescriptor shall be included.
- The `sd_buffer_size()` subdescriptor shall be included.
- The `sd_still_picture()` subdescriptor shall be included if the elementary stream contains still pictures.

Note that A/53, Part 3 [2], Section 6.2.1 for all ATSC Transport Streams, only permits one Registration Descriptor per descriptor loop and hence the multiple descriptor capabilities of RP227 [3] are not permitted.

### 6.1.2 Program Smoothing Buffer Descriptor

A smoothing buffer descriptor shall be used as defined in A/53, Part 3 [2], Section 6.8.2.

### 6.1.3 Adaptation Field Data Descriptor

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 128 [7] (see Section 6.3), 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 128 [7]. In the absence of such adaptation field private data, the descriptor shall not be included in the corresponding `ES_info_loop` of the PMT.

## 6.2 PES Constraints

The PES header and PES header extension fields shall be constrained as defined in A/53, Part 3 [2], sections 6.5 and 6.5.1, except for the `data_alignment_indicator`.

The `data_alignment_indicator` may be coded as '0' to indicate that any type of alignment, including no alignment, may exist between VC-1 data structures and PES packets. The `data_alignment_indicator` may also be coded as '1', which indicates that the payload bytes immediately following the PES header use one of the VC-1 alignment options. The `sd_alignment()` subdescriptor in the MPEG-2 Registration Descriptor (see 6.1.1 and RP227 [3]) defines the particular alignment option in use for the elementary stream.

Each PES packet header shall contain a PTS and additionally, it may contain a DTS as appropriate. A PES packet carrying VC-1 data shall contain zero or more bytes from VC-1 Video Access Units. It may have a fraction of a Video Access Unit, exactly one Video Access Unit or more than one Video Access Unit. A PES packet shall be void of VC-1 Video Access

Unit data only when transmitted in conjunction with the `discontinuity_indicator` to signal that the `continuity_counter` may be discontinuous.

### 6.3 Adaptation Field Constraints

As defined in Annex D of ETSI TS 101 154 [8], the `AU_information()` structure may be placed into the Adaptation Field Private Data of each TS packet carrying PES data. When this structure is placed in the PES packet header, the `SCTE_adaptation_field_data_descriptor` shall appear in the PMT as specified in Section 6.1.

### 6.4 Virtual Channels and Parameterized Services

Any virtual channel referencing an MPEG-2 Program carrying a VC-1 video component shall identify such channel within all transmitted VCTs (TVCT and/or CVCT per A/65 [6]). The `service_type` value for all such virtual channels shall be set to 0x07. Such virtual channels shall comply with the ATSC A/71 Parameterized Services Standard [5].

For Virtual Channels signaled as `service_type` 0x07, as required by A/71 [5] there is a `component_list_descriptor()` present following the `descriptors_length` field in the virtual channel descriptor loop in the 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()`, a `stream_info_details()` structure for the `stream_type` that is being or will be used is required by A/71 to be present.

The contents of the `stream_info_details()` for VC-1 Program Elements shall be as defined in Table 6.1. The `sd_profile_level()` structure shall be the sub-descriptor defined in RP227 [3] and shall match the VC-1 Program Elements. See A/71 for constraints on what must be signaled when `sd_profile_level()` varies over a time period.

**Table 6.1** Stream Information Details Syntax for VC-1

Syntax	No. of Bits	Format
<code>stream_info_details() {</code>		
<b>sd_profile_level()</b>		
<b>caption_data_rate</b>	3	uimsbf
<b>reserved</b>	5	uimsbf
<code>}</code>		

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 in the ATSC Code Points Register.

**caption\_data\_rate** – This is a three-bit unsigned integer field specifying the transport rate for CEA-708 [11] 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** caption\_data\_rate Values

<b>CEA-708 Transport Bitrate</b>	<b>Caption_data_rate value</b>
9600 bps	'000'
Reserved	'001'-'111'

## 6.5 Still Picture Support

Still pictures shall be supported according to RP227 [3].

When HRD\_PARAM\_FLAG is set to '1' and VC-1 still pictures are present in the VC-1 elementary stream, a receiver with fixed frame display rate capability should repeat the previously decoded picture when the next decoded picture is not completely available at the next display period.

Note: In applications that use low delay and still pictures, receivers with fixed frame rate display should repeat the previously decoded picture until a new picture is received.

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