|  |  |
| --- | --- |
| **ITU – Telecommunications Standardization Sector**STUDY GROUP 21 Question 6/21**Video Coding Experts Group (VCEG)**77th Meeting: 26 June – 4 July 2025, Daejeon, KR | Document VCEG-BY24-v1 |

|  |  |
| --- | --- |
| Question: | 6/21 (VCEG)  |
| Source: | **Jonathan Pfaff, Christof Fersch** | Email: | jonathan.pfaff@hhi.fraunhofer.de, christof.fersch@dolby.com |
| Title: | **CE description for H.BWC** |
| Purpose: | CE description |

**Abstract**

This document contains the core experiment description for H.BWC for experiments planned to follow the July 2025 meeting in Daejeon, Republic of Korea.

1. **CE on deblocking**

In VCEG-BW12, an illustration of the perceptual benefit of the deblocking approach was provided but it was recently observed that the deblocking causes some degradation in BD-rate performance.

In VCEG-BX13, an improved variant of the deblocking approach was proposed, which maintained the perceptual benefit while reducing but not eliminating the previously noted BD-rate degradation.

Therefore, the following core experiment (CE) on improved deblocking for biomedical waveform coding, based on the method described in VCEG-BW12 as well as VCEG-BX13, is being proposed.

**Technical approach**

* Improvement of deblocking approach by modification of processing and encoder optimization

**Evaluation methods**

* Subjective informal visual assessment by inspection of decoded waveforms at the July meeting
* Objective assessment as cross-check by calculating BD-rates; only minimal loss is acceptable.

|  |  |  |
| --- | --- | --- |
|  | Configuration | Test |
| CE-1.1 | CTC | Deblocking of VCEG-BX13 |

# Unification of Lossless coding

## General

This CE, called CE-2, aims to unify the lossless coding mode of H.BWC.

The experimental results presented below were generated by using the software SW-v2 from CE-4 and CE-5 of the 76th VCEG meeting as a starting point. On top of this, the software was further modified as follows:

* Huffman coding for transform skip coefficients was replaced by the CABAC entropy coding for transform skip coefficients supported in the current H.BWC.
* For LPC prediction, only the variant associated to lms\_lpc\_flag=1 was invoked.
* On each block, the number of zero least significant bits was detected and transmitted. If this number was greater than zero, the input signal was down-shifted at the encoder before coding and the reconstructed signal was up-shifted at the decoder as the last step to generate the final reconstruction.

The following experimental results were reported over H.BWC, version 2:

|  |  |
| --- | --- |
|  | **Lossless compression** |
|  | **Over BWC-2.0** |
|  | BR-R | EncT | DecT |
| MIT (ECG) | 0.05% | 58% | 71% |
| INCART (ECG) | -20.04% | 40% | 53% |
| CHBMIT (EEG) | -3.28% | 55% | 116% |
| NMR55 (EEG) | -3.83% | 33% | 68% |
| NMR57 (EEG) | #DIV/0! | #DIV/0! | #DIV/0! |
| Ozdemir (EMG) | 0.20% | 72% | 121% |
| **Overall**  | #DIV/0! | #DIV/0! | #DIV/0! |

The software to generate these results can be found in VCEG-BY12-Lossless-Software-v1.

## CE 2.1: Unification of lossless coding methods

In the lossless coding branch of the current H.BWC, there exist two variants for LPC coding and for the coding of transform skip (no trigonometric transform) coefficients. It is proposed to test a unification of these two methods.

First, it is proposed to support a single variant of linear predictive coding. From a decoder perspective, this means that there should only be one syntax and semantics to decode the LPC weights and to perform the LPC prediction. The LPC process associated to lms\_lpc\_flag equal to one is proposed to be the starting point, were further refinements to it that are potentially beneficial within the new harmonized design shall be investigated.

Second, for the coding of transform skip (no trigonometric transform) coefficients, it is proposed to always use the CABAC entropy coding version supported for transform skip coefficient coding in the current H.BWC and to entirely remove the Huffman coding version. It is proposed to test modifications of the current CABAC entropy coding for transform skip coefficients that might potentially be beneficial due to potential changes of the H.BWC design that might occur as an outcome of this meeting.

## CE 2.2: Bypassing zero LSBs on top of CE-2.1

It is proposed to test technologies that incorporate a down-shifting of the input at the encoder coupled with an up-shifting of the final output at the decoder for suitable input signals on a suitable granularity.

|  |  |  |
| --- | --- | --- |
|  | Configuration | Test |
| CE-2.1 | CTC with QP=0(lossless) only | Unification of lossless coding methods |
| CE-2.2 | CTC with QP=0(lossless) only | Bypassing zero LSBs on top of CE-2.1 |

# CE on Signal Re-referencing

This CE, called CE-3, tests the concept of automatic re-referencing of signals as introduced in VCEG-BY10. In this approach one channel per channel group is determined as a reference channel, and all other channels are reconstructed as the difference with respect to the reference channel. In VCEG-BY10 this was shown to improve the BD rate for a limited subset of the CTC datasets. In this CE the testing shall be extended further.

|  |  |  |
| --- | --- | --- |
|  | Configuration | Test |
| CE-3.1 | CTC | Re-referencing without sub-division into channel groups |
| CE-3.2 | CTC | Re-referencing with sub-division into channel groups |

# CE on Inter-Channel Averaging

In VCEG-BY07, inter-channel averaging prediction was proposed as part of the harmonization works between the LMS branch and the block-based prediction branch to reduce computational complexity.

In this CE, called CE-4, we test the use of inter-channel averaging prediction as an additional mode to further exploit inter-channel redundancies.

|  |  |  |
| --- | --- | --- |
|  | Configuration | Test |
| CE-4.1 | CTC | Inter-channel averaging |

# Test plan

|  |  |  |
| --- | --- | --- |
| CE-Test | Tester | Crosschecker |
| CE-1 | HHI  | ETRI  |
| CE-2.1 | HHI, Dolby | Philips |
| CE-2.2 | HHI, Dolby  | Philips |
| CE-3.1 | Philips | Dolby |
| CE-3.2 | Philips | Dolby |
| CE-4 | ETRI | HHI |

The tests are to be conducted before the next meeting.

**References**

[1] VCEG, “Reference software for biomedical waveform data compression,” tag BWC-2.1. 🌍: <https://vcgit.hhi.fraunhofer.de/vceg-sw/bwc/-/tags>, presets *combined...cfg* in directory*bwc/cfg*

[2] J. Pfaff, C. Fersch, and Rapporteur Q6/21, “Common test conditions and evaluation procedures for H.BWC technical experiments,” *ITU-T document SG21-TD68/WP3*, Geneva, Jan. 2025. 🌍: <https://www.itu.int/wftp3/av-arch/video-site/2506_Dae/VCEG-BY23-CTC-v1.docx>

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_