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1 Introduction

At MPEG#108, a contribution [1] proposed to qualify the relationships between dependent Representations with a new @dependencyType attribute at Representation level. In the meantime, the @associationId attribute initially suggested in [4] was accepted in the Amd2 of DASH Part-1 2nd edition [2]. Since the original contribution was related to @dependencyId but was finally merged as @associationType with the new @associationId, we propose to clarify with this contribution the use of this new @associationType attribute. We finally provide some examples of use that could be included in Part-3.

2 Clarifications on Representation dependencies and associations signaling in DASH

Distinguishing "dependent" Representation from "associated" Representation clarifies the DASH client expected behavior: for "dependent" Representation, client must download corresponding segments, while for "associated" Representation, the decision to download or not the corresponding segments is let to clients' decision according to application needs.
In order to help client's decision, the @associationType attribute specifies the kind of association for each supplemental Representation a Representation is associated to.

2.1 Clarification on dependent Representations

We then propose to clarify the specification of @dependencyId by replacing:

"*Dependent Representations are described by a* ***Representation*** *element that contains a* `@dependencyId` *attribute. Dependent Representations are regular Representations except that they depend on a set of complementary Representations for decoding and/or presentation. The* `@dependencyId` *contains the values of the* `@id` *attribute of all the complementary Representations, i.e. Representations that are necessary to present and/or decode the media content components contained in this dependent Representation*"

With:

"*Dependent Representations are described by a* ***Representation*** *element that contains a* `@dependencyId` *attribute. Dependent Representations are regular Representations except that they depend on a set of complementary Representations required for decoding and/or presentation. The* `@dependencyId` *contains the values of the* `@id` *attribute of all the complementary Representations, i.e. Representations that are mandatory to present and/or decode the media content components*

*contained in this dependent Representation. The segments corresponding to the complementary Representations must then be downloaded to make sure the dependent **Representation** can be correctly decoded and displayed.*"

2.2 Clarification on associated Representations

We propose to clarify @associationId and @associationType as defined by PDAM2 by introducing the following changes in PDAM2:

- adding the following definition for **Associated Representation** in section 3.1 of the spec:

Associated Representation
Representation which provides supplemental or descriptive information for at least one other Representation.

- adding the following description in the Representation definition (section 5.3.5):

*"Associated Representations are described by a **Representation** element that contains a @associationId attribute and optionally a @associationType attribute. Associated Representations are regular Representations except that they provide information on their relationships with other Representations. As opposed to complementary Representations, the segments of an Associated Representation may be optional for decoding and/or presentation of the Representations identified by @associationId. They can be considered as supplementary information, the kind of supplemental information and the optionality being given by @associationType."*

- correcting the semantic of @associationId and @associationType (to be added in clause 5.3.5.2):

Replace:

@associationId	O	specifies all complementary Representations the Representation is associated with in the decoding and/or presentation process as a whitespace-separated list of values of @id attributes. If not present, the Representation can be decoded and presented independently of any other Representation. This attribute shall not be present where there are no associations with other Representations that needs to be signaled.
@associationType	O	specifies the kind of association for each complementary Representation the Representation is associated with that has been signaled with the @associationId attribute. Values taken by this attribute are the reference types registered for the trak reference types at http://www.mp4ra.org/trackref.html. If not present, it is assumed that the Representation is associated with the complementary Representations for decoding and/or presentation process without more precise information. This attribute shall not be present when @associationId is not present.

With:

@associationId	O	specifies all Representations the Representation is associated with in the decoding and/or presentation process as a whitespace-separated list of values of @id attributes.
@associationType	O	specifies, as a whitespace separated list of type values, the kind of association for each Representation the Representation has been associated with through the @associationId attribute.

		Values taken by this attribute are the reference types registered for the track- reference types at http://www.mp4ra.org/trackref.html or the value “unknown”. This attribute shall not be present when @associationId is not present. This attribute must have as many values as the number of identifiers declared in the @associationId attribute

2.3 Values for @associationType

Since the goal of the @associationId is somehow to expose at DASH level the relationships between the different media tracks, the set of values taken by @associationType is the set of registered types for track references [8]. They can be used to indicate related content (‘cdsc’, ‘vdep’, ‘vplx’, ‘sync’ or more recently ‘tile’[7]) or dependent content (‘scal’, ‘lyra’, ‘dpnd’).

For example:
- a metadata stream can be associated to a video stream with @associationType=’cdsc’.
- a Representation conveying depth information for 3D video stream could be associated to the Representation for the texture information with @associationType=’vdep’.
- a Representation for a video being a spatial part of a panorama video could be associated to the Representation for this panorama video with @associationType=’tile’ as proposed in [7].
- a Representation for the base layer of an encoded video could be associated to all the Representations for the enhancement layers of this encoded video with @associationType=’sbas’.

2.4 Impact on MPD Schema

The changes to apply on XML schema for MPD indicated in the PDAM2 are not correct.
Indeed, *@associationId* and *@associationType* come in addition of @dependencyId and do not replace it. Then the correct piece of XML schema to replace in Annex B is:

```
      <!-- Representation -->
      <xs:complexType name="RepresentationType">
        <xs:complexContent>
          <xs:extension base="RepresentationBaseType">
            <xs:sequence>
              <xs:element name="BaseURL" type="BaseURLType" minOccurs="0" maxOccurs="unbounded"/>
              <xs:element name="SubRepresentation" type="SubRepresentationType" minOccurs="0"
    maxOccurs="unbounded"/>
              <xs:element name="SegmentBase" type="SegmentBaseType" minOccurs="0"/>
              <xs:element name="SegmentList" type="SegmentListType" minOccurs="0"/>
              <xs:element name="SegmentTemplate" type="SegmentTemplateType" minOccurs="0"/>
            </xs:sequence>
            <xs:attribute name="id" type="StringNoWhitespaceType" use="required"/>
            <xs:attribute name="bandwidth" type="xs:unsignedInt" use="required"/>
            <xs:attribute name="qualityRanking" type="xs:unsignedInt"/>
            <xs:attribute name="dependencyId" type="StringVectorType"/>
            <xs:attribute name="associationId" type="StringVectorType"/>
            <xs:attribute name="associationType" type="StringVectorType"/>
            <xs:attribute name="mediaStreamStructureId" type="StringVectorType"/>
          </xs:extension>
        </xs:complexContent>
      </xs:complexType>
```

3 Examples of use

3.1 Green metadata use case

This use case was initially proposed in [5]. With @associationId, a content author can indicate that a metadata Representation is associated to a media Representation. With @associationType, he can provide more information than the simple association. For example he can indicate that the metadata Representation is a description of the associated content, using the 'cdsc' registered track reference type [8]. An example MPD is provided below to illustrate such example.

```
<?xml version="1.0" encoding="UTF-8"?>
<MPD
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="urn:mpeg:DASH:schema:MPD:XXXX"
  xsi:schemaLocation="urn:mpeg:DASH:schema:MPD:xxxx"
  type="dynamic"
  minimumUpdatePeriod="PT2S"
  timeShiftBufferDepth="PT30M"
  availabilityStartTime="2011-12-25T12:30:00"
  minBufferTime="PT4S"
  profiles="urn:mpeg:dash:profile:isoff-live:2011">

  <BaseURL>http://cdn1.example.com/</BaseURL>
  <BaseURL>http://cdn2.example.com/</BaseURL>

  <Period>
    <!-- Video -->
    <AdaptationSet
      id="video"
      mimeType="video/mp4"
      codecs="avc1.4D401F"
      frameRate="30000/1001"
      segmentAlignment="true"
      startWithSAP="1">
      <BaseURL>video/</BaseURL>
      <SegmentTemplate timescale="90000" media="$Bandwidth$/$Time$.mp4v">
        <SegmentTimeline>
          <S t="0" d="180180" r="432"/>
        </SegmentTimeline>
      </SegmentTemplate>
      <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>
    <!-- English Audio -->
    <AdaptationSet mimeType="audio/mp4" codecs="mp4a.0x40" lang="en" segmentAlignment="0">
      <SegmentTemplate timescale="48000" media="audio/en/$Time$.mp4a">
        <SegmentTimeline>
          <S t="0" d="96000" r="432"/>
        </SegmentTimeline>
      </SegmentTemplate>
      <Representation id="a0" bandwidth="64000" />
    </AdaptationSet>
    <!-- French Audio -->
    <AdaptationSet mimeType="audio/mp4" codecs="mp4a.0x40" lang="fr" segmentAlignment="0">
      <SegmentTemplate timescale="48000" media="audio/fr/$Time$.mp4a">
        <SegmentTimeline>
          <S t="0" d="96000" r="432"/>
        </SegmentTimeline>
      </SegmentTemplate>
      <Representation id="a0" bandwidth="64000" />
    </AdaptationSet>
<!—AdapatationSet carrying Green Video Information for Video  -->
    <AdaptationSet id="green video" codecs="gvme.depr"/>
      <BaseURL>video green depr/</BaseURL>
      <SegmentTemplate timescale="90000" media="$id$/$Time$.mp4m">
        <SegmentTimeline>
          <S t="0" d="180180" r="432"/>
        </SegmentTimeline>
      </SegmentTemplate>
      <Representation id="gv0" bandwidth="1000" associationId="v0" associationType="cdsc"/>
      <Representation id="gv1" bandwidth="1000" associationId="v1" associationType="cdsc"/>
```

```
      <Representation id="gv2" bandwidth="1000" associationId="v2" associationType="cdsc"/>
    </AdaptationSet>
  </Period>

</MPD>
```

Using the @associationType attribute, the DASH client is informed that the metadata Representation provides description of the associated video Representation (meaning of 'cdsc'). This can be used for MPEG-Green metadata or quality metrics metadata and provides richer information than the @associationId alone.

3.2 Multi-view video description

The following example is taken from the DASH technologies under consideration document [6]. In this example, a provider organizes texture data and depth data of a single view into separate adaptation sets. Each type of media component (texture or depth) has two representations. The two Role elements have id's being "*t*0" and "*d*0" that indicate the texture and depth components of view 0. In the original example, the attribute @dependencyId was used in each depth representation to indicate its relationships with the corresponding texture Representation. With @associationId and @associationType, the content author can explicitly indicate that Representations D1 and D2 are respectively associated to Representations T1 and T2 since they contain auxiliary depth video information for the referenced video track.

```
<?xml version="1.0" encoding="UTF-8"?>
<MPD
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="urn:mpeg:DASH:schema:MPD:XXXX"
  xsi:schemaLocation="urn:mpeg:DASH:schema:MPD:xxxx"
  minBufferTime="PT4S"
  profiles="urn:mpeg:dash:profile:isoff-on-demand:2011">

  <Period duration="PT1256.00S">
    <SegmentList>
      <Initialization sourceURL="seg-m-init-2.mp4"/>
    </SegmentList>
    <!-- Below a single view texture with two representations -->
    <AdaptationSet mimeType="video/mp4" codecs="avc1.640828">
      <Role schemeIdUri="urn:mpeg:dash:stereoid:2013" id="t0"/>
      <Representation id="T1" bandwidth="128000">
        <SegmentList duration="10">
          <SegmentURL media="seg-m1-C2view-201.mp4"/>
          <SegmentURL media="seg-m1-C2view-202.mp4"/>
        </SegmentList>
      </Representation>
      <Representation id="T2" bandwidth="192000">
        <SegmentList duration="10">
          <SegmentURL media="seg-m1-C1view-201.mp4"/>
          <SegmentURL media="seg-m1-C1view-202.mp4"/>
        </SegmentList>
      </Representation>
    </AdaptationSet>

    <!—And below is the depth data associated with the above view texture -->
    <AdaptationSet mimeType="video/mp4" codecs="avc1.640828">
      <Role schemeIdUri="urn:mpeg:dash:stereoid:2013" id="d0"/>
      <Representation id="D1" bandwidth="28000" associationId="T1" associationType="vdep">
        <SegmentList duration="10">
          <SegmentURL media="seg-m1-D1view-201.mp4"/>
          <SegmentURL media="seg-m1-D1view-202.mp4"/>
        </SegmentList>
      </Representation>
      <Representation id="D2" bandwidth="58000" associationId="T2" associationType="vdep">
        <SegmentList duration="10">
          <SegmentURL media="seg-m1-D2view-201.mp4"/>
          <SegmentURL media="seg-m1-D2view-202.mp4"/>
        </SegmentList>
      </Representation>
    </AdaptationSet>
  </Period>
</MPD>
```

4 Conclusion

We suggest inclusion of the clarifications and corrections for the new @associationId and @associationType into the PDAM2 for Part-1. We suggest inclusion of the above examples of use for the new @associationType into Part-3. An extension of possible values for @associationType, especially for other encapsulation than ISOBMF could be useful.

5 References

[1] m33211 by F. Denoual, F. Maze, E. Nassor, C. Concolato and J. Le Feuvre: "*Dependency type signaling in DASH*", MPEG meeting 108, Valencia, March 2014.

[2] w14443 "*Information Technology — Dynamic adaptive streaming over HTTP (DASH) — Part 1: Media presentation description and segment formats / Amd 2*", MPEG meeting 108, April 2014

[3] m32202 by M. Hirabayashi and S. Hattori: "Additional parameters proposal on CE SRD", MPEG meeting 107, San José, January 2014.

[4] m32190 by X. Wang and S. Zhang: "Analysis of Dependency and Association Relationships of Representations in DASH", MPEG meeting 107, San José, January 2014.

[5] m32291 by P.Gendron, X. Ducloux, J. Le Feuvre: "*Metadata Representation Carrying Green Information Signaling for DASH*", MPEG meeting 107, San José, January 2014.

[6] w14346, "MPEG DASH: Technologies under consideration", MPEG meeting 108, Valencia, April 2014

[7] m33222 by C. Concolato, J. Le Feuvre, F. Denoual, F. Mazé and E. Nassor: "Tile information in ISOBMFF", MPEG meeting 108, Valencia, April 2014.

[8] MPEG-4 Registration Authority: registered types for track references at: http://www.mp4ra.org/trackref.html