



***Society of Cable  
Telecommunications  
Engineers***

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**ENGINEERING COMMITTEE  
Digital Video Subcommittee**

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**AMERICAN NATIONAL STANDARD**

**ANSI/SCTE 214-2 2016**

**MPEG DASH for IP-Based Cable Services  
Part 2: DASH/TS Profile**

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# 1. Scope

This standard is part of a suite documenting use of MPEG DASH in cable networks.

This document is not a standalone standard – the complete DASH/TS profile is a combination of this document and SCTE 214-1. The latter document defines restrictions on the MPD that are container-independent, applying to both MPEG-2 TS and ISO-BMFF segments.

This document defines DASH/TS – a profile of MPEG DASH which uses MPEG-2 TS segments. In addition, this profile integrates elements of SCTE specifications, on which define media formats and digital program insertion. This profile is based on of the philosophy of DASH MPEG-2 TS Simple Profile and is similar in its approach to the Common ISO-BMFF Profile.

In addition to the features specified in ISO 23009-1 for the MPEG-2 TS Simple Profile, the following features are specified for use in the DASH/TS profile:

- Features added in 2<sup>nd</sup> edition of MPEG DASH, in particular events (sec. 5.10);
- XLink (which was excluded from Simple and Main MPEG-2 TS profiles in ISO/IEC 23009-1)

Several additional restrictions were added in this document and in SCTE 214-1 in order to simplify implementations and make seamless switching realistically attainable.

## 2. Normative References

### 2.1. SCTE References

ANSI/SCTE 35 2014, Digital Program Insertion Cueing Message for Cable

ANSI/SCTE 128-1 2013, AVC Video Constraints for Cable Television Part 1: Coding

ANSI/SCTE 128-2 2013, AVC Video Constraints for Cable Television Part 2: Transport

ANSI/SCTE 193-1 2014, MPEG-4 AAC Family Audio System – Part 1 Coding Constraints for Cable Television

ANSI/SCTE 193-2 2014, MPEG-4 AAC Family Audio System – Part 2 Constraints for Carriage over MPEG-2 Transport

ANSI/SCTE 194-1 2013, DTS-HD System – Part 1: Coding Constraints for Cable Television

ANSI/SCTE 194-2 2014, DTS-HD System – Part 2: Constraints for Carriage over MPEG-2 Transport

SCTE 215-1 2015, HEVC Video Constraints for Cable Television, Part 1- Coding

SCTE 214-1 2016, MPEG DASH for IP-Based Cable Services Part 1: MPD Constraints and Extensions

SCTE 214-3 2015, MPEG DASH for IP-Based Cable Services Part 3: DASH/FF Profile

### 2.2. Standards from other Organizations

ATSC A/53 Part 5 ATSC Digital Television Standard, Part 5 – AC-3 Audio System Characteristics

ATSC A/65 ATSC Standard: Program and System Information Protocol for Terrestrial Broadcast and Cable

ISO/IEC 23009-1:2014 2<sup>nd</sup> Ed., Information technology -- Dynamic adaptive streaming over HTTP (DASH) -- Part 1: Media presentation description and segment formats (incl. ISO/IEC 23009-1:2014/COR1:2015, ISO/IEC 23009-1:2014/COR2:2015, ISO/IEC 23009-1:2014/AMD1:2015, ISO/IEC 23009-1:2014/AMD2:2015, and ISO/IEC 23009-1:2014/AMD3:2016).

ITU-T Recommendation H.264 (02/2015): "Advanced video coding for generic audio-visual services" | ISO/IEC 14496-10:2015: "Information technology – Coding of audio-visual objects – Part 10: Advanced Video Coding".

ISO/IEC 14496-12:2014 Information technology -- Coding of audio-visual objects -- Part 12: ISO base media file format.

ISO/IEC 14496-15:2014: Information technology -- Coding of audio-visual objects -- Part 15: Carriage of network abstraction layer (NAL) unit structured video in ISO base media file format.

ITU-T Recommendation H.265 (04/2015): "Advanced video coding for generic audio-visual services" | ISO/IEC 23008-2:2015: "High Efficiency Coding and Media Delivery in Heterogeneous Environments – Part 2: High Efficiency Video Coding"

ANSI/CEA-608-E, Line 21 Data Services, April 2008

ANSI/CEA-708-E, Digital Television (DTV) Closed Captioning, August 2013

IETF RFC 2141, URN Syntax, May 1997

IETF RFC 7230, Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing, June 2014.

IETF RFC 7231, Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content, June 2014.

IETF RFC 7232, Hypertext Transfer Protocol (HTTP/1.1): Conditional Requests, June 2014.

IETF RFC 7233, Hypertext Transfer Protocol (HTTP/1.1): Range Requests, June 2014.

IETF RFC 7234, Hypertext Transfer Protocol (HTTP/1.1): Caching, June 2014.

DASH-IF Implementation Guidelines: Interoperability Points; Version 3.1,  
<http://dashif.org/w/2015/04/DASH-IF-IOP-v3.1.pdf>

### **3. Informative References**

The following documents *may* provide valuable information to the reader but are not required when complying with this standard.

#### **3.1. Standards from other Organizations**

ETSI TS 103 285 V1.1.1 (2015-05): "MPEG-DASH Profile for Transport of ISO BMFF Based DVB Services over IP Based Networks"

Extensible Markup Language (XML) 1.0 (Fifth Edition), W3C Recommendation, 26 November 2008, available at <http://www.w3.org/TR/REC-xml/>

### 3.2. Published Materials

[HLS I-D] R. Pantos, W. May, HTTP Live Streaming, <https://tools.ietf.org/html/draft-pantos-http-live-streaming>

## 4. Compliance Notation

<i>shall</i>	This word or the adjective “required” means that the item is an absolute requirement of this specification.
<i>shall not</i>	This phrase means that the item is an absolute prohibition of this specification.
<i>should</i>	This word or the adjective “recommended” means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications <i>should</i> be understood and the case carefully weighted before choosing a different course.
<i>should not</i>	This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
<i>may</i>	This word or the adjective “optional” means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

## 5. Abbreviations and Definitions

### 5.1. Abbreviations

AAC	advanced audio coding
AC-3	Audio Codec 3 or Advanced Codec 3 (also Dolby Digital)
AES-CBC	Advanced Encryption Standard cipher block chaining
ANSI	American National Standards Institute
ATSC	Advanced Television Systems Committee
AVC	advanced video coding
BMFF	base media file format
BSS	bitstream switching segment
CBR	constant bit rate
CEA	Consumer Electronics Association
DASH	[MPEG] dynamic adaptive streaming over HTTP
DTS	trademark for DTS, Inc. audio (originally Digital Theater Systems, Inc.)
DTV	digital television
DVB	Digital Video Broadcasting [Project]
DVS	[SCTE] Digital Video Subcommittee
e.g.	for example ( <i>exempli gratia</i> )
ETSI	European Telecommunications Standards Institute
FF	file format
HEVC	high efficiency video coding
HLS	HTTP live streaming

HRD	hypothetical reference decoder
HTTP	hypertext transfer protocol
i.e.	that is ( <i>id est</i> )
IEC	International Electrotechnical Commission
IP	Internet protocol
ISO	International Organization for Standardization
ISO-BMFF	ISO base media file format
MPD	media presentation description
MPEG	Moving Picture Experts Group
MPEG-2 TS	MPEG-2 transport stream
NAL	network abstraction layer
PAT	program association table
PCR	program clock reference
PID	packet identifier
PMT	program map table
PTS	presentation time stamp
SCTE	Society of Cable Telecommunications Engineers
TS	transport stream
URI	uniform resource identifier
URN	universal resource name
VCL	video coding layer
XLink	external link
XML	extensible markup language

## 5.2. Notation

This document uses notation similar to the one of ISO/IEC 23009-1.

XML elements are written in bold face, e.g **Element1**.

Child XML elements are separated from parent elements by a dot ('.'), e.g. **Element2.Element1**.

XML attributes are prefixed by an at-sign ('@'), e.g. @attribute. Attributes of an element are separated from the name of the containing element by at-sign, e.g. **Element@attribute**.

ISO-BMFF boxes are written as box names enclosed in backquote ('`) signs, e.g. `box0`

Fields in ISO-BMFF boxes are separated from box names by a dot ('.'), e.g. `box0`.field0

In cases where an element has the same name as a concept it describes, when the name is written in bold face, it refers to the syntactic element. For example, **Representation** refers to an XML element named "Representation", while "representation" refers to the concept representation as defined in ISO/IEC 23009-1.

## 6. DASH/TS restrictions on MPD

### 6.1. General

MPD and segments in this profile *shall* comply with SCTE 214-1. The compliance to DASH/TS profile *shall* be signaled by **MPD@profiles** attribute with the value `urn:scte:dash:2015#ts`.

## 6.2. Restrictions on Adaptation Sets

1. **AdaptationSet@id** *shall* be unique within Period and same across continuous periods.
2. **AdaptationSet@bitstreamSwitching** *shall* be set for any adaptation set containing more than one representation.
3. PID values for PMT and elementary streams *shall* be same across all representations within an adaptation set.

## 6.3. Restrictions on Content Components

1. **ContentComponent@id** *shall* be the PID of the content component described by this element
2. If an adaptation set contains multiple audio bitstreams:
  - a. **ContentComponent@lang** *shall* be present for any audio content component
  - b. At least one audio content component *shall* contain a **Role** element with **@schemeIdUri="urn:mpeg:dash:role:2011"** and **@value="main"**. This content component will correspond to the primary language of the adaptation set.
  - c. Content components describing alternative languages *shall* contain a **Role** element with **@schemeIdUri="urn:mpeg:dash:role:2011"** and **@value="dub"**.
  - d. If an adaptation set contains more than one audio content component with **Role** element with **@schemeIdUri="urn:mpeg:dash:role:2011"** and identical value of **ContentComponent@lang**, the corresponding bitstreams *shall* be perceptually equivalent and *may* only differ in codecs, sampling rate and channel configuration unless one of them carries associated services.
  - e. If an audio content component contains an associated service, the **Role**-level signaling defined in SCTE 214-1 *shall* be used.

## 6.4. Restrictions on Representations

1. If PTS corresponding to the earliest presentation time of the first segment of a period is larger than zero, the **@presentationTimeOffset** attribute *shall* be present and have the value of this PTS in units of **@timescale**.
2. **@presentationTimeOffset** refers to the earliest presentation time of the main content component.

## 7. DASH/TS Restrictions on Segment Format

### 7.1. General

1. All restrictions specified in ISO/IEC 23009-1 sec 8.7.3 *shall* be obeyed.



**Note:** This implies that same PIDs *should* be used for all media components, and use of descriptors specifying profile, level, bitrate and HRD information *should* be avoided.

2. Even if not signaled explicitly, Adaptive Profile of MPEG-2 TS **shall** be assumed.

**Note:** The above implies that the implementer *should* expect discontinuities at representation switch point, and unless Bitstream Switching segment is not used these discontinuities will not be signaled in media. See 8.2 Bitstream Switching Segments.

## 7.2. Initialization information

1. Media segments **shall** be self-initializing.
2. A media (sub)segment *should* start from PAT followed by PMT followed by a PCR-bearing packet.

## 7.3. Restrictions on MPEG-2 Systems

1. Media segments **shall** comply with SCTE 128-2 or SCTE 215-2.
2. Concatenation of continuous media segments from the same representation **shall** comply with SCTE 128-2 or SCTE 215-2.
3. PMT *should not* carry descriptors that change across the representations within an adaptation set (e.g., HRD information is different per each representation). If PMTs are different across representations, their version numbers *should* differ.
4. Use of packets with PID value of 0x1FFF (null packet) is strongly discouraged. There is no strict CBR requirement in DASH.

## 7.4. Carriage of video elementary streams

### 7.4.1. Carriage of AVC video

Video encoded with H.264/AVC **shall** comply with SCTE 128-1. Restrictions on resolutions and frame rates as specified in SCTE 128-1 table 9 **shall not** apply – more operating points are possible.

Use of filler NAL units is discouraged.

### 7.4.2. Carriage of HEVC video

Video encoded with HEVC **shall** comply with SCTE 215-1. Restrictions on resolutions and frame rates as specified in SCTE 215-1 Appendix A **shall not** apply – more operating points are possible.

Use of filler NAL units is discouraged.

### 7.4.3. Carriage of closed captioning information

If `caption_service_descriptor()` descriptor is contained in PMT, then:

1. **ClosedCaptioning.Accessibility** element **shall** be present in the corresponding **ContentComponent**, and it **shall** carry CEA 608/708 signaling as defined in SCTE 214-1.

- Information in the **Accessibility** descriptor *shall not* contradict information in `caption_service_descriptor`.

## 7.5. Carriage of audio elementary streams

### 7.5.1. General

Audio elementary streams *shall* be formatted as defined in ATSC A/52 (AC-3 / E-AC-3), SCTE 193 (AAC), or SCTE 194 (DTS).

## 7.6. Associated services

- If an elementary stream has *ST* greater than zero, per definition of *ST* in SCTE 214-1 sec. 7.1, the corresponding **ContentComponent** element *shall* contain associated service signaling as defined in SCTE 214-1 sec. 7.1.
- Associated service signaling in elementary streams and in the MPD *shall not* contradict each other.

## 8. Representation switching

### 8.1. Segment Concatenation

Concatenation of two segments  $S_{R1}(i)$  and  $S_{R2}(k)$  is defined as bytes of  $S_{R2}(k)$  appended to the end of  $S_{R1}(i)$ . Concatenation will be denoted by the “.” operator.

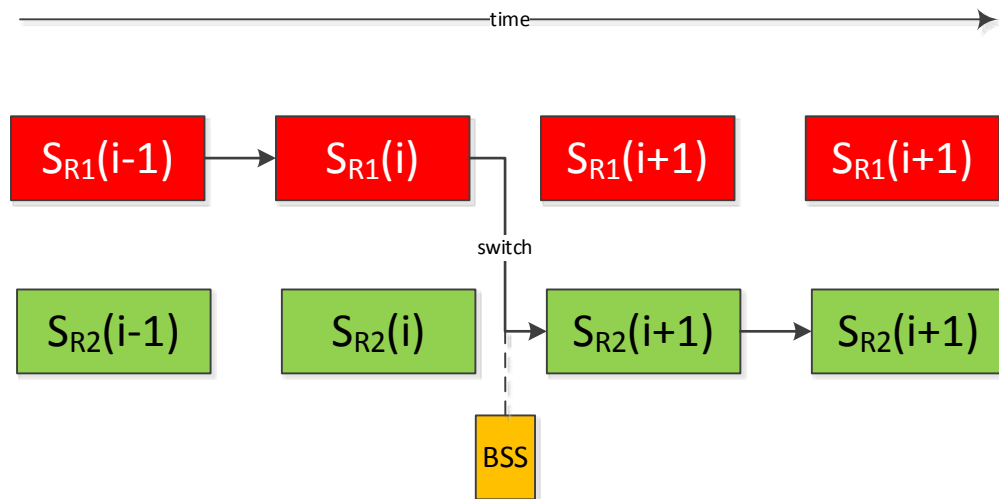


Figure 8-1 Segment Concatenation

Concatenation of segments occurs naturally – as we are concatenating discrete transport stream segments in order to receive a continuous transport stream. There are two different use cases: concatenation of segments from the same representation *RI*:  $S_{R1}(i-1) \cdot S_{R1}(i)$  and concatenation of segments from two different representations,  $S_{R1}(i) \cdot S_{R2}(i+1)$  that happens at representation switch from *RI* to *R2*.

During the content preparation segments *should* be authored in a way that  $S_{R1}(i-1) \cdot S_{R1}(i)$  is a valid continuous transport stream,  $S_{R1}(i) \cdot S_{R2}(i+1)$  is valid transport stream in adaptive profile (i.e., discontinuity is expected at the border between the two segments), and  $S_{R1}(i) \cdot BSS \cdot S_{R2}(i+1)$  is again a valid transport stream with explicitly declared discontinuity.

BSS, the bitstream switching segment, is optional and is discussed in the section below.

## 8.2. Bitstream Switching Segments

Bitstream Switching Segment, BSS, consists of a few transport stream packets that *may* not contain timing (PCRs, PTS/DTS) or playable media (e.g. VCL NALs). It is not necessary to provide bitstream switching segment explicitly. If it is not provided, a BSS can be constructed by the implementer at the client side. This section provides information on elements *should* be in such artificial BSS.

For any pair of consecutive segments  $S_{R1}(i)$  and  $S_{R2}(i + 1)$  belonging to any two representations  $R1$  and  $R2$ , and bitstream switching segment  $BSS$ , the concatenation  $S_{R1}(i) \cdot BSS \cdot S_{R2}(i + 1)$  *shall* comply with ISO/IEC 13818-1.

If not explicitly provided, the client *may* artificially construct a BSS given information in the PMT of representation  $R2$ . This BSS *shall* contain a MPEG-2 TS packet with PID value of PCR\_PID, no payload, and discontinuity indicator in the adaptation field set to 1.

## 9. Use of DASH events

### 9.1. Inband events

1. Inband events *should* appear in the beginning of the segment.

### 9.2. Inband SCTE 35 events

When SCTE 35 cue messages are carried as inband DASH events, SCTE 35 sections *shall* be carried in an `emsg` format on PID 0x04. Translation of `splice_info_section` into an inband event is defined in SCTE 214-3

**Note 1:** Carriage of SCTE 35 cue messages in a separate PID as defined in SCTE 35 is not precluded, but the author cannot assume they would be used by a client.

**Note 2:** Carriage of SCTE 35 cue messages in MPD event streams is defined in SCTE 214-1

## 10. Use of Content Protection

### 10.1. General

This part of the standard does not impose restrictions on content protection mechanisms, however restrictions on content protection as specified in ISO/IEC 23009-1 sec. 8.7.3 *shall* apply.

HLS compatibility *may* require implementation of encryption modes such as full-segment AES-CBC encryption or HLS sample encryption (see [HLS] for details). Key URIs are carried in HLS playlists, and a straightforward translation of this mode is use of ISO/IEC 23009-4.