



***Society of Cable  
Telecommunications  
Engineers***

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**ENGINEERING COMMITTEE  
Digital Video Subcommittee**

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**AMERICAN NATIONAL STANDARD**

**ANSI/SCTE 214-1 2016**

**MPEG DASH for IP-Based Cable Services  
Part 1: MPD Constraints and Extensions**

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## 1. Scope

This standard is part of a suite documenting usage of MPEG DASH in IP-based cable networks. It specifies restrictions on MPD and codecs that apply to both MPEG-2 TS and ISO-BMFF segments. Thus, DASH/TS profile is a combination of part 1 (this standard) and Part 2 (which defines aspects specific to MPEG-2 TS), and, analogously, DASH/FF profile is a combination of Part 1 and Part 3 (which defines aspects specific to ISO-BMFF). The DASH/TS profile is also very similar to the adaptive transport stream source description defined in SCTE 215.

Profile URNs for DASH/TS and DASH/FF appear in SCTE 214-2 and SCTE 214-3.

## 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 130-10, Digital Program Insertion – Advertising Systems Interfaces, Part 10 – Stream Restriction Data Model (SRDM)

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 Audio System – Part 1: Coding Constraints for Cable Television

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

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

### 2.2. Standards from other Organizations

ATSC A/52 Digital Audio Compression (AC-3) (E-AC-3) Standard

ATSC A/53 ATSC Digital Television Standard

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 (including Corrigenda 1 and 2, and Amendments 1 and 2).

ISO/IEC 23009-3:2014: Information technology -- Dynamic adaptive streaming over HTTP (DASH) – Part 3: Implementation Guidelines

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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"

ISO/IEC 23001-8:2013, "Information technology – MPEG systems technologies – Part 8: Coding-independent code points"

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

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

ANSI/CEA-708.1, Digital Television (DTV) Closed Captioning: 3D Extensions, October 2012

IETD RFC 2141, URN Syntax, May 1997

IETF RFC 2326, Real Time Streaming Protocol (RTSP), April 1998

IETF RFC 3339, Date and Time on the Internet: Timestamps, July 2002

IETF RFC 3406, Uniform Resource Names (URN) Namespace Definition Mechanisms, October 2002

IETF RFC 3986, Uniform Resource Identifier (URI): Generic Syntax, January 2005

IETF RFC 4648, The Base16, Base32, and Base64 Data Encodings, October 2006

IETF RFC 5234, Augmented BNF for Syntax Specifications: ABNF, January 2008.

IETF RFC 6381, The 'Codecs' and 'Profiles' Parameters for 'Bucket' Media Types

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/wp-content/uploads/2015/10/DASH-IF-IOP-v3.1.pdf>

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

XML Linking Language (XLink) Version 1.0, W3C Recommendation 27 June 2001, available at <http://www.w3.org/TR/xlink/>

XML Schema Part 2: Datatypes Second Edition, W3C Recommendation 28 October 2004, available at <http://www.w3.org/TR/xmlschema-2/>

### 3. Informative References

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

#### 3.1. SCTE References

No informative reference applicable

#### 3.2. 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"

#### 3.3. Published Materials

[HLS I-D] R. Pantos, W. May, HTTP Live Streaming, <https://tools.ietf.org/html/draft-pantos-http-live-streaming-17>

### 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
ATSC	Advanced Television Systems Committee
AVC	advanced video coding
BMFF	base media file format
BSS	bitstream switching segment
CBR	constant bit rate
CC	closed captioning
CEA	Consumer Electronics Association
CPB	coded picture buffer
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
HI	hearing impaired
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
MBT	minimum buffer time
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
PMT	program map table
PTS	presentation time stamp
SAP	stream access point(s)
SCTE	Society of Cable Telecommunications Engineers
SEI	supplemental enhancement information

TS	MPEG-2 transport stream
UPID	unique program identifier
URI	uniform resource identifier
URN	universal resource name
VCL	video coding layer
VI	visually impaired
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 of a representation as defined in ISO/IEC 23009-1.

XML elements and attributes defined in SCTE 214 are prefixed with `scte214:`

URLs that do not fit into a single line are escaped with `\\` character.

## 6. MPD Restrictions

### 6.1. Restrictions on MPD elements

1. **MPD@minBufferTime** *shall* be present. Its value *should* be equal or larger than maximum segment (live profile) or subsegment (on demand profile) duration.
2. If the **MPD@type** is "dynamic":
  - a. **MPD@minimumUpdatePeriod** *shall* be present;
  - b. **MPD@maxSegmentDuration** *shall* be present.

**Note:** It is unsafe to base player buffer allocation on the attributes above whenever XLink is used, or MPD type is "dynamic". See sec. 8.2.3 for more details.

- c. If it is expected that at some point in the future a media segment *may* become unavailable, then the **@timeShiftBufferDepth** attribute *shall* be present, or **@timeShiftBufferDepth** *shall* be present as a part of segment information.

### 6.2. Restrictions on Period elements

1. The **Subset** element *shall not* be present.
2. The **Period.SegmentList** element *shall not* be present
3. At least one **AdaptationSet** element *shall* contain a **Role** element with **@schemeIdUri="urn:mpeg:dash:role:2011"** and **@value="main"** and each Adaptation Set containing such a **Role** element *shall* provide perceptually equivalent media components.

**Note:** Perceptually equivalent media components differing in subtitle or closed captioning language are still considered perceptually equivalent.

4. If a **Period** element represents a part of a multi-period asset, this **Period** *shall* contain an **AssetIdentifier** element.

### 6.3. Restrictions on Adaptation Set elements

1. Every adaptation set *shall* use consistent addressing. Exactly one of the following restrictions *shall* be met:
  - a. Every Representation within this Adaptation Set has a **Representation.SegmentTemplate** element, and **AdaptationSet.SegmentTemplate** is not present.
  - b. **AdaptationSet.SegmentTemplate** element is present, and no **Representation.SegmentTemplate** elements are present;

- c. The **Representation.SegmentList** element is present in every representation in this **AdaptationSet**, and all media segments are MPEG-2 TS segments
  - d. Every Representation within this Adaptation Set consists of a single segment.
2. All Representations within an Adaptation Set *shall* use the same codecs, but not necessarily the same profiles and levels. Therefore, exactly one of the following restrictions *shall* be met:
- a. The **AdaptationSet@codecs** attribute *shall be* present and equal the maximum profile and level of any Representation contained in the Adaptation Set
- Note:** As an example, no adaptation set *may* contain both `avc1` (AVC) and `hev1` (HEVC) video, however `avc1.64Y01F` (Progressive [High@L3.1](#)) and `avc1.64Y028` (Progressive [High@L4.0](#)) can be in the same AVC adaptation set.
- b. **AdaptationSet@codecs** *shall* be present, and **Representation** elements within this **AdaptationSet** *shall not* contain the @codecs attribute.
3. **AdaptationSet@segmentAlignment** attribute *shall* be present and have a value of `true` or `1`.
4. **AdaptationSet@startWithSAP** *shall* be present and its value *shall* be 1 or 2.
5. If indexing (`sidx`) is used, then
- a. @subsegmentAlignment *shall be* present and have value of `true` or `1`.
  - b. **AdaptationSet@subsegmentStartsWithSAP** *shall* be present and have a value of `1` or `2`.
6. For any adaptation set that contains video the following attributes *shall* be present:
- a. @maxWidth (or @width if all Representations have the same width)
  - b. @maxHeight (or @height if all Representations have the same height)
  - c. @maxFrameRate *shall* be an integer multiple of each @frameRate in this adaptation set. If all representations have the same frame rate, @frameRate rather than @maxFrameRate *shall* be present
  - d. @scanType *shall* be present and have value "interlaced" if at least some of the pictures are interlaced.
- Note:** This implies that if an adaptation set is interlaced, all representations in it are interlaced.
- e. @sar *shall* be present and, consequently, all representations within this adaptation set *shall* have the same aspect ratio.
7. There *shall* be at most one video media component in a single **AdaptationSet**.

8. If a representation contains at least one interlaced picture, this representation is considered interlaced. Interlaced and non-interlaced representations **shall not** be mixed in the same adaptation set.

**Note:** Alignment between interlaced and non-interlaced adaptation sets can be expressed by setting (sub)segment alignment attributes to '1' rather than 'true'.

9. For any adaptation set, colorimetric properties of video representations, if known, **shall** be the same. When these properties are known, they **should** be signaled as defined in sec 10.1.5.
10. For any adaptation set containing a single audio component, the following elements and attributes **shall** be present (and thus **shall** apply to all representations):

- a. @lang

- b. @codecs, which contains sub-parameters as defined in RFC 6381. Note implies that only the option described in 2.b above is acceptable for audio adaptation sets.

- c. @audioSamplingRate

- d. **AudioChannelConfiguration**

11. If media segments contain CEA 608/708 closed captioning carried in video elementary stream (as defined in SCTE 128-1 and SCTE SCTE 215-1), this **shall** be reflected in the MPD using **AdaptationSet.Accessibility**, as described in 7.2.

#### 6.4. Restrictions on ContentComponent elements

1. **ContentComponent** element **shall** be used if and only if the adaptation set contains multiplexed representations.

**Note:** CEA 608/708 closed captioning is not considered a separate content component if embedded in media segments.

2. **AdaptationSet** elements **shall** contain a single **ContentComponent** element per each media component in a multiplexed representation.
3. If more than one audio content component is present, each one of them **shall** be signaled using a **ContentComponent** element. @lang attribute **shall** be present for each audio component.
4. **ContentComponent@contentType** attribute **shall** be present in any **ContentComponent** element

#### 6.5. Restrictions on Representation elements

1. The following attributes and elements **shall not** appear at Representation level within an adaptation set containing audio:
  - a. **AudioChannelConfiguration;**
  - b. @audioSamplingRate;

- c. @lang;
  - d. @codecs, if the representation is unmultiplexed.
2. For any **Representation** element within an adaptation set containing video the following attributes *shall* be present:
    - a. @width, if and only if **AdaptationSet@width** is not present in this adaptation set
    - b. @height, if and only if **AdaptationSet@height** is not present in this adaptation set
    - c. @frameRate, if and only if **AdaptationSet@frameRate** is not present in this adaptation set
    - d. @codecs, which *shall* contain complete sub-parameter string as defined in ISO/IEC 14496-15 Annex E. Note that this means that 2.a in 6.3 applies to video adaptation sets.
  3. **Representation@id** value *shall* be unique within the scope of the **Period** to which it belongs.
  4. **Representation@bandwidth** value *shall* be unique within its parent **AdaptationSet** element.
  5. **Representation.ContentProtection** element *shall not* be used.
  6. If content protection is used, it *shall* be signaled via **AdaptationSet.ContentProtection** element(s). In case of Common Encryption (ISO/IEC 23001-7 and ISO/IEC 23001-9), `pssh` information and the default **\_KID** attribute *should* be present in this descriptor.

## 6.6. Restrictions on use of XLink

The use of the XLink (only the subset defined in ISO/IEC 23009-1) is supported in SCTE profiles with the following restrictions:

1. The @xlink:href attribute *may* appear only in **Period** and **Representation.SegmentList** elements;
2. If **MPD@type='dynamic'** and the **Period@xlink:href** attribute is present, the value of **Period@xlink:actuate** *shall* be 'onLoad'
3. If **Representation.SegmentList@xlink:href** attribute is present, then the **Representation.SegmentList@xlink:actuate** attribute *shall* be present and have the value "onRequest". The remote entity *shall not* contain the **SegmentList@xlink:href** attribute. This guarantees that a representation-level XLink needs to be resolved only once.

**Note 1:** In the use case above, the expected client behavior is to select a suitable representation, and then to do XLink resolution for that representation. This operation is conceptually identical to media playlist download in HLS.

**Note 2:** **SegmentList** is prohibited for ISO-BMFF-based profile, and is strongly discouraged in case of MPEG-2 TS.

## 6.7. Use of events

### 6.7.1. Declaring events

1. **InbandEventStream** element *shall not* be present either at Representation or at SubRepresentation level.
2. If inband events are used, their presence *shall* be signaled in **AdaptationSet.InbandEventStream** element. A client is not expected to process undeclared events, though this specification does not disallow processing them.

### 6.7.2. DASH events

Inband events *shall* be aligned.

MPD Patch and MPD Update events *shall not* be used, either inband or in MPD.

### 6.7.3. User-defined events

If processing an event (i.e. either MPD or inband event) is essential for successful presentation, **EssentialProperty** with @schemeIdUri="urn:scte:dash:essential-event:2015" and **EssentialProperty**@value containing the @schemeIdUri of the essential event stream *shall* be present in the corresponding **MPD** element.

If there are several event schemes, and processing one of them is sufficient, then the **EssentialProperty** descriptors for them *shall* have identical values of **EssentialProperty**@id.

### 6.7.4. Carriage of SCTE 35 as user-defined MPD event

**Event** elements contained in **EventStream** element with @schemeIdUri="urn:scte:scte35:2013:xml" *shall* contain an XML representation of an SCTE 35 cue message.

A subset of this capability is defined by @schemeIdUri="urn:scte:scte35:2014:xml+bin", which implies that **Signal.Binary** element, and not the **Signal.SpliceInfoSection** element will appear as content of the **Event** element.

For both "urn:scte:scte35:2013:xml" and "urn:scte:scte35:2014:xml+bin" schemes:

1. The **Event**@messageData attribute *shall not* be used.
2. Sum of **Event**@presentationTime and **Event**@duration *shall* never exceed period duration, if known at authoring time. Event that has its **Event**@presentationTime later than the end of the period as a result of an MPD update *shall* be ignored.
3. There *should not* be more than one SCTE 35 MPD event with identical value of the **Event**@presentationTime attribute.

SCTE 35 events are considered essential, per definition of event essentiality in ISO/IEC 23009-1.

## 6.8. MPD Updates

MPD updates *may* only extend the timeline. This means that information provided in a previous version of the MPD *shall not* be invalidated in an updated MPD. Hence the only permitted change is addition or removal of **Period** elements or addition of segments in **SegmentList**.

In live scenarios MPD updates can add new MPD events but *shall not* remove existing MPD events in order to provide system consistency. As a consequence, a cancellation of a previous event *should* be done via MPD update adding a new event.

## 7. Signaling accessibility-related metadata

### 7.1. Associated audio services

#### 7.1.1. General

In many cases an audio component is not intended for a general presentation, but for a more specialized purpose (e.g., audio description for the visually impaired). Moreover, in some cases (known as “receiver mix”), two audio elementary streams need to be combined for the same service.

This section defines signaling for such services. If signaling is present both in the media segments and in MPD, the two *shall not* contradict each other.

This section uses the **Role** descriptor for two different purposes. In 7.1.2 **Role** is used to express the purpose of the audio component, while in 7.1.3 the value of the **Role** descriptor indicates whether an audio component represents a full or partial service.

#### 7.1.2. Roles

Associated services, such as visually impaired (VI) and hearing impaired (HI), *shall* be signaled using the **Role** descriptor with @schemeIdUri="urn:mpeg:dash:role:2011" or **Role** descriptor with @schemeIdUri="urn:scte:dash:associated-service:2015".

Let *ST* be service type signaled in an audio elementary stream.

For AC-3 and E-AC-3 elementary streams, *ST* takes the value of the bsmod field. The possible values for bsmod are defined in ATSC A/52 Table 5.7

For AAC elementary streams, *ST* takes the value of AAC\_service\_type, as defined in SCTE 193-2 Table 4.

For DTS elementary streams, *ST* value is derived from component\_type bit values b3, b4 and b5, as follows:  $ST = b5 \ll 2 + b4 \ll 1 + b3$ . The values b3, b4 and b5 are defined in SCTE 194-2 Table 6.

The value of the **Role**@value attribute *shall* be derived from *ST* as described in table below.

ST	Role@value (MPEG)	Role@value (SCTE)
0	"main"	
1		"music-and-effects"
2	"descriptions"	
3	"enhanced-audio-intelligibility"	
4		"dialogue"
5	"commentary"	
6		"emergency"
7		"voice-over"
8..15		value of <i>ST</i>

The expected practice in North America is that an audio adaptation set having @contentType="audio" and Role@value = "main" is equivalent to the audio service "Complete Main," which is defined for audio standards such as AAC and DTS. In North America, the "Complete Main" audio service is an audio component that contains a complete audio program (which typically includes dialog, music, silence, and effects).

The expected practice in North America is that audio adaptation sets having Role@value = "commentary" are equivalent to the audio service "commentary", which is defined for audio standards such as AAC and DTS.

Role descriptors *shall* appear within ContentComponent element if the latter is used, otherwise they will appear at AdaptationSet level.

DASH role scheme "urn:mpeg:dash:role:2011" *shall* be used if there is more than one audio component a client can select (i.e., multiple audio services within a single multiplex or multiple audio adaptation sets).

In case of  $ST=0$  and multiple audio content components (as described above), Role descriptor with @schemeIdUri="urn:mpeg:dash:role:2011" and @value="main" *shall* be used.

In case of  $ST > 1$ , Role descriptor with @schemeIdUri="urn:mpeg:dash:role:2011" and @value="alternate" *shall* be used in case of full service, and "supplementary" *shall* be used otherwise ("receiver mix").

### 7.1.3. Full and partial audio services

An audio service *may* be a full service suitable for presentation, or only a partial service which *should* be combined with another audio service before presentation ("receiver mix"). In case the partial and the full

services are in different adaptation sets, it is necessary to signal such dependence in order to indicate to the client that two adaptation sets need to be downloaded prior to the presentation.

**Note:** There is no need to signal this for a multiplex containing both – inband signaling in this multiplex is sufficient.

Let  $F$  be a boolean value, which indicates whether a service is a full service ('true'), or the client will need to combine it with a different audio service ('false').

For AC-3 and E-AC-3 elementary streams,  $F$  is true if and only if the `full_svc` bit in the `AC-3_audio_stream_descriptor` is set to '1'.

For AAC,  $F$  is true if and only if `receiver_mix_rqd` is set to '0' (see SCTE 193-2 Table 1).

For DTS,  $F$  is true if and only if `full_service_flag` bit in `component_type` field is set to '1' (see SCTE 194-2 tables 6 and 7).

If neither signaled nor known by other means,  $F$  is assumed to be true.

In case  $F$  is false for an audio service in adaptation set A, and it needs to be combined with a different audio service in a different adaptation set B, this will be signaled in adaptation set A using an **EssentialProperty** descriptor with `@schemeIdUri` attribute value of `urn:mpeg:dash:audio-receiver-mix:2015`. The `@value` attribute **shall** the value of **AdaptationSet@id** of B.

**Note 1:** this signalling is defined in sec. 5.8.5.7 of ISO/IEC 23009-1 and was introduced in ISO/IEC 23009-1:2014 AMD2.

**Note 2:** AC-3, E-AC-3 and AAC full service is signalled in PMT descriptors, hence when ISO-BMFF segments are generated from an MPEG-2 TS source, such signalling is expected to be translated into signalling defined in this section by the entity performing the container format conversion.

## 7.2. Caption service metadata

### 7.2.1. Introduction

CEA-608 and CEA-708 caption services are carried embedded in the elementary streams. Carriage of CEA-608 and CEA-708 in SEI messages is defined in SCTE 128-1 and SCTE 215-1. This section describes MPD signaling of caption service metadata for and applies to content with both MPEG-2 TS and ISO-BMFF segments.

Signaling is done using the **Accessibility** descriptors, one per each standard. The value string of each descriptor can be either list of languages or a complete map of services (or CC channels, in CEA-608 terminology).

Listing languages without service/channel information is strongly discouraged if more than one caption service is present. At any time language-channel (CEA-608) or language-service (CEA-708) is known at content generation time, it **shall** be used, as opposed to signaling mere presence or presence and language.

**Note:** Signaling described in this section is identical to DASH-IF IOP.

### 7.2.2. Signaling CEA-708 caption service metadata

If CEA-708 closed caption service is carried in the video elementary stream, the relevant metadata per CEA-708 sec. 4.5 will be expressed using **ContentComponent.Accessibility** or, if the latter is not used, **AdaptationSet.Accessibility** with @schemeIdURI set to urn:scte:dash:cc:cea-708:2015.

The @value attribute *shall* contain the Caption Service Metadata as provided in CEA-708 section 4.5, as a semicolon-separated string of service descriptions. Each service description is either a single language code or a list of colon-separated name-value pairs

```
@value          = service *15 [";" service]
service         = language / ( service-number "=" param )
service-number  = (%d1 - %d63) ; decimal numbers 1 through 63
param           = language["","easy-reader"]["","aspect-ratio"] ["","3d"]
language        = "lang" ":" 3ALPHA; language code per ISO 639.2/B
easy-reader     = "er" ":" BIT ; default value 0
aspect-ratio    = "war" ":" BIT / "?"
                  ; default value is 1 (16:9),
                  ; value '0' indicates 4:3,
                  ; value '?' if unknown
3d              = "3D" ":" BIT
                  ; 1 if caption disparity data is present (CEA-708.1)
                  ; default value 0 (no 3d support).
```

**Note:** ALPHA and BIT are as defined by IETF RFC 5234, Appendix B.1.

Each of the service parameters (except for language) *may* be present or not present. Default values can be assumed where specified.

The CEA-708 information supplied in the **Accessibility** descriptor *shall not* contradict information supplied in the caption\_service\_descriptor in the PMT. See 7.2.5 below for derivation.

### 7.2.3. Signaling CEA-608 caption service metadata

If CEA-608 closed caption service is carried in the video elementary stream, language metadata will be expressed using **AdaptationSet.Accessibility** with @schemeIdURI set to urn:scte:dash:cc:cea-608:2015.

The @value attribute *shall* contain description of caption service(s) provided in the stream, as either a semicolon-separated list of languages or of colon-separated channel-language pairs. The @value syntax *shall* be as described in the ABNF below.

```
@value          = channel *4 [";" channel]
channel         = language | ( channel-number "=" language )
channel-number  = CC1 | CC2 | CC3 | CC4
```

language = "lang" ":" 3ALPHA ; language code per ISO 639.2/B

### 7.2.4. Examples

```

<!-- Simple signaling of presence of CEA-608 closed caption service -->
<!-- NOTE: not signaling languages is a discouraged practice -->
<Accessibility
  schemeIdUri="urn:scte:dash:cc:cea608:2015"/>

<!-- Signaling of presence of CEA-608 closed caption service -->
<!-- in English and German -->
<Accessibility
  schemeIdUri="urn:scte:dash:cc:cea608:2015" value="eng;deu"/>

<!-- Signaling of presence of CEA-708 closed caption service
<!-- in English and German, with channel assignments -->
<Accessibility
  schemeIdUri="urn:scte:dash:cc:cea708:2015" value="CC1=eng;CC3=deu"/>

<!-- Signaling of presence of CEA-708 closed caption service -->
<!-- in English and German -->
<Accessibility
  schemeIdUri="urn:scte:dash:cc:cea708:2015" value="eng;deu"/>

<!-- Signaling of presence of CEA-708 closed caption service -->
<!-- in English and easy reader English -->
<Accessibility
  schemeIdUri="urn:scte:dash:cc:cea708:2015"
  value="1=lang:eng;2=lang:eng,war:1,er:1"/>

```

### 7.2.5. Derivation of caption service metadata from MPEG-2 TS

When MPD and media segments are generated from MPEG-2 transport stream, the PMT *may* contain the `caption_service_descriptor()` descriptor, as defined in Sec. 6.9.2 of ATSC A/65. If this descriptor is present, MPD signaling of caption service **shall** be generated using the procedure described below.

If there is a service for which `cc_data.digital_cc` bit is '0', then **Accessibility** with URI `urn:scte:dash:cea-608:2015` **shall** be used to signal it. If languages or channel-language association is known (from any source), it *should* be provided, using syntax from 7.2.3.

If there is at least one service with `cc_data.digital_cc` bit set to '1', then **Accessibility** with URI `urn:scte:dash:cea-708:2015` **shall** be used to signal it. For each such service syntax defined in 7.2.2 **shall** be used, and at least service number and language **shall** be provided.

**Note 1:** Descriptors for both CEA 608 and CEA 708 often appear in the same scope.

**Note 2:** PSI, and, consequently, caption service descriptors *may* change at splice points. In case of a splice we expect a new period to be started and the process above will be applied to the new period.

**Note 3:** Use of CEA 708.1 is not (as of 2015) reflected in `caption_service_descriptor()`

## 8. Signaling Asset Identification

### 8.1. General

**AssetIdentifier** elements are used in ISO/IEC 23009-1 to uniquely identify content in periods. This section identifies schemes that *may* be used in content compliant to this specification.

There may be several alternative identifiers applicable to the same content. **AssetIdentifier** elements are used for grouping periods with the same content and indicates to DASH client that one is continuation of the other. Thus choice of main identifier (carried in **AssetIdentifier**) needs to reflect continuity in terms of user interface, random access, and trick modes. Alternate identifiers (carried in **SupplementalProperty**) are informational and may be used for reporting purposes.

As an example, when the same advertisement is shown multiple times, its instances will have same value of Ad-ID, but different AiringID. Use of Ad-ID as **AssetIdentifier** will result in DASH client considering the second instance of the advertisement a continuation of the first. In this case, e.g. the UI may show at the start of the second instance progress bar at 50% and advertisement duration of twice its actual duration. Thus AiringID should be used as **AssetIdentifier**, while Ad-ID should be used as an alternative identifier carried in **SupplementalProperty** with the same value of @schemeIdUri

In the opposite case, when two periods carry same in-network content which has the same EIDR and a period between them is an advertisement, the two in-network periods are continuation of each other and thus EIDR should be used in **AssetIdentifier**, while AiringID of these periods will be different and, if used, it should be used in **SupplementalProperty**

**Note 1:** Alternative single-identifier scheme is defined in DASH-IF IOP.

### 8.2. UPID Content Identification scheme

The value of **AssetIdentifier**@schemeIdUri or **SupplementalProperty**@schemeIdUri for this scheme *shall* have the value "urn:scte:dash:asset-id:upid:2015". The content of this **AssetIdentifier** or **SupplementalProperty** descriptor *shall* contain one or more **ContentIdentifier** elements defined below.

Only **ContentIdentifier** elements with the same scope can appear in the same **AssetIdentifier** or **SupplementalProperty** element.

#### 8.2.1. ContentIdentifier element semantics

Element or Attribute Name	Use	Description
<b>ContentIdentifier</b>		Represents a textual value
@type	M	Type corresponding to SCTE 35 UPID type as specified in table 9-7. The value of this attribute <i>shall</i> be same as the value of segmentation_upid() (i.e., 3 <sup>rd</sup> column of the table).

Element or Attribute Name	Use	Description
		MID <i>shall not</i> be used – the structure shall be translated into multiple UPID elements.
@value	M	Textual representation of the UPID value. It <i>shall</i> correspond to the description in the Description column (i.e., 4 <sup>th</sup> column) of table 9-7 in SCTE 35.  In case of the UPID contains binary encoding (e.g., EIDR and ISAN), and a full textual representation is specified by the applicable standard, this textual representation <i>shall</i> be used. Otherwise binary encoding is represented as a byte string in hexadecimal format.
<p><b>Legend:</b>  For attributes: M=Mandatory, O=Optional, OD=Optional with Default Value, CM=Conditionally Mandatory.  For elements: &lt;minOccurs&gt;...&lt;maxOccurs&gt; (N=unbounded)  Elements are <b>bold</b>; attributes are non-bold and preceded with an @.</p>		

### 8.2.2. XML syntax

```
<xs:complexType name="UPID">
  <xs:sequence>
    <xs:any namespace="##other" processContents="lax"
      minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="type" type="xs:string" use="required"/>
  <xs:attribute name="value" type="xs:string" use="required"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
```

### 8.2.3. Example

```
<AssetIdentifier schemeIDUri="urn:scte:dash:asset-id:upid:2015">
  <!-- EIDR of the asset -->
  <scte214:ContentIdentifier type="EIDR" value="10.5240/EA73-79D7-1B2B-B378-3A73-M"/>
  <!-- Alternative ID using an opaque provider-specific scheme -->
  <scte214:ContentIdentifier type="MPU" value="CSP1DE12AB327FE312AF"/>
</AssetIdentifier>

<SupplementalProperty schemeIDUri="urn:scte:dash:asset-id:upid:2015">
  <!-- AiringID of the asset -->
  <scte214:ContentIdentifier type="AiringID" value="0xDEADBEEF"/>
</AssetIdentifier>
```

## 9. Generic restrictions on media segments

### 9.1. Terminology

For the purpose of this section the following variables are defined for any segment  $S(n)$  and its  $k^{\text{th}}$  subsegment  $n[k]$ :

$EPT(n)$  := earliest presentation time of segment  $n$ .  $EPT(0) = 0$ ;

$EPT(n[k])$  := earliest presentation time of its subsegment  $n[k]$ .  $EPT(n[0]) = EPT(n)$ .

$SD(R)$  := signaled segment duration for representation  $R$ , as expressed e.g. in the @duration attribute or the S@d in the **SegmentTimeline**. While this applies to a specific representation  $R$ , segment alignment requirement in this specification requires this value to be identical for all representations in an adaptation set.

$MSD$  := maximum segment duration, as indicated in **MPD**@maximumSegmentDuration

$MSSD$  := maximum subsegment duration, as indicated in **MPD**@maximumSubsegmentDuration

$D(n)$  := "real" presentation duration of segment  $n$ , i.e.  $EPT(n+1) - EPT(n)$ .

$SD(n[k])$ , the signaled subsegment duration, is same as  $D(n[k])$ , presentation duration of segment  $k$ , and is provided in `sidx`.subsegment\_duration[k] of the `sidx` box indexing segment  $n$ .

$BW[R]$  := value of **Representation**@bandwidth of a representation  $R$  to which segment  $n$  belongs.

$MBT$  := value of **MPD**@minBufferTime

All durations are in seconds, and bandwidth is given in bits per second.

### 9.2. Duration

#### 9.2.1. Segments

If representation contains more than one segment and is used for normal playback, the following restrictions **shall** be met:

1. Segments **shall** have almost equal "real" duration. The maximum tolerance of "real" segment duration  $D(n)$  **shall** be  $\pm 50\%$  of the stated segment duration, and the accumulated drift **shall not** exceed 50% of the stated segment duration  $SD$ .

$$\text{abs} \left( \sum_{i=0}^{n-1} D(i) - (n+1) * SD(R) \right) \leq 0.5 * SD(R)$$

**Note 1:** This is done so that if seeking is done using stated duration, correct segment will be identified despite the accumulating drift.

**Note 2:** drift *may* develop due to mismatch between  $D$  and  $SD$  due to imprecision of the clock used to state  $SD$ . For example, if  $SD=2$  sec and segments are 2002 ms each,  $\pm 50\%$  drift will be exceeded in less than 10 minutes.

- The "real" segment duration for representations containing more than one segment **shall** be between 0.47 and 30.03 seconds.

$$0.47 \leq D(n) \leq \min(MSD, 30.03);$$

**Note:** This is done in order to simplify client implementation when segment durations are unknown at MPD parse time. This can happen due to use of XLink in the "OnRequest" mode or/and in case of MPD updates.

### 9.2.2. Subsegments

For representation used for normal playback and containing subsegments, the "real" subsegment duration **shall** be less than 30.03 seconds.

$$D(n[k]) \leq SSD_{max} = \min(MSSD, 30.03);$$

### 9.2.3. Segment duration patterns

#### 9.2.3.1. Syntax and Semantics

If segment durations follow a well-defined pattern, the segment duration specified in the MPD *should* be the average duration. In case of number-based addressing this *should* be average over the duration of the period, while in case of **SegmentTimeline** it *should* apply only to segments described in an **S** element.

**Note:** There is no requirement to specify a precise segment duration – an approximation is good enough as long as the restrictions in 9.2.1 are maintained.

If there is a requirement for higher precision for precise lookup purposes, the following attributes are defined in the SCTE DASH namespace:

Element or Attribute Name	Use	Description
@offsetTimescale	OD	specifies the timescale in units per seconds to be used for the derivation of precise duration values in the Segment Information.  Default value is 1.
@offsetPattern	OD	specifies a repeating pattern of offsets.  Each offset is a signed integer in units specified by @offsetTimescale.  For a pattern with $N$ offsets, segment $i$ has offset $O(i) = \text{offsetPattern}[i\%N]$  The relation between real and stated duration of the segment is given by $D(n) = SD + O(n)$  Default value is 0 (i.e., a single offset of 0)
<b>Legend:</b> For attributes: M=Mandatory, O=Optional, OD=Optional with Default Value, CM=Conditionally Mandatory. For elements: <minOccurs>...<maxOccurs> (N=unbounded) Note that the conditions only holds without using <code>xlink:href</code> . If linking is used, then all attributes are "optional" and <minOccurs=0> Elements are <b>bold</b> ; attributes are non-bold and preceded with an @.		

The attributes *may* be used in **S** element or in **SegmentBase** and elements derived from it.

**Note 1:** Offsets are intended for precision purposes and are purely informational. In particular they do not affect URL construction.

### 9.2.3.2. Example

Let us assume **SegmentBase**@timescale = 1000 and @scte214:offsetTimescale = 90000

Let us further assume 2-sec segments with a pattern of 12 segments of 180480 90KHz clock ticks followed by a shorter 176640-tick segment, and  $SD = 2002$ .

In this case @scte214:offsetPattern = "300 300 300 300 300 300 300 300 300 300 300 300 -3540".

In our case the number of offsets (i.e., number of elements in the @scte214:offsetPattern list) is 12. Therefore segment  $i$  has duration (in 90KHz clock ticks) of  $D(n) = 2002 \times 90 + \text{offsetPattern}[i\%N]$ . For  $i=0...11$  the result will be  $2002 \times 90 + 300 = 180480$ .

### 9.3. Bandwidth, size, and buffering

#### 9.3.1. Introduction

This section formalizes the relationship between the declared bandwidth  $BW[R]$ ,  $MBT$ , and segment sizes.

The derivations below are a straightforward, albeit lengthy, translation of the requirement in ISO/IEC 23009-1 that if segments of representation  $R$  are delivered over a constant bitrate channel with bitrate equal to  $BW[R]$  attribute, then each sample with decoding time  $DT$  is available for decoding at the media engine by time  $DT + MBT$ .

**Note:** In many cases the latter *may* be a stricter limitation than the ones stated in the sections below, as the discussion below applies to complete (sub)segments, rather than samples.

While MBT does specify minimum time sufficient for ensuring continuous playout of a representation, it describes content encoding properties, rather than expected network behavior. Hence a player implementation has to account for realistic network conditions, and this specification provides neither restrictions nor any guidance on these issues.

#### 9.3.2. Segments

Let  $SD_{max}$  be the maximum segment duration. For representations containing more than one segment it is defined as follows:

$$SD_{max} = \min(1.5 * SD(R), MSD, 30.03)$$

Let  $SZ_R(n)$  be the size (in bits) of segment  $n$  from representation  $R$ .

**Note:**  $SZ_R(n)$  is the size of the complete segment including all headers, 'sidx' and 'ssix' boxes (for ISO-BMFF) and inband events.

Let  $MBT_s$  be the minimum buffer time in units of segments, defined as  $MBT_s = \text{ceil}\left(\frac{MBT}{SD_{max}}\right)$

**Note:** Buffer size of  $BW[R] * SD_{max} * MBT_s$  is sufficient for playback of representation  $R$  under idealized network conditions (i.e., assuming constant download rate).

For any representation that contains  $N > 1$  segments and is used for normal playback, the following restrictions **shall** be met:

1. Any segment  $n$  **shall not** exceed the buffer size, hence the following **shall** hold:

$$SZ_R(n) \leq BW[R] * SD_{max} * MBT_s$$

2. Combined size of any  $MBT_s$  consecutive segments **shall not** exceed the buffer size, hence for any  $0 \leq k \leq N - MBT_s$ , the following **shall** hold:

$$\sum_{i=k}^{MBT_s} SZ_R(i) \leq BW[R] * \sum_{i=k}^{MBT_s} D(i)$$

**Note 1:** In case of inband events care *should* be taken to keep events small enough in order not to break the model above.

**Note 2:** For representations without subsegments it is often useful to set *MBT* to  $SD_{max}$ . For representations containing subsegments  $SSD_{max}$  may be a better alternative. This agrees with the recommendation in DASH-IF IOP 3.0.

### **9.3.3. Video aspects**

*MBT* should not be less than CPB removal delay.

$MBT \cdot BW[R]$  should equal or exceed the size of CPB.

## **10. Codec-Specific Aspects**

### **10.1. Video**

#### **10.1.1. Supported video codecs**

The following video codecs are supported in SCTE DASH profiles:

1. AVC (ISO/IEC 14496-10, restrictions in SCTE 128-1 )
2. HEVC (ISO/IEC 23008-2, restrictions in SCTE 215-1)

#### **10.1.2. Resolutions and frame rates**

This specification neither specifies nor requires support for specific operating points (i.e., combination of resolution, frame rate and aspect ratio).

The input to encoding process is expected to be in one of the production formats specified in SCTE 215-1 sec. 6.0. At least one representation *should* have the resolution, frame rate, and aspect ratio listed in SCTE 215-1 Appendix A.

**Note:** Some of the possible derived operating points are specified in ETSI TS 103 285. The latter does not cover some of US-specific operating points.

#### **10.1.3. SAP values**

##### **10.1.3.1. AVC video**

Segments starting from an IDR picture in decoding order have SAP value of 1, unless this IDR picture is followed by a picture which precedes it in presentation order. In the latter case the segment has SAP value of 2.

##### **10.1.3.2. HEVC video**

Segments starting from pictures with `nal_unit_type` equal to `IDR_N_LP` or `BLA_N_LP` have SAP value of 1.

Segments starting from `IDR_W_RADL` or `BLA_W_RADL` have SAP value of 2.

### 10.1.4. Multiplexed segments

When a segment contains video and one or more audio elementary streams, its SAP value is the SAP value of the video elementary stream.

### 10.1.5. Colorimetry

**AdaptationSet.SupplementalProperty** descriptors *shall* be used to signal source signal information such as color primaries, optoelectronic transfer characteristics, as well as matrix coefficients for derivation of luma and chroma signals.

The URNs and corresponding values are defined in ISO/IEC 23001-8, and are informatively provided in the table below.

@schemeIdUri	@value
urn:mpeg:mpegB:cicp:ColourPrimaries	See ISO/IEC 23001-8 sec. 7.1
urn:mpeg:mpegB:cicp:TransferCharacteristics	See ISO/IEC 23001-8 sec. 7.2
urn:mpeg:mpegB:cicp:MatrixCoefficients	See ISO/IEC 23001-8 sec. 7.3

**Note:** This definition is a subset of the definition appearing in DASH-IF IOP 3.0

## 10.2. Audio

### 10.2.1. Supported codecs

The following audio codecs are supported in SCTE DASH profiles:

1. (E-)AC-3 (ATSC A/52, restrictions in A/53 Parts 5-6)
2. AAC (ISO/IEC 14496-3, restrictions in SCTE 193-1)
3. DTS-HD (ETSI TS 102 114, restrictions in SCTE 194-1)

### 10.2.2. SAP values

For AC-3, E-AC-3, DTS and AAC, all segments *shall* have SAP value of 1.

AAC segments *shall* be start with a RAP AU (as defined in SCTE 193-1) and *should* be encoded according to the MPEG DASH Implementation Guidelines sec. 5.1.2 in order to ensure seamless bitstream switching.

## 10.3. Trick Modes

### 10.3.1. Introduction

Playback of media content at speed and / or direction other than the ones intended for normal playback of this asset is referred to as *trick modes*. Trick modes include modes like fast forward, slow motion, and rewind; and are used to emulate visual experience of rewinding analog videotapes.

Trick modes can be implemented in multiple ways, starting from fetching segments at a different speed, to maintaining special trick mode representations, to bringing only specific frames from the segment. This standard does not prescribe a particular implementation strategy or combination of strategies. ETSI TS

103 285 sec. 6.2 provides a long discussion about ways of implementing trick modes in DASH, while encoding techniques discussed in SCTE 128 provide a content preparation perspective.

**Note:** SCTE 128 and SCTE 215 discuss trick modes based on extraction of identifiable pictures that result in respective decodable sub-bitstreams, or conversely, on discarding identifiable pictures to obtain respective decodable sub-bitstreams. This functionality can be implemented using Subsegment Index ('ssix') boxes

Trick modes are not necessarily permitted in all content – sometimes certain modes will be disallowed. This restriction model is described in SCTE 130-10, and sec. 11.3 defines its integration into DASH MPD.

### **10.3.2. Trick mode representations**

Periods *may* contain adaptation sets with representations intended for use in trick modes (e.g., representations with low frame rate). Such adaptation sets *shall* employ signaling as defined in DASH-IF IOP 3.0.

In particular this implies that the trick mode adaptation sets will be marked with a **SupplementalProperty** or **EssentialProperty** element with @schemeIdUri value of "http://dashif.org/guidelines/trickmode" and the @value the value of **AdaptationSet@id** attribute of the adaptation set to containing “normal” (non-trick-mode) representations of the same content.

## **11. Multi-period assets**

### **11.1. Period continuity**

If multi-period content is offered (e.g., when some of the periods represent placement opportunities), periods with identical **AssetIdentifier** elements are considered as contiguous parts of the same asset.

If an asset spans over more than one period, **Period.AssetIdentifier** element *shall* be present in each such period.

**Note:** Not all **Period** elements in the MPD need to contain asset identifiers – only the ones that contain parts of the same asset.

Periods with identical asset identifiers *shall* be *period-continuous* as specified in ISO/IEC 23009-1:2014 AMD3 (note – this reference will be replaced with reference to ISO/IEC 23009-1:201X 3<sup>rd</sup> edition when available).

### **11.2. Asset boundaries**

If multi-period content is offered in a dynamic MPD, periods can be removed and/or added during the presentation. In these cases the author *may* want to preserve the information regarding the playback location in time in order to allow e.g. correct display of time in UI.

If a period is the last period of a given asset, this *may* be signaled using **Period.SupplementalProperty** with @schemeIdUri="urn:scte:dash:asset-end".

Correspondence of *PeriodStart* to the time of the asset *may* be signaled using **Period.SupplementalProperty** with @schemeIdUri="urn:scte:dash:asset-time". The value of @value attribute *shall* be the timestamp corresponding to *PeriodStart*, as NPT or SMPTE relative timestamp, as defined in RFC 2326.

Correspondence of *PeriodStart* to UTC time *may* be signaled using **Period.SupplementalProperty** with @schemeIdUri="urn:scte:dash:utc-time". The value of @value attribute *shall* be the timestamp corresponding to *PeriodStart*, in format defined in RFC 3339.

**Note:** The difference between the asset time and UTC time is that asset time is relative to the asset start, while UTC time is the UTC time corresponding to the acquisition time of the first sample of the period. Thus, asset time will show that a period starts at 42<sup>nd</sup> minute of an asset, while UTC time will show that the period starts with content captured on October 21, 2015 at 4:29am.

### 11.3. Stream restrictions

Period elements *may* contain a **SupplementalProperty** element with **SupplementalProperty**@schemeIdUri value of "urn:scte:scte130-10:2014 ". The content of the descriptor is the SCTE 130-10 **StreamRestrictionList** element.

**NptRange** in this descriptor *shall* be relative to *PeriodStart* and the restrictions *shall* be valid only for the duration of the period in which the **SupplementalProperty** element appears.

**Note:** Given @nptstart value of  $N_s$ , @nptend value of  $N_e$ , and period duration  $D$ , the restrictions in the **StreamRestrictionList** element are valid in the range  $[\max(0:00.00, N_s), \min(D, N_e)]$ .

## 12. URL query parameters for XLink

### 12.1. Introduction

The only interface between an entity dereferencing XLink and the DASH client is the XLink URL. Passing avail metadata such as SCTE 35 cue messages may be useful when remote periods are used to signal upcoming avails. This usage is described in DASH-IF IOP and referred to as "server-based ad insertion".

The section below defines standardized names and values for parameters that can be used in XLink URLs. It defines the parameter name and the derivation of its value. Name and value shall contain only characters permitted by RFC 3986, and may need to be percent-coded.

The parameters defined in this section are not mandatory – i.e., the author is not required to use them. On the other hand, query parameter with the name defined in this section appears in a URL, its value *shall* be derived in a way defined in this section. The author *shall not* use query parameter names defined in this section with any different syntax and semantics.

The parameters in this section *shall not* be used in elements other than Period

### 12.2. Notation

The standardized parameters introduced in this section are <name>=<value> pairs embedded in a URL query string (as defined in RFC 3986). The <field> string in the above construct will be replaced with parameter name. For example, for parameter named `param` and having value 42, the URL will be <http://example.com?param=42>

Note: <name> is often referred to as "field" in different descriptions of URL query parameter syntax.

### 12.3. Carriage of SCTE 35 in a query parameter

Parameters defined in this section carry the complete SCTE 35 binary cue message, as well as message timing.

<name>	<value>	format
scte35-cue	splice_info_section()	base64url-encoded string with padding. Pad character ('=') replaced with "%3D" See Note 1 and 2 below.
scte35-time	Offset of splice start from presentation start time.	xsd:duration

	<p>This is a translation of <code>splice_time()</code> into presentation timeline. The time <i>should</i> be provided with millisecond accuracy if feasible.</p> <p>See note 3 below</p>	(defined in XML Schema Part 2, based on ISO 8601)
--	--	---

**Note 1:** Percent encoding is required to escape reserved characters in query string. Thus '=' character used as a padding character in base64 and base64url thus needs to be replaced with %3D. While `splice_info_section()` size is provided within the section, skipping padding per RFC 4648 sec 3.2 is explicitly disallowed in the definition above for simplicity and interoperability reasons.

**Note 2:** The format of the `scte35-cue` parameter is identical to the base64-coded format used in CUE attribute of #EXT-X-SCTE35 tag in SCTE 35 2016 sec. 12.2.1, with the following differences: (a) percent-coding of padding character, and (b) since base64url and not base64 alphabet is used, characters "+" and "/" in the CUE attribute are respectively replaced by "-" (minus) and "\_" (underscore), per RFC 4648.

**Note 3:** The `scte35-time` value is equivalent to the value of *PeriodStart* corresponding to the start of the avail if an avail is represented by a Period element. It is equivalent to the TIME attribute of the #EXT-X-SCTE35 tag in SCTE 35 2016. In the latter case the TIME attribute gives absolute time, while `scte35-time` value is relative to start of the presentation.

**Note 4:** The definition in this section does not preclude use of SCTE 35 in DASH events (either inband or MPD), as defined in this standard and in ANSI/SCTE 214-3.

### Example

**Table 12-1: Remote Period element with SCTE 35 embedded in XLink URL**

```

...
<Period duration="PT60.0S" id="ad break #1"
  xlink:href="https://adsrus.com/avail.mpd?scte35-cue=
    DAIAAAAAAAAAAAQAAZ_I0VniQAQAgBDVUVJQAAAAH+cAAAAAA%3D%3D"
  xlink:actuate="onLoad" >

  <!-- Default content, replaced by elements from remote entity -->
  <AdaptationSet mimeType="video/mp4" codecs="avc1.640828"
    frameRate="30000/1001"
    segmentAlignment="true" startWithSAP="1">
    <BaseURL availabilityTimeOffset="INF">default_ad/</BaseURL>
    <SegmentTemplate timescale="90000" initialization="$Bandwidth%/init.mp4v"
      media="$Bandwidth%/$Time$.mp4v"/>
      <Representation id="v0" width="320" height="240" bandwidth="250000"/>
      <Representation id="v1" width="640" height="480" bandwidth="500000"/>
      <Representation id="v2" width="960" height="720" bandwidth="1000000"/>
    </AdaptationSet>

```

```
</Period>
```

## 12.4. Carriage of geographical information in a query parameter

This section lists parameters can be used for carriage of geographical information in URLs.

Note that these parameters may have privacy implications, hence it is recommended to use HTTP over TLS (e.g., HTTPS) if the HTTP GET with these parameters is expected to be sent via an insecure channel.

<name>	<value>	format
scte-dash-syscode	syscode	Decimal number, assigned by NCC Media

## 13. Annotation

### 13.1. Generator identification

It is often necessary for debug purposes to indicate which software generated an MPD or responded to an XLink dereferencing request. In order to allow such information, the following schemes can be used in **MPD.SupplementalProperty** and/or in **Period.SupplementalProperty** elements:

@schemeIdUri	@value
urn:scte:dash:powered-by:2016	Human-readable string containing software name and version that generated this MPD or responded to the XLink dereferencing request
urn:scte:dash:generation-info:2016	Comma-separated list of name=value pairs with the following key values: <ol style="list-style-type: none"> <li>1. location=&lt;location&gt;: same as location header in HTTP (RFC 7213), as an absolute URI</li> <li>2. date=[time]: generation time (UTC), in format specified by ISO 8601. The time <i>should</i> be provided with millisecond accuracy if feasible.</li> </ol>
urn:scte:dash:generation-request:2016	Request target string (per RFC 7230 sec 5.3) from the HTTP request which resulted in generating the current response (MPD or Period).  Example: value of syscode, assuming scte-dash-syscode query parameter was used

#### Example

For remote period from example in Table 12-1, the remote entity (i.e., the contents of the HTTP response) containing generator identification information is described in Table 13-1 below.

In the example below the XLink URL from in Table 12-1 (sans host name) is reflected in the generation request information, while the arrival time of the XLink request and the server name of the responding server are reflected in the generation info.

**Table 13-1: Remote entity with generator information**

<pre>&lt;Period duration="PT60.0S" id="inserted ad #1" &gt;   &lt;SupplementalProperty schemeIdUri="urn:scte:dash:generation-info:2016"     value="location=adsrus.com date=2016-01-07T15:22:16-07:00"/&gt; &lt;/Period&gt;</pre>
---

```
<SupplementalProperty schemeIdUri="urn:scte:dash:generation-request:2016"
  value="/avail.mpd?scte-dash-syscode=123456789&&scte35-
  cue=DAIAAAAAAAAAAAQAAZ_IOVniQAQAgBDVUVVJQAAAAH+cAAAAAA%3D%3D" />

<!-- Replaced ad content, replacing by elements from remote entity -->
<AdaptationSet mimeType="video/mp4" codecs="avc1.640828"
  frameRate="30000/1001"
  segmentAlignment="true" startWithSAP="1">
  <BaseURL availabilityTimeOffset="INF">ad/</BaseURL>
  <SegmentTemplate timescale="90000" initialization="$Bandwidth%/init.mp4v"
    media="$Bandwidth%/$Time$.mp4v"/>
  <Representation id="v0" width="320" height="240" bandwidth="250000"/>
  <Representation id="v1" width="640" height="480" bandwidth="500000"/>
  <Representation id="v2" width="960" height="720" bandwidth="1000000"/>
</AdaptationSet>
</Period>
```

## Annex A URNs

The following URNs are defined in this specification:

**urn:scte:dash:2015**

XML namespace for this specification.

**urn:scte:dash:essential-event:2015**

Event essentiality, see 6.7.3

**urn:scte:scte35:2013:xml**

XML representation of SCTE 35, see 6.7.4

**urn:scte:scte35:2014:xml+bin**

base64-coded representation of SCTE 35 wrapped in XML, see 6.7.4

**urn:scte:dash:associated-service:2015**

Roles for non-accessibility associated audio services, see 7.1

**urn:scte:dash:cc:cea-608:2015**

Signaling of CEA-608 closed captions, see 7.2.3

**urn:scte:dash:cc:cea-708:2015**

Signaling of CEA-708 closed captions, see 7.2.2

**urn:scte:dash:asset-id:upid:2015**

Asset identifier scheme based on SCTE 35 UPIDs, see 8.2

**urn:scte:dash:asset-end**

End of last period of an asset, see 11.2

**urn:scte:dash:asset-time**

NPT corresponding to asset time, see 11.2

**urn:scte:dash:utc-time**

UTC time corresponding to asset time, see 11.2

**urn:scte:scte130-10:2014**

Carriage of SCTE 130-10, see 11.3

**urn:scte:dash:powered-by:2016**

Information on MPD / XLink authoring software

**urn:scte:dash:generation-info:2016**

Time and place of MPD or XLink remote entity generation

**urn:scte:dash:generation-query:2016**

Time and place of MPD or XLink remote entity generation