

# **SCTE** | **STANDARDS**

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**Digital Video Subcommittee**

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**AMERICAN NATIONAL STANDARD**

**ANSI/SCTE 214-2 2022**

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

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## 1. Introduction

### 1.1. Executive Summary

This document is part of a suite of documents related to MPEG DASH for IP-Based cable services and is referred to as a whole SCTE 214. Part 1 describes general **MPD** constraints and common features supported by both the DASH TS profile and DASH ISO-BMFF profile. Part 2 contains further constraints for the DASH TS profile. Part 3 (*deprecated*) contains further constraints for the DASH ISOBMFF profile. Part 4 provides an instance MPD template for the DASH TS profile. Part 5 which replaces Part 3 (*deprecated*) extends the features and constraints but only for ISOBMFF DASH Profiles.

### 1.2. Scope

This document describes general **MPD** constraints and common features supported by both the DASH TS profile and DASH ISOBMFF profile. This will allow a common feature parity between DASH Profile and ISOBMFF Profile versions of the service and includes multiplexed segments. [SCTE 214-1] and 214-2 (this document) are used together to support DASH TS Profile delivery which is beneficial while transitioning from traditional broadcast MPEG-2 TS delivery structures using an ATS structured stream. Additional features developed in later DASH editions and needed for CABLE IP Services will be supported in SCTE 214-5 but only for constrained DASH ISO-BMFF Profiles with non-multiplexed segments.

Profile URNs for DASH/TS and DASH/FF appear in SCTE 214-2 and SCTE 214-5.

### 1.3. Benefits

This document assists in the transition between a broadcast cable infrastructure to a unicast IP based cable services while allowing for a gradual transition of backend systems supporting these services. This document specifically addresses details and features exclusive to the DASH TS/Profile.

### 1.4. Intended Audience

This document is intended for the development, operations, and maintenance of IP based cable services. It is useful for those creating, ingesting, and delivering content for adaptive streaming services.

### 1.5. Areas for Further Investigation or to be Added in Future Versions

Additional developments in this document are limited to including additional features that can co-exist with features and constructs define in DASH edition 5 that enable parity between DASH MPEG-TS and DASH ISOBMFF profiles which includes the use of multiplexed segments.

## 2. Normative References

### 2.1. SCTE References

[SCTE 35] ANSI/SCTE 35 2020, Digital Program Insertion Cueing Message for Cable

[SCTE 128-1] ANSI/SCTE 128-1 2020, AVC Video Constraints for Cable Television Part 1: Coding

[SCTE 128-2] ANSI/SCTE 128-2 2018, AVC Video Constraints for Cable Television Part 2: Transport

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[SCTE 193-1] ANSI/SCTE 193-1 2020, MPEG-4 AAC Family Audio System – Part 1 Coding Constraints for Cable Television

[SCTE 193-2] ANSI/SCTE 193-2 2020, MPEG-4 AAC Family Audio System – Part 2 Constraints for Carriage over MPEG-2 Transport

[SCTE 194-1] ANSI/SCTE 194-1 2018, DTS-HD System – Part 1: Coding Constraints for Cable Television

[SCTE 194-2] ANSI/SCTE 194-2 2018, DTS-HD System – Part 2: Constraints for Carriage over MPEG-2 Transport

[SCTE 215-1] ANSI/SCTE 215-1 2020, HEVC Video Constraints for Cable Television, Part 1- Coding

[SCTE 215-1-1] ANSI/ SCTE 215-1-1 2020b, HEVC Video Constraints for Cable Television, Part 1- 1 HDR10 Coding

[SCTE 215-2] ANSI/ SCTE 215-2 2018, 1HEVC Video Constraints for Cable Television Part 2- Transport

[SCTE 214-1] ANSI/SCTE 214-1 2022, MPEG DASH for IP-Based Cable Services Part 1: MPD Constraints and Extensions

## **2.2. Standards from other Organizations**

[ATSC A/53] ATSC A/53 Part 5:2014 ATSC Digital Television Standard, Part 5 – AC-3 Audio System Characteristics

[ATSC A/65] ATSC A/65:20135 ATSC Standard: Program and System Information Protocol for Terrestrial Broadcast and Cable

[DASH] ISO/IEC 23009-1:2021 5<sup>th</sup> Ed., Information technology -- Dynamic adaptive streaming over HTTP (DASH) -- Part 1: Media presentation description and segment formats

[H.264/AVC] ITU-T Recommendation H.264: 2020 "Advanced video coding for generic audio-visual services" | ISO/IEC 14496-10: "Information technology – Coding of audio-visual objects – Part 10: Advanced Video Coding".

[ISO/BMFF] ISO/IEC 14496-12: 2020 Information technology -- Coding of audio-visual objects -- Part 12: ISO base media file format.

[ISO/BMFF-NAL] ISO/IEC 14496-15: 2019 Information technology -- Coding of audio-visual objects -- Part 15: Carriage of network abstraction layer (NAL) unit structured video in ISO base media file format.

[HEVC] ITU-T Recommendation H.265: 2021"Advanced video coding for generic audio-visual services" | ISO/IEC 23008-2: " High Efficiency Coding and Media Delivery in Heterogeneous Environments – Part 2: High Efficiency Video Coding”

[CTA 608] ANSI/CTA-608-E S-2019: Line 21 Data Services.

[CTA 708] ANSI/CTA-708-E R-2018: Digital Television (DTV) Closed Captioning.

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[RFC 8141] IETF RFC 8141, Uniform Resource Names (URNs), April 2017

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

[MPEG SYSTEMS] ISO/IEC 13818-1|H.222.0 Information technology – Generic coding of moving pictures and associated audio information:Systems.

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

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

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

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

[DASH-IF IOP] DASH-IF Implementation Guidelines: Interoperability Points; Version 4.3, 2018.

[DVB-TTML] ETSI EN 303 560, Digital Video Broadcasting (DVB); TTML subtitling systems, V1.1.1., 2018.

[IMSC 1] W3C TTML Profiles for Internet Media Subtitles and Captions 1.0 (IMSC1), 2020

[SEG ENCRYPT] ISO/IEC 23009-4 2<sup>nd</sup> Ed., Information technology—Dynamic adaptive Streaming over HTTP (DASH) part 4: Segment encryption and authentication.

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

[XML] 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 “ <i>required</i> ” 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>forbidden</i>	This word means the value specified shall never be used.
<i>should</i>	This word or the adjective “ <i>recommended</i> ” means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should 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 “ <i>optional</i> ” 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.
<i>deprecated</i>	Use is permissible for legacy purposes only. Deprecated features may be removed from future versions of the standard. Implementations should avoid use of deprecated features.

## 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
ATS	Adaptation Transport Stream
ATSC	Advanced Television Systems Committee
AVC	advanced video coding
BMFF	base media file format
BSS	bitstream switching segment
CBR	constant bit rate
CTA	Consumer Technology 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> )
E-AC3	Enhanced AC-3
ETSI	European Telecommunications Standards Institute
FF	file format
HDR	High Dynamic Range



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
ST	Service Type
TS	transport stream
TTML	Timed Text Markup Language
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 [DASH]

Extensible markup language (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 [DASH]

## 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:202115#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. Packet identifier (PID) values for program map table (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. Primary, Alternative, and dubbed audio content components *shall* follow Role-level or supplemental property assignments as defined in [SCTE 214-1].
  - c. 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.
  - d. If an audio content component contains an associated service, the **Role**-level and **Accessibility**- level signaling defined in [SCTE 214-1] *shall* be used.

### 6.4. Restrictions on Representations

1. If the presentation time stamp (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 [DASH] 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 program association table (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.

Filler NAL units *should* not be used.

#### 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.

HDR Video encoded with HEVC **shall** also comply with [SCTE 215-1-1].

Filler NAL units *should* not be used.

### 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 CTA 608/708 signaling as defined in [SCTE 214-1].
2. Information in the **Accessibility** descriptor *shall not* contradict information in `caption_service_descriptor`.
3. The corresponding **ContentComponent** *shall* also carry the **Role** and **Accessibility** signaling as defined in [SCTE 214-1].

### 7.5. Carriage of audio elementary streams

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

1. If an elementary stream has `audio_type` or `ST` greater than zero, per definition of `audio_type` and `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.
2. Associated service signaling in elementary streams and in the **MPD** *shall not* contradict each other.

### 7.7. Carriage of subtitles and captioning in a separate representation

In some cases (e.g. when CTA 708 charset is insufficient), there is a need to carry Unicode-based subtitles. In this case, [IMSC 1] text profile of W3C TTML *shall* be used, and [DVB-TTML] *shall* be used to encapsulate it.

This specification adds several additional restrictions over the ones specified in DVB-TTML content and *shall* obey the following additional constraints:

1. There *shall* be one and only one Timed Text Markup Language (TTML) segment in a PES packet.
2. For any two consecutive PES packets within the same **Period** the value of `p.begin` of the first PES packet *shall* not exceed the value of `p.begin` of the second PES packet.
3. The value of the `segment_mediatime` field *should* match the value of the subtitles start as expressed in the TTML segment (e.g. in the value of the `p.begin` TTML attribute)

**Note:** An otherwise valid interpretation of [DVB-TTML] where every TTML segment starts from 0:00 is incompatible with the above restrictions. The intent of the recommendation is to allow translation into ATSC 3.0 compatible segments as described in ATSC A/300 without parsing or modifying the underlying TTML.

4. There *shall* be same number of DASH media (sub)segments carrying video and TTML segments *should* be time-aligned with video (sub) segments with a  $\pm 100$ ms tolerance.

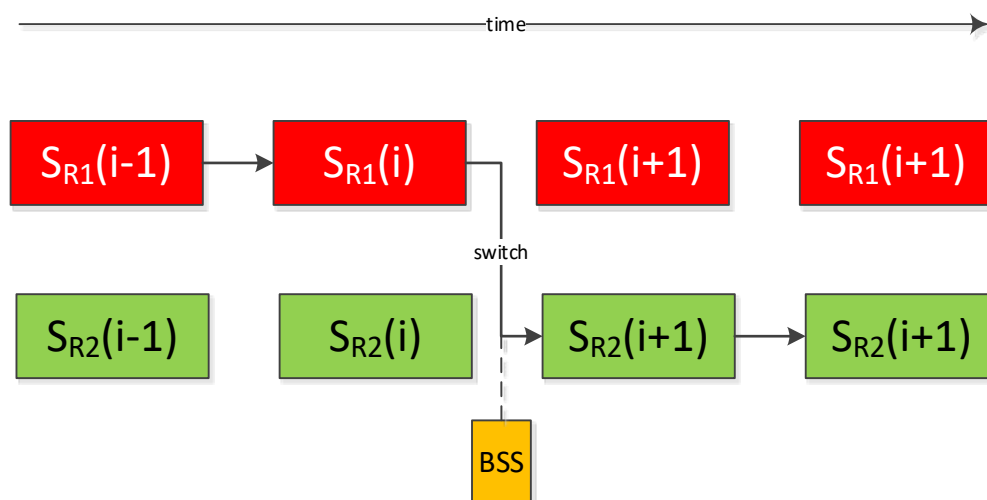
**Note:** The above is needed in order to support client implementations expecting approximate time alignment between segments belonging to all content components. It also disallows the practice of using long (e.g. 30s) TTML segments which are arguably more bandwidth-efficient but create a delay between the first video frame and first TTML segment rendering. Using gzip compression as described in [DVB-TTML] is the recommended way of saving bandwidth.

5. If there is no textual content for a duration of a single (sub)segment, an empty TTML segment *shall* be created.

## 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 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  $R1$ :  $S_{R1}(i-1) \cdot S_{R1}(i)$  and concatenation of segments from two different representations,  $S_{R1}(i) \cdot S_{R2}(i+1)$  that happens at representation switch from  $R1$  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 [MPEG SYSTEMS].

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 214-1].

**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 [DASH] 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 I-D] for details). Key uniform resource identifiers (URI) are carried in HLS playlists, and a straightforward translation of this mode is use of [SEG ENCRYPT].

Content that requires multi-key encryption *should* refer to the Content Protection section in [SCTE 214-1].