



Information technology — Dynamic adaptive streaming over HTTP (DASH) —

Part 1: Media presentation description and segment formats

TECHNICAL CORRIGENDUM 1

Technologies de l'information — Diffusion en flux adaptatif dynamique sur HTTP (DASH) —

Partie 1: Description de la présentation et formats de remise des médias

RECTIFICATIF TECHNIQUE 1

Technical Corrigendum 1 to ISO/IEC 23009-1:2012 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

Clause 2

Replace:

ITU-T Rec. H.222.0 | ISO/IEC 13818-1, *Information technology – Generic coding of moving pictures and associated audio information: Systems*

ISO/IEC 14496-10, *Information technology – Coding of audio-visual objects – Part 10: Advanced Video Coding*

ISO/IEC 14496-12, *Information technology – Coding of audio-visual objects – Part 12: ISO base media file format (technically identical to ISO/IEC 15444-12)*

ISO/IEC 23003-3, *Information technology – MPEG audio technologies – Part 3: Unified speech and audio coding*

IETF RFC 1521, *MIME (Multipurpose Internet Mail Extensions) Part One: Mechanisms for Specifying and Describing the Format of Internet Message Bodies*, September 1993

IETF RFC 1738, *Uniform Resource Locators (URL)*, December 1994

IETF RFC 2141, *URN Syntax*, May 1997

IETF RFC 2616, *Hypertext Transfer Protocol – HTTP/1.1*, June 1999

IETF RFC 3023, *XML Media Types*, January 2001

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 4122, *A Universally Unique IDentifier (UUID) URN Namespace*, July 2005

IETF RFC 4337, *MIME Type Registration for MPEG-4*, March 2006

IETF RFC 5646, *Tags for Identifying Languages*, September 2009

IETF RFC 6381, *The 'Codecs' and 'Profiles' Parameters for "Bucket" Media Types*, August 2011

W3C XLINK *XML Linking Language (XLink) Version 1.1*, W3C Recommendation 06, May 2010

with:

ITU-T Rec. H.222.0 | ISO/IEC 13818-1, *Information technology – Generic coding of moving pictures and associated audio information: Systems*

ISO/IEC 14496-12, *Information technology – Coding of audio-visual objects – Part 12: ISO base media file format (technically identical to ISO/IEC 15444-12)*

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

IETF RFC 2141, *URN Syntax*, May 1997

IETF RFC 2616, *Hypertext Transfer Protocol – HTTP/1.1*, June 1999

IETF RFC 3023, *XML Media Types*, January 2001

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

IETF RFC 3629, *UTF-8, a transformation format of ISO 10646*, November 2003

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

IETF RFC 4122, *A Universally Unique IDentifier (UUID) URN Namespace*, July 2005

IETF RFC 4288, *Media Type Specifications and Registration Procedures*, December 2005

IETF RFC 4337, *MIME Type Registration for MPEG-4*, March 2006

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

IETF RFC 5646, *Tags for Identifying Languages*, September 2009

IETF RFC 6381, *The 'Codecs' and 'Profiles' Parameters for "Bucket" Media Types*, August 2011

W3C XLINK *XML Linking Language (XLink) Version 1.1*, W3C Recommendation 06, May 2010

3.1.29

Replace:

remote element

element that is not fully contained in the MPD document but is referenced in the MPD with an HTTP-URL

with:

remote element

one or more elements that are not fully contained in the MPD document but is referenced in the MPD with an HTTP-URL

3.3

Replace:

- Namespace qualification of elements and attributes is used as per XML standards, in the form of **namespace:Element** or **@namespace:attribute**. The fully qualified namespace will be provided in the schema fragment associated with the declaration.

with:

- Namespace qualification of elements and attributes is used as per XML standards, in the form of **namespace:Element** or **@namespace:attribute**. The fully qualified namespace will be provided in the schema fragment associated with the declaration. External specifications extending the namespace of DASH are expected to document the element name in the semantic table with an extension namespace prefix.

4.3 DASH data model overview, paragraphs 12 to 14

Replace:

Segments may be further subdivided into **Subsegments** each of which contains a whole number of complete access units. There may also be media-format-specific restrictions on Subsegment boundaries, for example in the ISO Base Media File Format a Subsegment must contain a whole number of complete movie fragments. If a Segment is divided into Subsegments are described by a compact **Segment index**, which provides the presentation time range in the Representation and corresponding byte range in the Segment occupied by each Subsegment. Clients may download this index in advance and then issue requests for individual Subsegments.

Clients may switch from Representation to Representation within an Adaptation Set at any point in the media. However, switching at arbitrary positions may be complicated because of coding dependencies within Representations and other factors. It is also desirable to avoid download of 'overlapping' data i.e. media for the same time period from multiple Representations. Usually, switching is simplest at a random access point in the new stream. In order to formalize requirements related to switching DASH defines a codec-independent concept of Stream Access Point and identifies various types of Stream Access Point.

Segmentation and Subsegmentation may be performed in ways that make switching simpler. For example, in the very simplest cases each Segment or Subsegment begins with a random access point and the boundaries of Segments or Subsegments are aligned across the Representations of an Adaptation Set. In this case, switching Representation involves playing to the end of a (Sub)Segment of one Representation and then playing from the beginning of the next (Sub)Segment of the new Representation. The Media Presentation Description and Segment Index provide various indications, which describe properties of the Representations that may make switching simpler. Profiles of this specification may then require these indicators to be set in certain ways, making implementation of clients for those profiles simpler at the cost of requiring the media data to obey the indicated constraints.

with:

Segments may be further subdivided into **Subsegments** each of which contains a whole number of complete access units. There may also be media-format-specific restrictions on Subsegment boundaries, for example in the ISO Base Media File Format a Subsegment must contain a whole number of complete movie fragments. If a Segment is divided into Subsegments they are described by a compact **Segment index**, which provides the presentation time range in the Representation and corresponding byte range in the Segment occupied by each Subsegment. Clients may download this index in advance and then issue requests for individual Subsegments.

Clients may switch from Representation to Representation within an Adaptation Set at any point in the media. However, switching at arbitrary positions may be complicated because of coding dependencies within Representations and other factors. It is also desirable to avoid download of 'overlapping' data i.e. media for the same time period from multiple Representations. Usually, switching is simplest at a stream access point in the new stream. In order to formalize requirements related to switching DASH defines a codec-independent concept of Stream Access Points and identifies various types of Stream Access Points.

Segmentation and Subsegmentation may be performed in ways that make switching simpler. For example, in the very simplest cases each Segment or Subsegment begins with a stream access point and the boundaries of Segments or Subsegments are aligned across the Representations of an Adaptation Set. In this case, switching Representation involves playing to the end of a (Sub)Segment of one Representation and then playing from the beginning of the next (Sub)Segment of the new Representation. The Media Presentation Description and Segment Index provide various indications, which describe properties of the Representations that may make switching simpler. Profiles of this specification may then require these indicators to be set in certain ways, making implementation of clients for those profiles simpler at the cost of requiring the media data to obey the indicated constraints.

4.6 Brands

Replace:

sims	6.3.4.4	Media Segment conforming to the Sub-Indexed Media Segment format type for ISO base media file format.
dash	6.3.5.2	ISO base media file format file specifically designed for DASH including movie fragments and Segment Index.

with:

sims	6.3.4.4	Media Segment conforming to the Sub-Indexed Media Segment format type for ISO base media file format.
dsms	6.3.5.1	Media Segment conforming to the DASH Self-Initializing Media Segment format type for ISO base media file format.
dash	6.3.5.2	ISO base media file format file specifically designed for DASH including movie fragments and Segment Index.

4.7 Schemes

Replace:

Table 2 — Schemes defined in this part of ISO/IEC 23009

Scheme Identifier	Clause in this part of ISO/IEC 23009	Informative description
urn:mpeg:dash:mpd:2011	Annex B	The namespace of the XML schema for the MPD.
urn:mpeg:dash:14496:10:frame_packing_arrangement_type:2011	5.8.5.3	frame-packing arrangement as defined by Table D-8 of ISO/IEC 14496-10.
urn:mpeg:dash:13818:1:stereo_video_format_type:2011	5.8.5.3	frame-packing arrangement as defined by Table L-1 of ISO/IEC 13818-1.
urn:mpeg:dash:23003:3:audio_channel_configuration:2011	5.8.5.4	channel configuration as defined by Table 65 of ISO/IEC 23003-3.

with:

Table 2 — Schemes defined in this part of ISO/IEC 23009

Scheme Identifier	Clause in this part of ISO/IEC 23009	Informative description
urn:mpeg:dash:schema:mpd:2011	Annex B	The namespace of the XML schema for the MPD.
urn:mpeg:dash:14496:10:frame_packing_arrangement_type:2011	5.8.5.3	frame-packing arrangement identifier
urn:mpeg:dash:13818:1:stereo_video_format_type:2011	5.8.5.3	frame-packing arrangement identifier
urn:mpeg:dash:23003:3:audio_channel_configuration:2011	5.8.5.4	channel configuration identifier

5.2.1 General

Replace:

The MIME type of the MPD document is defined in Annex C.

with:

The MIME type of the MPD document is defined in Annex C.

The encoding of the MPD shall be UTF-8 as defined in IETF RFC 3629. All data provided in extension namespaces shall be UTF-8 as defined in IETF RFC 3629. If binary data needs to be added, it shall be included in Base64 as described in IETF RFC 4648 within a UTF-8 encoded element with a proper name space or identifier, such that an XML parser knows how to process or ignore it.

5.2.2 Schema

Replace:

```
<?xml version="1.0"?>
<xs:schema targetNamespace="urn:mpeg:DASH:schema:MPD:2011"
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns="urn:mpeg:DASH:schema:MPD:2011">
```

```

<xs:import namespace="http://www.w3.org/1999/xlink" schemaLocation="xlink.xsd"/>

<xs:annotation>
  <xs:appinfo>Media Presentation Description</xs:appinfo>
  <xs:documentation xml:lang="en">
    This Schema defines the Media Presentation Description for MPEG-DASH.
  </xs:documentation>
</xs:annotation>

<!-- MPD: main element -->
<xs:element name="MPD" type="MPDtype"/>

...

</xs:schema>

```

with:

```

<?xml version="1.0"?>
<xs:schema targetNamespace="urn:mpeg:dash:schema:mpd:2011"
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns="urn:mpeg:dash:schema:mpd:2011">

  <xs:import namespace="http://www.w3.org/1999/xlink" schemaLocation="xlink.xsd"/>

  <xs:annotation>
    <xs:appinfo>Media Presentation Description</xs:appinfo>
    <xs:documentation xml:lang="en">
      This Schema defines the Media Presentation Description for MPEG-DASH.
    </xs:documentation>
  </xs:annotation>

  <!-- MPD: main element -->
  <xs:element name="MPD" type="MPDtype"/>

  ...

</xs:schema>

```

5.3.1.1 Overview

Remove the fourth list point:

- A Representation may contain one or more Sub-Representations as described in 5.3.6.

5.3.1.2 Semantics

Replace:

@timeShiftBufferDepth	O	specifies the duration of the time shifting buffer that is guaranteed to be available for a Media Presentation with type 'dynamic'. When not present, the value is infinite. This value of the attribute is undefined if the type attribute is equal to 'static'.
-----------------------	---	---

with:

@timeShiftBufferDepth	O	specifies the duration of the smallest time shifting buffer for any Representation in the MPD that is guaranteed to be available for a Media Presentation with type 'dynamic'. When not present, the value is infinite. This value of the attribute is undefined if the type attribute is equal to 'static'.
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5.3.2.2 Semantics

Replace:

Table 4 — Semantics of **Period** element

Element or Attribute Name	Use	Description
Period		specifies the information of a Period.
@xlink:href	O	specifies a reference to an external Period element
@xlink:actuate	OD default: onRequest	specifies the processing instructions, which can be either "onLoad" or "onRequest". This attribute shall not be present if the @xlink:href attribute is not present.
@id	O	specifies an identifier for this Period. The identifier shall be unique within the scope of the Media Presentation. If not present, no identifier for the Period is provided.
AdaptationSet	0...N	specifies an Adaptation Set. At least one Adaptation Set shall be present in each Period. However, the actual element may be present only in a remote element if xlink is in use, For more details see 5.3.3.

with:

Table 4 — Semantics of **Period** element

Element or Attribute Name	Use	Description
Period		specifies the information of a Period.
@xlink:href	O	specifies a reference to a remote element that contains one or multiple elements of type Period
@xlink:actuate	OD default: onRequest	specifies the processing instructions, which can be either "onLoad" or "onRequest". This attribute shall not be present if the @xlink:href attribute is not present.
@id	O	specifies an identifier for this Period. The identifier shall be unique within the scope of the Media Presentation. If the MPD @type is "dynamic", then this attribute shall be present and shall not change in case the MPD is updated. If not present, no identifier for the Period is provided.
AdaptationSet	0...N	specifies an Adaptation Set. At least one Adaptation Set shall be present in each Period unless the value of the @duration attribute of the Period is set to zero. Note that the actual element may be present only in a remote element if xlink is in use. For more details see 5.3.3.

5.3.3.1 Overview

Replace:

If there exist multiple media content components then the properties of each media content component shall be described by a separate **ContentComponent** element as defined in 5.5.4. The **ContentComponent** element shares common elements and attributes with the **AdaptationSet** element. Default values, or values applicable to all media content components, may be provided directly in the **AdaptationSet** element. Attributes present in the **AdaptationSet** shall not be repeated in the **ContentComponent** element.

with:

If there exist multiple media content components then the properties of each media content component shall be described by a separate **ContentComponent** element as defined in 5.3.4. The **ContentComponent** element shares common elements and attributes with the **AdaptationSet** element. Default values, or values applicable to all media content components, may be provided directly in the **AdaptationSet** element. Attributes present in the **AdaptationSet** shall not be repeated in the **ContentComponent** element.

5.3.3.2 Semantics

Replace:

Table 5 — Semantics of AdaptationSet element

Element or Attribute Name	Use	Description
AdaptationSet		Adaptation Set description
@xlink:href	O	specifies a reference to external AdaptationSet element
@contentType	O	specifies the media content component type for this Adaptation Set. A value of the top-level Content-type 'type' value as defined in RFC1521, Clause 4 shall be taken. If not present, the media content component type may be defined for each media component or it may be unknown.

with:

Table 5 — Semantics of AdaptationSet element

Element or Attribute Name	Use	Description
AdaptationSet		Adaptation Set description
@xlink:href	O	specifies a reference to a remote element that shall contain exactly one element of type AdaptationSet
@contentType	O	specifies the media content component type for this Adaptation Set. A value of the top-level Content-type 'type' value as defined in RFC4288, Clause 4 shall be taken. If not present, the media content component type may be defined for each media component or it may be unknown.

5.3.4.1 Overview

Replace:

The semantics of the attributes and elements within a **ContentComponent** element are provided in Table 6 of 5.3.3.2. The XML syntax of the **ContentComponent** element is provided in 5.3.3.3.

with:

The semantics of the attributes and elements within a **ContentComponent** element are provided in Table 6 of 5.3.4.2. The XML syntax of the **ContentComponent** element is provided in 5.3.4.3.

5.3.5.1 Overview

Replace:

For any dependent Representation X that depends on complementary Representation Y, the m -th Subsegment of X and the n -th Subsegment of Y shall be non-overlapping (as defined in 4.5.3) whenever m is not equal to n . For dependent Representations the concatenation of the Initialization Segment with the sequence of Subsegments of the dependent Representations, each being preceded by the corresponding Subsegment of each of the complementary Representations in order as provided in the @dependencyId attribute shall represent a conforming Subsegment sequence as defined in 4.5.3 conforming to the media format as specified in the @mimeType attribute for this dependent Representation.

NOTE When decoding of a dependent Representation is started from a SAP in the (Sub)Segment with number i , the decoding process does not need to access data from the complementary Representation(s) from any earlier (sub)segments than (sub)Segment with number i of the complementary Representation(s).

with:

For any dependent Representation X that depends on complementary Representation Y, the m -th Subsegment of X and the n -th Subsegment of Y shall be non-overlapping (as defined in 4.5.2) whenever m is not equal to n . For dependent Representations the concatenation of the Initialization Segment with the sequence of Subsegments of the dependent Representations, each being preceded by the corresponding Subsegment of each of the complementary Representations in order as provided in the @dependencyId attribute shall represent a conforming Subsegment sequence as defined in 4.5.3 conforming to the media format as specified in the @mimeType attribute for this dependent Representation.

NOTE When decoding of a dependent Representation is started from a SAP in the (Sub)Segment with number i , the decoding process does not need to access data from the complementary Representation(s) from any earlier (sub)segments than (sub)Segment with number i of the complementary Representation(s).

If a Representation is offered in a Media Presentation with **MPD@type='dynamic'**, it is recommended that means to compensate such drift be included. For more details refer to A.8.

5.3.5.2 Semantics

Replace:

Table 7 —Semantics of Representation element

Element or Attribute Name	Use	Description
Representation		This element contains a description of a Representation.
@id	M	specifies an identifier for this Representation. The identifier shall be unique within a Period unless the Representation is functionally identically to another Representation in the same Period. The identifier shall not contain whitespace characters. If used in the template-based URL construction as defined in 5.3.9.4.4, the string shall only contain characters that are permitted within an HTTP-URL according to RFC 1738.
@bandwidth	M	Consider a hypothetical constant bitrate channel of bandwidth with the value of this attribute in bits per second (bps). Then, if the Representation is continuously delivered at this bitrate, starting at any SAP that is indicated either by @startWithSAP or by any Segment Index box, a client can be assured of having enough data for continuous playout providing playout begins after @minBufferTime * @bandwidth bits have been received (i.e. at time @minBufferTime after the first bit is received). For dependent Representations this value shall specify the minimum bandwidth as defined above of this Representation and all complementary Representations.

with:

Table 7 —Semantics of Representation element

Element or Attribute Name	Use	Description
Representation		This element contains a description of a Representation.
@id	M	specifies an identifier for this Representation. The identifier shall be unique within a Period unless the Representation is functionally identically to another Representation in the same Period. The identifier shall not contain whitespace characters. If used in the template-based URL construction as defined in 5.3.9.4.4, the string shall only contain characters that are permitted within an HTTP-URL according to RFC 3986.
@bandwidth	M	Consider a hypothetical constant bitrate channel of bandwidth with the value of this attribute in bits per second (bps). Then, if the Representation is continuously delivered at this bitrate, starting at any SAP that is indicated either by @startWithSAP or by any Segment Index box, a client can be assured of having enough data for continuous playout providing playout begins after @minBufferTime * @bandwidth bits have been received (i.e. at time @minBufferTime after the first bit is received). For dependent Representations this value specifies the bandwidth according to the above definition for the aggregation of this Representation and all complementary Representations.

5.3.7.2 Semantics

Replace:

@codecs	M	specifies the codecs present within the Representation. The codec parameters shall also include the profile and level information where applicable. The contents of this attribute shall conform to either the
---------	---	---

		<code>simp-list</code> or <code>fancy-list</code> productions of RFC6381, Section 3.2, without the enclosing <code>DQUOTE</code> characters. The codec identifier for the Representation's media format, mapped into the name space for codecs as specified in RFC6381, Section 3.3, shall be used.
ContentProtection	0 ... N	specifies information about content protection schemes used for the associated Representations. For details see 5.8.1 and 5.8.4.1.
Legend: For attributes: M=Mandatory, O=Optional, OD=Optional with Default Value, CM=Conditionally Mandatory. For elements: <minOccurs>..<maxOccurs> (N=unbounded) Elements are bold ; attributes are non-bold and preceded with an @.		

with:

@codecs	O	specifies the codecs present within the Representation. The codec parameters shall also include the profile and level information where applicable. For segment formats defined in this specification this element shall be present and the contents of this attribute shall conform to either the <code>simp-list</code> or <code>fancy-list</code> productions of RFC6381, Section 3.2, without the enclosing <code>DQUOTE</code> characters. The codec identifier for the Representation's media format, mapped into the name space for codecs as specified in RFC6381, Section 3.3, shall be used.
ContentProtection	0 ... N	specifies information about content protection schemes used for the associated Representations. For details see 5.8.1 and 5.8.4.1.
EssentialProperty	0 ... N	specifies information about the containing element that is considered essential by the Media Presentation author for processing the containing element. For details see 5.8.4.8.
SupplementalProperty	0 ... N	specifies supplemental information about the containing element that may be used by the DASH client optimizing the processing. For details see 5.8.4.9.
Legend: For attributes: M=Mandatory, O=Optional, OD=Optional with Default Value, CM=Conditionally Mandatory. For elements: <minOccurs>..<maxOccurs> (N=unbounded) Elements are bold ; attributes are non-bold and preceded with an @.		

5.3.7.3 XML syntax

Replace:

```

<!-- Representation base (common attributes and elements) -->
<xs:complexType name="RepresentationBaseType">
  <xs:sequence>
    <xs:element name="FramePacking" type="DescriptorType" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="AudioChannelConfiguration" type="DescriptorType" minOccurs="0"
maxOccurs="unbounded"/>
    <xs:element name="ContentProtection" type="DescriptorType" minOccurs="0"
maxOccurs="unbounded"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="profiles" type="xs:string"/>
  <xs:attribute name="width" type="xs:unsignedInt"/>
  <xs:attribute name="height" type="xs:unsignedInt"/>
  <xs:attribute name="sar" type="RatioType"/>
  <xs:attribute name="frameRate" type="FrameRateType"/>
  <xs:attribute name="audioSamplingRate" type="xs:string"/>
  <xs:attribute name="mimeType" type="xs:string"/>
  <xs:attribute name="segmentProfiles" type="xs:string"/>
  <xs:attribute name="codecs" type="xs:string"/>
  <xs:attribute name="maximumSAPPeriod" type="xs:double"/>
  <xs:attribute name="startWithSAP" type="SAPType"/>
  <xs:attribute name="maxPlayoutRate" type="xs:double"/>
  <xs:attribute name="codingDependency" type="xs:boolean"/>
  <xs:attribute name="scanType" type="VideoScanType"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>

<!-- Stream Access Point type enumeration -->
<xs:simpleType name="SAPType">
  <xs:restriction base="xs:unsignedInt">
    <xs:minInclusive value="0"/>
    <xs:maxInclusive value="6"/>
  </xs:restriction>
</xs:simpleType>

<!-- Video Scan type enumeration -->
<xs:simpleType name="VideoScanType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="progressive"/>
    <xs:enumeration value="interlaced"/>
    <xs:enumeration value="unknown"/>
  </xs:restriction>
</xs:simpleType>

```

with:

```

<!-- Representation base (common attributes and elements) -->
<xs:complexType name="RepresentationBaseType">
  <xs:sequence>
    <xs:element name="FramePacking" type="DescriptorType" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="AudioChannelConfiguration" type="DescriptorType" minOccurs="0"
maxOccurs="unbounded"/>
    <xs:element name="ContentProtection" type="DescriptorType" minOccurs="0"
maxOccurs="unbounded"/>
    <xs:element name="EssentialProperty" type="DescriptorType" minOccurs="0"
maxOccurs="unbounded"/>
    <xs:element name="SupplementalProperty" type="DescriptorType" minOccurs="0"
maxOccurs="unbounded"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="profiles" type="xs:string"/>
  <xs:attribute name="width" type="xs:unsignedInt"/>
  <xs:attribute name="height" type="xs:unsignedInt"/>
  <xs:attribute name="sar" type="RatioType"/>
  <xs:attribute name="frameRate" type="FrameRateType"/>
  <xs:attribute name="audioSamplingRate" type="xs:string"/>
  <xs:attribute name="mimeType" type="xs:string"/>
  <xs:attribute name="segmentProfiles" type="xs:string"/>
  <xs:attribute name="codecs" type="xs:string"/>
  <xs:attribute name="maximumSAPPeriod" type="xs:double"/>
  <xs:attribute name="startWithSAP" type="SAPType"/>
  <xs:attribute name="maxPlayoutRate" type="xs:double"/>
  <xs:attribute name="codingDependency" type="xs:boolean"/>
  <xs:attribute name="scanType" type="VideoScanType"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>

<!-- Stream Access Point type enumeration -->
<xs:simpleType name="SAPType">
  <xs:restriction base="xs:unsignedInt">
    <xs:minInclusive value="0"/>
    <xs:maxInclusive value="6"/>
  </xs:restriction>
</xs:simpleType>

<!-- Video Scan type enumeration -->
<xs:simpleType name="VideoScanType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="progressive"/>
    <xs:enumeration value="interlaced"/>
    <xs:enumeration value="unknown"/>
  </xs:restriction>
</xs:simpleType>

```

5.3.9.2.1 Overview

Replace:

In case multiple Media Segments are present, either a **SegmentList** or a **SegmentTemplate** is used that share the multiple Segment base information as provided in 5.3.9.2.3, Table 12.

with:

In case multiple Media Segments are present, either a **SegmentList** or a **SegmentTemplate** is used that share the multiple Segment base information as provided in 5.3.9.2.2, Table 12.

5.3.9.2.2 Semantics

Replace:

Table 11 — Semantics of SegmentBase element and Segment Base Information type

Element or Attribute Name	Use	Description
SegmentBase Segment Base Information		specifies Segment base element as well as the type for the Segment base information.

with:

Table 11 — Semantics of SegmentBase element and Segment Base Information type

Element or Attribute Name	Use	Description
SegmentBase Segment Base Information		specifies Segment base element. This element also specifies the type for the Segment base information that is the base type for other elements.

5.3.9.2.2 Semantics

Replace:

Segment Base Information		specifies Segment base information.
@startNumber	O	specifies the number of the first Media Segment in this Representation in the Period. For more details refer to 5.3.9.5.3.

with:

Segment Base Information		the Segment base information as specified in Table 11.
@startNumber	O	specifies the start number. The interpretation of the @startNumber depends on the segment addressing method. For more details refer to 5.3.9.5.3.

5.3.9.2.2 Semantics

Replace:

@presentationTimeOffset	O	specifies the presentation time offset of the Representation relative to the start of the Period. The value of the presentation time offset in seconds is the division of the value of this attribute and the value of the @timescale attribute. If not present on any level, the value of the presentation time offset is 0.
@indexRange	O	specifies the byte range that contains the Segment Index in all Media Segments of the

		Representation. The byte range shall be expressed and formatted as a <code>byte-range-spec</code> as defined in RFC 2616, Clause 14.35.1. It is restricted to a single expression identifying a contiguous range of bytes. If not present the value is unknown.
--	--	--

with:

@presentationTimeOffset	O	specifies the presentation time offset of the Representation relative to the start of the Period. The value of the presentation time offset in seconds is the division of the value of this attribute and the value of the @timescale attribute. If not present on any level, the value of the presentation time offset is 0.
@timeShiftBufferDepth	O	specifies the duration of the time shifting buffer for this Representation that is guaranteed to be available for a Media Presentation with type 'dynamic'. When not present, the value is of the @timeShiftBufferDepth on MPD level applies. If present, this value shall be not smaller than the value on MPD level. This value of the attribute is undefined if the type attribute is equal to 'static'. NOTE: When operating in a time-shift buffer on a Representation with value larger than the time-shift buffer than signalled on MPD level, not all Representations may be available for switching.
@indexRange	O	specifies the byte range that contains the Segment Index in all Media Segments of the Representation. The byte range shall be expressed and formatted as a <code>byte-range-spec</code> as defined in RFC 2616, Clause 14.35.1. It is restricted to a single expression identifying a contiguous range of bytes. If not present the value is unknown.

5.3.9.2.3 XML-Syntax

Replace:

<pre> <!-- Segment information base --> <xs:complexType name="SegmentBaseType"> <xs:sequence> <xs:element name="Initialization" type="URLType" minOccurs="0"/> <xs:element name="RepresentationIndex" type="URLType" minOccurs="0"/> <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/> </xs:sequence> <xs:attribute name="timescale" type="xs:unsignedInt"/> <xs:attribute name="presentationTimeOffset" type="xs:unsignedInt"/> <xs:attribute name="indexRange" type="xs:string"/> <xs:attribute name="indexRangeExact" type="xs:boolean" default="false"/> <xs:anyAttribute namespace="##other" processContents="lax"/> </xs:complexType> <!-- Multiple Segment information base --> <xs:complexType name="MultipleSegmentBaseType"> <xs:complexContent> <xs:extension base="SegmentBaseType"> <xs:sequence> <xs:element name="SegmentTimeline" type="SegmentTimelineType" minOccurs="0"/> <xs:element name="BitstreamSwitching" type="URLType" minOccurs="0"/> </xs:sequence> <xs:attribute name="duration" type="xs:unsignedInt"/> <xs:attribute name="startNumber" type="xs:unsignedInt"/> </xs:extension> </xs:complexContent> </xs:complexType> </pre>
--

```
</xs:complexContent>
</xs:complexType>

<!-- Segment Info item URL/range -->
<xs:complexType name="URLType">
  <xs:sequence>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="sourceURL" type="xs:anyURI"/>
  <xs:attribute name="range" type="xs:string"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
```

with:

```
<!-- Segment information base -->
<xs:complexType name="SegmentBaseType">
  <xs:sequence>
    <xs:element name="Initialization" type="URLType" minOccurs="0"/>
    <xs:element name="RepresentationIndex" type="URLType" minOccurs="0"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="timescale" type="xs:unsignedInt"/>
  <xs:attribute name="presentationTimeOffset" type="xs:unsignedLong"/>
  <xs:attribute name="timeShiftBufferDepth" type="xs:duration"/>
  <xs:attribute name="indexRange" type="xs:string"/>
  <xs:attribute name="indexRangeExact" type="xs:boolean" default="false"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>

<!-- Multiple Segment information base -->
<xs:complexType name="MultipleSegmentBaseType">
  <xs:complexContent>
    <xs:extension base="SegmentBaseType">
      <xs:sequence>
        <xs:element name="SegmentTimeline" type="SegmentTimelineType" minOccurs="0"/>
        <xs:element name="BitstreamSwitching" type="URLType" minOccurs="0"/>
      </xs:sequence>
        <xs:attribute name="duration" type="xs:unsignedInt"/>
        <xs:attribute name="startNumber" type="xs:unsignedInt"/>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>

<!-- Segment Info item URL/range -->
<xs:complexType name="URLType">
  <xs:sequence>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="sourceURL" type="xs:anyURI"/>
  <xs:attribute name="range" type="xs:string"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
```

5.3.9.3.2 Semantics

Replace:

Table 14 — Semantics of SegmentList element

Element or Attribute Name	Use	Description
SegmentList		specifies Segment information.
@xlink:href	O	specifies a reference to external SegmentList element

MultipleSegmentBaseInformation		Multiple Segment base information as defined in 5.3.9.2.
--------------------------------	--	--

with:

Table 14 — Semantics of SegmentList element

Element or Attribute Name	Use	Description
SegmentList		specifies Segment information.

Element or Attribute Name	Use	Description
@xlink:href	O	specifies a reference to a remote element that contains one or multiple elements of type SegmentList
MultipleSegmentBaseInformation		Multiple Segment base information as defined in 5.3.9.2, Table 12.

5.3.9.4.4 Template-based Segment URL construction

Replace:

Strings outside identifiers shall only contain characters that are permitted within URLs according to RFC 1738.
with:

Strings outside identifiers shall only contain characters that are permitted within URLs according to RFC 3986.

5.3.9.5.3 Media Segment information

Replace:

Each Representation has assigned a list of consecutive Media Segments. Each entry in the list of a Media Segment has assigned the following parameters:

- A valid Media Segment URL and possibly a byte range,
- the number of the Media Segment in the Representation,
- the MPD start time of the Media Segment in the Representation providing an approximate presentation start time of the Segment,
- MPD duration of the Media Segment providing an approximate presentation duration of the Segment.

These parameters are specified by the **SegmentTemplate** or **SegmentList** elements. To obtain at least one entry in the list of Media Segments, one of the following shall apply:

- if **SegmentTemplate** element is present the Template-based Segment URL construction in 5.3.9.4.4 shall be applied with the number of the Media Segment in the Media Segment list. The first number in the list is determined by the value of the **SegmentTemplate@startNumber** attribute, if present, or is 1 in case this attribute is not present.
- if one or more **SegmentList** elements are present they contain itself a list of **SegmentURL** elements for a consecutive list of Media Segment URLs. The first number in the list is determined by the value of the **SegmentList@startNumber** attribute, if present, or is 1 in case this attribute is not present. The sequence of multiple **SegmentList** elements within a Representation shall result in Media Segment List with consecutive numbers.
- none of the above: In this case only a single Media Segment shall be present with the URL provided by a **BaseURL** element and the **SegmentBase** element may be present.

The MPD start time is relative to the start of the Representation provided by the MPD. The MPD start time and the MPD duration are approximate and do not reflect the exact Media Presentation time. For more details on the relation of MPD start times and Media Presentation time refer to 7.2.1.

For the derivation of the MPD start time and duration of each Media Segment in the list of Media Segments, the *Number* of the Media Segment and the following information is used.

- If neither `@duration` attribute nor **SegmentTimeline** element is present, then the Representation shall contain exactly one Media Segment. The MPD start time is 0 and the MPD duration is obtained in the same way as for the last Media Segment in the Representation (see below for more details).
- If `@duration` attribute is present, then the MPD start time of the Media Segment is determined as $(\text{Number} - \text{Number}_{\text{Start}} - 1)$ times the value of the attribute `@duration` with $\text{Number}_{\text{Start}}$ the value of the `@startNumber` attribute. The MPD duration of the Media Segment is the value of the attribute `@duration` unless the Media Segment is the last one the Representation (see below for more details).
- If `@duration` attribute is not present and the **SegmentTimeline** element is present then rules in 5.3.9.6 apply to determine the start time and duration of each Media Segment in the Media Segment list.
- To determine the duration of the only or the last Media Segment of any Representation in a Period, the MPD shall include sufficient information to determine the duration of the containing Period. For example, the **MPD**`@mediaPresentationDuration`, or **Period**`@duration`, or next **Period**`@start` may be present.

For services with **MPD**`@type='dynamic'`, the Segment availability start time of a Media Segment is the sum of the value of the **MPD**`@availabilityStartTime`, the *PeriodStart* time of the containing Period as defined in 5.3.2.1, the MPD start time and the MPD duration of the Media Segment. The Segment availability end time of a Media Segment is the sum of the Segment availability start time, the MPD duration of the Media Segment and the value of the attribute **MPD**`@timeShiftBufferDepth`.

The MPD shall include URL information for all Segments with an availability start time less than both (i) the end of the Media Presentation and (ii) the sum of the latest time at which this version of the MPD is available on the server and the value of the **MPD**`@minimumUpdatePeriod`.

The data structures retrieved from the URL referring to a Media Segment are defined in 6.2.3.

with:

Each Representation has assigned a list of consecutive Media Segments. Each entry in the list of a Media Segment has assigned the following parameters:

- A valid Media Segment URL and possibly a byte range,
- the number of the Media Segment in the Representation,
- the MPD start time of the Media Segment in the Representation providing an approximate presentation start time of the Segment,
- MPD duration of the Media Segment providing an approximate presentation duration of the Segment.

These parameters are specified by the **SegmentTemplate** or **SegmentList** elements. To obtain at least one entry in the list of Media Segments, one of the following shall apply:

- if **SegmentTemplate** element is present the Template-based Segment URL construction in 5.3.9.4.4 shall be applied with the number of the Media Segment in the Media Segment list. If the Representation contains or inherits a **SegmentTemplate** element with *\$Number\$* then the URL of the media segment at position *k* is determined by replacing the *\$Number\$* identifier by $(k-1) + \text{@startNumber}$. If the Representation contains or inherits a **SegmentTemplate** element with *\$Time\$* then the URL of the media segment at position *k* is determined by replacing the *\$Time\$*

identifier by the time address associated to this segment. The time address is determined as follows:

- if the `@duration` attribute is present, then the time address is determined by replacing the `$Time$` identifier with $((k-1) + @startNumber) * @duration$. Further, if the Segment does not contain the Segment Index, then the media time of the Segment shall be accurately expressed by the MPD information in the following sense:
 - the value $((k-1) + @startNumber) * @duration$ shall be identical to the earliest presentation time in the segment.
 - the duration of the segment in media presentation time shall be identical to the value of the `@duration` attribute.
- if the `SegmentTimeline` element is present, then the time address is determined by replacing the `$Time$` identifier with the earliest presentation time of the k-th segment as documented in the Segment timeline in 5.3.9.6.
- if one or more `SegmentList` elements are present they contain itself a list of `SegmentURL` elements for a consecutive list of Media Segment URLs. The first number in the list within this Period is determined by the value of the `SegmentList@startNumber` attribute, if present, or is 1 in case this attribute is not present. The sequence of multiple `SegmentList` elements within a Representation shall result in Media Segment List with consecutive numbers.
- none of the above: In this case only a single Media Segment shall be present with the URL provided by a `BaseURL` element and the `SegmentBase` element may be present.

The MPD start time is relative to the start of the Representation provided by the MPD. The MPD start time and the MPD duration are approximate and do not reflect the exact Media Presentation time. For more details on the relation of MPD start times and Media Presentation time refer to 7.2.1.

For the derivation of the MPD start time and duration of each Media Segment in the list of Media Segments, the *Number* of the Media Segment and the following information is used.

- If neither `@duration` attribute nor `SegmentTimeline` element is present, then the Representation shall contain exactly one Media Segment. The MPD start time is 0 and the MPD duration is obtained in the same way as for the last Media Segment in the Representation (see below for more details).
- If `@duration` attribute is present, then the MPD start time of the Media Segment is determined as $(Number - Number_{Start})$ times the value of the attribute `@duration` with $Number_{Start}$ the value of the `@startNumber` attribute. The MPD duration of the Media Segment is the value of the attribute `@duration` unless the Media Segment is the last one the Representation (see below for more details).
- If `@duration` attribute is not present and the `SegmentTimeline` element is present then rules in 5.3.9.6 apply to determine the start time and duration of each Media Segment in the Media Segment list.
- To determine the duration of the only or the last Media Segment of any Representation in a Period, the MPD shall include sufficient information to determine the duration of the containing Period. For example, the `MPD@mediaPresentationDuration`, or `Period@duration`, or next `Period@start` may be present.

For services with `MPD@type='dynamic'`, the Segment availability start time of a Media Segment is the sum of the value of the `MPD@availabilityStartTime`, the *PeriodStart* time of the containing Period as defined in 5.3.2.1, the MPD start time and the MPD duration of the Media Segment. The Segment availability end time of a Media Segment is the sum of the Segment availability start time, the MPD duration of the Media Segment and the value of the attribute `@timeShiftBufferDepth` for this Representation.