Source	**Canon Research Centre France, Sony, Telecom Paris Tech**
Status	**For consideration at the 108th MPEG Meeting**
Title	**Input Text for SRD inMPEG-DASH Part3 Amd.1**
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1   Introduction

During its 107th meeting, MPEG decided to close the Core Experiment on DASH-SRD since a solution has been achieved. This solution was initially described in MPEG-DASH TuC [2] as result of 106th meeting. During 107th meeting, this solution has been updated (m32646 [3]) to reflect latest discussions and to integrate new accepted contributions.

As conclusion of the 107th meeting, MPEG made the following recommendations with regards to SRD [4]:

    2) Create Part 1 2nd Ed Amendment 2 WD or Part 5 WD
        a. URL Query Parameter Insertion
        b. SRD
    3) Update the WD of Part 3 Amd with
        a. Low latency
        b. Namespace extension in MPEG-DASH
        c. MPEG-DASH over Emerging Protocols
        d. SRD part for part 3
        e. URL Query Parameter Insertion

This contribution provides input text for SRD to be included in 23009-3 Amd.1 [1] according to above recommendations.

2   Proposed Text

--------------------------------------change 1: add new section---

5.6 Support for Spatial Relationship Description
5.6.1 Use case

With the advent of very high resolution videos and the heterogeneity of display devices, spatial adaptation is required. In this context, very high resolution content authorize new usages in video streaming like for instance interactive pan and zoom features. In addition, streaming such high resolution content over today's networks also raise problems due to the bandwidth restrictions of

the network and the limitations of the video decoder. By describing spatial relationship between video contents, streaming only spatial sub-parts of a video can address both above aspects.

As an example, a spatial relationship may express that a video represents a spatial part of another full-frame video. That spatial part may be a tile or a region of interest described in terms of positions and sizes. This description provides additional choices for the client in terms of adaptation. An SRD aware DASH client can use SRD annotations to select a full-frame representation or a spatial part of this full-frame that better fits its needs. This can save bandwidth and client-side computations (avoiding full-frame fetching, decoding and cropping for example).

5.6.2 General Approach
ISO/IEC 23009 allows the Media Presentation authors to express spatial relationships among Adaptations Sets, Representations or SubRepresentations using the **SupplementalProperty** and/or **EssentialProperty** descriptors with @schemeIdURI equal to "urn:mpeg:dash:srd:2013".
Details of this scheme is described in ISO/IEC 23009-1, Clause 5.8.5.7.

5.6.3 Examples
5.6.3.1 Scenario 1: Zoom feature in a sport event
This scenario relies on two videos. The first one is a full HD panorama of the scene. The other is the central part of the scene encoded in a full HD resolution too.

Figure 1 - Full panorama with zoom and pan features

Different MPD can be written with SRD to describe spatial relationship between those two videos depending on the focus of the author as follows.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<MPD
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="urn:mpeg:dash:schema:mpd:2011"
  xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd"
  [...]>

  <Period>
    <!—Full Panorama -->
    <AdaptationSet […]>
        <SupplementalProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0,
1920, 1080, 1920, 1080"/>
        <Representation id="1" bandwidth="5000000" width="1920" height="1080" ...>
            <BaseURL>full_panorama.mp4</BaseURL>
        </Representation>
    </AdaptationSet>

    <!—Zoomed video-->
    <AdaptationSet […]>
        <EssentialProperty  schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 960, 540,
1920, 1080, 3840, 2160"/>
        <Representation id="2" bandwidth="5000000" width="1920" height="1080" ...>
            <BaseURL>zoomed_part.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
  </Period>
</MPD>
```

Notes:
1. The first Adaptation Set contains SRD describing that the video(s) in the AdaptationSet element represent the full panorama since its SRD w and h parameters are equal to the SRD W and H parameters (respectively). The second Adaptation Set contains SRD describing that the video(s) in the AdaptationSet element represent a video spatially related to video of the first Adaptation Set (since the SRD source_id parameter is the same) but only a part of the full panorama because its w and h parameters are less than its W and H parameters (respectively).
2. The full panorama contains a `SupplementalProperty` SRD descriptor so that legacy clients will end up with an MPD containing one non-empty AdaptationSet after processing of the EssentialProperty SRD descriptor.
3. Two reference spaces are defined here: one is 1920x1080 and the other is 3840x2160, because the author wishes to set the SRD w and h parameters equal to the @width and @height of the associated Representations.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<MPD
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="urn:mpeg:dash:schema:mpd:2011"
  xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd"
  [...]>

  <Period>
    <!—Full Panorama -->
    <AdaptationSet […]>
        <SupplementalProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0,
3840, 2160, 3840, 2160"/>
        <Representation id="1" bandwidth="5000000" width="1920" height="1080" ...>
            <BaseURL>full_panorama.mp4</BaseURL>
        </Representation>
        <Representation id="3" bandwidth="2000000" width="960" height="540" ...>
            <BaseURL>full_panorama_half_res.mp4</BaseURL>
        </Representation>
    </AdaptationSet>

    <!—Zoomed video-->
    <AdaptationSet […]>
        <EssentialProperty  schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 960, 540,
1920, 1080"/>
        <Representation id="2" bandwidth="5000000" width="1920" height="1080" ...>
            <BaseURL>zoomed_part.mp4</BaseURL>
        </Representation>
        <Representation id="4" bandwidth="2000000" width="960" height="540" ...>
            <BaseURL>zoomed_part_half_res.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
  </Period>
</MPD>
```

Notes:

This MPD expresses the same relationship between the two videos as the previous one but with
the following change: the same reference space has been used for both SRD. In this case, the
author wishes to enable easier identification that the second video represents a spatial part of the
first one by using the same units in both SRD. As a consequence, the W and H parameters of the
second SRD are omitted; but also the @width and @height of the first Representation do not
match the w and h parameters of its SRD. This is not problematic and in fact particularly useful
because the Adaptation Set can contain two Representations that represent the same spatial part
of the source but at different resolutions.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<MPD
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="urn:mpeg:dash:schema:mpd:2011"
  xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd"
  [...]>

  <Period>
    <!—Full Panorama -->
    <AdaptationSet […]>
        <SupplementalProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 4,
4, 4, 4"/>
        <Representation id="1" bandwidth="5000000" width="1920" height="1080" ...>
            <BaseURL>full_panorama.mp4</BaseURL>
        </Representation>
        <Representation id="3" bandwidth="2000000" width="960" height="540" ...>
            <BaseURL>full_panorama_half_res.mp4</BaseURL>
        </Representation>
    </AdaptationSet>

    <!—Zoomed video-->
    <AdaptationSet […]>
        <EssentialProperty  schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 1, 1, 2,
2"/>
        <Representation id="2" bandwidth="5000000" width="1920" height="1080" ...>
            <BaseURL>zoomed_part.mp4</BaseURL>
        </Representation>
        <Representation id="4" bandwidth="2000000" width="960" height="540" ...>
            <BaseURL>zoomed_part_half_res.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
  </Period>
</MPD>
```

Notes:

This MPD expresses the same relationship between the two videos as the previous one but with the units in the SRD chosen to easily position the zoomed part of the video on a grid, while the full video covers the entire grid.

5.6.3.2 Scenario 2: Panning in a large panorama

This scenario allows a DASH client panning in a large panorama. Each tile has a resolution of 1920x1080 and the whole set composes a panorama of 5760x3240.
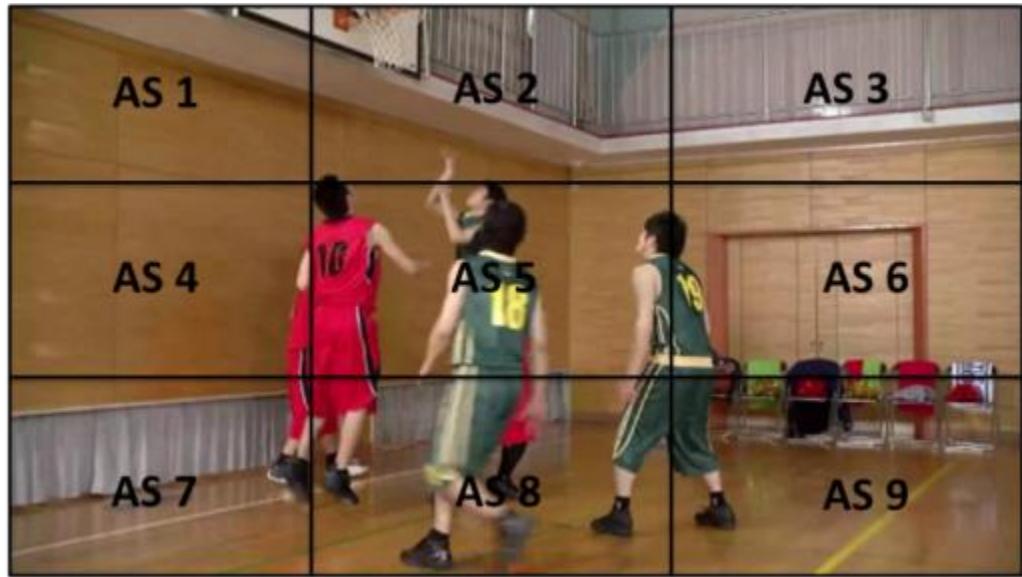
Figure 2 - Panning in a large panorama

The following is an MPD example implementing scenario 2.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<MPD
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="urn:mpeg:dash:schema:mpd:2011"
  xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd"
  [...]>


  <Period>
    <!--9 tiles -->
    <AdaptationSet                                                          […]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 1920,
1080, 5760, 3240"/>
        <Representation id="1" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile1.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet                                                          […]>
        <EssentialProperty  schemeIdUri="urn:mpeg:dash:srd:2013"  value="1,  1920,   0,
1920, 1080"/>
        <Representation id="2" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile2.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet                                                          […]>
        <EssentialProperty  schemeIdUri="urn:mpeg:dash:srd:2013"  value="1,  3840,   0,
1920, 1080"/>
        <Representation id="3" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile3.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet                                                          […]>
        <EssentialProperty  schemeIdUri="urn:mpeg:dash:srd:2013"  value="1,  0,   1080,
1920, 1080"/>
        <Representation id="4" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile4.mp4</BaseURL>
        </Representation>
    </AdaptationSet>

    <!--Legacy  clients  will  end  up  with  a  valid  MPD  after  processing  unknown
SupplementalProperty or EssentialProperty SRD descriptors. It will contain only this
AdaptationSet since SupplementalProperty is used here. -->
```

```
    <AdaptationSet                                                           [...]>
        <SupplementalProperty  schemeIdUri="urn:mpeg:dash:srd:2013"  value="1,  1920,
1080, 1920, 1080"/>
        <Representation id="5" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile5.mp4</BaseURL>
        </Representation>
    </AdaptationSet>

    <AdaptationSet                                                           [...]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 3840, 1080,
1920, 1080"/>
        <Representation id="6" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile6.mp4</BaseURL>
        </Representation>
    </AdaptationSet>

    <AdaptationSet                                                           [...]>
        <EssentialProperty  schemeIdUri="urn:mpeg:dash:srd:2013"  value="1,  0,  2160,
1920, 1080"/>
        <Representation id="7" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile7.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet                                                           [...]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 1920, 2160,
1920, 1080"/>
        <Representation id="8" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile8.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet                                                           [...]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 3840, 2160,
1920, 1080"/>
        <Representation id="9" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile9.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
  </Period>
</MPD>
```

Notes:

1. The example above shows that (`W, H`) optional 6th and 7th parameters of `@value` are not repeated for each `EssentialProperty` or `SupplementalProperty` SRD descriptor. By default they apply to all the SRD annotations present in the `Period` that have the same `source_id` value (first parameter of `@value`).

2. The example above indicates that non SRD-aware client could only see the tile in the middle of the panorama (thanks to the use of `SupplementalProperty` rather than `EssentialProperty`).

3. No `group_id` is specified in the example above indicating that all those Adaptation Sets belong to the same group identified by the default value 0.

5.6.3.3 Scenario 3: Arbitrary values for SRD description

This scenario demonstrates how to use SRD annotations without the need of using the video resolutions as values for the spatial parameters. This scenario considers the tile scheme depicted in Figure 3 composed of 4 HD videos/tiles.
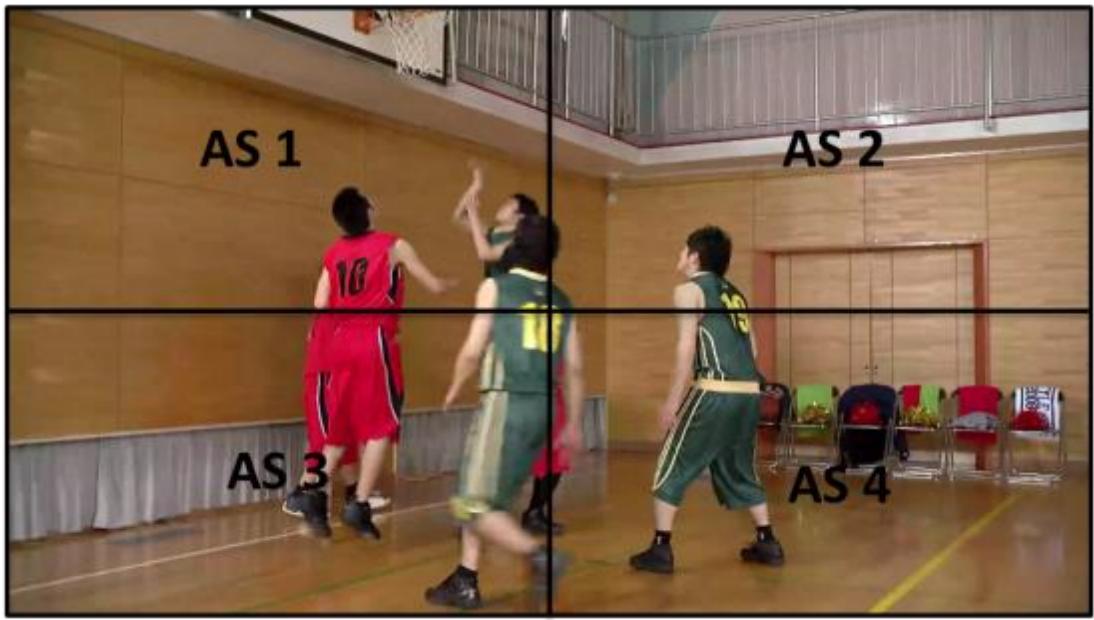
Figure 3 - Scenario 3

The following is an MPD example implementing this scenario.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<MPD
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="urn:mpeg:dash:schema:mpd:2011"
  xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd"
  [...]>

  <Period>
    <!-4 tiles -->
    <AdaptationSet […]>
        <SupplementalProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0,
100, 100, 200, 200"/>
        <Representation id="1" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile1.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet […]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 100, 0, 100,
100"/>
        <Representation id="2" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile2.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet […]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 100, 100,
100"/>
        <Representation id="3" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile3.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet […]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 100, 100,
100, 100"/>
        <Representation id="4" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile4.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
  </Period>
</MPD>
```

Notes:
1. This MPD contains a SRD annotation whose reference space is 200 by 200 large. Each tile represents a 100 by 100 part of it.
2. Although this MPD is valid, the spatial parameters do not follow the aspect ratio of the videos. This solution is efficient to describe the relative relationship between tiles e.g. this tile is on the left side of that one, etc…. But in most cases the MPD author has to be aware that additional computations may be required at the application level to make use of the SRD information.

5.6.3.4 Scenario 4: Overlapping tiles

In some applications overlapping tiles provide some benefits. The following scenario describes an example of this structure.

Figure 4 - Overlapping tile structure

The following is an MPD example implementing this scenario.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<MPD
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="urn:mpeg:dash:schema:mpd:2011"
  xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd"
  [...]>


  <Period>
    <!—Central tile -->
    <AdaptationSet                                                         […]>
        <SupplementalProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 960, 0,
1920, 1080, 3840, 1080"/>
        <Representation id="AS1" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile1.mp4</BaseURL>
        </Representation>
    </AdaptationSet>

    <!—Left-side tile -->
    <AdaptationSet                                                         […]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 1920,
1080"/>
        <Representation id="AS2" bandwidth="5000000" width="1920" height="1080">
            <BaseURL>tile2.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
```

```
     <!-Right-side tile -->
   <AdaptationSet                                                      [...]>
       <EssentialProperty  schemeIdUri="urn:mpeg:dash:srd:2013"  value="1,  1920,  0,
1920, 1080"/>
       <Representation id="AS3" bandwidth="5000000" width="1920" height="1080">
           <BaseURL>tile3.mp4</BaseURL>
       </Representation>
   </AdaptationSet>
     </Period>
</MPD>
```

5.6.3.5 Scenario 5: Spatial resolution enhancement

This scenario allows a content author to describe a program as depicted on the figure below. With SRD annotations, the client has the choice between different representations for the same spatial part of the full panorama.
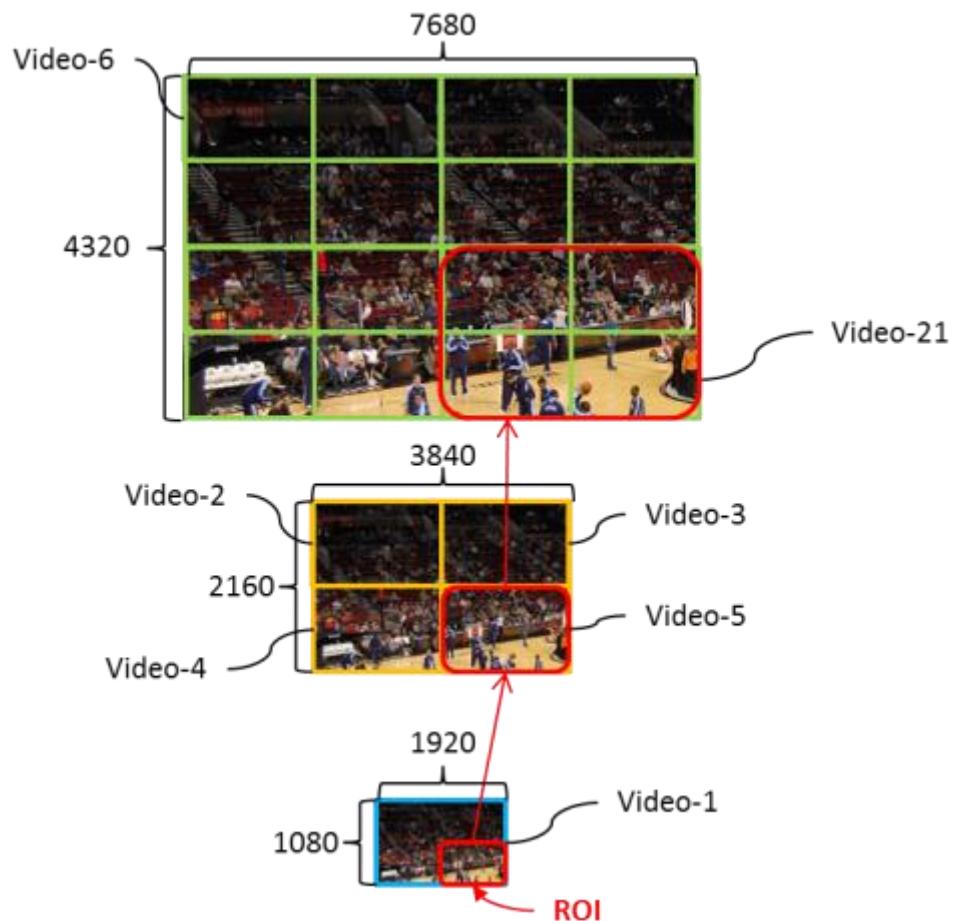

Figure 5 – Mosaic TV

The following is an MPD example implementing this scenario. (Not all 21 videos are described for brevity).

```
<?xml version="1.0" encoding="UTF-8"?>
<MPD
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="urn:mpeg:dash:schema:mpd:2011"
  xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd"
  [...]>
```

```xml
  <Period>
    <AdaptationSet id="Video-1" […]>
        <SupplementalProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0,
1920, 1080, 1920, 1080, 1"/>
        <Representation id="1" bandwidth="1000000" width="1920" height="1080">
            <BaseURL>video-1.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet id = "Video-2"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 1920,
1080, 3840, 2160, 2"/>
        <Representation id="2" bandwidth="4500000" width="1920" height="1080">
            <BaseURL>video-2.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet id = "Video-3"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 1920, 0,
1920, 1080, 3840, 2160, 2"/>
        <Representation id="video-3" bandwidth="2000000" width="1920" height="1080">
            <BaseURL>video-3.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
[…]
    <AdaptationSet id="video-5"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 1920, 1080,
1920, 1080, 3840, 2160, 2"/>
        <Representation id="5" bandwidth="1500000" width="1920" height="1080">
            <BaseURL>video-5.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
<!-- Last level -->
    <AdaptationSet id="video-6"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 1920,
1080, 7680, 4320, 3"/>
        <Representation id="6" bandwidth="3500000" width="1920" height="1080">
            <BaseURL>video-6.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
[…]
    <AdaptationSet id="video-21"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 5760, 3240,
1920, 1080, 7680, 4320, 3"/>
        <Representation id="21" bandwidth="4000000" width="1920" height="1080">
            <BaseURL>video-21.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
  </Period>
</MPD>
```

Notes:
1. SRD annotations express the different resolutions by specifying in each SRD the W, H parameters.
2. The MPD author has indicated that the videos 1, 2 to 5 and 6 to 21 form 3 different groups using 3 group_id values.

The following MPD expresses the same spatial information as the previous one:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<MPD
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="urn:mpeg:dash:schema:mpd:2011"
  xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd"
  [...]>


  <Period>
```

```xml
    <AdaptationSet id="Video-1" […]>
        <SupplementalProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 4,
4, 4, 4, 1"/>
        <Representation id="1" bandwidth="1000000" width="1920" height="1080">
            <BaseURL>video-1.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet id = "Video-2"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 2, 2,
4, 4, 2"/>
        <Representation id="2" bandwidth="4500000" width="1920" height="1080">
            <BaseURL>video-2.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet id = "Video-3"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 2, 0, 2, 2,
4, 4, 2"/>
        <Representation id="video-3" bandwidth="2000000" width="1920" height="1080">
            <BaseURL>video-3.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
[…]
    <AdaptationSet id="video-5"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 2, 2, 2, 2,
4, 4, 2"/>
        <Representation id="5" bandwidth="1500000" width="1920" height="1080">
            <BaseURL>video-5.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
<!-- Last level -->
    <AdaptationSet id="video-6"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 1, 1,
4, 4, 3"/>
        <Representation id="6" bandwidth="3500000" width="1920" height="1080">
            <BaseURL>video-6.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
[…]
    <AdaptationSet id="video-21"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 3, 3, 1, 1,
4, 4, 3"/>
        <Representation id="21" bandwidth="4000000" width="1920" height="1080">
            <BaseURL>video-21.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
  </Period>
</MPD>
```

Notes:
1. In this MPD, a normalized grid is used to express relationships. The W, H SRD parameters could be omitted for all representations but the first one. The group_id parameter could be omitted for all representations.

5.6.3.6 Scenario 6: Spatial resolution enhancement (2)

This scenario allows a content author to describe a program as depicted on the figure below. With SRD annotations, the client has the choice between different representations for the same spatial part of the full panorama. The spatial parts are available in two different granularities for a given resolution level.
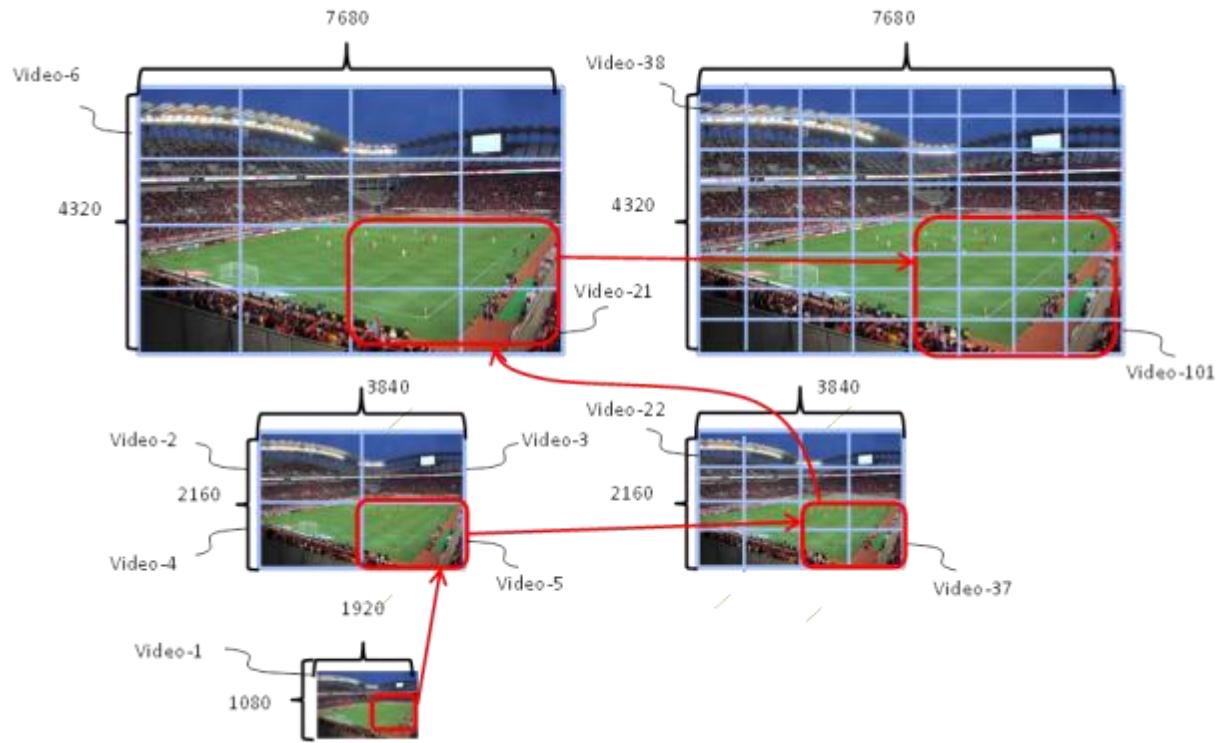
Figure 6 – Mosaic TV(2)

The following is an MPD example implementing this scenario. (Not all 101 videos are described for brevity).

```xml
<?xml version="1.0" encoding="UTF-8"?>
<MPD
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="urn:mpeg:dash:schema:mpd:2011"
  xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd"
  [...]>


  <Period>
    <AdaptationSet id="Video-1" [...]>
        <SupplementalProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0,
1920, 1080, 1920, 1080, 1"/>
        <Representation id="1" bandwidth="1000000" width="1920" height="1080">
            <BaseURL>video-1.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet id = "Video-2"[...]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 1920,
1080, 3840, 2160, 2"/>
        <Representation id="2" bandwidth="4500000" width="1920" height="1080">
            <BaseURL>video-2.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet id = "Video-3"[...]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 1920, 0,
1920, 1080, 3840, 2160, 2"/>
        <Representation id="video-3" bandwidth="2000000" width="1920" height="1080">
            <BaseURL>video-3.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
[...]
    <AdaptationSet id="video-5"[...]>
```

```xml
                <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 1920, 1080,
1920, 1080, 3840, 2160, 2"/>
            <Representation id="5" bandwidth="1500000" width="1920" height="1080">
                <BaseURL>video-5.mp4</BaseURL>
            </Representation>
        </AdaptationSet>
[…]
    <AdaptationSet id="video-6"[…]>
            <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 1920,
1080, 7680, 4320, 3"/>
            <Representation id="6" bandwidth="3500000" width="1920" height="1080">
                <BaseURL>video-6.mp4</BaseURL>
            </Representation>
        </AdaptationSet>
[…]
    <AdaptationSet id="video-21"[…]>
            <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 5760, 3240,
1920, 1080, 7680, 4320, 3"/>
            <Representation id="21" bandwidth="4000000" width="1920" height="1080">
                <BaseURL>video-21.mp4</BaseURL>
            </Representation>
        </AdaptationSet>
    <AdaptationSet id="video-22"[…]>
            <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 960,
540, 3840, 2160, 4"/>
            <Representation id="22" bandwidth="900000" width="960" height="540">
                <BaseURL>video-22.mp4</BaseURL>
            </Representation>
        </AdaptationSet>
[…]
    <AdaptationSet id="video-37"[…]>
            <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 2880, 1620,
960, 540, 3840, 2160, 4"/>
            <Representation id="37" bandwidth="1000000" width="960" height="540">>
                <BaseURL>video-37.mp4</BaseURL>
            </Representation>
        </AdaptationSet>
    <AdaptationSet id="video-38"[…]>
            <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 960,
540, 7680, 4320, 5"/>
            <Representation id="38" bandwidth="900000" width="960" height="540">>
                <BaseURL>video-38.mp4</BaseURL>
            </Representation>
        </AdaptationSet>
[…]
    <AdaptationSet id="video-101"[…]>
            <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 6720, 3780,
960, 540, 7680, 4320, 5"/>
            <Representation id="101" bandwidth="1000000" width="960" height="540">>
                <BaseURL>video-101.mp4</BaseURL>
            </Representation>
        </AdaptationSet>
  </Period>
</MPD>
```

Note: in above example, SRD annotations express the different resolution levels by specifying in each SRD annotation the W, H parameters and a group_id value. The tiles that share the same group_id value pertain to the same reference space.

The following MPD is equivalent to previous one:
```xml
<?xml version="1.0" encoding="UTF-8"?>
<MPD
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="urn:mpeg:dash:schema:mpd:2011"
  xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd"
  [...]>
```

```xml
  <Period>
    <AdaptationSet id="Video-1" […]>
        <SupplementalProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 8, 8, 8, 8"/>
        <Representation id="1" bandwidth="1000000" width="1920" height="1080">
            <BaseURL>video-1.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet id = "Video-2"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 4, 4"/>
        <Representation id="2" bandwidth="4500000" width="1920" height="1080">
            <BaseURL>video-2.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
    <AdaptationSet id = "Video-3"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 4, 0, 4, 4"/>
        <Representation id="video-3" bandwidth="2000000" width="1920" height="1080">
            <BaseURL>video-3.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
[…]
    <AdaptationSet id="video-5"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 4, 4, 4, 4"/>
        <Representation id="5" bandwidth="1500000" width="1920" height="1080">
            <BaseURL>video-5.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
[…]
    <AdaptationSet id="video-6"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 2, 2"/>
        <Representation id="6" bandwidth="3500000" width="1920" height="1080">
            <BaseURL>video-6.mp4</BaseURL>
        </Representation>
        <Representation id="22" bandwidth="900000" width="960" height="540">
            <BaseURL>video-22.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
[…]
    <AdaptationSet id="video-21"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 6, 6, 2, 2"/>
        <Representation id="21" bandwidth="4000000" width="1920" height="1080">
            <BaseURL>video-21.mp4</BaseURL>
        </Representation>
        <Representation id="37" bandwidth="1000000" width="960" height="540">
            <BaseURL>video-37.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
 […]
    <AdaptationSet id="video-38"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 0, 0, 1, 1"/>
        <Representation id="38" bandwidth="900000" width="960" height="540">
            <BaseURL>video-38.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
[…]
    <AdaptationSet id="video-101"[…]>
        <EssentialProperty schemeIdUri="urn:mpeg:dash:srd:2013" value="1, 7, 7, 1, 1"/>
        <Representation id="101" bandwidth="1000000" width="960" height="540">
            <BaseURL>video-101.mp4</BaseURL>
        </Representation>
    </AdaptationSet>
  </Period>
</MPD>
```

Notes:

1. In this MPD, a normalized grid is used to express relationships. The W, H SRD parameters are omitted for all representations but the first one. The group_id parameter is omitted for all representations.
2. The SRD values are the same for videos 6 and 22 because the videos represent the same spatial part but at different resolutions. The same is valid for 7 and 23, …, 21 and 37. Therefore they are grouped in the same adaptation sets to rely on basic DASH capabilities.

-------------------------------------- end of change 1 ---

3 Conclusion

We recommend MPEG to include this text proposal into the PDAM1 of MPEG-DASH Implementation Guideline (23009-3) at this meeting.

4 Reference

[1]   ISO/IEC 23009-3:2014 PDAM 1, w14139, *Information Technology — Dynamic adaptive streaming over HTTP (DASH) — Part 3: Implementation Guidelines / AMD1: Alignment with ISO/IEC 23009-1:2014 and extensibility*, January 2014

[2]   ISO/IEC JTC1/SC29/WG11 MPEG2013/N13976, *Technologies under Consideration for Dynamic Adaptive Streaming over HTTP 23009, parts 1, 3 and 4*, November 2013

[3]   ISO/IEC JTC1/SC29/WG11 MPEG2014/m32646, *Updated TuC for SRD in DASH*, January 2014

[4]   ISO/IEC JTC1/SC29/WG11 MPEG2014/m32655, *DASH Subgroup Report*, January 2014