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1 Introduction
In this document, we report the result of our core experiment on the Weight DS. In the last meeting a decision is made to continue the Weight DS CE in order to address:
• an improvement of the Weight DS syntax which is currently part of the XM document
• to demonstrate the benefit to have such component as a basic datatype to provide a large variety of functionalities for various DS
• to accommodate for required MPEG-7 functionalities (such as ordering) [1], for specific DS’s (e.g., Segment DS, Semantic DS components).

2 Outline of CE activity
2.1 Participants and functionalities to be validated
The main activities and the participants are summarized in the below table

<table>
<thead>
<tr>
<th>Name</th>
<th>Company</th>
<th>Functionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yoshiaki Shibata</td>
<td>Sony</td>
<td>Definition of new syntax of Weight DS</td>
</tr>
<tr>
<td>Kyoungro Yoon</td>
<td>LG CIT</td>
<td>Definition of new syntax of Weight DS and usage of Weight DS to identify</td>
</tr>
<tr>
<td></td>
<td></td>
<td>segments (video segments) which represents objects defined in the Object DS</td>
</tr>
<tr>
<td>Alessandro Bugatti</td>
<td>University of</td>
<td>Definition of new syntax of Weight DS, instantiation of Weight DS for</td>
</tr>
<tr>
<td>Riccardo Leonardi</td>
<td>Brescia</td>
<td>ordering functionality and realization of two demos in order to demonstrate</td>
</tr>
<tr>
<td>Benoit Mory</td>
<td>Philips</td>
<td>Cross-check of results of Brescia experiments</td>
</tr>
</tbody>
</table>

2.2 Methodology
For the three main parts of the CE the following strategies has been used:
• the new Weight DS syntax definition is based on that included in MDS XM 3.0 and an agreement has been achieved in order to obtain both representation functionalities (see paragraph …) and ordering keys functionalities (see paragraph …)
• an instantiation of the Weight DS was built to demonstrate its utility to obtain a measure of how each segment (video segment) represents a selected object by a weight value
• two demos were built to show ordering keys functionalities. For each demo there is an XML file MDS compliant validated by XML 3.0 Spy

3 Experimental results
3.1 New syntax of Weight DS
3.1.1 Syntax and semantics definition of the Weight DS
The Weight DS syntax contained in MDS XM 3.0 was improved in order to obtain both generic weighting functionalities and ordering functionalities.
<!-- # pretended carriage return -->
<!-- Weight DS as a basic element -->
<!-- Improved Weight DS definition based on MDS XM 3.0-->

<!-- Definition of ReliabilityType-->

<simpleType name="ReliabilityType" base="decimal">
    <minInclusive value="0.0"/>
    <maxInclusive value="1.0"/>
</simpleType>

<!-- Definition of WeightValueType-->

<simpleType name="WeightValueType" base="float">
    <minInclusive value="0.0"/>
    <maxInclusive value="1.0"/>
</simpleType>

<!-- Definition of WeightValue-->

<complexType name="WeightValue">
    <attribute name="Value" type="mpeg7:WeightValueType"/>
    <attribute name="idref" type="IDREF" use="optional"/>
</complexType>

<!-- Definition of DescriptorReference-->

<!-- Note: the DescriptorReference allows to indicate a Descriptor or a Description scheme. At the moment is not clear which method should be used to obtain this functionality (XPointer, an abstract class for each D or DS,...). Further discussion is needed-->

<complexType name="DescriptorReference" base="mpeg7:Descriptor" derivedBy="extension">
    <attribute name="Reliability" type="mpeg7:ReliabilityType" use="optional"/>
</complexType>

<!-- Definition of ReferencedWeight-->

<complexType name="ReferencedWeight">
    <element name="DescriptorReference" type="mpeg7:DescriptorReference"/>
    <attribute name="idref" type="IDREF" use="optional"/>
</complexType>

<!-- At the moment the Value usage is not clear, so further discussion is needed-->

<attribute name="Value" type="mpeg7:WeightValueType" use="optional"/>
</complexType>

<!-- Definition of Weight DS-->

<complexType name="Weight">
    <choice>
        <element name="WeightValue" type="mpeg7:WeightValue" minOccurs="1" maxOccurs="unbounded"/>
        <element name="ReferenceWeight" type="mpeg7:ReferencedWeight" minOccurs="1" maxOccurs="unbounded"/>
    </choice>
</complexType>
where the semantic of each component is summarized as

Semantics of the datatypes:

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ReliabilityType</td>
<td>Datatype of the reliability value defined within 0.0 and 1.0 where 1.0 for the most reliable while 0.0 for the least (no reliable).</td>
</tr>
<tr>
<td>WeightValue</td>
<td>Datatype of the weighting value defined within 0.0 and 1.0 where 1.0 for the most important while 0.0 for the least.</td>
</tr>
</tbody>
</table>

Semantics of WeightValue:

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>WeightValue</td>
<td>Type of primitive weight element in this scheme. It allows an association of a weight to an instance of description scheme by idref.</td>
</tr>
<tr>
<td>Value</td>
<td>The weigh value assigned to the component.</td>
</tr>
<tr>
<td>idref</td>
<td>Id reference to the target entity to be weighted. This component can be omitted when the weighting value is assigned as a nested form.</td>
</tr>
</tbody>
</table>

Semantics of ReferencedWeight:

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ReferencedWeight</td>
<td>Type of primitive weight element in this scheme. It allows to indicate which descriptor/s can be useful for ordering functionalities.</td>
</tr>
<tr>
<td>DescriptorReference</td>
<td>Reference to a Descriptor class. NOTE: At the moment it is not clear which method should be used to implementate this functionality (Xpointer, Xpath,...).</td>
</tr>
<tr>
<td>DescriptionReliability</td>
<td>Element to specify the reliability that is associated with the specific descriptor (it is a 'local' reliability, different from the global reliability which is included at Weight level)</td>
</tr>
<tr>
<td>Value</td>
<td>The weigh value assigned to the component. NOTE: Its utility is not so clear, but its insertion in this scheme could address new functionalities in the future</td>
</tr>
<tr>
<td>idref</td>
<td>Reference to an instance of a description scheme. Each node child of the referenced node can be ordered using the referenced Descriptor. It is optional because its use is only required in schemes which don't contain a Weight DS in their sintax, while it is not needed in schemes which include Weight DS</td>
</tr>
</tbody>
</table>

Semantics of Weight DS:

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>Standard weight element in this scheme.</td>
</tr>
<tr>
<td>WeightName</td>
<td>The semantics of the reference value. This value specifies how to interpret the weight value.</td>
</tr>
<tr>
<td>WeightValue</td>
<td>Primitive element to associate a weight to an instance of description scheme by idref</td>
</tr>
<tr>
<td>ReferencedWeight</td>
<td>Primitive element to indicate which descriptor/s can be useful for</td>
</tr>
</tbody>
</table>
ordering functionalities.

<table>
<thead>
<tr>
<th>id</th>
<th>Identifier for each instance of the Weight DS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>Describes how reliable the weights are. In other words, it is a confidence measure of the weights. For example, if the reliability is low, the weight value is not trustworthy; on the other hand, if the reliability is high, the weight value represents the importance of the target description very well. The range of this value is 0.0 to 1.0.</td>
</tr>
</tbody>
</table>

3.1.2 Description extraction

The Weight DS can be used in any kinds of entity weighting and thus its description extraction is up to applications, where either automatic or manual extraction or both may be used.

3.1.3 Description examples

The Weight DS defined above supports any weighting description forms. In the following description examples, we show both generic functionalities and ordering functionalities, in nested form (when the Weight DS can be contained in a Description Scheme) and in top level form (when the Weight is used as top-level element). In order yo validate these examples an MPEG-7-Root has been defined and some names have been changed, but these changes do not appear in the below examples in order to be clearer.

Example 1: using only the generic weighting functionality in nested form

```xml
<?xml version="1.0" encoding="UTF-8"?>
<MPEG-7-Root xmlns="http://www.mpeg7.org/2001/MPEG-7_Schema"
xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
C:\users\Bugatti\UPMSAnnotator\mds4CE.xsd">
  <Concept id="id1" name="Fruit">
    <ConceptObject id="id2" name="Apple">
      <Weight>
        <WeightValue Value="0.765"/>
      </Weight>
    </ConceptObject>
    <ConceptObject id="id3" name="Banana">
      <Weight>
        <WeightValue Value="1.235"/>
      </Weight>
    </ConceptObject>
  </Concept>
</MPEG-7-Root>
```

In this case it is possible to associate a weight to each ConceptObject (Apple and Banana) in nested form because ConceptObject contains the Weight DS in itself.

Example 2: using only the weighting functionality in referenced from

```xml
<?xml version="1.0" encoding="UTF-8"?>
<MPEG-7-Root xmlns="http://www.mpeg7.org/2001/MPEG-7_Schema"
xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
C:\users\Bugatti\UPMSAnnotator\mds4CE.xsd">
```

In this case it is possible to associate a weight to video segments (id2 and id3), which don't contain the Weight DS, by idref attribute.

**Example 3:** using the nested form to allow to choose an Descriptor or Description Scheme to obtain ordering functionalities

```xml
<?xml version="1.0" encoding="UTF-8"?>
  <Concept id="id1" name="Fruit">
    <Weight>
      <ReferencedWeight>
        <DescriptorReference>ColorHistogram</DescriptorReference>
      </ReferencedWeight>
    </Weight>
  </Concept>
  <ConceptObject id="id2" name="Apple">
    <MediaModel SemanticLabel="Apple" Confidence="0.9">
      <MediaLocator>
        <MediaURL>c:/apple.jpg</MediaURL>
      </MediaLocator>
    </MediaModel>
    <Example SemanticLabel="Apple" NumElements="1" Confidence="0.8" DescriptorName="ColorHistogram">
      <Descriptor>
        4617 11986 938 2628 458 1463 5178 2258 444 134 69 456 9300 3210
        121 21 14 18 48 107 77 53 47 1926 8281 793 38 11 0 5 201 28 0
        1 1 2 23 252 122 6 3 433 1517 46 1 1 0 0 0 0 0 0 0 0 0 2 55 13560
        3326 678 221 1610 5602 916 32 8 1 21 58 11 1 0 2 61 331 179
        14 7 2388 6213 51 0 0 0 0 0 0 0 0 0 2 337 243 0 0 220 194 0 0
      </Descriptor>
    </Example>
  </ConceptObject>
</MPEG-7-Root>
```
In this case the object id1 (fruit) contains a weight DS which is used to point at a Descriptor (ColorHistogram). This Descriptor can be used to the application for ordering the children nodes (apple and banana).

**Example 4**: using the referenced form to allow to indicate a Descriptor or Description Scheme to obtain ordering functionalities

```xml
<?xml version="1.0" encoding="UTF-8"?>
  <VideoSegment id="id1">
    <SegmentDecomposition DecompositionType="temporal">
      <VideoSegment id="id2">
        <MediaTime>
          <MediaTimePoint/>
        </MediaTime>
        <CameraMotion NumSegmentDescription="3" DescriptionMode="1">
          <CameraMotionSegment>
            <FractionalPresence>
              <TRACK_LEFT_F>0.23</TRACK_LEFT_F>
              <ZOOM_IN_F>0.56</ZOOM_IN_F>
            </FractionalPresence>
            <Amount/>
          </CameraMotionSegment>
        </CameraMotion>
      </VideoSegment>
    </SegmentDecomposition>
  </VideoSegment>
</MPEG-7-Root>
```
<VideoSegment id="id3">
    <MediaTime>
        <MediaTimePoint/>
    </MediaTime>
    <CameraMotion NumSegmentDescription="3" DescriptionMode="1">
        <CameraMotionSegment>
            <FractionalPresence>
                <TRACK_LEFT_F>0.1</TRACK_LEFT_F>
                <ZOOM_IN_F>0.8</ZOOM_IN_F>
            </FractionalPresence>
            <Amount/>
        </CameraMotionSegment>
    </CameraMotion>
</VideoSegment>

<VideoSegment id="id4">
    <MediaTime>
        <MediaTimePoint/>
    </MediaTime>
    <CameraMotion NumSegmentDescription="3" DescriptionMode="1">
        <CameraMotionSegment>
            <FractionalPresence>
                <TRACK_LEFT_F>0.67</TRACK_LEFT_F>
            </FractionalPresence>
            <Amount/>
        </CameraMotionSegment>
    </CameraMotion>
</VideoSegment>

</SegmentDecomposition>

<Weight id="id5" Reliability="0.8">
    <WeightName>Action</WeightName>
    <ReferencedWeight idref="id1">
        <DescriptorReference>TRACK_LEFT_F</DescriptorReference>
    </ReferencedWeight>
</Weight>

<Weight id="id6" Reliability="0.5">
    <WeightName>Interesting</WeightName>
    <ReferencedWeight idref="id1">
        <DescriptorReference>TRACK_LEFT_F</DescriptorReference>
        <DescriptorReference>ZOOM_IN_F</DescriptorReference>
    </ReferencedWeight>
</Weight>

</MPEG-7-Root>

In this case the Description Scheme (VideoSegment) doesn't contain the weight DS, so it is not possible to use the nested form as in example 3, but the idref is needed to point at the parent node. In weight DS id="id5" the referenced node is the video segment id1 and so its children (video segments id2, id3 and id4) can be ordered using the TRACK_LEFT_F descriptor. The label "Action" indicates the semantic of this ordering. The other weight id="id6" points at the same parent node (video segment id1) and so its child
(video segments id2, id3 and id4) can be ordered using the TRACK_LEFT_F and ZOOM_IN_F descriptor. If a child (in this example id4) doesn't contain a descriptor (ZOOM_IN_F), it is can't be ordered with this weight.

3.1.4 Validation experiments

In the following paragraphs two experiments are shown, one for generic weighting functionalities and one for ordering functionalities.

3.2 Experiment 1: Weight DS usage to obtain how well a Segment represents a Semantic Object

The context of this part of CE is to identify segments (video segments) which represents objects defined in the Object DS. How well each segment represents the selected object is represented by the Weight Value (in the GoodnessOfRepresentation). In this way, users can easily locate the segments relevant to the Object (semantic element, in general) in the sorted order based on the Weight Value. The extraction methods of the Weight Value can be various and one example of the extraction and measure can be the relative size of the object in the Frame (or Group of Frames).

A new definition of SegmentSemanticLink DS is used in order to allows links between a segment and a Object. This definition is the following:

```xml
<complexType name="ReferenceToSegment" base="mds:Reference"
derivedBy="restriction">
    <attribute name="href" type="uriReference" use="optional"/>
    <attribute name="idref" type="IDREF" refType="Segment" use="optional"/>
</complexType>

<complexType name="SegmentNode">
    <element name="ReferenceToSegment" type="mds:ReferenceToSegment"/>
    <element name="GoodnessOfRepresentation" type="mds:Weight" minOccurs="0" maxOccurs="1"/>
</complexType>

<complexType name="SegmentSemanticLink">
    <element name="ReferenceToSemanticElement" type="mds:ReferenceToSemanticElement"/>
    <element name="SegmentNodes" type="mds:SegmentNode" maxOccurs="unbounded"/>
    <attribute name="id" type="ID" use="optional"/>
</complexType>
```

A schema file (testSchema.xml) and an instantiation of Weight DS (WeightCEFinal.xml) are attached at this document and both were validated using XML Spy 3.0. Only the relevant parts (Video Segment DS, partial Object DS and SegmentSemanticLink DS) are specified and instantiated. The Video Segment DS definition was changed in order to achieve validation.
3.3 **Experiment 2: ordering functionalities**

Two demos were built to show ordering key functionalities and instantiations of these two examples are contained in files VideoSegment.xml and Fruit.xml. Both the files was validated using XML Spy 3.0 and a MDS WD and XM schema from Yoshiaki with adds in order to validate the above examples (mds4CEnew.xsd).

In the first one we used a pre-existing structure (in terms of programs, scenes and shots decomposition) and we translated it in MDS XML form with also the ordering functionalities.

![Image of a browser interface with a segmented structure and a selected scene](image)

*Figure 1 - In the left panel there is the segmented structure (programs, scenes, shots) and a scene (Spain 1-0 Morientes) is selected. By Ordering keys button click is possible to select one Ordering key (in this case Pan Speed) and to obtain the following result*
Figure 2 - The shots contained in scene "Spain 1-0 Morientes" are ordered by Pan speed ordering key

In the second one the same results are achieved, but the example use the Concept DS and Concept Object DS to describe a classification of fruit.
Figure 3 - Fruits are ordered by name
Figure 4 - Varieties of apple are ordered by their colour

4 Conclusions and recommendations

We have demonstrated that this new syntax of Weight DS can support both generic functionalities and ordering functionalities. For both a nested form (when the Weight DS is included in DS) and a referenced form (when the Weight is used as top level element) are possible. We recommend a further discussion about the possibility to indicate a D or a DS and to verify if Xpath is proper to achieve this aim.

5 References