Joint Video Experts Team (JVET) of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11
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Title: **AHG8: Content Adaptive Transform Precision for High Bit Depth Coding**

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Purpose: Proposal

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Abstract

The intermediate transform coefficient precision is fixed to 16 bit signed representation in VVC. Therefore, a pre-computed down-shift is performed after inverse quantization and inverse transform in order to avoid exceeding the 16 bit buffer. It is argued that this down-shift is too conservative as the prediction mechanism results in low magnitude residuals. For High Bit-Depth coding, the down-shift is increased to ensure 16 bit representation, which further decreases the quality of the inverse transformed coefficients. This contribution proposes to adaptively assign the down-shift according the contents.

Introduction

As shown in Figure 1, the operation of the dequantization and inverse transform includes three shifts.

Figure 1 Down-shift in VVC

According to VVC specification, shift1 is computed as:

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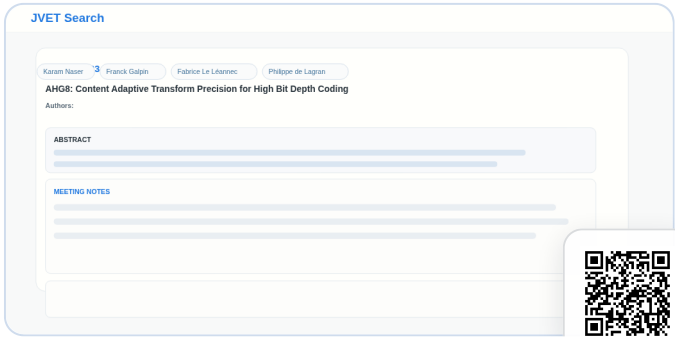
LINKS

CARD

JVET-V0133

http://vexpertise.stbit.ru/documents/JVET-V0133



SOURCE

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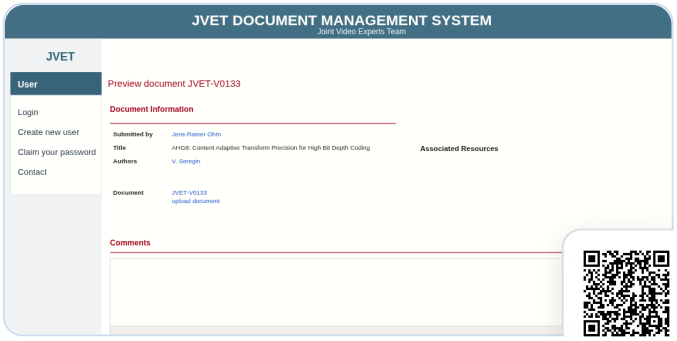

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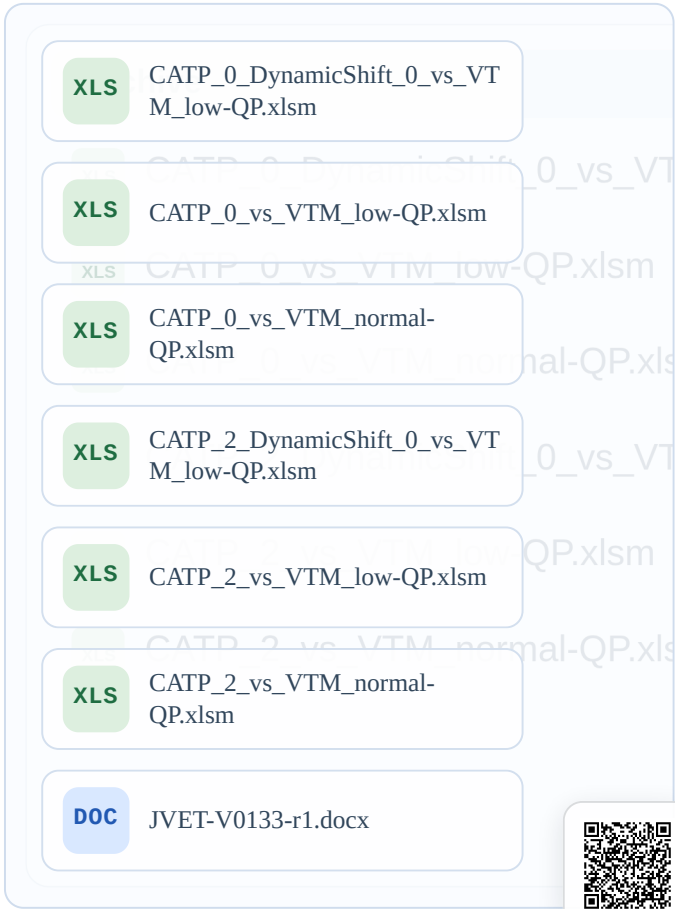
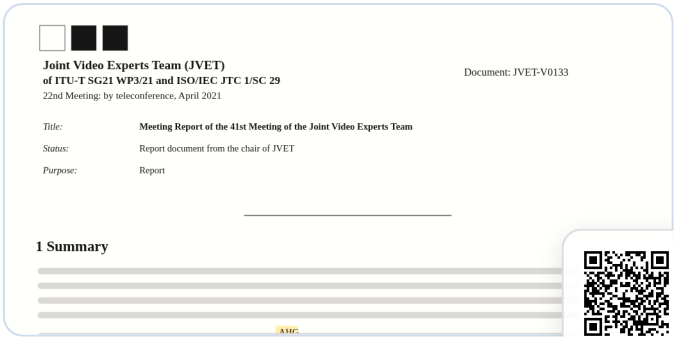


MEETING NOTES

external meeting notes

http://vexpertise.stbit.ru/meeting-notes/source/meeting_22_v



MEETING NOTES

JVET-V0133 AHG8: Content Adaptive Transform Precision for High Bit Depth Coding [K. Naser, F. Galpin, F. Le Léannec, P. De Lagrange (InterDigital)]

The intermediate transform coefficient precision is fixed to 16 bit signed representation in VVC. Therefore, a pre-computed down-shift is performed after inverse quantization and inverse transform in order to avoid exceeding the 16 bit buffer. It is argued that this down-shift is too conservative as the prediction mechanism results in low magnitude residuals. For High Bit-Depth coding, the down-shift is increased to ensure 16 bit representation, which further decreases the quality of the inverse transformed coefficients. This contribution proposes to adaptively assign the down-shift according the contents.

The following experimental results of bdrate gain are reported, for CATP0, Low QP:

- 0.00%, -0.12% and -0.06% in bdrateY in PQ, HLG and SVT in AI
- -0.22%, -0.18% and -0.08% in bdrateY in PQ, HLG and SVT in LDB
- X.XX%, X.XX% and X.XX% in bdrateY in PQ, HLG and SVT in RA

Normal QP

- -0.04% and 0.00% in bdrateY in H1 and H2 in AI
- - 0.17% and X.XX% in bdrateY in H1 and H2 in RA

Additional results Low QP, SVT 16 with *TrDynamicRange = bitDepth*

- -0.41% for SVT16 in AI

CATP1: Low QP

- -0.50%, -0.20% and -0.11% in bdrateY in PQ, HLG and SVT in AI
- -0.39%, -0.28% and -0.13% in bdrateY in PQ, HLG and SVT in LDB
- X.XX%, X.XX% and X.XX% in bdrateY in PQ, HLG and SVT in RA

Normal QP

- -0.05% and 0.00% in bdrateY in H1 and H2 in AI
- - 0.15% and X.XX% in bdrateY in H1 and H2 in RA

Additional results Low QP, SVT 16 with *TrDynamicRange = bitDepth*

- -1.50% for SVT16 in AI

Presented in session 13 1415-1435 UTC (chaired by JRO)

The approach is to analyse the maximum value of transform coefficient in current block, and determine the amount of shift. This keeps the buffer size lower, and also less precision in multiplier.

Questions:

- Would the gain still appear with precision extension flag enabled? Likely not.
- Was it tested with the CE base anchor? No.

Implementing precision extension flag increases complexity and requires some re-design. The same is true for this proposal, but more investigation would be necessary to assess if it is more implementation friendly.

> It was agreed to study this in a CE.

CITATION

K. Naser, F. Galpin, F. Le Léannec, P. De Lagrange, "AHG8: Content Adaptive Transform Precision for High Bit Depth Coding", JVET-V0133, 22nd Meeting: by teleconference, April 2021.

REFERENCES

1. A. Browne, T. Ikai, D. Rusanovskyy, M. Sarwer, X. Xiu, "Common test conditions for high bit depth and high bit rate video coding", JVET-U2018, 21st Meeting: by teleconference, January 2021.