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| **Title** | **Clarification on Layered HEVC over MPEG-2 TS** |
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# 1   Introduction

During its 110th meeting, MPEG issued the DAM of Carriage of Layered HEVC over MPEG-2 TS [1]. The specification features an annex giving some examples of layered HEVC, which greatly helps the reader understand the design of the carriage of layered HEVC. This contribution identifies some errors and unclear parts of this annex. While reviewing the annex, some inconsistencies were found in the specification text itself. This contribution also points out these inconsistencies.

# 2   Specification inconsistencies

## 2.1   Signaling of Operation Points

The text of clause 2.17.1 states:
"

- When an Rec. ITU-T H.222.0 | ISO/IEC 13818-1 program includes one or more elementary streams with *stream_type* equal to 0x27, 0x28, 0x29 or 0x2A, at least one HEVC operation point descriptor shall be present in the program map table associated with the program.

"

This is in contradiction with annex U saying that implicit operation points signaling exist:

"One possible set of operations points that could be signaled without using the HEVC operation point descriptor is shown in Figure Annex U-4. In order to signal dependencies and profile/tier/level for all 10 operation points listed above, the HEVC operation point descriptor is needed"

Implicit signaling of operation point is however an important feature for most simple use cases featuring a few layers, where each layer has only a single dependency to a lower layer, as shown in Annex U, as shown in Figure 1.
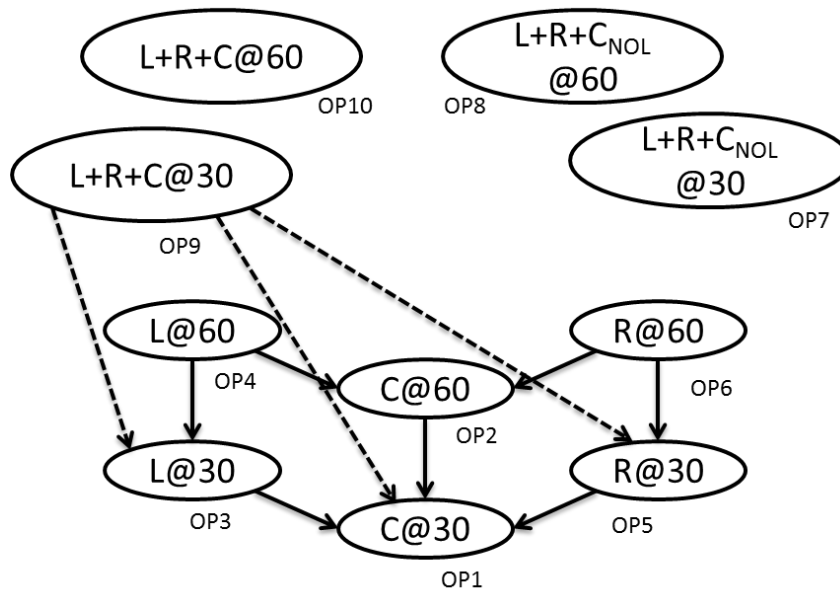
Figure 1 - References and Operation Point for multiview example of Annex U

We suggest removing the bullet in the clause and clarifying as follows clause 2.6.100:

"Some operation points can be implicitly found by following the hierarchy of dependencies of a component (PID), whether implicit or defined using Hierarchy Descriptor or Hierarchy Extension Descriptor. Profile/tier/level for such operation points can be found in the HEVC Descriptor defined for that component."

## 2.2 Signaling of Non-output layers

There could be cases where a layer is never an output layer in any operation points of the complete layered bitstream (for example the PID corresponding to OP2 in Figure 1). Such an awkward configuration could break implicit operation point discovery. There is a need for signaling this at the TS level. Several options could be used:

1. Modify the Operation Point Descriptor by adding a flag signaling only that the operation points described by the descriptor are valid (i.e., disable implicit OP discovery). The drawback of this approach is that all initially implicit OPs have to be sent, thereby greatly increasing the size of the PMT.
2. Use a reserved bit of the HEVC Descriptor to indicate that the layer carried in this stream is never an output layer stream in any operation point.
3. Mandate that a Layered HEVC component (PID) with no HEVC descriptor shall not be used as an implicit operation point.

We recommend option 2 or 3.

## 2.3 Hierarchy Descriptors

The text of clause 2.17.1 states:

"

- When an Rec. ITU-T H.222.0 | ISO/IEC 13818-1 program includes more than one elementary streams with the same *stream_type* value of 0x24, 0x25 or in the range of 0x27- 0x2A, either one hierarchy descriptor as defined in 2.6.7 or one HEVC hierarchy extension descriptor as defined in 2.6.102 shall be present for each elementary stream with a *stream_type* value of 0x24, 0x25 or in the range of 0x27-0x2A.

"

This is in contradiction with "Aggregation of elementary streams" defining implicit hierarchies between streams. This sentence should be replaced with:

"When an Rec. ITU-T H.222.0 | ISO/IEC 13818-1 program includes more than one elementary streams with the same *stream_type* value of 0x24, 0x25 or in the range of 0x27- 0x2A and hierarchy cannot be implied as specified in table 2-113, either one hierarchy descriptor as defined in 2.6.7 or one HEVC hierarchy extension descriptor as defined in 2.6.102 shall be present for each elementary stream with a *stream_type* value of 0x24, 0x25 or in the range of 0x27-0x2A."

## 3   Annex U clarification

The first example U-3 describes a multi-view encoding featuring a central view at 30 / 60 fps, a left view at 30 / 60 fps and a right view at 30 – 60 fps. It is assumed that the left view is only dependent on the central view, and the right view is only dependent on the central view. The corresponding 10 possible operation points are given.

The figure U-4 gives the ordering of layers per PID with their respective stream types and associated operation point. The right view streams are labeled with operation point 9 for the 30fps stream and 10 for the 60 fps temporal subset.

However, according to the list of operation point given, op9 is the combination of central, left and right at 30 fps and op10 is the combination of central, left and right at 60 fps. Such operation points cannot be implicitly defined, since the hierarchy (extension) descriptors will not indicate a possible combination of left and right views together. We believe the correct values should be 5 and 6. If 9 and 10 are the intended OP, the associated hierarchy of dependencies should be indicated in the annex and the mention that there are no dependencies between Right and Left views should be removed.

## 4   Conclusion

We suggest integrating the proposed modifications in a study text of "DAM3 of 13818:2014 Carriage of Layered HEVC"

## 5   References

[1] w14819 - Text of ISO/IEC 13818-1:201x/DAM 3 Carriage of Layered HEVC