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| *Title:* | **MV-HEVC/SHVC HLS: On support of different luma CTB sizes for different layers** | | |
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# Abstract

This contribution provides complexity analysis on supporting different luma coding tree block sizes between layers. Additionally, this contribution proposes options of restrictions on luma coding tree block size relationship between layers for the purpose of providing a start point for the planning of determining how SHVC or MV-HEVC specification will handle it.

# Introduction

In the multi-layer extension of HEVC (e.g. SHVC and MV-HEVC), luma CTB (Coding Tree Block) size is signalled in SPS. This means that each layer may have different luma CTB sizes. Although it is preferable functionality in terms of flexibility, supporting different luma CTB sizes for different layers could introduce complexity in decoder implementation. Moreover, verification of scalable decoder could be much more burdensome. Thus, complexity impact should better be evaluated.

Unfortunately, the latest reference software does not support different luma CTB sizes for different layers. It implies lack of verification and evaluation of the functionality. The main purpose of this contribution is to provide some analysis regarding different luma CTB sizes. We hope it helps to verify whether the current spec design is valid for supporting the functionality and to discuss whether how much flexibility we will allow regarding the luma CTB sizes in the upcoming profiles.

The rest part of this contribution provides complexity analysis of support for different luma CTB sizes per layer. In addition, based on the analysis, several options of restrictions regarding CTB sizes between layers are suggested.

# Complexity analysis

A) Sample prediction

Using different luma CTB sizes for different layer does not complicate the implementation of the sample prediction very much. In practical implementation, an access for the reconstructed samples is not affected by the CTB size.

B) Mode prediction

In practical implementation (also with SHM-3.01), mode information is stored in CTU/CU basis. This design was taking into account when we decided TMVP candidate position in HEVC version 1, where the bottom right position is only available if it is in the same CTB line. Thus, different luma CTB sizes could complicate the access to the stored mode information. This is especially true for the case where the two layers have the same resolutions since the mode information of the reference layer picture can be used for both inter-layer prediction and temporal prediction.

In TMVP derivation process, mode information such as CuPredMode, PredFlagLX, MvLX and RefIdxLX of collocated the collocated prediction block on the reference picture. An access to a prediction block tends to relate to luma CTB size. Therefore, if an implementation allows to access those information without the knowledge of luma CTB size, supporting different CTB sizes could complicate the design.

In addition, to avoid an access to different CTB line, luma CTB size (CtbLog2SizeY) of the current picture is referenced to determine the location of the prediction block for deriving bottom-right candidate. This means that a) a TMVP candidate for a position for a picture having the same luma CTB size as the reference picture and b) a TMVP candidate for the same position for a picture having the different luma CTB size from the reference picture could be different.

C) Alignment of CTU position

If CTB positions are aligned between layers, it is more friendly to CTU-level parallel processing. Allowing different luma CTB sizes for different layers complicates the algorithm for the CTU-level parallel processing. Especially in case current and reference layer have the same resolution, if luma CTB sizes between layers are not the same, all CTB positions are not aligned.

# Proposed options for CTU sizes per layer

The followings are the possible options regarding luma CTB sizes in multi-layer extensions.

Option 1: Same luma CTB size for every directly or indirectly dependent layer

Option 2: Reference layer shall have luma CTB size smaller than or equal to that of current layer

Option 3: No restriction on luma CTB size relation between layers

Among above options, Option 1 is least complex and it is already verified with reference software, but has least flexibility on luma CTB sizes. With option 2, one could use the luma CTB size in enhancement layer larger than or equat to that of base layer. It is natural to support this option especially for scalable scalability. Option 3 puts no restriction on luma CTB sizes. If Option 2 or Option 3 will be taken, the modification and verification of the reference software should be conducted before finalizing specification.

Our preferred options are as follows:

(1) For MV-HEVC, we prefer Option 1. In the typical use case of creating MV-HEVC bitstream, base and enhancement layer will be created with the same encoder. Therefore, there is not much reason to use different luma CTB sizes for different layer. In addition, there is no resolution change in MV-HEVC.

(2) For SNR scalability, we prefer Option 1.When layers have the same resolution, having the same luma CTB size is equivalent to the alignment of CTUs. Accounting that mv for inter-layer prediction has zero vector in SHVC, CTU alignment is useful for CTU-level parallel decoding of multi-layer bitstream with SNR scalability.

(3) For Spatial scalability, we prefer Option 2. There is a use case for spatial scalability, where existing base layer is extended by adding enhancement layer. In that scenario, if base layer is encoded with relatively small CTU sizes, it is useful to be able to encode enhancement layer using larger luma CTB sizes since larger luma CTB sizes tend to be effective for larger resolution.

If it is preferred to support the same restriction irrespective of scalability type, we suggest to take Option 2.

Although we do not have concrete use case for smaller luma CTB size for enhancement layer, if someone could provide an important use case, we should consider supporting Option 3.

# Conclusion

This contribution provides complexity analysis on supporting different luma coding tree block sizes between layers. Additionally, this contribution proposes options of restrictions on luma coding tree block size relationship between layers for the purpose of providing a start point for the planning of determining how SHVC or MV-HEVC specification will handle it.

It is suggested to discuss and clarify what SHVC or MV-HEVC will allow regarding the support of different luma CTB sizes for different layers. If an option that is not supported by the current software is taken, it is recommended to implement and verify the option.

# Patent rights declaration(s)

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