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| *Title:* | Evaluation of IBP-like coding structure and non-HEVC base layer for hybrid standard scalability | | |
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# Abstract

This contribution presents coding efficiency comparison between different coding structures (hierarchical B or IBP-like) as well as comparison among base layers coded with different codecs (HEVC or AVC) in the purpose of providing information that could be a basis of future considerations for hybrid standard scalability. It is asserted that SHVC potentially provides good gain even when base layer is coded with non-HEVC codec or with non hierarchical B coding structure.

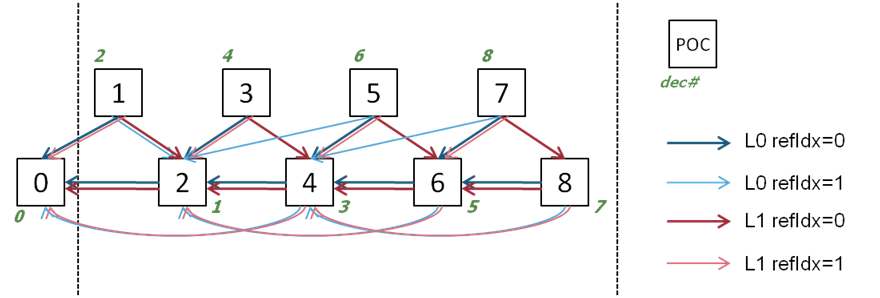
# Introduction

Although an early stage of SHVC development seems to put relatively high weight on exploring the scalability for HEVC base layer, a support of hybrid standard scalability (in other words, support of AVC or MPEG-2 base layer) is also an important topic to be considered.

One of the applications of hybrid standard scalability is an enhancement of the existing broadcasting. For that kind of applications, base-layer coding structure may not necessarily be hierarchical B with periodical intra frames or IPPP/IBBB without periodical intra frames. When we account for the legacy broadcasting, IBP like coding structure with periodical intra frames should also be important base layer for hybrid standard scalability. The rest of the contribution provides some information regarding such scenario.

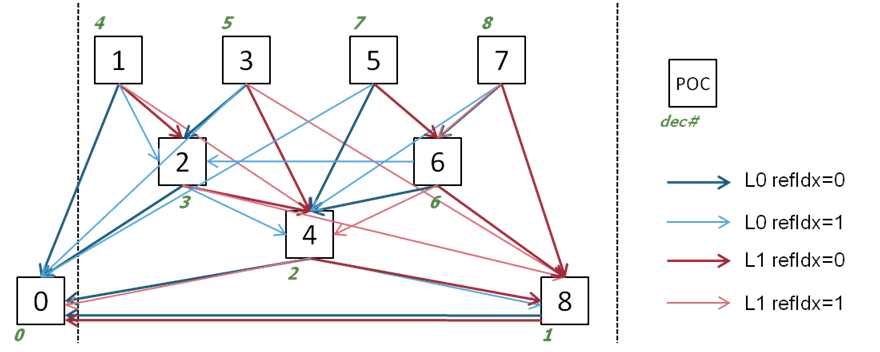
# IBP-like coding structure

Figure 1 (a) illustrates IBP-like coding structure we used for the experiments. In order to make it easy to compare with hierarchical B (HierB) structure in common test condition (Figure 1 (b)), 8 pictures consists of SOP (Structure of Pictures). Intra period is set to about 1 sec. (Same as CTC random access case [1].) In IBP-like coding structure (Figure 1 (a)), POC 2, 4, 6, and 8 only use reference pictures with smaller POC values (reference pictures preceding to the current picture in output order). For these pictures, QP offset is set to 2. POC 1, 3, 5, and 7 corresponds to non-reference B pictures. For these pictures, QP offset is set to 4.



(a) IBP-like coding structure

(b) Hierarchical B coding structure



**Figure 1: Structure of picture used for the experiments.**

# Experiments

In the experiments, coding performance is evaluated using SHM-1.0 software. Following base layer (BL) and enhancement layer (EL) combinations were evaluated.

(R) HierB\_on\_HierB; **BL:** HEVC HierB, **EL:** SHVC HierB (CTC RA).

(a) IBP\_on\_IBP; **BL:** HEVC IBP-like, **EL:** SHVC IBP-like.

(b) HierBr\_on\_HierB**; BL:** HEVC HierB, **EL:** SHVC HierB (\*1)

(c) HierBr\_on\_IBP; **BL:** HEVC IBP-like, **EL:** SHVC HierB (\*1).

(d) IBPr\_on\_IBP; **BL:** HEVC IBP-like, **EL:** SHVC IBP-like (\*1).

(e) HierBr\_on\_HierBa; **BL:** AVC HierB, **EL:** SHVC HierB (\*1) (CTC AVC-BL RA).

(f) HierBr\_on\_IBPa; **BL:** AVC IBP-like, **EL:** SHVC HierB (\*1).

(g) IBPr\_on\_IBPa; **BL:**AVC IBP-like, **EL:** SHVC IBP-like (\*1).

\*1: Reconstructed base layer is used. (It means no inter-layer MV prediction.)

Since current SHM software does not support different coding structure for BL and EL, we used SHM-1.0 setting for AVC BL. Combinations (b) through (g) use that setting.

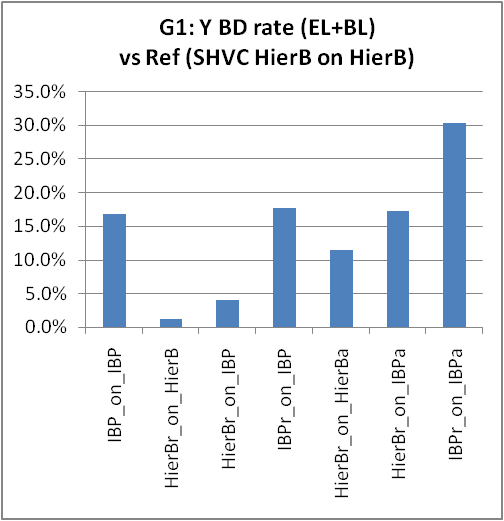
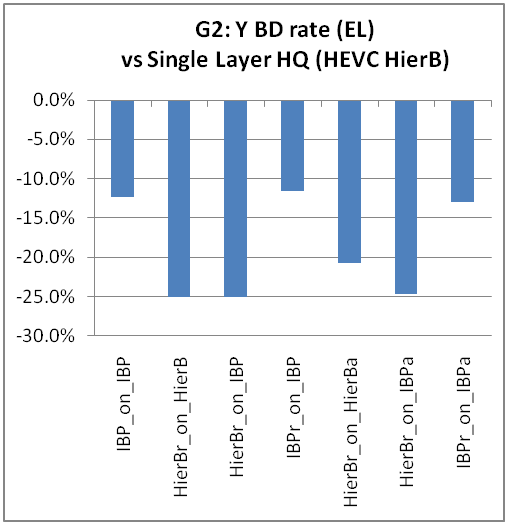
Figure 2 summarizes the results of the experiments in terms of coding performance (Y BD-rate). Graph G1 shows the coding loss of tested scalable bitstream compared to reference scalable bitstream (SHM-1.0, TextureRL, random access anchor). Graph G2 shows the coding gain of EL of tested scalable bitstream compared to HEVC HierB single layer bitstream for higher layer. Note that G2 graph is important for hybrid broadcasting application where existing broadcasting delivers base layer anyway. From G1 and G2 graphs, we could observe followings.

**(1) BL coding structure difference:** Difference between HierBr\_on\_HierB and HierBr\_on\_IBP indicates a penalty by using HEVC IBP-like BL instead of HEVC HierB BL. In G1, IBP-like BL performs less (3%) due to less performance of BL. However, G2 shows that there is no much difference in EL performance.

**(2) BL codec difference:** Difference between HierBr\_on\_IBP and HierBr\_on\_IBPa indicates a penalty by using AVC IBP-like BL instead of HEVC IBP-like BL. Similarly to the observation (1), in G1, AVC IBP-like BL performs much less (13%) due to superior performance of HEVC IBP-like BL. However, G2 shows that there is no much difference in EL performance.

**(3) EL coding structure difference:** Difference between HierBr\_on\_IBPa and IBPr\_on\_IBPa indicates a penalty by using IBP-like EL instead of HierB EL. In both G1 and G2, HierB EL performs far better (13% or 12%) than IBP-like EL.

Based on the observations (1) and (2), for the application where G2 criteria is important (e.g. hybrid broadcasting), SHVC potentially provides good gain even when BL is coded with non-HEVC codec or with non-HierB coding structure. Considering observation (3), capability of using better-performance coding structure (e.g. HierB) for EL even when BL is coded with legacy coding structure (e.g. IBP) is important.



**Figure 2. Coding performance (Y BD-rate) summary**

Further results including chroma coding performance are shown in Table 1 and 2. Table 3 shows the performance of base layer. This information is important to understand EL only performance results (e.g. G2 graph) because EL coding efficiency relies much on quality (PSNR) of reconstructed BL.

**Table 1. Coding performance (relative to SHVC scalable bitstream anchor)**



**Table 2. Coding performance (relative to single layer higher-quality bitstream)**



**Table 3. Base-layer coding performance (relative to HEVC HierB base layer)**



# Conclusion

This contribution provides information that could be a basis of future considerations for hybrid standard scalability. Current SHM-1.0 software has functionality to support non-HEVC base layers. It is desirable to keep this functionality for the future evaluation of hybrid standard scalability. In addition, considering the application where hybrid standard scalability is useful, it is desirable to support different coding structures in enhancement layer and base layer.

# Reference

1. X. Li, J. Boyce, P. Onno, Y. Ye, “Common SHM test conditions and software reference configurations”, JCTVC-L1009, Geneva, Switzerland, 14–23 Jan. 2013.

# Patent rights declaration(s)

**SHARP Corporation may have current or pending patent rights relating to the technology described in this contribution and, conditioned on reciprocity, is prepared to grant licenses under reasonable and non-discriminatory terms as necessary for implementation of the resulting ITU-T Recommendation | ISO/IEC International Standard (per box 2 of the ITU-T/ITU-R/ISO/IEC patent statement and licensing declaration form).**