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| **Joint Video Experts Team (JVET)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  17th Meeting: Brussels, BE, 7–17 January 2020 | Document: JVET-Q\_Notes\_d4 |

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| *Title:* | **Meeting Report of the 17th Meeting of the Joint Video Experts Team (JVET), Brussels, BE, 7–17 Jan. 2020** | | |
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| *Source:* | Chairs of JVET | | |

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# Summary

The Joint Video Experts Team (JVET) of ITU-T WP3/16 and ISO/IEC JTC 1/ SC 29/ WG 11 held its seventeenth meeting during 7–17 January 2020 at Square – Brussels Convention Center in Brussels, BE. The JVET meeting was held under the chairmanship of Dr Gary Sullivan (Microsoft/USA) and Dr Jens-Rainer Ohm (RWTH Aachen/Germany). For rapid access to particular topics in this report, a subject categorization is found (with hyperlinks) in section 2.13 of this document. It is further noted that the unabbreviated name of JVET was formerly known as “Joint Video *Exploration* Team”, but the parent bodies modified it when entering the phase of formal development of a new standard. The name Versatile Video Coding (VVC) was chosen in April 2018 as the informal nickname for the new standard.

The JVET meeting began at approximately 0900 hours on Tuesday 7 January 2020. Meeting sessions were held on all days (including weekend days) until the meeting was closed at approximately XXXX hours on Friday 17 January 2020. On the first day of the meeting, only aspects related to high level syntax were on the agenda. Approximately XXX people attended the JVET meeting, and approximately XXX input documents, 5 CE summary reports, and 16 AHG reports were discussed. The meeting took place in a collocated fashion with a meeting of SG16 – one of the two parent bodies of the JVET. The subject matter of the JVET meeting activities consisted of developing video coding technology with a compression capability that significantly exceeds that of the current HEVC standard, or otherwise gives better support regarding the requirements of future application domains of video coding. As a primary goal, the JVET meeting reviewed the work that was performed in the interim period since the sixteenth JVET meeting in producing a sixth draft of the VVC standard and the sixth version of the associated VVC test model (VTM). Further important goals were reviewing the results of 5 Core Experiments (CE), reviewing other technical input on novel aspects of video coding technology, producing the next versions of the VVC draft text and VTM, and plan next steps for further investigation of candidate technology towards the formal standard development.

The JVET produced 11 output documents from the meeting (update):

* JVET-P2001 Versatile Video Coding specification text (Draft 7), also issued as ISO/IEC DIS 23090-3 Versatile Video Coding
* JVET-P2002 Algorithm description for Versatile Video Coding and Test Model 7 (VTM 7)
* JVET-P2005 Methodology and reporting template for coding tool testing
* JVET-P2007 Supplemental enhancement information messages for coded video bitstreams (Draft 2), also issued as ISO/IEC DIS 23002-7
* JVET-P2008 Conformance testing for versatile video coding (Draft 1)
* JVET-P2011, JVET common test conditions and software reference configurations for HDR/WCG video
* JVET-P2021 through JVET-P2025, Description of Core Experiments 1 through 5

For the organization and planning of its future work, the JVET established XX “ad hoc groups” (AHGs) to progress the work on particular subject areas. At this meeting, X Core Experiments (CE) were defined. The next four JVET meetings were planned for 15–24 April 2020 under WG 11 auspices in Alpbach, AT, during 23 June – 01 July 2020 under ITU-T SG16 auspices in Geneva, CH, during 7–16 October 2020 under WG 11 auspices in Rennes, FR, and during 6–15 January 2021 under WG 11 auspices in Capetown, ZA.

The document distribution site <http://phenix.it-sudparis.eu/jvet/> was used for distribution of all documents.

The reflector to be used for discussions by the JVET and all its AHGs is the JVET reflector:  
[jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de) hosted at RWTH Aachen University. For subscription to this list, see  
<https://lists.rwth-aachen.de/postorius/lists/jvet.lists.rwth-aachen.de/>.

# Administrative topics

## Organization

The ITU-T/ISO/IEC Joint Video Experts Team (JVET) is a group of video coding experts from the ITU-T Study Group 16 Visual Coding Experts Group (VCEG) and the ISO/IEC JTC 1/SC 29/WG 11 Moving Picture Experts Group (MPEG). The parent bodies of the JVET are ITU-T WP3/16 and ISO/IEC JTC 1/SC 29/WG 11.

The Joint Video Experts Team (JVET) of ITU-T WP3/16 and ISO/IEC JTC 1/ SC 29/ WG 11 held its sixteenth meeting during 1–11 October 2019 at the ITU premises in Geneva, CH. The JVET meeting was held under the chairmanship of Dr Gary Sullivan (Microsoft/USA) and Dr Jens-Rainer Ohm (RWTH Aachen/Germany).

It is further noted that the unabbreviated name of JVET was formerly known as “Joint Video *Exploration* Team”, but the parent bodies modified it when entering the phase of formal development of a new standard. The name Versatile Video Coding (VVC) was chosen in April 2018 as the informal nickname for the new standard.

## Meeting logistics

Information regarding logistics arrangements for the meeting had been provided via the email reflector [jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de) and at <http://wftp3.itu.int/av-arch/jvet-site/2020_01_Q_Brussels/>.

## Primary goals

As a primary goal, the JVET meeting reviewed the work that was performed in the interim period since the sixteenth JVET meeting in producing a seventh draft of the VVC standard and the seventh version of the associated VVC test model (VTM). Further important goals were reviewing the results of 5 Core Experiments (CE), reviewing other technical input on novel aspects of video coding technology, producing the next versions of draft text and VTM, and planning next steps for further investigation of candidate technology towards the formal standard development.

## Documents and document handling considerations

### General

The documents of the JVET meeting are listed in Annex A of this report. The documents can be found at <http://phenix.it-sudparis.eu/jvet/>.

Registration timestamps, initial upload timestamps, and final upload timestamps are listed in Annex A of this report.

The document registration and upload times and dates listed in Annex A and in headings for documents in this report are in Paris/Geneva time. Dates mentioned for purposes of describing events at the meeting (other than as contribution registration and upload times) follow the local time at the meeting facility.

Highlighting of recorded decisions in this report is practised as follows:

* Decisions made by the group that might affect the normative content of a future standard are identified in this report by prefixing the description of the decision with the string “Decision:”.
* Decisions that affect the VTM software but have no normative effect are marked by the string “Decision (SW):”.
* Decisions that fix a “bug” in the VTM description (an error, oversight, or messiness) or in the software are marked by the string “Decision (BF):”.
* Decisions that are merely editorial without effect on the technical content of the draft standard are marked by the string "Decision (Ed.):". Such editorial decisions are merely suggestions to the editor, who has the discretion to determine the final action taken if their judgment differs.

This meeting report is based primarily on notes taken by the JVET chairs. The preliminary notes were also circulated publicly by ftp and http during the meeting on a daily basis. It should be understood by the reader that 1) some notes may appear in abbreviated form, 2) summaries of the content of contributions are often based on abstracts provided by contributing proponents without an intent to imply endorsement of the views expressed therein, and 3) the depth of discussion of the content of the various contributions in this report is not uniform. Generally, the report is written to include as much information about the contributions and discussions as is feasible (in the interest of aiding study), although this approach may not result in the most polished output report.

### Late and incomplete document considerations

The formal deadline for registering and uploading non-administrative contributions had been announced as Tuesday, 31 December 2019. Any documents uploaded after 1159 hours Paris/Geneva time on Wednesday 1 January 2020 were considered “officially late”, giving a grace period of 12 hours to accommodate those living in different time zones of the world. The deadline does not apply to AHG reports, and other such reports which can only be produced after the availability of other input documents.

As agreed by the fifteenth meeting as permanent rule, contributions related to CE proposals (including draft text) were to be uploaded 1 week ahead of the above mentioned deadline, such that more thorough study was possible, and in particular the CE summary reports could be provided in time by the regular deadline. Consequently, CE proposal documents which were uploaded after 1159 hours Paris/Geneva time on Wednesday 25 December 2019 were considered “officially late”.

It was suggested to have CE description documents include a description of how the results are planned to be reported – e.g., the form of the tables to be used for the results data. Complexity analysis characterizations were suggested to be a particular issue where this applies.

All contribution documents with registration numbers higher than JVET-Q0523 were registered after the “officially late” deadline (and therefore were also uploaded late). Likewise, CE proposal documents with registration numbers higher than JVET-Q0096 were registered late. However, some documents in the “late” range might include break-out activity reports that were generated during the meeting, and are therefore better considered as report documents rather than as late contributions. Also, all cross-check reports were uploaded late.

In many cases, contributions were also revised after the initial version was uploaded. The contribution document archive website retains publicly accessible prior versions in such cases. The timing of late document availability for contributions is generally noted in the section discussing each contribution in this report.

One suggestion to assist with the issue of late submissions was to require the submitters of late contributions and late revisions to describe the characteristics of the late or revised (or missing) material at the beginning of discussion of the contribution. This was agreed to be a helpful approach to be followed at the meeting.

The following technical design proposal contributions were registered and/or uploaded late:qq

* JVET-Q0XXX (a proposal on …), uploaded XX-XX.
* …

It may be observed that some of the above-listed contributions were submissions made in response to issues that arose in discussions during the meeting or from the study of other contributions, and thus could not have been submitted by the ordinary deadline. For example, some of them were proposing combinations or simplifications of other proposals.

The following other document not proposing normative technical content, but with some need for consideration, were registered and/or uploaded late:

* JVET-Q0XXX (a document on …), uploaded XX-XX.
* …

All cross-verification reports at this meeting (except for JVET-Q0XXX) were registered late and all were uploaded late. In the interest of brevity, these are not specifically identified here. Initial upload times for each document are recorded in Annex A of this report.

The following (X) contribution registrations were later cancelled, withdrawn, never provided, were cross-checks of a withdrawn contribution, or were registered in error: JVET-Q0XXX, … .

The following cross verification reports had not been uploaded yet by the end of the meeting, but were provided later: JVET-Q0XXX, … .

“Placeholder” contribution documents that were basically empty of content, or lacking any results showing benefit for the proposed technology, and obviously uploaded with an intent to provide a more complete submission as a revision, had been agreed to be considered unacceptable and to be rejected in the document management system until a more complete version was available (which would then typically be counted as a late contribution). At the current meeting, this situation applied to the initial uploads of documents JVET-Q0XXX, … .

Contributions that had significant problems with uploaded versions included the following:

* JVET-Q0XXX (…)
* …

As a general policy, missing documents were not to be presented, and late documents (and substantial revisions) could only be presented when there was a consensus to consider them and there was sufficient time available for their review. Again, an exception is applied for AHG reports, CE summaries, and other such reports which can only be produced after the availability of other input documents. There were no objections raised by the group regarding presentation of late contributions, although there was some expression of annoyance and remarks on the difficulty of dealing with late contributions and late revisions.

It was remarked that documents that are substantially revised after the initial upload can also be a problem, as this becomes confusing, interferes with study, and puts an extra burden on synchronization of the discussion. This can especially be a problem in cases where the initial upload is clearly incomplete, and in cases where it is difficult to figure out what parts were changed in a revision. For document contributions, revision marking is very helpful to indicate what has been changed. Also, the “comments” field on the web site can be used to indicate what is different in a revision although participants tend to seldom notice what is recorded there.

A few contributions may have had some problems relating to IPR declarations in the initial uploaded versions (missing declarations, declarations saying they were from the wrong companies, etc.). These issues were corrected by later uploaded versions in a reasonably timely fashion in all cases (to the extent of the awareness of the responsible coordinators).

Some other errors were noticed in other initial document uploads (wrong document numbers or meeting dates or meeting locations in headers, etc.) which were generally sorted out in a reasonably timely fashion. The document web site contains an archive of each upload.

### Outputs of the preceding meeting

All output documents of the previous meeting, particularly the meeting report JVET-P2000, the Versatile Video Coding specification text (Draft 7) JVET-P2001, the Algorithm description for Versatile Video Coding and Test Model 7 (VTM 7) JVET-P2002, the Methodology and reporting template for coding tool testing JVET-P2005, the Supplemental enhancement information messages for coded video bitstreams (Draft 2) JVET-P2007, the Conformance testing for VVC (Draft 1) JVET-P2008, the JVET common test conditions and software reference configurations for HDR/WCG video JVET-P2011, and the Description of Core Experiments 1 through 5 (JVET-P2021 through JVET-P2025), had been completed and were approved. The software implementation of VTM (versions 7.0 and 7.1) was also approved.

The group was initially asked to review the meeting report of the previous meeting for finalization. The meeting report was later approved without modification.

The available output documents of the previous meeting and the software had been made available in a reasonably timely fashion.

## Attendance

The list of participants in the JVET meeting can be found in Annex B of this report.

The meeting was open to those qualified to participate either in ITU-T WP3/16 or ISO/IEC JTC 1/‌SC 29/‌WG 11 (including experts who had been personally invited as permitted by ITU-T or ISO/IEC policies).

Participants had been reminded of the need to be properly qualified to attend. Those seeking further information regarding qualifications to attend future meetings may contact the responsible coordinators.

## Agenda

The agenda for the meeting was as follows:

* Opening remarks and review of meeting logistics and communication practices
* IPR policy reminder and declarations
* Contribution document allocation
* Review of results of the previous meeting
* Reports of *ad hoc* group (AHG) activities
* Reports of core experiments planned at the previous meeting
* Consideration of contributions and communications on project guidance
* Consideration of additional video coding technology contributions
* Consideration of information contributions
* Coordination activities
* Approval of output documents and associated editing periods
* Future planning: Determination of next steps, discussion of working methods, communication practices, establishment of coordinated experiments, establishment of AHGs, meeting planning, other planning issues
* Other business as appropriate for consideration

On the first day of the meeting (January 7), only aspects related to high level syntax (including AHG8, AHG9, AHG12, and AHG14 reports) were on the agenda. In the morning of January 8, the meeting was continued with general status review and administrative matters, and then proceeded with reports of ad *hoc* group activities, reports of core experiments, and other matters.

## IPR policy reminder

Participants were reminded of the IPR policy established by the parent organizations of the JVET and were referred to the parent body websites for further information. The IPR policy was summarized for the participants.

The ITU-T/ITU-R/ISO/IEC common patent policy shall apply. Participants were particularly reminded that contributions proposing normative technical content shall contain a non-binding informal notice of whether the submitter may have patent rights that would be necessary for implementation of the resulting standard. The notice shall indicate the category of anticipated licensing terms according to the ITU-T/ITU-R/ISO/IEC patent statement and licensing declaration form.

This obligation is supplemental to, and does not replace, any existing obligations of parties to submit formal IPR declarations to ITU-T/ITU-R/ISO/IEC.

Participants were also reminded of the need to formally report patent rights to the top-level parent bodies (using the common reporting form found on the database listed below) and to make verbal and/or document IPR reports within the JVET necessary in the event that they are aware of unreported patents that are essential to implementation of a standard or of a draft standard under development.

Some relevant links for organizational and IPR policy information are provided below:

* <http://www.itu.int/ITU-T/ipr/index.html> (common patent policy for ITU-T, ITU-R, ISO, and IEC, and guidelines and forms for formal reporting to the parent bodies)
* <http://ftp3.itu.int/av-arch/jvet-site> (JVET contribution templates)
* <http://www.itu.int/ITU-T/dbase/patent/index.html> (ITU-T IPR database)
* <http://www.itscj.ipsj.or.jp/sc29/29w7proc.htm> (JTC 1/‌SC 29 Procedures)

It is noted that the ITU TSB director’s AHG on IPR had issued a clarification of the IPR reporting process for ITU-T standards, as follows, per SG 16 TD 327 (GEN/16):

“TSB has reported to the TSB Director’s IPR Ad Hoc Group that they are receiving Patent Statement and Licensing Declaration forms regarding technology submitted in Contributions that may not yet be incorporated in a draft new or revised Recommendation. The IPR Ad Hoc Group observes that, while disclosure of patent information is strongly encouraged as early as possible, the premature submission of Patent Statement and Licensing Declaration forms is not an appropriate tool for such purpose.

In cases where a contributor wishes to disclose patents related to technology in Contributions, this can be done in the Contributions themselves, or informed verbally or otherwise in written form to the technical group (e.g. a Rapporteur’s group), disclosure which should then be duly noted in the meeting report for future reference and record keeping.

It should be noted that the TSB may not be able to meaningfully classify Patent Statement and Licensing Declaration forms for technology in Contributions, since sometimes there are no means to identify the exact work item to which the disclosure applies, or there is no way to ascertain whether the proposal in a Contribution would be adopted into a draft Recommendation.

Therefore, patent holders should submit the Patent Statement and Licensing Declaration form at the time the patent holder believes that the patent is essential to the implementation of a draft or approved Recommendation.”

The responsible coordinators invited participants to make any necessary verbal reports of previously-unreported IPR in technology that might be considered as prospective candidate for inclusion in future standards, and opened the floor for such reports: No such verbal reports were made.

## Software copyright disclaimer header reminder

It was noted that the VTM software implementation package uses the same software copyright license header as the HEVC reference software, where the latter had been agreed at the 5th meeting of the JCT-VC and approved by both parent bodies at their collocated meetings at that time. This license header language is based on the BSD license with a preceding sentence declaring that other contributor or third party rights, including patent rights, are not granted by the license, as recorded in [N 10791](http://phenix.it-sudparis.eu/mpeg/doc_end_user/current_document.php?id=27881&id_meeting=16) of the 89th meeting of ISO/IEC JTC 1/‌SC 29/‌WG 11. Both ITU and ISO/IEC will be identified in the <OWNER> and <ORGANIZATION> tags in the header. This software is used in the process of designing the VTM software, and for evaluating proposals for technology to be potentially included in the design. This software or parts thereof might be published by ITU-T and ISO/IEC as an example implementation of a future video coding standard and for use as the basis of products to promote adoption of such technology.

Different copyright statements shall not be committed to the committee software repository (in the absence of subsequent review and approval of any such actions). As noted previously, it must be further understood that any initially-adopted such copyright header statement language could further change in response to new information and guidance on the subject in the future.

These considerations apply to the 360Lib video conversion software and HDRTools as well.

## Communication practices

The documents for the meeting can be found at <http://phenix.it-sudparis.eu/jvet/>.

It was reminded to send a notice to the chairs in cases of changes to document titles, authors etc.

JVET email lists are managed through the site <https://lists.rwth-aachen.de/postorius/lists/jvet.lists.rwth-aachen.de/>, and to send email to the reflector, the email address is [jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de). Only members of the reflector can send email to the list. However, membership of the reflector is not limited to qualified JVET participants.

It was emphasized that reflector subscriptions and email sent to the reflector must use real names when subscribing and sending messages and subscribers must respond to inquiries regarding the nature of their interest in the work. The current number of subscribers was 1221.

For distribution of test sequences, a password-protected ftp site had been set up at RWTH Aachen University, with a mirror site at FhG-HHI. Accredited members of JVET may contact the responsible JVET coordinators to obtain the password information (but the site is not open for use by others).

## Terminology

Some terminology used in this report is explained below:

(check for completeness with JVET-N0013, and draft text)

* **ACT**: Adaptive colour transform.
* **AFF**: Affine.
* **AI**: All-intra.
* **AIF**: Adaptive interpolation filtering.
* **ALF**: Adaptive loop filter.
* **AMP**: Asymmetric motion partitioning – a motion prediction partitioning for which the sub-regions of a region are not equal in size (in HEVC, being N/2x2N and 3N/2x2N or 2NxN/2 and 2Nx3N/2 with 2N equal to 16 or 32 for the luma component).
* **AMVP**: Adaptive motion vector prediction.
* **AMT or MTS**: Adaptive multi-core transform, or multiple transform selection.
* **AMVR**: (Locally) adaptive motion vector resolution.
* **APS**: Adaptation parameter set.
* **ARC**: Adaptive resolution conversion (synonymous with DRC, and a form of RPR).
* **ARSS**: Adaptive reference sample smoothing.
* **ATMVP** or “subblock-based temporal merging candidates”: Alternative temporal motion vector prediction.
* **AU**: Access unit.
* **AUD**: Access unit delimiter.
* **AVC**: Advanced video coding – the video coding standard formally published as ITU-T Recommendation H.264 and ISO/IEC 14496-10.
* **BA**: Block adaptive.
* **BC**: See CPR or IBC.
* **BCW**: Biprediction with CU based weighting
* **BD**: Bjøntegaard-delta – a method for measuring percentage bit rate savings at equal PSNR or decibels of PSNR benefit at equal bit rate (e.g., as described in document VCEG-M33 of April 2001).
* **BDOF**: Bi-directional optical flow (formerly known as **BIO**).
* **BDPCM**: Block-wise DPCM.
* **BL**: Base layer.
* **BMS**: Benchmark set (no longer used), a former preliminary compilation of coding tools on top of VTM, which provide somewhat better compression performance, but are not deemed mature for standardzation.
* **BoG**: Break-out group.
* **BR**: Bit rate.
* **BV**: Block vector (used for intra BC prediction).
* **CABAC**: Context-adaptive binary arithmetic coding.
* **CBF**: Coded block flag(s).
* **CC**: May refer to context-coded, common (test) conditions, or cross-component.
* **CCLM**: Cross-component linear model.
* **CCP**: Cross-component prediction.
* **CE**: Core Experiment – a coordinated experiment conducted toward assessment of coding technology.
* **CG**: Coefficient group.
* **CGS**: Colour gamut scalability (historically, coarse-grained scalability).
* **CIIP**: Combined inter/intra prediction.
* **CL-RAS**: Cross-layer random-access skip.
* **CPMV**: Control-point motion vector.
* **CPMVP**: Control-point motion vector prediction (used in affine motion model).
* **CPR**: Current-picture referencing, also known as IBC – a technique by which sample values are predicted from other samples in the same picture by means of a displacement vector called a block vector, in a manner conceptually similar to motion-compensated prediction.
* **CST**: Chroma separate tree.
* **CTC**: Common test conditions.
* **CVS**: Coded video sequence.
* **DCT**: Discrete cosine transform (sometimes used loosely to refer to other transforms with conceptually similar characteristics).
* **DCTIF**: DCT-derived interpolation filter.
* **DF**: Deblocking filter.
* **DMVR**: Decoder-side motion vector refinement.
* **DPS**: Decoding parameter sets.
* **DRC**: Dynamic resolution conversion (synonymous with ARC, and a form of RPR).
* **DT**: Decoding time.
* **ECS**: Entropy coding synchronization (typically synonymous with WPP).
* **EMT**: Explicit multiple-core transform.
* **EOTF**: Electro-optical transfer function – a function that converts a representation value to a quantity of output light (e.g., light emitted by a display.
* **EPB**: Emulation prevention byte (as in the emulation\_prevention\_byte syntax element).
* **ECV**: Extended Colour Volume (up to WCG).
* **EL**: Enhancement layer.
* **ET**: Encoding time.
* **FRUC**: Frame rate up conversion (pattern matched motion vector derivation).
* **GRA**: Gradual random access
* **HDR**: High dynamic range.
* **HEVC**: High Efficiency Video Coding – the video coding standard developed and extended by the JCT-VC, formalized by ITU-T as Rec. ITU-T H.265 and by ISO/IEC as ISO/IEC 23008-2.
* **HLS**: High-level syntax.
* **HM**: HEVC Test Model – a video coding design containing selected coding tools that constitutes our draft standard design – now also used especially in reference to the (non-normative) encoder algorithms (see WD and TM).
* **HMVP**: History based motion vector prediction.
* **HRD**: Hypothetical reference decoder.
* **HyGT**: Hyper-cube Givens transform (a type of NSST).
* **IBC** (also **Intra BC**): Intra block copy, also known as CPR – a technique by which sample values are predicted from other samples in the same picture by means of a displacement vector called a block vector, in a manner conceptually similar to motion-compensated prediction.
* **IBDI**: Internal bit-depth increase – a technique by which lower bit-depth (8 bits per sample) source video is encoded using higher bit-depth signal processing, ordinarily including higher bit-depth reference picture storage (ordinarily 12 bits per sample).
* **IBF**: Intra boundary filtering.
* **ILP**: Inter-layer prediction (in scalable coding).
* **IPCM**: Intra pulse-code modulation (similar in spirit to IPCM in AVC and HEVC).
* **ISP**: Intra subblock partitioning
* **JCCR**: Joint coding of chroma residuals
* **JEM**: Joint exploration model – the software codebase for future video coding exploration.
* **JM**: Joint model – the primary software codebase that has been developed for the AVC standard.
* **JSVM**: Joint scalable video model – another software codebase that has been developed for the AVC standard, which includes support for scalable video coding extensions.
* **KLT**: Karhunen-Loève transform.
* **LB** or **LDB**: Low-delay B – the variant of the LD conditions that uses B pictures.
* **LD**: Low delay – one of two sets of coding conditions designed to enable interactive real-time communication, with less emphasis on ease of random access (contrast with RA). Typically refers to LB, although also applies to LP.
* **LFNST**: Low-frequency non-separable transform
* **LIC**: Local illumination compensation.
* **LM**: Linear model.
* **LMCS**: Luma mapping with chroma scaling (formerly sometimes called “in-loop reshaping”)
* **LP** or **LDP**: Low-delay P – the variant of the LD conditions that uses P frames.
* **LUT**: Look-up table.
* **LTRP**: Long-term reference pictures.
* **MC**: Motion compensation.
* **MCP**: Motion compensated prediction.
* **MDNSST**: Mode dependent non-separable secondary transform.
* **MIP**: Matrix-based intra prediction
* **MMLM**: Multi-model (cross component) linear mode.
* **MMVD**: Merge with MVD.
* **MPEG**: Moving picture experts group (WG 11, the parent body working group in ISO/IEC JTC 1/‌SC 29, one of the two parent bodies of the JVET).
* **MPM**: Most probable mode (in intra prediction).
* **MRL**: Multiple reference line intra prediction.
* **MV**: Motion vector.
* **MVD**: Motion vector difference.
* **NAL**: Network abstraction layer (as in AVC and HEVC).
* **NSQT**: Non-square quadtree.
* **NSST**: Non-separable secondary transform.
* **NUH**: NAL unit header.
* **NUT**: NAL unit type (as in AVC and HEVC).
* **OBMC**: Overlapped block motion compensation (e.g., as in H.263 Annex F).
* **OETF**: Opto-electronic transfer function – a function that converts to input light (e.g., light input to a camera) to a representation value.
* **OLS**: Output layer set.
* **OOTF**: Optical-to-optical transfer function – a function that converts input light (e.g. l,ight input to a camera) to output light (e.g., light emitted by a display).
* **operation point**: A temporal subset of an OLS.
* **PDPC**: Position dependent (intra) prediction combination.
* **PERP**: Padded equirectangular projection (a 360° projection format).
* **PHEC**: Padded hybrid equiangular cubemap (a 360° projection format).
* **PMMVD**: Pattern-matched motion vector derivation.
* **POC**: Picture order count.
* **PoR**: Plan of record.
* **PROF**: Prediction refinement with optical flow
* **PPS**: Picture parameter set (as in AVC and HEVC).
* **PTL**: Profile/tier/level combination.
* **QM**: Quantization matrix (as in AVC and HEVC).
* **QP**: Quantization parameter (as in AVC and HEVC, sometimes confused with quantization step size).
* **QT**: Quadtree.
* **BT**: Binary tree.
* **TT**: Ternary tree.
* **RA**: Random access – a set of coding conditions designed to enable relatively-frequent random access points in the coded video data, with less emphasis on minimization of delay (contrast with LD).
* **RADL**: Random-access decodable leading.
* **RASL**: Random-access skipped leading.
* **R-D**: Rate-distortion.
* **RDO**: Rate-distortion optimization.
* **RDOQ**: Rate-distortion optimized quantization.
* **RDPCM**: Residual DPCM
* **ROT**: Rotation operation for low-frequency transform coefficients.
* **RPLM**: Reference picture list modification.
* **RPR**: Reference picture resampling (e.g., as in H.263 Annex P), a special case of which is also known as ARC or DRC.
* **RPS**: Reference picture set.
* **RQT**: Residual quadtree.
* **RRU**: Reduced-resolution update (e.g. as in H.263 Annex Q).
* **RVM**: Rate variation measure.
* **SAO**: Sample-adaptive offset.
* **SBT**: Subblock transform.
* **SbTMVP**: Subblock based temporal motion vector prediction.
* **SCIPU**: Smallest chroma intra prediction unit.
* **SD**: Slice data; alternatively, standard-definition.
* **SDT**: Signal-dependent transform.
* **SEI**: Supplemental enhancement information (as in AVC and HEVC).
* **SH**: Slice header.
* **SHM**: Scalable HM.
* **SHVC**: Scalable high efficiency video coding.
* **SIF**: Switchable (motion) interpolation filter.
* **SIMD**: Single instruction, multiple data.
* **SMVD**: Symmetric MVD.
* **SPS**: Sequence parameter set (as in AVC and HEVC).
* **STMVP**: Spatial-temporal motion vector prediction.
* **TBA/TBD/TBP**: To be announced/determined/presented.
* **TGM**: Text and graphics with motion – a category of content that primarily contains rendered text and graphics with motion, mixed with a relatively small amount of camera-captured content.
* **TPM**: Triangular partitioning mode
* **UCBDS**: Unrestricted center-biased diamond search.
* **UWP**: Unequal weight prediction.
* **VCEG**: Visual coding experts group (ITU-T Q.6/16, the relevant rapporteur group in ITU-T WP3/16, which is one of the two parent bodies of the JVET).
* **VPS**: Video parameter set – a parameter set that describes the overall characteristics of a coded video sequence – conceptually sitting above the SPS in the syntax hierarchy.
* **VTM**: VVC Test Model.
* **VVC**: Versatile Video Coding, the standardization project developed by JVET.
* **WAIP**: Wide-angle intra prediction
* **WCG**: Wide colour gamut.
* **WG**: Working group, a group of technical experts (usually used to refer to WG 11, a.k.a. MPEG).
* **WPP**: Wavefront parallel processing (usually synonymous with ECS).
* Block and unit names in HEVC:
  + **CTB**: Coding tree block (luma or chroma) – unless the format is monochrome, there are three CTBs per CTU.
  + **CTU**: Coding tree unit (containing both luma and chroma, synonymous with LCU), with a size of 16x16, 32x32, or 64x64 for the luma component.
  + **CB**: Coding block (luma or chroma), a luma or chroma block in a CU.
  + **CU**: Coding unit (containing both luma and chroma), the level at which the prediction mode, such as intra versus inter, is determined in HEVC, with a size of 2Nx2N for 2N equal to 8, 16, 32, or 64 for luma.
  + **PB**: Prediction block (luma or chroma), a luma or chroma block of a PU, the level at which the prediction information is conveyed or the level at which the prediction process is performed in HEVC.
  + **PU**: Prediction unit (containing both luma and chroma), the level of the prediction control syntax within a CU, with eight shape possibilities in HEVC:
    - **2Nx2N**: Having the full width and height of the CU.
    - **2NxN (or Nx2N)**: Having two areas that each have the full width and half the height of the CU (or having two areas that each have half the width and the full height of the CU).
    - **NxN**: Having four areas that each have half the width and half the height of the CU, with N equal to 4, 8, 16, or 32 for intra-predicted luma and N equal to 8, 16, or 32 for inter-predicted luma – a case only used when 2N×2N is the minimum CU size.
    - **N/2x2N** paired with **3N/2x2N** or **2NxN/2** paired with **2Nx3N/2**: Having two areas that are different in size – cases referred to as AMP, with 2N equal to 16 or 32 for the luma component.
  + **TB**: Transform block (luma or chroma), a luma or chroma block of a TU, with a size of 4x4, 8x8, 16x16, or 32x32.
  + **TU**: Transform unit (containing both luma and chroma), the level of the residual transform (or transform skip or palette coding) segmentation within a CU (which, when using inter prediction in HEVC, may sometimes span across multiple PU regions).
* Block and unit names in VVC:
  + **CTB**: Coding tree block (luma or chroma) – there are three CTBs per CTU in a P or B slice or in an I slice that uses a single tree, and one CTB per luma CTU and two CTBs per chroma CTU in an I slice that uses separate trees.
  + **CTU**: Coding tree unit (synonymous with LCU, containing both luma and chroma in a P or B slice or in an I slice that uses a single tree, containing only luma or only chroma in an I slice that uses separate trees), with a size of 16x16, 32x32, 64x64, or 128x128 for the luma component.
  + **CB**: Coding block, a luma or chroma block in a CU.
  + **CU**: Coding unit (containing both luma and chroma in P/B slice, containing only luma or chroma in I slice), a leaf node of a QTBT. It’s the level at which the prediction process and residual transform are performed in JEM. A CU can be square or rectangle shape.
  + **PB**: Prediction block, a luma or chroma block of a PU.
  + **PU**: Prediction unit, has the same size as a CU in the VVC context.
  + **TB**: Transform block, a luma or chroma block of a TU.
  + **TU**: Transform unit, has the same size as a CU in the VVC context.

## Opening remarks

Remarks during the opening session of the meeting 0900 Tuesday 7 January (chaired by GJS) were as follows.

* The first day was dedicated to high-level syntax (incl. AHGs 8, 9, 12)
* 0900 start time on the first two days; 0800 generally thereafter
* Balloting and approval timeline: "H.VVC" | ISO/IEC 23090-3 for VVC and H.SEI | ISO/IEC 23002-7
  + DIS as output of the previous meeting (N18873 and N18877), with ballot period between the January and April meetings
    - Post-meeting editing
  + FDIS and Consent in July
* The meeting logistics, agenda, working practices, policies, and document allocation were reviewed.
  + The meeting host is XXXX
  + Having text and software available is crucial (and not just arriving at the end of the meeting).
  + There were no objections voiced in the opening plenary to the consideration of late contributions.
* The results of the previous meeting and the meeting report were reviewed.
  + See the AHG3 report for the software integration status
  + The relationship between the VVC and SEI texts was noted
    - VUI is in the SEI text, mostly for providing colour interpretation
      * It was noted that VUI is within the SPS, whereas SEI is in the SEI payload syntax structure, although this is not so relevant to the SEI text itself, and is more tied with the bitstream (less likely to be altered or removed).
      * VUI has a clear scope, is more tied to the sequence level
      * Should VUI be in the VVC spec instead of the SEI spec?
      * VUI could contain other info, such as constraint indicators (info that does not affect the decoding process)
      * SEI has a length parameter that enables discarding; VUI does not. SPS extension data follows the VUI. It was remarked that having a size indicator for VUI may be desirable.
    - field\_seq\_flag was put into the SPS to improve
* There was somewhat less of a problem of late non-cross-check documents and no “placeholders” – (see section 2.4.2).
* The primary goals of the meeting were to review the results of CEs, identify promising technology directions, and adopt proposed technology into the VVC and associated SEI draft texts and VTM.
* Due to the high number of input contributions, parallelization and breakout work were planned to be used at the meeting.
* Viewing & equipment setup was discussed – having a visual comparison of VVC vs. HEVC was encouraged
* Principles of standards development were discussed.
  + It was noted that now is the time for the filing of formal IPR declarations for those who have patent rights that would be necessary for implementation of VVC or the associated SEI standard.

## Scheduling of discussions

Scheduling: Generally meeting time was scheduled during 0800–2100+ hours, with coffee and lunch breaks as convenient. Ongoing scheduling refinements were announced on the group email reflector as needed. Some particular scheduling notes are shown below, although not necessarily 100% accurate or complete:

* Tue. 7 Jan., 1st day
  + 0900–1000 Opening remarks, review of practices, agenda, IPR reminder
  + 1010-1215 Reports of AHGs 8, 9, 12
  + 1400-1800 room 201, 1900-2230 Bozar bldg BoG Q0625 (J. Boyce)
    - High-level tool control (section 6.19.2)
    - RPR and reference wrap-around (section 6.19.1.2)
    - Parameter sets cleanup (section 6.19.4)
  + 1400-1800, 1845-2245, room 100 (GJS)
    - Subpicture general issues (section 6.20.1.1)
    - Subpicture layout signalling (section 6.20.1.2)
    - Subpicture ID signalling (section 6.20.1.3)
* Wed. 8 Jan., 2nd day (Rooms available: 100 (200) until 2300, The Arc (140) until 2200, Bozar 1 (70), Bozar 2 (70))
  + 0900 Status review (GJS & JRO)
  + 0940–1300, 1430–XX Remaining AHG reports, room 100 (GJS & JRO)
  + Track A (room The Arc - GJS)
    - 1640 CE4: Inter prediction with geometric partitioning (7) (section 5.4) (Track A)
    - 1920-2200 Subpicture ID signalling (section 6.20.1.3)
    - 2200-2240 Slices and tiles (section 6.20.2)
  + Track B (room 100 - JRO) 1645-2250
    - CE1: Deblocking filtering (5) (section 5.1) (Track B)
    - CE5: Cross-component adaptive loop filtering (7) (section 5.5) (Track B)
    - CE2: Palette mode coding (5) (section 5.2) (Track B)
    - CE3: Lossless coding (12) (section 5.3) (Track B)
  + 1930- BoG on CE4-related: Inter prediction with geometric partitioning (31) (section 6.4) (room Bozar 1 H. Yang)
* Thu. 9 Jan., 3rd day (Rooms available: 100 (200), The Arc (140), Hall 300 (65), 311+312 (75), 314+316 (75), Bozar 1 (70), Bozar 2 (20))
  + Track A (GJS)
    - 0800-1330 Slices and tiles (section 6.20.2)
    - 1500 Picture header, slice header, and AUD (section 6.19.6)
  + 0800- BoG on CE4-related: Inter prediction with geometric partitioning (31) (section 6.4) (room Hall 300, H. Yang)
  + Track B (room 100 - JRO)
    - 0800-1015 CE3: Lossless coding
    - 1100-1300 CE3 related
    - 1430-1500 CE1 revisit and further planning
    - 1500-1600 CE3 related
    - 1630-1800 Lossless and near lossless coding (6.16) and Entropy coding (6.13)
    - 1800-1900 Residual coding (6.12)
    - 1900-2150 Transforms and transform signaling (6.11)
* Fri. 10 Jan., 4th day
  + 0800-1100 BoG CE5 related (room 100, A. Segall, C.-Y. ChenQ0625 (see BoG topics above, Room The Arc, J. Boyce)
  + Track B (room 100 - JRO)
    - 1100-XXXX Revisits on CEs
    - Transforms and transform signaling (6.11)
    - CE1 related (6.1)
    - Loop filtering (6.8)
    - Intra prediction and mode coding (6.7)
    - Further track B topics Fri/Sat: CE5 related (6.5), Reference picture resampling (6.9), Quantization control (6.10), Partitioning (6.14), Chroma formats and chroma related coding tools (6.15), Screen content coding tools (6.17), complexity analysis (7), encoder optimization (8)
  + 0900-1100 JCT-VC opening plenary (outside of JVET) room 300
* Sat. 11 Jan., 5th day
  + 0800-2130 TBD
* Sun. 12 Jan., 6th day
  + 0800- JVET plenary

## Contribution topic overview

The approximate subject categories and quantity of contributions per category for the meeting were summarized as follows (note that the noted document counts do not include crosschecks, and may not be completely accurate):

* AHG reports (18) (section 3) (Plenary)
* Project development (section 4) (Plenary)
  + Text and software development (2)
  + Test conditions (0)
  + Performance assessment (3)
  + Coding studies and tools on specific use cases (3)
  + Test Material (0)
  + Conformance (1)
  + Implementation studies (11)
  + Profile/level specification (4)
* Core Experiments (section 5) with subtopics
  + CE1: Deblocking filtering (5) (section 5.1) (Track B)
  + CE2: Palette mode coding (5) (section 5.2) (Track B)
  + CE3: Lossless coding (12) (section 5.3) (Track B)
  + CE4: Inter prediction with geometric partitioning (7) (section 5.4) (Track A)
  + CE5: Cross-component adaptive loop filtering (7) (section 5.5) (Track B)
* Non-CE technology proposals (section 6) with subtopics
  + CE1 related – Deblocking filtering (4) (section 6.1) (Track B)
  + CE2 related – Palette mode coding (13) (section 6.2) (Track B)
  + CE3 related – Lossless coding (26) (section 6.3) (Track B)
  + CE4 related – Inter prediction with geometric partitioning (31) (section 6.4) (Track A)
  + CE5 related – Cross-component adaptive loop filtering (24) (section 6.5) (Track B)
  + Inter prediction and MV coding (29) (section 6.6) (Track B|A)
  + Intra prediction and mode coding (20) (section 6.7) (Track B)
  + Loop filtering (8) (section 6.8) (Track B)
  + Reference picture resampling (4) (section 6.9) (Track B)
  + Quantization control (13) (section 6.10) (Track B)
  + Transforms and transform signalling (24) (section 6.11) (Track B)
  + Residual coding (11) (section 6.12) (Track B)
  + Entropy coding (3) (section 6.13) (Track B)
  + Partitioning (5) (section 6.14) (Track B)
  + Chroma formats and chroma related coding tools (22) (section 6.15) (Track B)
  + Lossless and near lossless coding (1) (section 6.16) (Track B)
  + Screen content coding tools (2) (section 6.17) (Track B)
  + 360 degree video (0) (section 6.18) (Track X)
  + AHG9: General high-level syntax (133) (section 6.19) (Track A)
  + AHG12: High-level parallelism and coded picture regions (53) (section 6.20) (Track A)
  + AHG8: Layered coding and resolution adaptation (19) (section 6.21) (Track A)
* Complexity analysis (3) (section 7) (Track B)
* Encoder optimization (2) (section 8) (Track B)
* Metrics and evaluation criteria (0) (section 9) (Track B)
* Withdrawn (13) (section 10) (Track none)
* Joint meetings, plenary discussions, BoG reports, Summary of actions (section 11)
* Project planning (section 12)
* Establishment of AHGs (section 13)
* Output documents (section 14)
* Future meeting plans and concluding remarks (section 15)

The document counts above do not include cross-checks and CE summary reports.

Track A (241) was generally chaired by GJS and Track B (246) by JRO.

# AHG reports (16)

These reports were discussed Tuesday 7 January 2020 during 1010-1215 (chaired by GJS) and Wednesday 8 January during 0940–1300 and 1430–XX (chaired by GJS and JRO), except as otherwise noted.

[JVET-Q0001](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9361) JVET AHG report: Project management (AHG1) [J.-R. Ohm, G. J. Sullivan]

This AHG report was discussed Wednesday 8 January 2020 at 0940 (chaired by GJS & JRO).

This document reports on the work of the JVET ad hoc group on Project Management, including an overall status report on the VVC standardization project and the progress made during the interim period since the preceding meeting.

The work of the JVET overall had proceeded well in the interim period with a huge number of input documents submitted to the current meeting. Intense discussion had been carried out on the group email reflector, and all output documents from the preceding meeting had been produced.

Output documents from the preceding meeting had been made available at the "Phenix" site (<http://phenix.it-sudparis.eu/jvet/>) or the ITU-based JVET site ([http://wftp3.itu.int/av-arch/jvet-site/2019\_10\_ P\_Geneva/](http://wftp3.itu.int/av-arch/jvet-site/2019_10_%20P_Geneva/)), particularly including the following:

* The meeting report (JVET-P2000) [Posted 2020-01-06]
* Versatile Video Coding (Draft 7) (JVET-P2001) [Posted 2019-10-12, last update 2019-11-13]
* Algorithm description for Versatile Video Coding and Test Model 7 (VTM 7) (JVET-P2002) [Posted 2019-11-10]
* Methodology and reporting template for coding tool testing (JVET-P2005) [Posted 2019-11-28]
* Supplemental enhancement information messages for coded video bitstreams (Draft 2) (JVET-P2007) [Posted 2019-10-31, last update 2019-11-15]
* Conformance testing for Versatile Video Coding (Draft 1) (JVET-P2008) [Posted 2019-11-28]
* JVET common test conditions and software reference configurations for HDR/WCG video (JVET-P2011) [Posted 2019-10-23]
* Description of CE 1..5 (JVET-P2021..25) [all first posted 2019-10-11/12, further updates during the CE definition period of 3 weeks after the meeting]. The following CE description documents had later updates (more than 4 weeks after the meeting):
  + - JVET-P2021 [last updated 2019-12-28]
    - JVET-P2022 [last updated 2019-11-21]
    - JVET-P2023 [last updated 2019-12-18]

The sixteen *ad hoc* groups had made progress, and reports from those activities had been submitted.

Software integration of VTM was finalized approximately according to the plan.

Various problem reports relating to asserted bugs in the software, draft specification text, and reference encoder description had been submitted to an informal "bug tracking" system. That system is not intended as a replacement of our ordinary contribution submission process. However, the bug tracking system was considered to have been helpful to the software coordinators and text editors. The bug tracker reports had been automatically forwarded to the group email reflector, where the issues were discussed – and this is reported to have been helpful.

Roughly 500 input contributions to the current meeting, not counting the AHG and CE summary reports and cross-checks, had been registered for consideration at the meeting. Almost half of these documents were submitted on aspects of high-level syntax, whereas submissions on low-level coding tools (including CEs) has significantly decreased.

A preliminary basis for the document subject allocation and meeting notes for the 17th meeting had been made publicly available on the ITU-hosted ftp site.

[JVET-Q0002](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9362) JVET AHG report: Draft text and test model algorithm description editing (AHG2) [B. Bross, J. Chen, J. Boyce, S. Kim, S. Liu, Y.-K. Wang, Y. Ye]

This AHG report was discussed Wednesday 8 January 2020 at 1000 (chaired by GJS & JRO).

This document reports the work of the JVET ad hoc group on draft text and test model algorithm description editing (AHG2) between the 16th meeting in Geneva, CH (1–11 October 2019) and the 17th meeting in Brussels, BE (7–17 January 2020).

At the 16th JVET meeting, it was decided to include additional coding features for intra picture-prediction, inter-picture prediction, transform, CABAC engine and in-loop filter in the seventh draft of Versatile Video Coding (VVC D7) and the VVC Test Model 7 (VTM7) encoding.

The normative decoding process for Versatile Video Coding is specified in the VVC draft 7 text specification document. The VVC Test Model 7 (VTM 7) Algorithm and Encoder Description document provides an algorithm description as well as an encoder-side description of the VVC Test Model 7, which serves as a tutorial for the algorithm and encoding model implemented in the VTM7.x software.

An issue tracker (<https://jvet.hhi.fraunhofer.de/trac/vvc>) was used to facilitate the reporting of errata with the VVC documents.

Fourteen versions of JVET-P2001 were published by the Editing AHG between the 16th meeting in Geneva, CH, (1–11 October 2019) and the 17th meeting in Brussels, BE, (7–17 January 2020).

An input document JVET-Q0041 had been prepared to provide integrations of a number of bug fixes reported in the bug tracking system as well as some other editorial changes made by the authors, based on the latest JVET output draft VVC text in JVET-P2001-vE.

The following reported issues had been reported and it seemed that fixing these issues was not straight-forward or that there are multiple ways to fix these. Input contributions that have been identified to be related to these issues are listed as well.

Please note that the following list represents what the editors had been aware of at the time of writing this report and was claimed to be complete.

#519 Mismatch with VTM on CU chroma QP offset enabling

JVET-Q0484 AHG9: HLS control of chroma QP offset

JVET-Q0576 AHG15: History of local chroma QP offsets

#659 CuQpOffset Reset

JVET-Q0126 Initializations and propagation of Chroma QP Offset

JVET-Q0267 AHG16: On Propagation of Chroma CU QP Offsets

JVET-Q0476 On chroma QP offsets for zero-CBF leading chroma coding blocks

JVET-Q0570 AHG15: Reset chroma QP offsets when starting a CTU

#786 JVET-P1001: Encoder / decoder deblocker mismatches for chroma QP

JVET-Q0474 AHG15: Defining QP at TU level

#783 RPR - Interpolation filters for chroma affine blocks.

JVET-Q0517 On RPR down-sampling filters for affine mode

JVET-Q0518 Mismatch between text specification and reference software on RPR chroma down-sampling for affine mode

#678 JVET-P1026 - DST-7/DCT-8 TUs with coefficients outside 16x16 region

JVET-Q0057 Coefficient group based restriction on MTS signaling

JVET-Q0055 On MTS index signalling

JVET-Q0136 Alignment of MTS index signalling condition with MTS zero-out

JVET-Q0196 MTS redundancy removal

JVET-Q0295 On residual coding for MTS

JVET-Q0430 AHG16: Syntax based MTS zero out

JVET-Q0448 MTS dependent coefficient subblock scanning for zero-out

JVET-Q0529 On LFNST index and MTS index signaling

#727 Wrong filter coefficient value specified for CCLM

#776 Mismatch on getting the down-sampled neighbouring top luma samples in CCLM for 4:2:2

JVET-Q0275 Suggested bugfixes for CCLM filtering in the VVC specification draft

*JVET-P2002 VVC Test Model 7 (VTM 7) Algorithm and Encoder Description*

One version of JVET-P2002 were published by the Editing AHG between the 16th meeting in Geneva, CH, (1–11 October 2019) and the 17th meeting in Brussels, BE, (7–17 January 2020).

JVET-P2002 has been established based on JVET-O2002. It provides the algorithm description for majority of coding tools in VVC. In this editing period, the following changes were included:

* Incorporated JVET-O0683: adaptive color transform
* Incorporated JVET-O1038: ALF boundary padding
* Incorporated JVET-P0505: Fixing non-linear ALF clipping values for 8-bit video
* Incorporated JVET-P0254: Fix number of LMCS segments to 32 regardless of bit depth
* Incorporated JVET-P0371: Signalling of corrective values for chroma residual scaling
* Remove bricks
* Add subpicture
* Incorporated JVET-P0325: Change the checking order of the first two spatial merge candidates
* Incorporated JVET-P0057: 1/32-pel precision of PROF motion refinement
* Incorporated JVET-P1023: Reference picture conditions in DMVR and BDOF

The AHG recommended to:

* Approve the edited JVET-P2001 and JVET-P2002 documents as JVET outputs,
* Continue to edit the VVC draft and Test Model documents to ensure that all agreed elements of VVC are fully described,
* Compare the VVC documents with the VVC software and resolve any discrepancies that may exist, in collaboration with the software AHG,
* Encourage the use of the issue tracker to report issues with the text of both the VVC specification draft and the algorithm and encoder description (helpful work by Allegro and Broadcom was mentioned),
* Continue to improve the editorial consistency of VVC WD and Test Model documents,
* Ensure that, when considering the addition of new feature to VVC, properly drafted text for addition to the VVC Test Model and/or the VVC Working Draft is made available in a timely manner.
* Use the the editorial input and fixes for VVC draft 7 in JVET-Q0041 as the basis for integration of adoptions of the 17th JVET meeting. This was reviewed and agreed.

[JVET-Q0003](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9363) JVET AHG report: Test model software development (AHG3) [F. Bossen, X. Li, K. Sühring]

This AHG report was discussed Wednesday 8 January 2020 at 1020 (chaired by GJS & JRO).

This report summarizes the activities of the AhG3 on Test model software development that had taken place between the 16th and 17th JVET meetings.

*VTM software development*

Development was continued on the GitLab server, which allows participants to register accounts and use a distributed development workflow based on git.

The server is located at:

<https://vcgit.hhi.fraunhofer.de>

The registration and development workflow is documented at:

<https://vcgit.hhi.fraunhofer.de/jvet/VVCSoftware_VTM/wikis/VVC-Software-Development-Workflow>

The VTM software can be found at

<https://vcgit.hhi.fraunhofer.de/jvet/VVCSoftware_VTM/>

VTM 6.2 was tagged on Oct. 19, 2019. Changes related to VTM 6.1 were listed in the AHG report.

The version number was increased to VTM 6.3 on Oct. 15, but the tag was only created on Jan. 7. This version removed the previous meeting cycle’s excess macros.

After one release candidates, VTM 7.0 was tagged on Nov. 13, 2019. Changes related to VTM 6.3 were listed in the AHG report.

VTM 7.1 was tagged on Dec 6, 2019. The tag was made on request by AHG13 for testing ACT, which had not been included in VTM 7.0. Changes in this version were listed in the AHG report.

Particularly noted aspects of this version were:

* Fix to low-delay P configuration
* Refinement of LMCS offset in configuration in intra and low-delay B configurations

VTM 7.2 was expected to be tagged during the 17th JVET meeting. Changes so far for that version were listed in the AHG report.

The following tables show **VTM 7.0** performance over **HM 16.20**:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | **All Intra** |  |  |
|  |  |  | **Over HM 16.20** |  |  |
|  | Y | U | V | EncT | DecT |
| Class A1 | -28.27% | -33.55% | -33.95% | 1635% | 173% |
| Class A2 | -27.97% | -20.66% | -12.93% | 2664% | 182% |
| Class B | -21.27% | -20.04% | -27.35% | 2916% | 184% |
| Class C | -22.00% | -19.82% | -23.88% | 4102% | 184% |
| Class E | -25.40% | -21.93% | -26.55% | 2364% | 166% |
| **Overall** | -24.40% | -22.66% | -25.14% | 2717% | 179% |
| Class D | -17.82% | -13.97% | -15.50% | 4532% | 187% |
| Class F | -38.93% | -39.38% | -41.87% | 4825% | 180% |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | **Random access** |  |  |
|  |  |  | **Over HM 16.20** |  |  |
|  | Y | U | V | EncT | DecT |
| Class A1 | -37.33% | -40.26% | -45.92% | 830% | 173% |
| Class A2 | -41.50% | -39.26% | -33.53% | 937% | 192% |
| Class B | -33.99% | -43.21% | -44.37% | 884% | 169% |
| Class C | -28.60% | -34.73% | -36.68% | 1153% | 195% |
| Class E |  |  |  |  |  |
| **Overall** | -34.73% | -39.57% | -40.46% | 948% | 181% |
| Class D | -26.30% | -30.81% | -31.55% | 1224% | 230% |
| Class F | -40.43% | -46.25% | -47.51% | 647% | 158% |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | **Low delay B** |  |  |
|  |  |  | **Over HM 16.20** |  |  |
|  | Y | U | V | EncT | DecT |
| Class A1 |  |  |  |  |  |
| Class A2 |  |  |  |  |  |
| Class B | -29.83% | -32.71% | -33.55% | 770% | 167% |
| Class C | -27.54% | -27.83% | -28.88% | 915% | 190% |
| Class E | -31.24% | -38.55% | -40.10% | 404% | 157% |
| **Overall** | -29.42% | -32.54% | -33.63% | 694% | 172% |
| Class D | -24.44% | -22.74% | -24.33% | 970% | 246% |
| Class F | -41.43% | -44.49% | -46.18% | 519% | 155% |

The following tables show **VTM 7.0** performance compared to **VTM 6.2**:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | **All Intra** |  |  |
|  |  |  | **Over VTM 6.2** |  |  |
|  | Y | U | V | EncT | DecT |
| Class A1 | -0.18% | -0.14% | -0.44% | 107% | 100% |
| Class A2 | -0.13% | 0.12% | 0.16% | 107% | 99% |
| Class B | -0.20% | -0.20% | -0.05% | 102% | 103% |
| Class C | -0.24% | -0.07% | 0.11% | 102% | 99% |
| Class E | -0.28% | -0.76% | -1.20% | 101% | 102% |
| **Overall** | -0.21% | -0.20% | -0.23% | 104% | 101% |
| Class D | -0.08% | 0.57% | 0.31% | 98% | 99% |
| Class F | 0.08% | 0.14% | -0.01% | 112% | 103% |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | **Random access** |  |  |
|  |  |  | **Over VTM 6.2** |  |  |
|  | Y | U | V | EncT | DecT |
| Class A1 | 0.01% | -3.12% | -2.57% | 96% | 100% |
| Class A2 | 0.27% | -1.35% | -1.64% | 97% | 104% |
| Class B | 0.01% | -2.64% | -2.08% | 95% | 101% |
| Class C | 0.11% | -2.87% | -2.69% | 103% | 116% |
| Class E |  |  |  |  |  |
| **Overall** | 0.09% | -2.54% | -2.25% | 98% | 105% |
| Class D | 0.24% | -1.73% | -1.82% | 96% | 131% |
| Class F | 0.51% | -1.58% | -1.23% | 102% | 112% |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | **Low delay B** |  |  |
|  |  |  | **Over VTM 6.2** |  |  |
|  | Y | U | V | EncT | DecT |
| Class A1 |  |  |  |  |  |
| Class A2 |  |  |  |  |  |
| Class B | -3.58% | -2.98% | -2.95% | 92% | 111% |
| Class C | -5.64% | -5.62% | -4.57% | 89% | 118% |
| Class E | -7.37% | -10.25% | -9.60% | 93% | 128% |
| **Overall** | -5.21% | -5.68% | -5.15% | 91% | 117% |
| Class D | -3.60% | -4.00% | -3.81% | 94% | 140% |
| Class F | -4.83% | -3.58% | -3.92% | 99% | 126% |

The following tables show **VTM 7.1** performance compared to **VTM 7.0**:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | **All Intra** |  |  |
|  |  |  | **Over VTM 7.0** |  |  |
|  | Y | U | V | EncT | DecT |
| Class A1 | 0.14% | -1.78% | -1.48% | 98% | 100% |
| Class A2 | 0.17% | -2.09% | -2.05% | 98% | 96% |
| Class B | 0.11% | -1.64% | -1.65% | 99% | 101% |
| Class C | 0.13% | -1.37% | -1.35% | 99% | 97% |
| Class E | 0.10% | -1.49% | -1.20% | 98% | 97% |
| **Overall** | 0.13% | -1.65% | -1.55% | 99% | 98% |
| Class D | 0.04% | -1.38% | -1.29% | 98% | 94% |
| Class F | 0.14% | -0.82% | -0.81% | 100% | 100% |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | **Random access** |  |  |
|  |  |  | **Over VTM 7.0** |  |  |
|  | Y | U | V | EncT | DecT |
| Class A1 | 0.03% | 0.03% | 0.03% | 101% | 101% |
| Class A2 | 0.03% | 0.03% | 0.03% | 100% | 101% |
| Class B | 0.07% | 0.07% | 0.07% | 101% | 96% |
| Class C | 0.15% | 0.14% | 0.14% | 102% | 99% |
| Class E |  |  |  |  |  |
| **Overall** | 0.07% | 0.07% | 0.07% | 101% | 99% |
| Class D | 0.40% | 0.40% | 0.41% | 101% | 100% |
| Class F | 0.16% | 0.20% | 0.22% | 101% | 104% |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | **Low delay B** |  |  |
|  |  |  | **Over VTM 7.0** |  |  |
|  | Y | U | V | EncT | DecT |
| Class A1 |  |  |  |  |  |
| Class A2 |  |  |  |  |  |
| Class B | 0.10% | -0.99% | -0.56% | 102% | 100% |
| Class C | 0.25% | -0.86% | -0.64% | 104% | 99% |
| Class E | 0.72% | -0.45% | -0.54% | 99% | 98% |
| **Overall** | 0.31% | -0.81% | -0.58% | 102% | 99% |
| Class D | 0.51% | -0.28% | -0.86% | 101% | 97% |
| Class F | 0.59% | -0.17% | 0.57% | 101% | 97% |

Full results are attached to the AHG report as Excel files.

Several issues were encountered during software development:

* + An issue was identified regarding text and software integration of JVET-N0278 “On VVC HLS relevant to MPEG requirements on immersive media delivery and access”, and the proponents’ expectations of what needed to be integrated. Draft 5 version 1 integrated the exact text of JVET-N0278, which defines an input filter in the decoder that removes all layers except the target layer (LIdTarget). Software was provided implementing this filter into VTM. Later, in Draft 5 version 4 “fixes for JVET-N0278” were integrated that refer to layers in multiple locations of the specification, including definitions, reference picture list construction, and constraints on different NAL unit types. These changes are likely borrowed from layered HEVC, but not required in the case where a decoder would see only one specific value of nuh\_layer\_id. Proponents modified these editorially added constraints later on in the Gothenburg meeting. They expected the original constraints to be implemented in software. Also, for the implementation of scalable coding, proponents expected that the software would already contain some infrastructure for multi-layer coding, which did not exist. This issue still caused problems because proponents of JVET-O1159 “Scalability for VVC – Text for approach 1” did not feel responsible for implementing multi-layer infrastructure into the software. The implementation was seen as “volunteer work”, and the software coordinator requests regarding software quality and documentation were initially dismissed.

Substantial work on the multi-layer software functionality was done by V. Seregin and Y. He. The software for JVET-O1159, other than aspects replaced later by a different proposal, was said to have been completed. Integration of scalability adoptions from the last meeting was still pending.

It was commented that having config files for some use cases is needed so that the software can be tested effectively and regressions can be identified in a timely manner.

V. Seregin said that DPB management aspects were pending integration.

* + A side discussion was opened on the licensing terms for the software manual. The manual uses the same header as other JVET documents, including a list of authors (which are rather editors as for the standard document). One individual claimed that he could not add to that document because of that authors list. It was also asked, if the document should be BSD licensed as the software. There is no explicit license statement in the document, although it resides in a folder of the software, which contains a BSD style license statement. No such problems were brought up in previous meeting cycles. It also seems to be no problem to contribute to the standard document, which also has a list of authors/editors. These issues need to be clarified.

In the JVET review, it was agreed that the header should identify the named people as editors rather than authors. As a group-prepared output, copyright on the output document is understood to belong to ITU-T/ISO/IEC. People responsible for contributing to the software are understood to also be responsible for contributing to the relevant aspects of the manual as well. New parameters (or modified behaviour of existing parameters) need to be described in the manual.

There are some gaps in the manual that need to be filled – e.g., for ALF. (V. Seregin volunteered to help for ALF.)

Revisit for identifying additional aspects needing help and arranging volunteers.

* + After merging MR 1048 that addresses issue #561 on RPR clipping and padding, the runtime of the VTM 7.0 decoder was noticeably increased. The issue turned out to be related to MAX\_SCALING\_RATIO being set to 8, leading to excessive padding of reference pictures. Setting MAX\_SCALING\_RATIO to 2 (which is the maximum RPR downsampling ratio) alleviates the problem. Two related tickets were opened on this issue. It was further suggested to modify the motion compensation implementation to operate on smaller blocks to avoid large padded areas.
  + The coordinators wished to clarify that their comments on merge requests have been made to ensure high quality and usability of the software. They have commonly requested fixes to coding style (as defined in software guidelines) and documentation for newly added configuration parameters. They also commonly ask for clarification if the don’t understand something, and if they sense that something is missing or could be improved, if the impact of a change on coding efficiency is unclear, or if they are unable to determine whether submitted software matches meeting agreements. They reported that they don’t intend to prevent the inclusion of meeting agreements into the software.

At the beginning of the 17th meeting, JVET-O1143 subpicture aspects were partially implemented:

For the following implementations, issues reportedly remained:

* + JVET-O0145/JVET-O0215: The number of entry points is derived instead of being signalled. For this the number of bricks needs to be known in the slice header. The software needs to be restructured to allow derivation of the slice/tile/brick related variables within the slice header parsing process. An initial version of the code has been merged, but disabled.
  + JVET-O0042: The syntax was included with JVET-O0041, but no configuration options exist for frame repetitions. Also, the decoder does not repeat frames.

The following proposals have pending merge requests:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | Notes from the previous meeting |  |
| General | unavailable reference pictures and max\_dec\_pic\_buffering\_minus1 | clarification | JVET-P0184 | !1201 | See notes for HLS BoG report JVET-P0968 | S. Deshpande |
| Intra prediction | Cleanup of reference sample padding for intra prediction | optional editorial improvement | JVET-P0626 | !1096 | just editorial cleanup, it should be up to the editors to decide |  |

Regarding the merge request for JVET-P0626, it was reported that the text change had a problem, as it refers to a list entry that has not been set to value. The editor was asked to correct this. There appeared to be no need for the corresponding software change.

The following proposals had not been implemented:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **HLS** |  |  |  |  | Notes from the previous meeting |  |
| Profile |  | Functionality | Profiles, tiers and levels | JVET-P0894 | Decision: Adopt, but with a maxDpbPicBuf of 8 rather than 7 (see notes for P0133). | J. Boyce |
| Parameter sets | VUI | Conformance | Constraining the maximum number of bits for a CU or CTU | JVET-P0188 | Decision: It was agreed to establish a picture-level constraint the same as in HEVC (using MinCR as a function of timing). | T. Suzuki |
| RPL | Constraints | expression of existing intent |  | JVET-P0978 | See notes for HLS BoG report JVET-P0968 | M. Pettersson |
| Scalability | ilrp\_idc and DirectDependentLayerIdx | expression of existing intent |  | JVET-P0221, JVET-P0589 | See notes for HLS BoG report JVET-P0968 | B. Choi |
| APS | ALF APS constraints | cleanup unnecessary constraints | Remove some ALF APS constraints | JVET-P0122 | See notes for HLS BoG report JVET-P0968 | Y.-K. Wang, X. Ma, R. Chernyak |
| SEI | self\_contained\_cvs\_flag | cleanup |  | JVET-P0359 | See notes for HLS BoG report JVET-P0968 | R. Sjöberg |
| SEI | Omnidirectional video | enhanced vs. HEVC based on prior work in JVET | Add a new SEI message on omnidirectional video | JVET-P0597 | See notes for HLS BoG report JVET-P0968 | Y.-H. Lee |
| Subpictures | Boundary treating | BF |  | JVET-P0378, JVET-P0572 | See notes for HLS BoG report JVET-P0968 | K. Zhang |
| Scalability | General decoding process | consequence of agreement on OLS decoding concept |  | JVET-P0115 | See notes for HLS BoG report JVET-P0968 | Y.-K. Wang, X. Ma, R. Chernyak |
| Scalability | PTL | consequence of agreement on OLS decoding concept |  | JVET-P0117 | See notes for HLS BoG report JVET-P0968 | Y.-K. Wang, X. Ma, R. Chernyak |
| Scalability | HRD | consequence of agreement on OLS decoding concept | HRD signalling and process | JVET-P0118 | See notes for HLS BoG report JVET-P0968 | Y.-K. Wang, X. Ma, R. Chernyak |
| Scalability | HRD | consequence of agreement on OLS decoding concept | Scalable nesting SEI message | JVET-P0190 | See notes for HLS BoG report JVET-P0968 | Y.-K. Wang, X. Ma, R. Chernyak |
| NUH | Tid and Lid | expression of existing intent | Constraints and rules on values of TemporalId and nuh\_layer\_id | JVET-P0125 | See notes for HLS BoG report JVET-P0968 | Y.-K. Wang, X. Ma, R. Chernyak |
| SEI | General SEI constraints | consequence of agreement on OLS decoding concept |  | JVET-P0125 | See notes for HLS BoG report JVET-P0968 | Y.-K. Wang, X. Ma, R. Chernyak |
| VPS | Single layer bitstreams | expression of existing intent |  | JVET-P0097, JVET-P0205 | When sps\_video\_parameter\_set\_id is equal to 0, it is a requirement for bitstream conformance that there shall be only a single layer in the bitstream. | M. M. Hannuksela |
| Scalability | Random access | layered coding support simpler than in SHVC | POC for independent layers | JVET-P0116 | See notes for HLS BoG report JVET-P0968 | Y.-K. Wang, X. Ma, R. Chernyak |
| Scalability | Random access | layered coding support simpler than in SHVC | POC for dependent layers | JVET-P0101 | See notes for HLS BoG report JVET-P0968 | M. M. Hannuksela |
| Scalability | Random access | layered coding support simpler than in SHVC | IRAP AU | JVET-P0116 | Each IRAP AU is complete (i.e., there is a picture in each layer present in the CVS) and all pictures in an IRAP AU are IRAP pictures with the same NAL unit type. | Y.-K. Wang, X. Ma, R. Chernyak |
| HRD | Sub-bitstream extraction | existing design intent for extraction process | Keep DPS, VPS, and EOB in extraction | JVET-P0098 | See notes for HLS BoG report JVET-P0968 | M. M. Hannuksela |
| Scalability | EOS | existing design intent esp. for independent layers | Specify EOS NUTs to be layer specific | JVET-P0125 | See notes for HLS BoG report JVET-P0968 | Y.-K. Wang, X. Ma, R. Chernyak |
| Scalability | Output layers and pictures | expression of existing intent | Clarification to the bullet items in setting of PicOutputFlag | JVET-P0097 | See notes for HLS BoG report JVET-P0968 | M. M. Hannuksela |
| Subpictures | Extraction and merging | extraction/merge functionality | Mixed IRAP/non-IRAP VCL NALUs within a picture | JVET-P0124, P0095, P0222 | See notes for HLS BoG report JVET-P0968 | Y.-K. Wang, X. Ma, R. Chernyak |
| Tiles and slices |  | cleanup | Refinement that avoids sending an unnecessary syntax element for the last slice under some circumstance | JVET-P1012 | See notes for HLS BoG report JVET-P0968 | W. Lim |
| Subpictures |  | cleanup | Signalling of subpicture layout | JVET-P0171 | See JVET meeting notes | J. Li |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Software** |  |  |  |  |
| RPL | Bug fix | bugfix of SPS flags and reference picture list structure | JVET-P0235 | The text problem has already been fixed in P0113. Decision (SW): The software bug also needs fixing |

Revisit for scheduling of the integration effort.

*Software manual*

Possible license issues (as reported above) were requested to be clarified.

Many parameters still have their outdated HEVC documentation and need to be updated. Other parameters for VVC tools are completely missing.

To make the software manual a valuable document, those missing parts need to be added.

See notes above regarding this issue.

*CE software*

For each CE, a group was created in GitLab and CE coordinators were given owner rights to the group. This way they could clone VTM as required, create branches for different tests and assign user access to the group themselves.

The CE development workflow is described at:

<https://vcgit.hhi.fraunhofer.de/jvet/VVCSoftware_VTM/wikis/Core-experiment-development-workflow>

CE read access is available using shared accounts: One account exists for MPEG members, which uses the usual MPEG account data. A second account exists for VCEG members with account information available in the TIES system at:

<https://www.itu.int/ifa/t/2017/sg16/exchange/wp3/q06/vceg_account.txt>

The bug tracker for VTM and specification text is located at:

<https://jvet.hhi.fraunhofer.de/trac/vvc>

The bug tracker uses the same accounts as the HM software bug tracker. Users may need to log in again due to the different sub-domain. For spam fighting reasons account registration is only possible at the HM software bug tracker at

<https://hevc.hhi.fraunhofer.de/trac/hevc>

Please file all issues related to the VVC reference software into the bug tracker. Try to provide all the details, which are necessary to reproduce the issue. Patches for solving issues and improving the software are always appreciated.

The AHG recommended to:

* Continue to develop the VTM reference software
* Improve documentation, especially the software manual
* Resolve any normative issues resulting from the large number of integrations in the most recent development cycle
* Encourage people to test VTM software more extensively outside of common test conditions.
* Encourage people to report all (potential) bugs that they are finding.
* Encourage people to submit bit-streams/test cases that trigger bugs in VTM.
* Encourage people to submit non-normative changes that reduce encoder run time without significantly sacrificing compression performance
* Make sure that contributions considered for adoption in the future are subject to adequate text and software review by the JVET at large
* Design and add configuration files to the VTM software for testing of HLS features. See the notes above regarding this issue.

[JVET-Q0004](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9364) JVET AHG report: Test material and visual assessment (AHG4) [V. Baroncini, T. Suzuki, M. Wien, R. Chernyak, A. Norkin]

This AHG report was discussed Wednesday 8 January 2020 at 1215 (chaired by GJS & JRO).

The test sequences used for CfP/CTC are available on <ftp://jvet@ftp.ient.rwth-aachen.de> in directory “/jvet-cfp” (accredited members of JVET may contact the JVET chairs for login information).

Due to copyright restrictions, the JVET database of test sequences is only available to accredited members of JVET (i.e. members of ISO/IEC MPEG and ITU-T VCEG).

In the last meeting, a modified directory structure was approved as follows.

* ctc/ Contains the active test set of the common testing conditions
* ahg/ Contains subdirectories with sequences under consideration.
* ce/ Contains subdirectories for data exchange for specific CE
* jvet-cfe/ The sequences used for CfE
* jvet-cfp/ The sequences used for CfP
* old/ Contains the JEM bitstreams directory, used before the CfP
* upload Stays as before

In the CTC directory, following subdirectories have been created:

* ctc/360/
* ctc/hdr/
* ctc/scc/
* ctc/sdr/

No related contributions were submitted

The AHG recommended to continue to collect new test sequences available for JVET with licensing statement.

It was commented that a late contribution would be provided, offering 8K 60 fps test sequences under a Creative Commons license. It was commented that these could be helpful as verification test source material and for preparation of conformance test bitstreams.

[JVET-Q0005](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9365) JVET AHG report: Conformance testing (AHG5) [J. Boyce, W. Wan, E. Alshina, I. Moccagatta, K. Kawamura, S. McCarthy, K. Sühring]

This AHG report was discussed Wednesday 8 January 2020 at 1225 (chaired by GJS & JRO).

This document summarizes the activity of AHG5: “Conformance testing” between the 16th Meeting in Geneva, CH (1–11 Oct 2019) and the 17th Meeting in Brussels, BE (7–17 Jan 2020).

At the 16th JVET meeting (October 2019) the following preliminary timeline had been agreed on:

* 17th meeting Jan. 2020: Preliminary guidelines for bitstream preparation (e.g., naming conventions), improved list of conformance bitstreams
* 18th meeting Apr. 2020: Final guidelines for bitstream preparation and improved list of conformance bitstreams with identified responsible experts, initial bitstreams provided
* 19th meeting July 2020: Confirmed list of bitstreams to be included in v1, collection of bitstream  
  candidates for CD ballot at next meeting
* 20th meeting Oct. 2020: CD of conformance specification
* 21st meeting Jan. 2021: Final bitstreams provided, DIS ballot in ISO/IEC at 22nd meeting
* April 2021: No action pending DIS ballot
* 23rd meeting July 2021: Final conformance specification

Output document JVET-P2008 “Conformance testing for versatile video coding (Draft 1)” published on November 28th, 2019.

The regular JVET e-mail reflector was used for discussions ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de)).

The AHG chairs sent 2 emails on the JVET e-mail reflector to solicit volunteers to generate the streams listed in tables in the conformance testing draft.

Huawei, InterDigital, Ericsson, Samsung, KKDI, HHI, Dolby, Futurewei, MediaTek, LGE, and Panasonic volunteered to create conformance streams, and provided names of volunteers who will generate the streams. In addition, feedback was provided by email to improve the conformance testing draft.

After the publication of the first draft of [JVET-P2008](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8861), the following companies volunteered to create conformance streams in the follow categories:

* Nokia (J. Lainema) for IP (Intra Prediction) and JCCR (Joint coding of chroma residuals)
* Tencent (Xiaozhong Xu) for IBC (Intra block copy mode)
* Mediatek (Jian-Liang Li) for loop filters on/off at virtual boundaries
* Bytedance (Na) for Subblock-based temporal merging candidates

The status at the start of the 17th JVET meeting was as follow:

* 81 bitstream categories have been identified
* VTM SW support is needed to output the log file specified in section 2.4 of [JVET-P2008](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8861), and described as follows:
  + Per picture in output order: Picture width, picture height, MD5sum for each of Y, U, and V
  + Each output picture log file contains one row for each output picture in the bitstream, in output order.
  + Each row contains the following information, as CSV.
    - PicOrderCntVal
    - pic\_width\_max\_in\_luma\_samples
    - pic\_height\_max\_in\_luma\_samples
    - MD5 checksum for the Y component
    - MD5 checksum for the U component
    - MD5 checksum for the V component
* Volunteers have been identified to generate 51/81 streams (63%)
* Volunteers are needed for the following tools / features:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Categories** | **Tool description** | **Feature name** | **Bitstream features** | **Submitter** |
| All | Tool set 0 | SET0 | Basic set, with all tools with enable flags disabled |  |
| All | Tool set 1 | SET1 | ???? |  | |
| All | Tool set 2 | SET2 | SET1 + ???? |  | |
| All | Tool set 3 | SET3 | SET2 + ???? |  | |
| CTU partition | CTC tool set | SETCTC | All tools enabled in CTC version X |  | |
| Intra coding | Quantized residual DPCM | RDPCM |  |  | |
| Inter coding | Temporal motion vector predictor | TMVP |  |  | |
| In-loop filter | Adaptive loop filter | ALF | Use multiple APSes |  | |
| Transform and quantization | Transform |  | min and max transform |  | |
|  |  |  | min number of entropy coded coeff. |  | |
|  |  |  | max number of coeff. |  | |
| Entropy coding | Entropy coding |  | max bins and bits |  | |
|  |  |  | min bits |  | |
| Inter coding | All merge modes |  | max number of merge candidates |  | |
| Intra coding | Position dependent prediction combination (PDPC) |  | Force clipping. Different PU sizes and shapes. |  | |
| SCC coding | Palette mode |  | For 4:4:4 |  | |
| SCC coding | Adaptive Color Transform | ACT | For 4:4:4 |  | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tool description** | | **Feature name** | **Bitstream features** | **Submitter** |
| Tile rows / columns |  | pictures partitions in tiles, bricks and slices |  | |
|  | Different tile sizes in same picture |
|  | loop filters on/off |
| Reference picture resizing |  |  |  | |
| Ref pic wrap-around |  |  |  | |
| Temporal scalability |  |  |  | |
| 360 Video w/ cube map layout and SEI |  |  |  | |
| 360 Video bitstream created using sub-picture extraction & merging |  |  |  | |
| Wavefronts |  |  |  | |
| Conformance cropping window |  |  |  | |
| NAL unit type |  | Exercise all types, including STSA and random access |  | |

|  |  |  |  |
| --- | --- | --- | --- |
| **Tool description** | **Feature** | **Bitstream features** | **Submitter** |
| **Name** |
| 8b 4:0:0 |  | Main 10 profile |  |
| 8b 4:2:0 |  | Main 10 profile |  |
| 8b 4:2:2 |  | Main 4:4:4 10 profile |  |
| 8b 4:4:4 |  | Main 4:4:4 10 profile |  |
| 10b 4:0:0 |  | Main 10 profile |  |
| 10b 4:2:2 |  | Main 4:4:4 10 profile |  |
| 10b 4:4:4 |  | Main 4:4:4 10 profile |  |

The procedure to exchange the bitstream (ftp cite, bitstream files, etc.) is specified in Sec 2 “Procedure” of [JVET-P2008](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8861). As a reminder, the ftp site at ITU-T is used to exchange bitstreams. The ftp site for downloading bitstreams is

<ftp://ftp3.itu.int/jvet-site/bitstream_exchange/>

The files can also be read via http at:

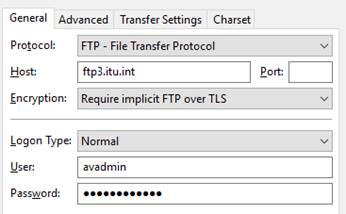
<http://wftp3.itu.int/av-arch/jvet-site/bitstream_exchange/>

The ftp site for uploading bitstream file is as follows.

<ftp://ftp3.itu.int/jvet-site/dropbox/>

(user id: avguest, p w: Avguest201007)

For access to the ftp site, using FileZilla with the following configuration in the Site manager settings (not accessing directly without using the Site manager) is suggested:



The following related contribution was noted: JVET-Q0479 Updates to conformance testing for versatile video coding [I. Moccagatte, J. Boyce (Intel)]

The AHG recommends the following:

* Review related input contributions
* Discuss and refine the list of conformance bitstreams
* Identify contributors for all identified bitstreams
* Develop a plan to implement the VTM software to output the logfile
* Identify a volunteer to submit initial bitstreams, to test the process

A. Fillipov volunteered to implement the log file output into the VTM software.

BoG and revisit were planned for identifying additional volunteered contributions.

[JVET-Q0006](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9366) JVET AHG report: 360° video coding tools, software and test conditions (AHG6) [J. Boyce, Y. He, K. Choi, J.-L. Lin, Y. Ye]

This AHG report was discussed Wednesday 8 January 2020 at 1255 (chaired by GJS & JRO).

The document summarizes activities on 360-degree video content coding between the 16th (1–11 Oct. 2019) and the 17th (7–17 Jan. 2020) JVET meetings.

The 360Lib-10.0 software package was released on Dec. 3, 2019, and included following changes:

* FishEye projection format from JCTVC-AE1005 was integrated;
* Generalized cubemap projection format from JVET-P0597 was integrated;
* Adding encoding configuration files for two new projection formats;
* Updating configuration files for format conversion between different formats;
* Updating the software manual document.

The 360Lib software is developed using a Subversion repository located at:

<https://jvet.hhi.fraunhofer.de/svn/svn_360Lib/>

The released version of 360Lib-10.0 can be found at:

<https://jvet.hhi.fraunhofer.de/svn/svn_360Lib/tags/360Lib-10.0/>

360Lib-10.0 testing results can be found at:

[ftp.ient.rwth-aachen.de/ahg/testresults/360Lib-10.0](ftp://ftp.ient.rwth-aachen.de/ahg/testresults/360Lib-10.0)

360Lib bug tracker

<https://hevc.hhi.fraunhofer.de/trac/jem/newticket?component=360Lib>

360Lib-10.0 results were reported as follows.

The first table below is for the projection formats comparison using VTM-7.0 according to 360-degree video CTC (JVET-L1012). It compares padded hybrid equi-angular cubemap (PHEC) coding and padded equi-rectangular projection (PERP) coding using VTM-7.0.

The second table is for PERP coding comparison between VTM-7.0 and HM-16.16. The third table below is to compare PHEC coding with VTM-7.0 with and CMP coding with HM-16.16.

**VTM-7.0 PHEC vs PERP (PERP as anchor)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **PHEC over PERP (VTM-7.0)** | | | | | |
|  | **End-to-end WS-PSNR** | | | **End-to-end S-PSNR-NN** | | |
|  | Y | U | V | Y | U | V |
| Class S1 | -11.71% | -6.95% | -7.51% | -11.61% | -6.85% | -7.44% |
| Class S2 | -5.34% | -1.70% | -1.80% | -5.31% | -1.62% | -1.73% |
| **Overall** | -9.16% | -4.85% | -5.23% | -9.09% | -4.76% | -5.16% |

**VTM-7.0 PERP vs HM-16.16 PERP (HM-16.16 PERP as anchor)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **VTM-7.0 PERP - Over HM-16.16 PERP** | | | | | |
|  | **End-to-end WS-PSNR** | | | **End-to-end S-PSNR-NN** | | |
|  | Y | U | V | Y | U | V |
| Class S1 | -25.07% | -40.90% | -43.34% | -25.07% | -40.92% | -43.31% |
| Class S2 | -34.68% | -41.56% | -43.89% | -34.67% | -41.59% | -43.93% |
| **Overall** | -28.91% | -41.17% | -43.56% | -28.91% | -41.19% | -43.56% |

**VTM-7.0 PHEC vs HM-16.16 CMP (HM-16.16 CMP as anchor)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **VTM-7.0 PHEC - Over HM-16.16 CMP** | | | | | |
|  | **End-to-end WS-PSNR** | | | **End-to-end S-PSNR-NN** | | |
|  | Y | U | V | Y | U | V |
| Class S1 | -29.52% | -42.64% | -44.69% | -29.41% | -42.61% | -44.66% |
| Class S2 | -37.39% | -44.13% | -46.27% | -37.38% | -44.13% | -46.29% |
| **Overall** | -32.67% | -43.23% | -45.32% | -32.60% | -43.22% | -45.31% |

There were 10 input documents noted as related to signalling syntax for 360-degree video coding, which are listed below.

* JVET-Q0134 AHG8: Disabling reference wraparound for reference picture resampling [B. Heng, P. Chen, T. Hellman, W. Wan, M. Zhou (Broadcom)]
* JVET-Q0184 AHG9: On signalling of wrap-around motion compensation [C.-Y. Chiu, C.-C. Chen, C.-W. Hsu, L. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]
* JVET-Q0212 [AHG9/AHG12] On sub-picture wrap around signaling [Y. He, A. Hamza (InterDigital), B. Choi, S. Wenger (Tencent)]
* JVET-Q0238 AHG8/AHG9: On reference picture wraparound [M. M. Hannuksela (Nokia)]
* JVET-Q0287 AHG9: On wrap-around motion compensation [B. Choi, S. Wenger, S. Liu (Tencent)]
* JVET-Q0316 AHG9: On signaling of the wraparound offset [K. Zhang, L. Zhang, Y.-K. Wang, H. Liu, J. Xu, Z. Deng (Bytedance)]
* JVET-Q0335 AhG9: On the wraparound offsets [Y.-J. Chang, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]
* JVET-Q0343 AHG6/AHG9: Signalling guard band type for generalized cubemap projection [Y.-H. Lee, J.-L. Lin, Y.-J. Chen, C.-C. Ju (MediaTek)]
* JVET-Q0344 AHG6/AHG9: Signalling wrap-around for subpictures [Y.-H. Lee, J.-L. Lin, Y.-J. Chen, C.-C. Ju (MediaTek)]
* JVET-Q0345 AHG6/AHG9: Signalling EAP via the ERP SEI message [Y.-H. Lee, J.-L. Lin, Y.-J. Chen, C.-C. Ju (MediaTek)]

The AHG recommended:

* To review input contributions
* To continue software development of the 360Lib software package.
* To generate CTC VTM anchors according to 360 video CTC, and provide the reporting template for the common test conditions.

[JVET-Q0007](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9367) JVET AHG report: Coding of HDR/WCG material (AHG7) [A. Segall, E. François, W. Husak, S. Iwamura, D. Rusanovskyy]

This AHG report was discussed Wednesday 8 January 2020 at 1305 (chaired by GJS & JRO).

This document summarizes the activity of AHG7: Coding of HDR/WCG Material between the 16th meeting in Geneva, CH (1–11 October 2019) and the 17th meeting in Brussels, BE (7–17 January 2020).

The AHG used the main JVET reflector, [jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de), with an [AHG7] indication on message headers. Only a couple of messages were sent in this manner. The primary activity of the AhG was related to the mandates of (i) generating CTC anchor for the VTM according to JVET-P2011 and (ii) comparing the performance of the VTM for HDR/WCG content. This work is described in the following subsection.

The AhG generated CTC anchors for the VTM according to JVET-P2011. The performance of the anchors was reported to the reflector on December 3, 2019. A summary of the performance is provided below, and more detailed information may be found in the included XLS data.

It was observed that the bit-allocation between luma and chroma in the HDR configuration changed between the two releases of the VTM – especially for Class H1. This is likely due to the change in the chroma table mapping function adopted into VTM 6, as well as the merge of request 857 (discussed later).

VTM 7.0 versus VTM 6.0

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra** | | | | | | | | | |
|  | **Over VTM-6.0** | | | | | | | | | |
|  |  |  | **wPSNR** | | | **PSNR** | | |  |  |
|  | DE100 | PSNR-L100 | Y | U | V | Y | U | V | EncT | DecT |
| Class H1 | 17.89% | -3.92% | -3.61% | 24.85% | 74.26% | -2.16% | 27.76% | 86.34% | 97% | 94% |
| Class H2 |  |  |  |  |  | -0.17% | -0.30% | -0.18% | 101% | 92% |
| **Overall** | 17.89% | -3.92% | -3.61% | 24.85% | 74.26% | -1.44% | 17.56% | 54.88% | 99% | 93% |
|  |  |  |  |  |  |  |  |  |  |  |
|  | **Random Access** | | | | | | | | | |
|  | **Over VTM-6.0** | | | | | | | | | |
|  |  |  | **wPSNR** | | | **PSNR** | | |  |  |
|  | DE100 | PSNR-L100 | Y | U | V | Y | U | V | EncT | DecT |
| Class H1 | 34.30% | -4.15% | -4.15% | 44.54% | 132.58% | -2.71% | 48.92% | 150.48% | 96% | 101% |
| Class H2 |  |  |  |  |  | -0.18% | -0.23% | -0.16% | 97% | 95% |
| **Overall** | 34.30% | -4.15% | -4.15% | 44.54% | 132.58% | -1.79% | 31.04% | 95.70% | 97% | 99% |

VTM 7.0 versus HM 16.18

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra** | | | | | | | | | |
|  | **Over HM-16.18** | | | | | | | | | |
|  |  |  | **wPSNR** | |  | **PSNR** |  |  |  |  |
|  | DE100 | PSNR-L100 | Y | U | V | Y | U | V | EncT | DecT |
| Class H1 | -36.72% | -26.75% | -26.32% | -50.47% | -38.22% | -23.66% | -44.82% | -26.06% | - | - |
| Class H2 |  |  |  |  |  | -21.28% | -37.80% | -39.98% | - | - |
| **Overall** | -36.72% | -26.75% | -26.32% | -50.47% | -38.22% | -22.79% | -42.27% | -31.12% | - | - |
|  |  |  |  |  |  |  |  |  |  |  |
|  | **Random Access** | | | | | | | | | |
|  | **Over HM-16.18** | | | | | | | | | |
|  |  |  | **wPSNR** | |  | **PSNR** |  |  |  |  |
|  | DE100 | PSNR-L100 | Y | U | V | Y | U | V | EncT | DecT |
| Class H1 | -24.81% | -31.32% | -31.15% | -37.91% | -4.93% | -28.13% | -30.10% | 14.56% | - | - |
| Class H2 |  |  |  |  |  | -28.37% | -46.02% | -49.72% | - | - |
| **Overall** | -24.81% | -31.32% | -31.15% | -37.91% | -4.93% | -28.21% | -35.89% | -8.82% | - | - |

In addition to evaluating the performance of VTM 7.0, the AhG also studied the performance of individual coding tools in the context of HDR content. This was accomplished by conducting a Tool-On/Tool-Off test according to the methodology established in AhG13.

Results are summarized in the tables below. Additionally, more detailed results are provided in the included XLS data.

The AhG would like to thank the following companies for contributing to the Tool-On tests: Alibaba, Dolby, InterDigital, LG, MediaTek, NHK, and Sharp.

Class H1 (PQ)

Simulation Results for AI (Class H1)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **AI** |  |  |  |  |
| **Abbreviation** | **DE100** | **PSNR-L** | **BDR-wY** | **BDR-wU** | **BDR-wV** | **Tester EncTime** | **Tester DecTime** | **XChecker EncTime** | **XChecker DecTime** |
| **CST** | **18.90%** | **0.84%** | **0.74%** | **17.22%** | **24.68%** | **154%** | **103%** | **151%** | **101%** |
| **DQ** | **-1.65%** | **1.59%** | **1.70%** | **-3.24%** | **-4.41%** | **96%** | **108%** | **96%** | **104%** |
| **CCLM** | **22.33%** | **2.26%** | **2.05%** | **70.63%** | **78.26%** | **101%** | **101%** | **100%** | **100%** |
| **MTS** | **0.92%** | **1.14%** | **1.19%** | **0.91%** | **1.02%** | **87%** | **108%** | **85%** | **100%** |
| **ALF** | **2.85%** | **2.89%** | **2.36%** | **4.79%** | **3.55%** | **97%** | **89%** | **95%** | **91%** |
| **MRLP** | **0.35%** | **0.34%** | **0.31%** | **0.14%** | **0.36%** | **99%** | **101%** | **101%** | **100%** |
| **IBC on** | **-0.20%** | **-0.34%** | **-0.33%** | **-0.06%** | **-0.12%** | **145%** | **102%** | **164%** | **100%** |
| **ISP** | **0.04%** | **0.66%** | **0.74%** | **-0.34%** | **-0.19%** | **90%** | **99%** | **84%** | **98%** |
| **LMCS** | **2.66%** | **1.19%** | **0.71%** | **0.72%** | **3.70%** | **96%** | **98%** | **95%** | **99%** |
| **BDPCM on** | **-0.04%** | **0.00%** | **-0.03%** | **-0.12%** | **-0.06%** | **105%** | **99%** | **105%** | **100%** |
| **MIP** | **0.39%** | **0.70%** | **0.56%** | **0.19%** | **0.19%** | **93%** | **99%** | **88%** | **101%** |
| **LFNST** | **-0.73%** | **1.08%** | **1.04%** | **-1.70%** | **-0.64%** | **98%** | **99%** | **105%** | **101%** |
| **JCCR** | **0.36%** | **0.55%** | **0.57%** | **2.83%** | **-0.22%** | **98%** | **99%** | **97%** | **101%** |
| **SAO** | **0.98%** | **0.07%** | **0.00%** | **1.17%** | **2.47%** | **100%** | **102%** | **98%** | **100%** |

Class H2 (HLG)

Simulation Results for AI (Class H2)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **AI** |  |  |  |  |
| **Abbreviation** | **BDR-Y** | **BDR-U** | **BDR-V** | **Tester EncTime** | **Tester DecTime** | **XChecker EncTime** | **XChecker DecTime** |
| **CST** | **0.57%** | **13.68%** | **20.27%** | **165%** | **104%** | **159%** | **103%** |
| **DQ** | **1.85%** | **-1.29%** | **-1.45%** | **100%** | **103%** | **99%** | **105%** |
| **CCLM** | **1.75%** | **40.57%** | **20.50%** | **103%** | **100%** | **101%** | **100%** |
| **MTS** | **1.78%** | **2.89%** | **2.18%** | **87%** | **97%** | **85%** | **98%** |
| **ALF** | **2.83%** | **2.16%** | **3.16%** | **98%** | **88%** | **93%** | **90%** |
| **MRLP** | **0.04%** | **-0.02%** | **-0.10%** | **99%** | **100%** | **100%** | **99%** |
| **IBC on** | **-0.11%** | **0.03%** | **0.05%** | **186%** | **100%** | **165%** | **100%** |
| **ISP** | **0.34%** | **-0.72%** | **-0.36%** | **86%** | **99%** | **84%** | **100%** |
| **LMCS** | **0.06%** | **-0.78%** | **-0.64%** | **95%** | **96%** | **94%** | **97%** |
| **RDPCM on** | **0.00%** | **0.00%** | **-0.08%** | **108%** | **100%** | **109%** | **101%** |
| **MIP** | **0.71%** | **0.93%** | **0.50%** | **90%** | **101%** | **91%** | **102%** |
| **LFNST** | **0.67%** | **-0.11%** | **-0.44%** | **113%** | **101%** | **110%** | **101%** |
| **JCCR** | **0.28%** | **0.43%** | **5.37%** | **100%** | **101%** | **98%** | **101%** |
| **SAO** | **0.05%** | **0.25%** | **0.58%** | **100%** | **97%** | **99%** | **97%** |

**Simulation Results for RA (Class H2)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **VTM RA** |  |  |  |  |
| **Abbreviation** | **BDR-wY** | **BDR-wU** | **BDR-wV** | **Tester EncTime** | **Tester DecTime** | **XChecker EncTime** | **XChecker DecTime** |
| **CST** | **0.21%** | **8.36%** | **15.19%** | **103%** | **100%** | **102%** | **101%** |
| **DQ** | **1.79%** | **-0.46%** | **-0.80%** | **103%** | **102%** | **104%** | **103%** |
| **CCLM** | **0.77%** | **48.22%** | **25.89%** | **101%** | **101%** | **99%** | **101%** |
| **MTS** | **1.11%** | **1.57%** | **0.94%** | **95%** | **100%** | **95%** | **99%** |
| **ALF** | **3.54%** | **3.36%** | **2.76%** | **97%** | **88%** | **95%** | **93%** |
| **AFF** | **0.70%** | **0.49%** | **0.55%** | **80%** | **97%** | **83%** | **99%** |
| **SbTMVP** | **0.40%** | **0.24%** | **0.20%** | **102%** | **102%** | **101%** | **99%** |
| **AMVR** | **0.73%** | **1.06%** | **1.62%** | **87%** | **102%** | **83%** | **102%** |
| **TPM** | **0.37%** | **0.60%** | **0.62%** | **100%** | **101%** | **98%** | **98%** |
| **BDOF** | **0.61%** | **0.29%** | **0.19%** | **98%** | **98%** | **98%** | **99%** |
| **PROF** | **0.12%** | **0.13%** | **0.05%** | **99%** | **99%** | **98%** | **98%** |
| **CIIP** | **0.18%** | **-0.29%** | **-0.47%** | **99%** | **101%** | **98%** | **101%** |
| **MMVD** | **0.18%** | **0.35%** | **0.50%** | **91%** | **101%** | **91%** | **101%** |
| **BCW** | **0.20%** | **0.23%** | **0.29%** | **94%** | **102%** | **96%** | **102%** |
| **MRLP** | **0.03%** | **-0.03%** | **0.05%** | **100%** | **100%** | **100%** | **100%** |
| **IBC on** | **0.11%** | **-0.03%** | **-0.04%** | **108%** | **100%** | **107%** | **101%** |
| **ISP** | **0.25%** | **0.19%** | **0.09%** | **97%** | **100%** | **95%** | **100%** |
| **DMVR** | **0.87%** | **1.04%** | **0.95%** | **101%** | **97%** | **102%** | **98%** |
| **SBT** | **0.28%** | **-0.14%** | **-0.17%** | **97%** | **100%** | **98%** | **100%** |
| **LMCS** | **0.94%** | **1.33%** | **0.92%** | **99%** | **99%** | **98%** | **100%** |
| **SMVD** | **0.20%** | **0.07%** | **0.19%** | **97%** | **100%** | **96%** | **102%** |
| **RDPCM on** | **0.00%** | **-0.05%** | **-0.05%** | **101%** | **100%** | **101%** | **102%** |
| **MIP** | **0.49%** | **0.58%** | **-0.07%** | **97%** | **100%** | **96%** | **101%** |
| **LFNST** | **0.53%** | **0.06%** | **-0.33%** | **96%** | **100%** | **96%** | **101%** |
| **JCCR** | **0.20%** | **-0.07%** | **7.15%** | **99%** | **100%** | **98%** | **100%** |
| **SAO** | **0.05%** | **0.36%** | **1.96%** | **101%** | **99%** | **101%** | **99%** |

PSNR-Y vs weighted runtime ratio figures were also provided in the report.

There was one contribution related to HDR video coding.

* JVET-Q0523 Redistribution of chroma information for improved HDR color representation [Maryam Azimi (Univ. of Cambridge), Mahsa T. Pourazad (TELUS), Panos Nasiopoulos (UBC)]

While not listed in the AHG report, it is noted that responses to CE5 also evaluated the performance of in-loop filtering on HDR content:

The AHG recommends to review the relevant input contributions.

[JVET-Q0008](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9368) JVET AHG report: Layered coding and resolution adaptivity (AHG8) [S. Wenger, A. Segall, M. M. Hannuksela, Hendry, S. McCarthy, Y.-C. Sun, P. Topiwala, M. Zhou]

This AHG report was discussed Tuesday 7 January 2020 at 1010 (chaired by GJS).

The document summarizes activities of AHG on Layered coding and resolution adaptivity between the 16th and the 17th JVET meetings. Two email messages were exchanged on the reflector, covering the DPB size in case of layered coding. While there was no extended discussion, the conclusion reached can be summarized as follows: In VVC version 1, the constraint on DPB size should be specified to be independent of the number of layers, without specifying an explicit limit on the maximum number of layers. Proposal contribution JVET-Q0112 to this meeting is aligned with this suggestion.

A total of 35 relevant documents were received in preparation of the Brussels meeting.

The AHG recommended:

* To review all related contributions
* To continue to study VVC layered coding and resolution adaptivity

[JVET-Q0009](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9369) JVET AHG report: High-level syntax (AHG9) [R. Sjöberg, J. Boyce, B. Choi, S. Deshpande, M. M. Hannuksela, R. Skupin, A. Tourapis, Y.-K. Wang, W. Wan]

This AHG report was discussed Tuesday 7 January 2020 at 1020 (chaired by GJS).

This AHG report summarizes the activities of the AHG on High-level syntax (HLS) between the 16th JVET meeting in Geneva, CH (1–11 October 2019) and the 17th JVET meeting in Brussels, BE (7–17 January 2020).

It is reported that the estimated number of input contributions related to high-level syntax has increased from 137 at the 16th JVET meeting to 188 at this 17th meeting.

It is noted that the first day of the 17th meeting in Brussels was announced on the reflector on November 6 to be devoted to high-level syntax related topics.

An e-mail reflector discussion on HLS planning took place. The discussion was summarized by the AHG as the following lists of suggested actions:

Suggested actions to handle HLS input contributions at this meeting:

* Encourage joint contributions to reduce the number of documents
* Allocate more meeting time for HLS compared to low-level work
* Let software availability impact the presentation times of HLS proposals

Suggested actions for future meetings:

* Require that software is provided with HLS contributions, preferably also require cross-checks
* Prioritize missing HLS adoptions for VTM-8 integration
* Allocate much earlier time slots for the HLS-related implementation work
* Define test conditions for HLS aspects (e.g. scalability, RPR, subpictures) to ensure that the software works as expected

It was commented that we need greater clarity on who is responsible for providing software for contributions that merge proposals from different organizations.

It was also commented that when we have some part of the design that has not yet been adequately implemented in the software, the focus should be on getting that problem fixed rather than making additional refinements of the non-implemented feature.

[JVET-Q0010](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9370) JVET AHG report: Encoding algorithm optimization (AHG10) [A. Duenas, A. Tourapis, S. Ikonin, A. Norkin, R. Sjöberg, J. Le Tanou, J.-M. Thiesse]

This AHG report was discussed Wednesday 8 January 2020 at 1430 (chaired by GJS & JRO).

The document summarizes the activities of the AHG on Encoding algorithm optimizations between the 16th meeting in Geneva, CH (1-11, October 2019) and the 17th meeting in Brussels, BE (7-17, January 2020).

No particular coordinated work was identified in the AHG report, which listed the relevant input contributions as follows:

* JVET-Q0323: Encoder optimization for chroma BDPCM
* JVET-Q0433: Encoder only: On unbalanced luma/chroma gains for dependent quantization
* JVET-Q0447: Encoder estimation of Weighted-Prediction parameters
* JVET-Q0493: Non-CE2: Palette encoder improvements for lossless coding
* JVET-Q0502: Non-CE2: Encoder only approach for CTU row palette predictor initialization
* JVET-Q0503: CE2-related: Encoder improvement for palette mode
* JVET-Q0514: AHG11: Encoder improvements on JCCR with chroma transform skip mode

The AHG recommended that the related input contributions are reviewed and to further continue the study of encoding algorithm optimizations in JVET.

[JVET-Q0011](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9371) JVET AHG report: Screen content coding (AHG11) [S. Liu, J. Boyce, A. Filippov, Y.-C. Sun, J. Xu, H. Yang]

This AHG report was discussed Wednesday 8 January 2020 at 1435 (chaired by GJS & JRO).

This document summarizes the activity of AHG11: Screen Content Coding between the 16th meeting in Geneva, CH (1–11 October 2019) and the 17th Meeting in Brussels, BE (7–17 January 2020).

The AHG used the main JVET reflector, jvet@lists.rwth-aachen.de, with [AHG11] in message headers. There were few email activities through the main reflector but many email exchanges among CE2 participants using jvet-ce@lists.rwth-aachen.de reflector with tool-specific discussions.

In total there were 22 SCC related technical contributions identified in the AHG report, among which there were 4 IBC related technical contributions and 18 Palette related technical contributions identified for this meeting. The contributions were listed in the AHG report.

Transform skip and BDPCM were also mentioned as relevant, but were not listed in this AHG report, as they are covered in AHG14.

The AHG recommended:

* To review all related contributions.
* To continue investigating SCC coding tool performance, complexity and interactions between these and other coding tools.
* To continue evaluating new test materials.

[JVET-Q0012](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9372) JVET AHG report: High-level parallelism and coded picture regions (AHG12) [S. Deshpande, B. Choi, M. M. Hannuksela, R. Sjöberg, R. Skupin, W. Wan, Y.-K. Wang]

This AHG report was discussed Tuesday 7 January 2020 at 1110 (chaired by GJS).

The document summarizes activities of AHG on High-level parallelism and coded picture regions between the 16th and the 17th JVET meetings.

In the JVET email reflector, a kick-off message was sent. There were no other emails on the reflector specifically focusing on AHG12.

Input documents (total 70) related to AHG12 were listed in the AHG report, categorized as follows:

* Slice, tile information signalling (14)
* Sub-pictures/ independent coded regions (39)
* Entry point (2)
* Miscellaneous (11)
* Summaries (4)

[JVET-Q0013](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9373) JVET AHG report: Tool reporting procedure and testing (AHG13) [W.-J. Chien, J. Boyce, W. Chen, Y.-W. Chen, R. Chernyak, K. Choi, R. Hashimoto, Y.-W. Huang, H. Jang, R.-L. Liao, S. Liu]

This AHG report was discussed Wednesday 8 January 2020 at 1505 (chaired by GJS & JRO).

This document summarizes the activity of AHG13: “Tool reporting procedure” between the 16th meeting in Geneva, CH (1–11 Oct 2019) and the 17th Meeting in Brussels, BE (7–17 Jan. 2020). Tool on/off experimental results vs. VTM anchor are provided for the tools specified in JVET-P2005.

The initial version of JVET-P2005 “Methodology and reporting template for tool testing” was provided on November 28th.

All tests described in JVET-P2005 were conducted. VTM tool tests were conducted on VTM-7.0 (or VTM-7.1 for adaptive colour transform) software with VTM configuration by switching off or on specific tool either in configuration files or macros.

The tested tools, testers, and cross-checkers are listed in the tables below.

Tools included in VTM (Tool off test vs VTM Anchor)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Tool Name** | **Acronym** | **Document reference(s)** | **AI** | **RA** | **LD** | **Tester** | **Crosscheck** |
| Chroma separate tree | CST | JVET-N0137, JVET-P0063, JVET-P0406 | X | X | X | Tzu-Der Chuang (peter.chuang@mediatek.com) | Wei-Jung Chien (wchien@qti.qualcomm.com) |
| Dependent quantization\* | DQ | JVET-M0173, JVET-M0251, JVET-M0470, JVET-P0170 | X | X | X | Tzu-Der Chuang (peter.chuang@mediatek.com) | Wei Chen (wei.chen@interdigital.com) |
| Cross-component linear model | CCLM | JVET-O1124 | X | X | X | Roman Chernyak (chernyak.roman@huawei.com) | Shan Liu (shanl; leolzhao@ tencent.com) |
| multiple transform set | MTS | JVET-O0294, JVET-O0474, JVET-O0541, | X | X | X | Kiho Choi (kiho14.choi@samsung.com) | Shan Liu (shanl; xinzzhao@ tencent.com) |
| Adaptive loop filter | ALF | JVET-O0064, JVET-O0090, JVET-O0216, JVET-O0228, JVET-O0247, JVET-O0625, JVET-O0662, JVET-O0669, JVET-P0162, JVET-P0164, JVET-P0505, JVET-P0554, JVET-P0665, JVET-P1038, | X | X | X | Wei-Jung Chien (wchien@qti.qualcomm.com) | Wei Chen (wei.chen@interdigital.com) |
| Affine motion model | AFF | JVET-O0070 |  | X | X | Roman Chernyak (chernyak.roman@huawei.com) | Shan Liu (shanl; guichunli@ tencent.com) |
| subblock-based temporal merging candidates | SbTMVP | JVET-O0163, JVET-O0220, JVET-P0385 |  | X | X | Shan Liu  (shanl; guichunli@ tencent.com) | Wei-Jung Chien (wchien@qti.qualcomm.com) |
| Adaptive motion vector resolution | AMVR | JVET-O0057 |  | X | X | Shan Liu (shanl; guichunli@ tencent.com) | Wei-Jung Chien (wchien@qti.qualcomm.com) |
| Triangular partition mode | TPM | JVET-O0265, JVET-P0530 | X | X | X | Kiho Choi (kiho14.choi@samsung.com) | Shan Liu (shanl; leolzhao@ tencent.com) |
| Bi-directional optical flow | BDOF | JVET-O0055, JVET-O0304, JVET-O0570, JVET-O0594, JVET-P0091, JVET-P0519, JVET-P1023 |  | X |  | Kiho Choi (kiho14.choi@samsung.com) | Tzu-Der Chuang (peter.chuang@mediatek.com) |
| Combined intra/inter prediction | CIIP | JVET-O0108, JVET-O0681 |  | X | X | Kiho Choi (kiho14.choi@samsung.com) | Tzu-Der Chuang (peter.chuang@mediatek.com) |
| Merge with MVD | MMVD | JVET-N0127,  JVET-N0332, JVET-N0448, JVET-N0380, JVET-P1023 |  | X | X | Kiho Choi (kiho14.choi@samsung.com) | Hyeongmun Jang ([hm.jang@lge.com](mailto:hm.jang@lge.com)) |
| Bi-predictive with CU weights | BCW | JVET-O0366, JVET-P0280 |  | X | X | Wei Chen (wei.chen@interdigital.com) | Tzu-Der Chuang (peter.chuang@mediatek.com) |
| Multi-reference line prediction | MRLP | JVET-O0426, JVET-P0418 | X | X | X | Shan Liu (shanl; leolzhao@ tencent.com) | Hyeongmun Jang (hm.jang@lge.com) |
| Intra block copy mode | IBC | JVET-O0078, JVET-O0162, JVET-O0258, JVET-O0455, JVET-O1170, JVET-P0400, JVET-P0457, JVET-P1018 | X | X | X | Shan Liu (shanl; xiaozhongxu@ tencent.com) | Wei-Jung Chien (wchien@qti.qualcomm.com) |
| Intra sub-partitioning | ISP | JVET-O0106, JVET-O0341, JVET-O0502 | X | X | X | Roman Chernyak (chernyak.roman@huawei.com) | Hyeongmun Jang (hm.jang@lge.com) |
| Decoder motion vector refinement | DMVR | JVET-O0297, JVET-O0590, JVET-O0634 |  | X |  | Wei Chen (wei.chen@interdigital.com) | Roman Chernyak  ([chernyak.roman@huawei.com](mailto:chernyak.roman@huawei.com)) |
| Sub-block transform | SBT | JVET-M0140, JVET-P1026 |  | X | X | Roman Chernyak (chernyak.roman@huawei.com) | Shan Liu (shanl; xinzzhao@ tencent.com) |
| Luma mapping with chroma scaling | LMCS | JVET-O0272, JVET-O0428, JVET-O1109, JVET-P0254, JVET-P0371 | X | X | X | Taoran Lu (tlu@dolby.com) | Hyeongmun Jang (hm.jang@lge.com) |
| Symmetric motion vector difference | SMVD | JVET-O0284, JVET-O0414, JVET-O0567, JVET-O0572 |  | X |  | Yi-Wen Chen(yiwenchen@kwai.com) | Hyeongmun Jang (hm.jang@lge.com) |
| Quantized residual DPCM | BDPCM | JVET-O0315, JVET-O1136, JVET-P0059 | X | X | X | Ru-Ling Liao (ruling.lrl@alibaba-inc.com) | Yi-Wen Chen(yiwenchen@kwai.com) |
| Matrix based intra prediction | MIP | JVET-O0925, JVET-P0054, JVET-P0199, JVET-P0803 | X | X | X | Ru-Ling Liao (ruling.lrl@alibaba-inc.com) | Yi-Wen Chen(yiwenchen@kwai.com) |
| Low frequency non-separable transform | LFNST | JVET-O0094, JVET-O0213, JVET-O0219, JVET-O0368, JVET-O0472, JVET-O0529, JVET-P1026, JVET-P0350 | X | X | X | Ru-Ling Liao (ruling.lrl@alibaba-inc.com) | Yi-Wen Chen(yiwenchen@kwai.com) |
| Joint coding of chrominance residuals | JCCR | JVET-N0054 | X | X | X | Ru-Ling Liao (ruling.lrl@alibaba-inc.com) | Yi-Wen Chen(yiwenchen@kwai.com) |
| Sampled-adaptive offset | SAO | HEVC | X | X | X | Tzu-Der Chuang (peter.chuang@mediatek.com) | Wei Chen (wei.chen@interdigital.com) |
| Prediction refinement using optical flow | PROF | JVET-O0070, JVET-P0409, JVET-P0057, JVET-P0154, JVET-P0491, JVET-P0653 |  | X | X | Wei Chen (wei.chen@interdigital.com) | Ru-Ling Liao (ruling.lrl@alibaba-inc.com) |
| Palette coding mode\*\* | PLT | JVET-P0077 | X | X | X | Yung-Hsuan Chao (yunghsua@qti.qualcomm.com) | Yi-Wen Chen(yiwenchen@kwai.com) |
| Adaptive colour transform\*\*\* | ACT | JVET-P0517 | X | X | X | Xiaoyu Xiu (xiaoyuxiu@kwai.com) | Shan Liu (shanl; xinzzhao@ tencent.com) |

\* Test was conducted by disabling DQ and enabling Sign Data Hiding.

\*\* Test was conducted with test sequences and test condition defined in JVET-P2022.

\*\*\* Test was conducted Test sequences and test condition are defined in JVET-P0517.

The results of the tests are summarized in Table 2-6 below. The attached spreadsheet provides additional data. Table 7 shows tool test results across several VTM versions. The combined BD-Rate is computed based on (BD-Rate\_Y\*8+ BD-Rate\_U+ BD-Rate\_V)/10. Scatter plots are also provided for the tested tools in random access configuration, comparing PSNR-Y based bd-rate on the Y axis vs. each of Enc runtime ratio, Dec runtime ratio, and a weighted average of Enc and Dec runtime ratio, (*Enc + a\*Dec)/(a+1)*, with a configurable weight, *a*. The exemplary weighting is set to 6 and can be adjusted in the spreadsheet attached to this report.

Full experimental results and configuration files can be found at the link below:

<https://hevc.hhi.fraunhofer.de/svn/svn_VVCTestConfig/branches/VTM-6.0/>

There was no bitrate or PSNR differences between testers and cross-checkers.

Encoder and Decoder runtime ratios provided by both the testers and cross-checkers are included in the reporting template, to identify if there were significant runtime differences.

Table 3 Simulation results in all intra configuration (AI) of VTM tool tests. (VTM anchor)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | **AI** |  |  |  |
| **Acronym** | **BDR-Y** | **BDR-U** | **BDR-V** | **Tester EncTime** | **Tester DecTime** | **XChecker EncTime** | **XChecker DecTime** |
| CST | 0.35% | 9.34% | 9.26% | 152% | 103% | 154% | 103% |
| DQ | 1.99% | -0.66% | -0.73% | 99% | 101% | 96% | 104% |
| CCLM | 1.61% | 14.73% | 15.86% | 100% | 100% | 100% | 98% |
| MTS | 1.22% | 0.98% | 1.07% | 81% | 98% | 86% | 101% |
| ALF | 2.37% | 2.91% | 3.62% | 98% | 91% | 96% | 92% |
| MRLP | 0.32% | 0.10% | 0.14% | 98% | 101% | 98% | 101% |
| IBC | 0.65% | 0.62% | 0.66% | 54% | 100% | 58% | 99% |
| ISP | 0.52% | 0.29% | 0.26% | 85% | 98% | 85% | 98% |
| LMCS | 1.09% | -1.11% | -0.71% | 99% | 99% | 98% | 98% |
| BDPCM | 0.01% | 0.04% | -0.01% | 94% | 100% | 98% | 105% |
| MIP | 0.61% | 0.16% | 0.17% | 89% | 101% | 86% | 96% |
| LFNST | 1.20% | 0.72% | 1.03% | 111% | 101% | 107% | 98% |
| JCCR | 0.59% | 0.28% | 0.41% | 98% | 100% | 96% | 98% |
| SAO | 0.00% | 0.15% | 0.17% | 100% | 96% | 100% | 97% |

Table 4 Simulation results in random access configuration (RA) of VTM tool tests. (VTM anchor)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | **RA** |  |  |  |
| **Acronym** | **BDR-Y** | **BDR-U** | **BDR-V** | **Tester EncTime** | **Tester DecTime** | **XChecker EncTime** | **XChecker DecTime** |
| CST | 0.10% | 3.78% | 4.53% | 104% | 100% | 102% | 100% |
| DQ | 1.76% | -0.25% | -0.52% | 104% | 98% | 99% | 102% |
| CCLM | 1.02% | 11.85% | 13.71% | 99% | 100% | 99% | 100% |
| MTS | 0.70% | 0.56% | 0.72% | 90% | 100% | 93% | 100% |
| ALF | 4.56% | 4.93% | 4.94% | 98% | 89% | 96% | 90% |
| AFF | 3.01% | 2.04% | 2.00% | 81% | 96% | 82% | 97% |
| SbTMC | 0.46% | 0.32% | 0.36% | 101% | 101% | 101% | 100% |
| AMVR | 1.42% | 2.17% | 2.27% | 84% | 101% | 85% | 102% |
| TPM | 0.38% | 0.64% | 0.68% | 95% | 100% | 98% | 101% |
| BDOF | 0.76% | 0.31% | 0.27% | 98% | 97% | 101% | 94% |
| CIIP | 0.28% | 0.01% | 0.01% | 99% | 100% | 98% | 101% |
| MMVD | 0.51% | 0.47% | 0.51% | 93% | 101% | 93% | 101% |
| BCW | 0.40% | 0.42% | 0.45% | 94% | 100% | 98% | 99% |
| MRLP | 0.16% | 0.07% | 0.10% | 100% | 100% | 100% | 100% |
| IBC | -0.04% | 0.05% | 0.05% | 91% | 100% | 91% | 100% |
| ISP | 0.32% | 0.24% | 0.31% | 95% | 100% | 96% | 100% |
| DMVR | 0.83% | 1.08% | 1.10% | 100% | 97% | 100% | 97% |
| SBT | 0.40% | -0.03% | -0.01% | 95% | 100% | 95% | 100% |
| LMCS | 1.42% | 1.39% | 0.96% | 95% | 98% | 94% | 98% |
| SMVD | 0.25% | 0.25% | 0.26% | 93% | 97% | 97% | 101% |
| BDPCM | -0.01% | -0.04% | -0.05% | 99% | 100% | 103% | 103% |
| MIP | 0.33% | 0.40% | 0.52% | 95% | 100% | 92% | 97% |
| LFNST | 0.88% | 0.02% | 0.49% | 94% | 100% | 91% | 98% |
| JCCR | 0.57% | 0.04% | -0.52% | 98% | 100% | 94% | 97% |
| SAO | 0.08% | 0.20% | 0.33% | 100% | 98% | 100% | 98% |
| PROF | 0.46% | 0.16% | 0.13% | 98% | 99% | 98% | 98% |

Table 5 Simulation results in low delay B configuration (LDB) of VTM tool tests. (VTM anchor)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | **LDB** |  |  |  |
| **Acronym** | **BDR-Y** | **BDR-U** | **BDR-V** | **Tester EncTime** | **Tester DecTime** | **XChecker EncTime** | **XChecker DecTime** |
| CST | 0.00% | 1.34% | 2.21% | 110% | 97% | 100% | 98% |
| DQ | 1.56% | 0.29% | -0.05% | 109% | 99% | 100% | 102% |
| CCLM | 0.01% | 3.39% | 3.69% | 100% | 100% | 100% | 99% |
| MTS | 0.53% | 0.12% | 0.10% | 99% | 100% | 98% | 98% |
| ALF | 4.26% | 5.11% | 4.67% | 96% | 90% | 94% | 90% |
| AFF | 2.96% | 1.90% | 2.29% | 74% | 94% | 75% | 96% |
| SbTMC | 0.78% | 0.86% | 0.78% | 101% | 97% | 101% | 97% |
| AMVR | 0.60% | 0.83% | 0.67% | 86% | 100% | 87% | 101% |
| TPM | 0.92% | 1.29% | 1.25% | 97% | 102% | 97% | 100% |
| CIIP | 0.39% | 0.46% | 0.48% | 99% | 100% | 97% | 97% |
| MMVD | 0.45% | 0.34% | 0.36% | 96% | 100% | 95% | 100% |
| BCW | 0.28% | 0.17% | 0.10% | 100% | 103% | 97% | 99% |
| MRLP | 0.05% | -0.36% | -0.04% | 100% | 100% | 100% | 100% |
| IBC | -0.01% | -0.01% | -0.06% | 85% | 100% | 85% | 100% |
| ISP | 0.07% | -0.05% | 0.13% | 99% | 100% | 99% | 99% |
| SBT | 0.57% | -0.22% | -0.13% | 93% | 99% | 93% | 98% |
| LMCS | 0.97% | -0.59% | -0.86% | 97% | 99% | 94% | 95% |
| BDPCM | 0.03% | 0.28% | 0.01% | 99% | 100% | 102% | 103% |
| MIP | 0.17% | 0.48% | 0.49% | 95% | 103% | 103% | 99% |
| LFNST | 0.42% | 0.09% | -0.07% | 92% | 103% | 108% | 98% |
| JCCR | 0.15% | 1.92% | 2.55% | 99% | 98% | 97% | 99% |
| SAO | 0.09% | 0.36% | 0.93% | 101% | 99% | 100% | 96% |
| PROF | 0.33% | -0.03% | 0.00% | 98% | 98% | 97% | 92% |

Table 7 Simulation results for screen coding tools for ClassF and ClassTGM (VTM anchor)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | **AI** |  |  |  |
| **Acronym** | **BDR-Y** | **BDR-U** | **BDR-V** | **Tester EncTime** | **Tester DecTime** | **XChecker EncTime** | **XChecker DecTime** |
| IBC Class F | 15.22% | 15.16% | 15.31% | 54% | 101% | 57% | 99% |
| IBC Class TGM | 47.19% | 44.63% | 44.63% | 64% | 103% | 67% | 103% |
| BDPCM ClassF | 0.92% | 0.81% | 0.95% | 98% | 100% | 96% | 93% |
| BDPCM ClassTGM | 1.39% | 1.27% | 1.24% | 101% | 102% |  |  |
|  |  |  |  | **RA** |  |  |  |
| IBC Class F | 12.19% | 12.14% | 12.29% | 85% | 100% | 88% | 100% |
| IBC Class TGM | 22.12% | 21.66% | 22.06% | 88% | 102% | 102% | 105% |
| BDPCM ClassF | 0.68% | 0.66% | 0.70% | 99% | 100% | 94% | 95% |
| BDPCM ClassTGM | 0.70% | 0.75% | 0.78% | 100% | 101% |  |  |
|  |  |  |  | **LD** |  |  |  |
| IBC Class F | 6.04% | 6.85% | 6.63% | 84% | 101% | 86% | 99% |
| IBC Class TGM | 11.33% | 12.03% | 12.34% | 84% | 105% | 95% | 102% |
| BDPCM ClassF | 0.45% | -0.18% | 0.90% | 99% | 101% | 97% | 97% |
| BDPCM ClassTGM | 0.27% | 0.08% | 0.14% | 100% | 100% |  |  |

Table 8 Simulation results of coding tools for color space 4:4:4 (VTM anchor)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | **AI** |  |  |  |
| **Acronym** | **BDR-Y** | **BDR-U** | **BDR-V** | **Tester EncTime** | **Tester DecTime** | **XChecker EncTime** | **XChecker DecTime** |
| PLT | 11.35% | 14.77% | 15.95% | 98% | 108% | 98% | 107% |
| ACT, RGB | 10.61% | 2.74% | 3.57% | 104% | 100% | 98% | 102% |
|  |  |  |  | **RA** |  |  |  |
| PLT | 7.83% | 10.48% | 11.87% | 99% | 101% | 100% | 102% |
| ACT, RGB | 19.12% | 6.66% | 8.27% | 104% | 100% | 97% | 101% |
|  |  |  |  | **LD** |  |  |  |
| PLT | 3.98% | 7.23% | 8.24% | 96% | 101% | 96% | 99% |
| ACT, RGB | 28.47% | 9.24% | 11.13% | 103% | 100% | 98% | 101% |

Table 9 Luma sample usage and memory bandwidth results of VTM tool “off” test. (VTM anchor)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | AI |  | RA |  |  | LDB |  |
| Acronym | Sample usage | Sample usage | Ave mem BW | Max mem BW | Sample usage | Ave mem BW | Max mem BW |
| CCLM | 48.72% | 3.71% |  |  | 0.80% |  |  |
| ALF | 99.00% | 54.96% |  |  | 51.76% |  |  |
| AFF |  | 19.05% |  |  | 28.61% |  |  |
| SBTMC |  | 11.54% |  |  | 14.55% |  |  |
| AMVR |  | 5.44% |  |  | 2.59% |  |  |
| TPM |  | 2.09% |  |  | 5.55% |  |  |
| BDOF |  | 44.56% |  |  |  |  |  |
| CIIP |  | 0.86% |  |  | 1.46% |  |  |
| MMVD |  | 6.98% |  |  | 8.42% |  |  |
| BCW |  | 9.83% |  |  | 8.02% |  |  |
| MRLP | 6.41% | 0.59% |  |  | 0.24% |  |  |
| DMVR |  | 39.82% |  |  |  |  |  |
| SBT |  | 2.50% |  |  | 3.91% |  |  |
| SMVD |  | 2.80% |  |  |  |  |  |
| MIP | 23.73% | 5.12% |  |  | 2.44% |  |  |
| LFNST | 9.41% | 0.86% |  |  | 0.39% |  |  |
| JCCR | 10.81% | 0.52% |  |  | 0.12% |  |  |
| SAO | 31.33% | 7.10% |  |  | 7.88% |  |  |

Table 7 test results of VTM tool “off” test on various VTM versions

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | **VTM RA** |  |  |
| **Abbreviation** | **VTM3** | **VTM4** | **VTM5** | **VTM6** | **VTM7** |
| CST | 0.74% | 1.25% | 1.47% | 0.99% | 0.91% |
| DQ | 1.39% | 1.36% | 1.24% | 1.32% | 1.33% |
| CCLM | 4.09% | 4.20% | 4.00% | 3.33% | 3.37% |
| MTS | 1.25% | 0.80% | 0.36% | 0.68% | 0.69% |
| ALF | 3.61% | 3.73% | 4.79% | 4.65% | 4.64% |
| AFF | 2.42% | 2.46% | 2.38% | 2.84% | 2.81% |
| SbTMVP | 0.52% | 0.43% | 0.40% | 0.48% | 0.44% |
| AMVR | 0.98% | 1.13% | 1.14% | 1.59% | 1.58% |
| TPM | 0.43% | 0.43% | 0.41% | 0.39% | 0.44% |
| BDOF | 1.02% | 0.63% | 0.66% | 0.68% | 0.67% |
| CIIP | 0.43% | 0.51% | 0.31% | 0.24% | 0.23% |
| MMVD | 0.81% | 0.52% | 0.59% | 0.52% | 0.51% |
| BCW | 0.48% | 0.45% | 0.45% | 0.43% | 0.41% |
| MRLP | 0.24% | 0.18% | 0.16% | 0.18% | 0.15% |
| IBC | 0.07% | 0.00% | 0.05% | -0.01% | -0.02% |
| ISP |  | 0.24% | 0.12% | 0.20% | 0.31% |
| DMVR |  | 0.80% | 0.87% | 0.87% | 0.88% |
| SBT |  | 0.33% | 0.33% | 0.32% | 0.32% |
| LMCS |  | 0.62% | 0.57% | 1.03% | 1.37% |
| SMVD |  | 0.26% | 0.24% | 0.27% | 0.26% |
| BDPCM |  |  | -0.02% | -0.03% | -0.01% |
| MIP |  |  | 0.27% | 0.32% | 0.36% |
| LFNST |  |  | 0.75% | 0.61% | 0.76% |
| JCCR |  |  | 0.34% | 0.42% | 0.41% |
| SAO | 0.81% | 0.64% | 0.17% | 0.13% | 0.12% |
| PROF |  |  |  | 0.41% | 0.40% |

PSNR-Y vs encoding runtime ratio of VTM with VTM tool tests (VTM anchor)

PSNR-Y vs decoding runtime ratio of VTM with VTM tool tests (VTM anchor)

PSNR-Y vs weighted runtime ratio (a = 6) of VTM with VTM tool tests (VTM anchor)

The AHG recommends the following:

* Consider the reported tool test results during tool adoption decision making
* Review related contributions
* Refine list of tested tools and test methodology for the next meeting cycle
  + Consider the reported tool test results as a benchmark for CE tests
  + Consider including reporting of compute system information for testers and cross-checkers

Three tools were mentioned as having less than 0.3% BD benefit in RA configuration without a compensating subjective rationale:

* Combined intra/inter prediction (CIIP)
* Multi-reference line prediction (MRLP)
* Symmetric motion vector difference (SMVD)

It was commented that it would not be difficult to somewhat improve the CIIP with encoder optimization if that is desired.

It was commented that these three features are not difficult from a decoder perspective.

It was also commented that design stability favours not making changes, that people have already started implementing the draft standard, and that the tradeoffs are sometimes quite different in a real implementation. There are also interactions between features, such that trying to remove things could have unexpected side effects.

It was noted that the adaptive colour transform (ACT) is primarily intended for RGB content and does not provide a significant benefit for YCbCr sequences.

It was noted that we do not have a CTC for 4:4:4, and it was suggested that such CTC should be established.

It was also suggested that having a way to routinely test RPR would be desirable (although the rationale for this was suggested for a somewhat different purpose – just testing whether the feature functions properly). Having a way of exercising and testing the coding efficiency impact of tiles was also suggested.

As noted previously, it would be highly desirable to improve the test sequence selection for SCC.

Development of the following types of tests was planned:

* The CE2 coordinators were asked to work on preparing a CTC (which should include both camera and SCC content and RGB as well as YCbCr content and 4:4:4, 4:2:2 and monochrome testing).
* For an RPR functionality confirmation testing (FCT) output, we can base this on the prior CE test scheme. J. Luo volunteered to prepare that.
* For lossless and near lossless, we can produce CTC based on CE3 conditions, requesting this to be prepared by the CE3 coordinators.

Revisit for review of drafts.

[JVET-Q0014](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9374) JVET AHG report: Lossless and near-lossless coding (AHG14) [T. Nguyen, T.-C. Ma, M. Ikeda, H. Jang, X. Zhao]

This AHG report was discussed Wednesday 8 January 2020 at 1445 (chaired by GJS & JRO).

This document reports the activity of AHG 14 on lossless and near-lossless coding tools between the 16th JVET meeting in Geneva and the 17th Meeting in Brussels.

Discussions related to AHG14 used the JVET email reflector ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de)), and the AHG chairs sent a kick-off message on 28th October 2019. No emails have been exchanged related to the AHG. The AHG chairs provided a software implementation (encoder only) that enables lossless capability in VTM-7.0. The performance of VTM-7.0 are as follows.

The results for HEVC RExt relative to HEVC Main/Main10 are as follows using HM-16.20 and CE3 test conditions.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra** | | | **Random Access** | | |
| **ratio** | | bit-rate impact | **ratio** | | bit-rate savings |
| HM-16.20 | HM-16.20 Rext | HM-16.20 | HM-16.20 Rext |
| Class A1 | 2.2 | 2.3 | -4.50% | 2.3 | 2.4 | -3.88% |
| Class A2 | 1.7 | 1.8 | -5.88% | 1.8 | 1.9 | -4.52% |
| Class B | 2.2 | 2.3 | -5.06% | 2.3 | 2.4 | -2.59% |
| Class C | 1.9 | 2.0 | -5.42% | 2.5 | 2.5 | -2.22% |
| Class D | 1.9 | 2.1 | -7.85% | 2.8 | 2.9 | -2.56% |
| Class E | 2.7 | 3.0 | -8.22% |  |  |  |
| Class F | 4.5 | 5.2 | -12.17% | 26.6 | 30.6 | -8.54% |
| TGM | 6.1 | 8.1 | -22.91% | 74.4 | 99.5 | -20.65% |
| **Overall** | **2.1** | **2.3** | **-5.71%** | **2.3** | **2.3** | **-3.14%** |
| Enc Time[%] | 95% | | | 105% | | |
| Dec Time[%] | 93% | | | 90% | | |

The results for VVC VTM-7.0 relative to HEVC Main/Main10 are as follows.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra** | | | **Random Access** | | |
| **ratio** | | bit-rate impact | **ratio** | | bit-rate savings |
| HM-16.20 | VTM-7.0 | HM-16.20 | VTM-7.0 |
| Class A1 | 2.2 | 2.2 | -0.24% | 2.3 | 2.2 | 1.49% |
| Class A2 | 1.7 | 1.6 | 5.96% | 1.8 | 1.7 | 5.45% |
| Class B | 2.2 | 2.2 | -0.30% | 2.3 | 2.3 | 0.11% |
| Class C | 1.9 | 1.9 | -0.36% | 2.5 | 2.4 | 1.55% |
| Class D | 1.9 | 1.9 | -0.82% | 2.8 | 2.8 | 1.20% |
| Class E | 2.7 | 2.8 | -2.18% |  |  |  |
| Class F | 4.5 | 5.3 | -13.28% | 26.6 | 33.7 | -10.55% |
| TGM | 6.1 | 11.8 | -44.31% | 74.4 | 107.1 | -30.87% |
| **Overall** | **2.1** | **2.1** | **0.43%** | **2.3** | **2.2** | **1.84%** |
| Enc Time[%] | 3133% | | | 1339% | | |
| Dec Time[%] | 172% | | | 136% | | |

The results for VVC VTM-7.0 relative to HEVC RExt are as follows.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra** | | | **Random Access** | | |
| **ratio** | | bit-rate impact | **ratio** | | bit-rate savings |
| HM-16.20 Rext | VTM-7.0 | HM-16.20 Rext | VTM-7.0 |
| Class A1 | 2.3 | 2.2 | 4.47% | 2.4 | 2.2 | 5.59% |
| Class A2 | 1.8 | 1.6 | 12.66% | 1.9 | 1.7 | 10.50% |
| Class B | 2.3 | 2.2 | 5.06% | 2.4 | 2.3 | 2.81% |
| Class C | 2.0 | 1.9 | 5.37% | 2.5 | 2.4 | 3.86% |
| Class D | 2.1 | 1.9 | 7.65% | 2.9 | 2.8 | 3.86% |
| Class E | 3.0 | 2.8 | 6.59% |  |  |  |
| Class F | 5.2 | 5.3 | -1.51% | 30.6 | 33.7 | -2.52% |
| TGM | 8.1 | 11.8 | -28.31% | 99.5 | 107.1 | -12.06% |
| **Overall** | **2.3** | **2.1** | **6.55%** | **2.3** | **2.2** | **5.18%** |
| Enc Time[%] | 3285% | | | 1270% | | |
| Dec Time[%] | 185% | | | 151% | | |

The related input contributions were discriminated into three groups:

* AHG14 related: high throughput and lossless operation mode (4)
* CE3 related: proposals further improving the lossless performance (see section 5.3)
* CE3 input documents: input documents for the tests conducted in CE3 (see section 6.3)

The AHG recommended:

* To review all related contributions
* To continue the investigation on lossless and near-lossless performance of VVC
  + for high throughput
  + for chroma 4:4:4 chroma format

It was noted that these results do not include comparison with the SCC profiles of HEVC, which affects class F and TGM test sequences.

A benefit relative to HEVC was not evident in general. Contributions to the current meeting showed that it is feasible to improve that behaviour.

[JVET-Q0015](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9375) JVET AHG report: Quantization control (AHG15) [R. Chernyak, E. François, C. Helmrich, S. McCarthy, A. Segall]

This AHG report was discussed Wednesday 8 January 2020 at 1555 (chaired by GJS & JRO).

This document summarizes the activity of AHG15: Quantization control between the 16th meeting in Geneva, CH (1-11, Oct. 2019 and the 17th meeting in Brussels, BE (7-17, Jan. 2019).

The regular JVET e-mail reflector was used for discussions (jvet@lists.rwth-aachen.de) with [AHG15] in message headers. There were two emails besides AHG kickoff message sent to the JVET reflector during the AHG period.

Input documents related to AHG15 were summarized as follows

***Quantization matrices related (4)***

1. [JVET-Q0148](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0148-v1.zip), AHG15: Additional coefficients for low frequency region of 64x64 scaling matrix, K. Abe, T. Toma (Panasonic).
2. [JVET-Q0421](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0421-v1.zip), AHG15: Clean up for signaling quantization matrix, Hendry, J. Zhao, S. Kim (LGE).
3. [JVET-Q0472](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0472-v2.zip), AHG15: Quantization matrix signalling, P. de Lagrange, F. Leléannec, E. François, K. Naser (InterDigital).
4. [JVET-Q0505](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0505-v1.zip), AHG15: Improvement for Quantization Matrix Signaling, H. Zhang, X. Li, G. Li, L. Li, S. Liu (Tencent).

***Chroma QP offsets related (8)***

1. [JVET-Q0126](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0126-v1.zip), Initializations and propagation of Chroma QP Offset, K. Kawamura, S. Naito (KDDI).
2. [JVET-Q0209](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0209-v1.zip), [AHG9][AHG15]: On chroma Qp offsets, Hendry, J. Zhao, S. Kim (LGE).
3. [JVET-Q0267](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0267-v1.zip), AHG16: On Propagation of Chroma CU QP Offsets, B. Heng, M. Zhou, W. Wan (Broadcom).
4. [JVET-Q0425](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0425-v1.zip), AHG15: QP offsets for adaptive colour transform, R. Sjöberg, M. Pettersson, M. Damghanian, D.Saffar (Ericsson).
5. [JVET-Q0476](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0476-v1.zip), On chroma QP offsets for zero-CBF leading chroma coding blocks, A. K. Ramasubramonian, B. Ray, G. Van der Auwera, M. Karczewicz (Qualcomm).
6. [JVET-Q0484](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0484-v1.zip), AHG9: HLS control of chroma QP offset, W. Wan, B. Heng, P. Chen, T. Hellman, M. Zhou (Broadcom).
7. [JVET-Q0570](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0570-v2.zip), AHG15: reset chroma QP offsets when starting a CTU, P. de Lagrange (InterDigital).
8. [JVET-Q0576](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0576-v1.zip), AHG15: history of local chroma QP offsets, P. de Lagrange (InterDigital).

***QP Adjustment for Adaptive Color Transform related (3)***

1. [JVET-Q0098](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0098-v2.zip), On QP Adjustment for Adaptive Color Transform, T. Tsukuba, M. Ikeda, Y. Yagasaki, T. Suzuki (Sony).
2. [JVET-Q0241](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0241-v1.zip), On QP adjustment in adaptive color transform, J. Jung, D. Kim, G. Ko, J.-H. Son, J. Kwak (WILUS).
3. [JVET-Q0511](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9340), On ACT QP clipping, J. Zhao, Hendry, S.-H. Kim (LGE), X. Xiu, Y.-W. Chen, T.‑C. Ma, H.-J. Jhu, X. Wang (Kwai), W. Zhu, J. Xu, L. Zhang (Bytedance).

***Others (5)***

1. [JVET-Q0142](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0142-v1.zip), Clipping of minimum QP prime value, K. Unno, K. Kawamura, S. Naito (KDDI).
2. [JVET-Q0227](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0227-v1.zip), Dependent Quantization with Qp offset adaptation, P. de Lagrange, F. Hiron, F. Le Léannec, E. Francois (InterDigital).
3. [JVET-Q0410](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0410-v1.zip), AHG12: Bitstream merging with variable initial Qp, N. Ouedraogo, E. Nassor, G. Kergourlay, F. Mazé (Canon).
4. [JVET-Q0473](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0473-v2.zip), AHG15: Demultiplexing joint CbCr before dequantization, P. de Lagrange, F. Leléannec, E. François, P. Bordes (InterDigital).
5. [JVET-Q0474](http://phenix.it-sudparis.eu/jvet/doc_end_user/documents/17_Brussels/wg11/JVET-Q0474-v2.zip), AHG15: defining QP at TU level, P. de Lagrange, F. Leléannec, F. Urban, K. Naser (InterDigital).

The AHG recommended to:

* Review all related contributions;
* Continue investigating VVC Quantization control techniques.

[JVET-Q0016](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9376) JVET AHG report: Implementation studies (AHG16) [M. Zhou, J. An, E. Chai, K. Choi, S. Sethuraman, T. Hsieh, X. Xiu]

This AHG report was discussed Wednesday 8 January 2020 at 1600 (chaired by GJS & JRO).

This document summarizes the activity of AHG16: Implementation studies, between the 16th JVET meeting in Geneva, CH (1–11 October 2019) and the 17th JVET meeting in Brussels, BE (7–17 January 2020).

Email discussions were held on the main JVET email reflector (jvet@lists.rwth-aachen.de) with an [AHG16] indication on message headers. A summary of the AHG activities is provided as follows:

Topics discussed on the email reflector

Entry point offset signalling:

1. In the current design the signalling of entry point offsets is optional for tiles.
2. It was commented that without entry point offsets decoder implementation of raster scan order processing is impossible for single slice/multi-tile streams.
3. It was suggested that if the signaling of entry point offset in ES is optional the system level spec definition of entry point offsets be made mandatory.
4. It was commented without mandating tiles parallel decoding is not guaranteed even if the entry point offsets are made mandatory, unless the parsing and pixel processing are fully decoupled (in which case, however, decoder implementation of raster scan order processing is possible without entry point offsets).
5. It was further commented that even if entry point offsets are made mandatory the parallel parsing/decoding may still be not be guaranteed because of bit-rate unbalancing among tiles.
   1. **Feedback provided on tools being tested in CEs**
6. CE4 GEO (Geometric partitions)
   1. The JVET-P0884/ JVET-P0885 (a combination of JVET-P0107/JVET-P0264/JVET-P0304) version of GEO removes the original GEO elements of partial transform and deriving the motion mask from the blending mask, which addresses the majority of implementation concerns.
   2. The newly proposed slope-based GEO (JVET-P0107/JVET-P0264) removes the multiplications from the blending mask/motion mask derivation and provides a second option of on-the-fly derivation. This simplifies the design and provides more implementation flexibility. There is no big difference between those two options in terms of implementation complexity. Compared to other designs such as the one tested in CE4-1.14, this kind of simplification does not seem to be critical if it hurts coding efficiency (visual quality).
   3. The newly proposed idea of deriving the blending/motion mask of different sizes by cropping directly from the pre-stored masks of the largest sizes would be the simplest because only (offsetX, offsetY) needs to be computed at CU level. However, this is not practical for implementation as it is too costly due to the large table size (still needs about ~300 KB for 80 modes according to JVET-P0304). Not sure whether giving up on this would help improve coding efficiency and/or simplify the design.
   4. It is desirable to reduce the number of GEO partitions and supported PU sizes. In particular, PU sizes of 64x128/128x64/128x128 should be disabled.  JVET-P0663 and JVET-P0107 have some good ideas that are worth trying out. Unlike the angular intra prediction in which a subset of the modes supported by a less capable encoder still provides decent gain (the angular intra prediction has increased from 9 modes in AVC to 33 modes in HEVC, and to 65 modes in VVC), the GEO design of JVET-P0884/JVET-P0885 does not seem to be quality scalable on the encoder side. Using the JVET-P0884 code and supporting the first 16 modes out of 82 modes on the encoder side led to 0.19% loss in RA as opposed to -0.22% RA gain if all the 82 modes would be supported. It would be more practical to support a reasonable amount of partitions and PU sizes. Otherwise, the GEO becomes just an off-line coding tool, but imposes unnecessary burden on the testing and verification of decoder designs. As a comparison, the wedge mode has 16 partitions and supports 9 PU sizes in an existing standard.
   5. The last round of subjective testing is disappointing in many senses. Nevertheless, it might be worth testing it again to make sure that the proposed technology at least does not hurt visual quality.
7. CE5 Cross-Component ALF (CCALF)
   1. Recommended adding the combination tests of the CE anchor with the joint Cb/Cr CC-ALF and the multiplication removal, to see whether further reduction of buffering and multiplication costs is possible without compromising coding efficiency.
8. CE3 Lossless mode
   1. In terms of signalling, lots of tests seem to assume that a picture or a slice is either entirely coded in lossy or in lossless mode, but the real use case might be that only portion of a picture/slice is coded in lossless mode.
      1. Examples include: TSRC/RRC switch in CE3-1.3, CE3-2.3/2.4, CE3-2.5.3, residual rotation in CE3-1.4 and lossless IBC blocks using RRC in CE3-2.6/2.7.
      2. Signalling using high-level flags to control those switches may not be sufficient in mixed lossy/lossless coding environment.
   2. Also, the high-level signalling used in CE3-2.5.1/CE3-2.5.2 (TU/CU level TSRC/RRC switch) may not be that relevant.
   3. **Additional comments posted on the email reflector**
9. With the adoption of JVET-P1001, the actual chroma QPs (instead of QPs derived from luma QPs) are now used for chroma de-blocking, including those for not-coded TUs. However, in the current design the chroma QP derivation for not-coded TUs is not defined. The spec is broken in this regard and needs to be fixed.
10. In the current spec text **alf\_chroma\_num\_alt\_filters\_minus1** is signalled using ue(v) but no maximum value for this element is defined, which leads to unbounded ALF APS size.  In the adopted test of JVET-O0090 variant CE5-4.2 and in VTM7.0 the maximum number of alternative chroma ALF filter sets is set to 8. (Note: the spec text is since fixed)
11. The adoption of JVET-P1026 has opened up the possibility of signaling non-zero MTS coefficients outside the top-left 16x16 TU region. The current design of checking last\_sig\_coeff\_pos <= (15, 15) does not guarantee at syntax level that all coefficients outside 16x16 are zero. The temporary fix is to impose a bitstream restriction, but a much more preferred solution is to prevent it at syntax level.
12. At the last meeting the chroma transform skip was adopted to support lossless mode, but the combination of LFNST and chroma TS was not disabled in the syntax table. Due to the adoption of JVET-P0365 which can disable scaling lists for LFNST, a decoder does not know what kind of inverse quantization and inverse transform to apply before the lfnst\_idx is decoded, which is signaled at the end of CU after luma/chroma transform coefficients. Allowing the combination of chroma TS and LFNST doubles transform coefficient buffering and processing latency.

* 1. **Memory bandwidth study for VTM7.0**

Broadcom conducted a memory bandwidth study by running both the VTM7.0 and VTM6.0 for CTC with a commercial motion compensation cache model integrated. The summary results of the random access configuration are provided in the table below (for informational purposes).

For class F, the peak memory bandwidth consumption (see MBW\_diff column) has roughly 2% increases for non-obvious reasons.

***Memory bandwidth comparison (VTM7.0 vs. VTM6.0, RA)***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random Access Main 10** | | | | | | | |
|  | **Over VTM-6.0** | | | | | | | |
|  | Y | U | V | TCM\_diff | ABW\_diff | MBW\_diff | EncT | DecT |
| Class A1 | 0.00% | -3.16% | -2.57% | -0.17% | -0.14% | -0.64% | 97% | 96% |
| Class A2 | 0.26% | -1.39% | -1.61% | 0.22% | 0.28% | 0.94% | 102% | 99% |
| Class B | 0.00% | -2.65% | -2.09% | 0.20% | 0.21% | 0.40% | 95% | 92% |
| Class C | 0.08% | -2.90% | -2.66% | 0.22% | 0.20% | -0.24% | 98% | 96% |
| Class E |  |  |  |  |  |  |  |  |
| **Overall** | 0.07% | -2.56% | -2.24% | 0.12% | 0.14% | 0.12% | 98% | 95% |
| Class D | 0.17% | -1.76% | -1.81% | 0.36% | 0.39% | -1.05% | 92% | 104% |
| Class F (optional) | 0.51% | -1.59% | -1.24% | 1.77% | 2.40% | 1.85% | 101% | 103% |

Where

* TCM\_diff : Total cache misses (over all the frames coded), percentage difference relative to VTM6.0.
* ABW\_diff: Average memory bandwidth (over all the frames coded), percentage difference relative to VTM6.0.
* MBW\_diff : Worst case (Max) memory bandwidth (among all the frames coded), percentage difference relative to VTM6.0.

MBW\_diff is the most important measure, which shows the worst case memory bandwidth consumption difference of VTM7.0 relative to VTM6.0.

* 1. **Bin to bit ratio study for VTM7.0**

JVET-Q0102 reports that the bin to bit ratio remains unchanged from VTM6.0 to VTM7.0. As far as the low-QP (QP =2, 7, 12, 17) AI configuration is concerned, the weighted and un-weighted bin to bit ratio of the VTM7.0 is roughly 18% and 10% higher than that of HM16.19, respectively.

In the weighted bin to bit ratio, a bypass bin is counted at 0.25 context coded bins; in the unweight bin to bit ratio, a bypass bin and a context coded bin carry an equal weight (1:1).

Related contributions

The following contributions are identified for the AHG.

CABAC bin to bit ratio (2)

1. JVET-Q0102, “AHG16: A study of bin to bit ratio for VTM7.0”, M. Zhou (Broadcom)
2. JVET-Q0436, “CABAC zero word threshold”, A. Browne, K. Sharman, S. Keating (Sony)

Entry point offset signalling (2)

1. JVET-Q0151, “AHG12: On entry point offset signalling”, M. Coban, Y.-J. Chang, V. Seregin, A. K. Ramasubramonian, M. Karczewicz (Qualcomm)
2. JVET-Q0205, “AHG12: On the presence of entry point signaling”, Hendry, S. Kim, S. Lee (LGE)

Chroma QP offset signalling (2)

1. JVET-Q0267, “AHG16: On Propagation of Chroma CU QP Offsets”, B. Heng, M. Zhou, W. Wan (Broadcom)
2. JVET-Q0476, “On chroma QP offsets for zero-CBF leading chroma coding blocks”, A. K. Ramasubramonian, B. Ray, G. Van der Auwera, M. Karczewicz (Qualcomm)

Maximum number of Chroma ALF filter sets (1)

1. JVET-Q0378, “Non-CE5: On the number of ALF Chroma filters”, P. Onno, G. Laroche, N. Ouedraogo (Canon)

Prevention of non-zero MTS coefficients in “zero-out” region (5)

1. JVET-Q0055, “On MTS index signaling”, J. Lainema (Nokia)
2. JVET-Q0057, “Coefficient group based restriction on MTS signaling”, M. Coban, M. Karczewicz, H.E. Egilmez, V. Seregin (Qualcomm)
3. JVET-Q0136, “Alignment of MTS index signalling condition with MTS zero-out”, M. Koo, M. Salehifar, J. Lim, S. Kim (LGE)
4. JVET-Q0430, “AHG16: Syntax based MTS zero out”, F. Le LÃ©annec, K. Naser, F. Galpin, P. Delagrange (InterDigital)
5. JVET-Q0448, “MTS dependent coefficient subblock scanning for zero-out”, S. De-Luxán-Hernández,T. Nguyen,B. Bross,H. Schwarz,D. Marpe,T. Wiegand (HHI)

Combination of LFNST with Chroma transform skip (9)

1. JVET-Q0099, “On Interaction of LFNST and Transform Skip”, T. Tsukuba, M. Ikeda, Y. Yagasaki, T. Suzuki (Sony)
2. JVET-Q0103, “LFNST Signaling for Chroma based on Chroma Transform Skip Flags”, H.E. Egilmez, A. Nalci, M. Coban, V. Seregin, M. Karczewicz (Qualcomm)
3. JVET-Q0106, “AHG16: Combination of LFNST with transform skip”, B. Heng, T. Hellman, M. Zhou, W. Wan (Broadcom)
4. JVET-Q0126, “Initializations and propagation of Chroma QP Offset”, K. Kawamura, S. Naito (KDDI)
5. JVET-Q0138, “Separate transform skip checking of Luma and Chroma for LFNST index signaling”, M. Koo, M. Salehifar, J. Lim, S. Kim (LGE)
6. JVET-Q0193, “LFNST signalling cleanup with TS checking”, M.-S. Chiang, C.-W. Hsu, C.-M. Tsai, T.-D. Chuang, C.-Y. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)
7. JVET-Q0328, “On LFNST signalling and transform skip”, C. Rosewarne, J. Gan (Canon)
8. JVET-Q0499, “On LFNST signaling with Transform-skip mode”, T.-C. Ma, X. Xiu, Y.-W. Chen, H.-J. Jhu, X. Wang (Kwai Inc.)
9. JVET-Q0529, “On LFNST index and MTS index signaling”, Z.-Y. Lin, M.-S. Chiang, T.-D. Chuang, C.-Y. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek)

Parallel merge and merge estimation region (3)

1. JVET-Q0185, “AHG16: On merge estimation region for VVC”, Y.-L. Hsiao, C.-C. Chen, C.-W. Hsu, T.-D. Chuang, C.-Y. Chen, Y.-W. Huang, S.-M. Lei (MediaTek), H. Huang, W.-J. Chien, T. Hsieh, V. Seregin, C.-C. Chen, K. Reuze, M. Karczewicz (Qualcomm)
2. JVET-Q0297, “AHG16: Merge estimation region with constrain in HMVP update”, H. Huang, W.-J. Chien, T. Hsieh, V. Seregin, C.-C. Chen, K. Reuze, M. Karczewicz (Qualcomm)
3. JVET-Q0356, “AHG16: Parallel Merge Estimation for VVC”, S. Esenlik, H. Gao, B. Wang, A. M. Kotra, E. Alshina (Huawei), Y.-L. Hsiao, C.-C. Chen, C.-W. Hsu, T.-D. Chuang, C.-Y. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)

VVC decoder implementation (2)

1. JVET-Q0211, “AHG16: VVC software decoder and performance analysis”, S. Gudumasu, S. Bandyopadhyay, A. Srivastava, Y. He, Y. He (InterDigital)
2. JVET-Q0386, “AHG16: Feature-rich implementation of VVC real-time decoding and playback on ARM based mobile clients”, J.Arumugam, S.Kotecha, S.Ramamurthy (Ittiam)

Other AHG16-related contributions (4)

1. JVET-Q0495, “AHG16: Simplified clip ranges for NL-ALF”, Y.-W. Chen, X. Xiu, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai Inc.)
2. JVET-Q0496, “AHG16: On motion shift derivation of SbTMVP “, Y.-W. Chen, X. Xiu, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai Inc.)
3. JVET-Q0500, “AHG16: On derivation of CCLM predictors”, Y.-W. Chen, X. Xiu, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai Inc.)
4. JVET-Q0513, “AHG16: Clipping residual samples for JCCR”, X. Xiu, Y.-W. Chen, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai)

The AHG recommended reviewing the input contributions.

# Project development

Contributions in this category were discussed XXday X Jan. XXXX–XXXX (chaired by XXX)

## Text and software development and general guidance (2)

[JVET-Q0041](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8866) AHG2: Editorial input on VVC draft text [Y.-K. Wang (Bytedance), B. Bross (HHI), V. Drugeon (Panasonic), J. Chen (Futurewei)]

This contribution was discussed Wednesday 8 January 2020 at 1015 (chaired by GJS & JRO).

This document provides integrations of a number of bug fixes reported in the bug tracking system as well as some other editorial changes made by the authors, based on the latest JVET output draft VVC text in JVET-P2001-vE.

It is suggested to use the attached spec text as the basis for integration of adoptions of the 17th JVET meeting. And proponents are encouraged to use this text as the basis for their proposed text changes.

List of logged changes:

* Fixed the bugs [#672](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/672), [#700](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/700), [#711](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/711), [#715](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/715), [#716](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/716), [#720](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/720), [#729](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/729), [#737](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/737), [#739](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/739).
* Fixed subpicture figure together with accompanying text ([#740](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/740)).
* Removed the editing note comment in the semantics of tile\_idx\_delta[ i ], which was concluded not needed after a study (input: Hendry).
* Fixed quite some format and style consistency issues in syntax tables, equations, etc. as well as some bugs in those places.
* Made some fixes in the semantics of DPS and VPS.
* Fixed the semantics of sps\_loop\_filter\_across\_virtual\_boundaries\_disabled\_present\_flag and ph\_loop\_filter\_across\_virtual\_boundaries\_disabled\_present\_flag, and changed the syntax element names to sps\_virtual\_boundaries\_present\_flag and ph\_virtual\_boundaries\_present\_flag.
* Fixed the following issues:
  + The definition of the sub-bitstream extraction process still referred to a target LayerId: "A specified process by which NAL units in a bitstream that do not belong to a target set, determined by a target OLS index and a target highest TemporalId and a target LayerId, are removed from the bitstream, …". However, the process in clause C.6 only mentions a target OLS index and a target highest TemporalId in the inputs, but no target LayerId.
  + In the VPS syntax: "ols\_hrd\_parameters( firstSubLayer, hrd\_max\_temporal\_id[ i ] )". hrd\_max\_temporal\_id is not defined anywhere. It should be "hrd\_max\_tid" instead.
  + In the VPS semantics, when deriving LayerUsedAsRefLayerFlag, it was initialised as follows: "LayerUsedAsRefLayerFlag[ j ] = 0." But j is not defined at this point, since it gets defined in the following loop.
  + Fixed a bug in Equation 40 by changing "layerIncludedFlag[ i ][ j ] = 1" to "layerIncludedFlag[ i ][ k ] = 1" and then changed the variable name to layerIncludedInOlsFlag[ ][ ] to be more intuitive.
  + In the semantics of dpb\_size\_only\_flag, only the value 1 was specified, twice, and in a contradicting way. The second sentence should be: "dpb\_size\_only\_flag[ i ] equal to 0 specifies that…".
  + In the semantics of num\_ols\_hrd\_params\_minus1: "When TotalNumOlss is greater than 1, the value of num\_ols\_hrd\_params\_minus1 is inferred to be equal to 0". However, num\_ols\_hrd\_params\_minus1 is signalled when TotalNumOlss is greater than 1. It should be "When TotalNumOlss is equal to 1, the value of num\_ols\_hrd\_params\_minus1 is inferred to be equal to 0".
  + In the semantics of hrd\_max\_tid, there should be an inference for this syntax element when the value of vps\_max\_sublayers\_minus1 is greater than 0, but vps\_all\_layers\_same\_num\_sublayers\_flag is 1, similarly as in the semantics of ptl\_max\_temporal\_id[ i ] and dpb\_max\_temporal\_id[ i ].
  + In the semantics of sps\_ptl\_dpb\_hrd\_params\_present\_flag: "The value of sps\_ptl\_dpb\_hrd\_params\_present\_flag shall be equal to vps\_independent\_layer\_flag[ nuh\_layer\_id ]." Everywhere else vps\_independent\_layer\_flag is indexed by the layer index rather than the layer identifier. It should be the following instead: "The value of sps\_ptl\_dpb\_hrd\_params\_present\_flag shall be equal to vps\_independent\_layer\_flag[ GeneralLayerIdx[ nuh\_layer\_id ] ]."
  + Annex A still mentioned bit\_depth\_luma\_minus8 and bit\_depth\_chroma\_minus8, although these two syntax elements have been replaced by bit\_depth\_minus8.
  + Annex A still mentioned num\_tile\_columns\_minus1 and num\_tile\_rows\_minus1, although these syntax elements do not exist anymore.
  + The list NestingLayerId[ ] and the variable NestingNumLayers specified in the semantics of the scalable nesting SEI message are not used in other places, thus two variable names were changed to be local variables, i.e., nestingLayerId[ ] and nestingNumLayers.
* Fixed the bugs [#600](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/600), [#713](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/713) and some typos.
* Fixed the bugs [#604](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/604), [#613](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/613), [#710](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/710), [#717](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/717), [#723](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/723) and some typos.
* Fixed the bugs [#742](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/742), [#751](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/751) and some other editorial bugs.
* Changed numerous occurences of recPictureL[ hx, vy ] etc. to recPicture[ hx ][ vy ] etc. (removal of 'L' and to be in the form of two-dimention array; input: Yang Wang).

Decision (Ed.&BF): It was agreed to use this as the basis of the further work.

[JVET-Q0273](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9098) AHG9: Editorial changes related to picture header [M. Pettersson, R. Sjöberg, M. Damghanian (Ericsson)]

## Test conditions (0)

## Performance assessment (3)

### Tool level analysis (AHG13) (3)

[JVET-Q0050](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8875) AHG13: Decoding Time and Energy Assessment of VTM-7.0 [M. Kränzler, C. J. Herglotz, A. Kaup]

[JVET-Q0053](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8878) AHG13: Analysis of the Energy Demand and Time Complexity of Several Coding Tools in VTM-7.0 [M. Kränzler, C. J. Herglotz, A. Kaup]

[JVET-Q0320](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9145) AHG13: Performance of VVC field coding [H.-W. Sun, H.-B. Teo, C.-S. Lim (Panasonic)]

### Overall VVC performance (0)

## Coding studies and tools on specific use cases (3)

[JVET-Q0438](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9264) Monochrome processing [A. Browne, K. Sharman, S. Keating (Sony)]

[JVET-Q0424](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9249) Mandatory film grain [R. Sjöberg, D. Saffar, M. Pettersson, M. Damghanian (Ericsson)]

[JVET-Q0533](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9379) Film Grain Synthesis Support [A. Norkin (Netflix)] [late]

[JVET-Q0614](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9460) Film Grain Synthesis Support in VVC [A. M. Tourapis, K. Rapaka, D. Singer, K. Kolarov (Apple)] [late]

## Test material (0)

## Conformance (1)

[JVET-Q0479](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9306) Updates to conformance testing for versatile video coding [I. Moccagatte, J. Boyce (Intel)]

## Implementation studies (AHG16) (11)

[JVET-Q0102](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8927) AHG16: A study of bin to bit ratio for VTM7.0 [M. Zhou (Broadcom)]

[JVET-Q0185](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9010) AHG16: On merge estimation region for VVC [Y.-L. Hsiao, C.-C. Chen, C.-W. Hsu, T.-D. Chuang, C.-Y. Chen, Y.-W. Huang, S.-M. Lei (MediaTek), H. Huang, W.-J. Chien, T. Hsieh, V. Seregin, C.-C. Chen, K. Reuzé, M. Karczewicz (Qualcomm)]

[JVET-Q0640](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9486) Crosscheck of JVET-P0185 (AHG16: On merge estimation region for VVC) [S. Esenlik (Huawei)] [late]

[JVET-Q0211](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9036) [AHG16] VVC software decoder and performance analysis [S. Gudumasu, S. Bandyopadhyay, A. Srivastava, Y. He, Y. He (InterDigital)]

[JVET-Q0297](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9122) AHG16: Merge estimation region [H. Huang, W.-J. Chien, T. Hsieh, V. Seregin, C.-C. Chen, K. Reuze, M. Karczewicz (Qualcomm)]

[JVET-Q0654](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9500) Cross-check of JVET-Q0297 (AHG16: Merge estimation region with constrain in HMVP update) [Y.-W. Chen (Kwai Inc.)] [late]

[JVET-Q0356](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9181) AHG16: Parallel Merge Estimation for VVC [S. Esenlik, H. Gao, B. Wang, A. M. Kotra, E. Alshina (Huawei), Y.-L. Hsiao, C.-C. Chen, C.-W. Hsu, T.-D. Chuang, C.-Y. Chen, Y.-W. Huang, S.-M. Lei (Mediatek)]

[JVET-Q0583](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9429) Crosscheck of JVET-Q0356 (AHG16: Parallel Merge Estimation for VVC) [B. Bross (HHI)] [late]

[JVET-Q0386](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9211) AHG16: Feature-rich implementation of VVC real-time decoding and playback on ARM based mobile clients [J. Arumugam, S. Kotecha, S. Ramamurthy (Ittiam)]

[JVET-Q0495](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9323) AHG16: Simplified clip ranges for NL-ALF [Y.-W. Chen, X. Xiu, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai Inc.)]

[JVET-Q0609](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9455) Crosscheck of JVET-Q0495: AHG16: Simplified clip ranges for NL-ALF [C.-H. Hung, Y.-H. Chao (Qualcomm)] [late]

[JVET-Q0496](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9324) AHG16: On motion shift derivation of SbTMVP [Y.-W. Chen, X. Xiu, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai Inc.)]

[JVET-Q0500](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9328) AHG16: On derivation of CCLM predictors [Y.-W. Chen, X. Xiu, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai Inc.)]

[JVET-Q0610](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9456) Crosscheck of JVET-Q0500: AHG16: On derivation of CCLM predictors [C.-H. Hung, C.-H. Chao (Qualcomm)] [late]

## Profile/level specification (4)

[JVET-Q0065](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8890) Level restrictions on maximum tile width for line buffer reduction [M. Ikeda, Y. Yagasaki, T. Suzuki (Sony)]

[JVET-Q0111](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8936) A proposal of an 8-bit profile [Li Zhang, Y.-K. Wang, J. Wang (Bytedance)]

[JVET-Q0112](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8937) On level definitions [Y.-K. Wang (Bytedance), Y. He (InterDigital), P. Wu (ZTE)]

See also the AHG8 report, which describes relevant email reflector discussion.

[JVET-Q0485](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9312) Profile and Level Definitions [W. Wan, T. Hellman, M. Zhou, B. Heng, P. Chen (Broadcom)]

# Core Experiments

## CE1: Deblocking filtering (5)

Contributions in this category were discussed Tuesday 8 Jan. 1645-1750 in Track B (chaired by JRO).

[JVET-Q0021](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9333) CE1: Summary Report on Deblocking Filtering [K. Andersson, A. Norkin]

Initially presented Wed 8 Jan 1645-1750

CE1-1.1: Long-tap deblocking filter JVET-Q0054

Long luma deblocking is unaware of samples at p6 and q6 since no gradient check include them.

- This can enable long luma deblocking although it should not be used

Add additional gradient calculation when maxFilterLengthP or maxFilterLengthQ is equal to 7

CE1-1.2 Modification to long-tap deblocking filter (gradient computation only) [JVET-Q0054](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8879)

Long luma deblocking is unaware of samples at p6 and q6 since no gradient check include them.

- This can enable long luma deblocking although it should not be used

Add additional gradient calculation when maxFilterLengthP or maxFilterLengthQ is equal to 7

CE1-1.3 Modification to long-tap deblocking filter (threshold change only) [JVET-Q0054](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8879)

Threshold for ramp insensitive long luma filter decision is too high for samples p0 to p5 and q0 to q5.

- This can enable long deblocking although it should not be used

Reduce beta threshold for ramp insensitive gradient calculations

CE1-1.4 Non-normative modification to beta threshold using beta offset (VTM / VVC Draft )

Reduce beta threshold for this test by using a beta threshold offset equivalent to setting beta\_offset\_div2 to -6.

Comments from cross-checkers on subjective quality

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test #** | **Cross-checker** | **PSNR&BR Match (Y/N)** | **RunT matched? (Y/N)** | **SW studied? (Y/N)** | **Significant inconsistencies between description and SW? (Y/N)** | **Studied visual quality? (Y/N)** | **Visual quality observations** | **Other comments** |
| CE1-1.1 | K. Misra | Y | Y | Y | N | Y | Observed in increase in blocking artifacts for some sequences; observed visual quality improvement in sequences that were over smoothed. |  |
| CE1-1.2 | F. Pu | Y | Similar as anchor | Y | N | Y | Local texture improvement for some clips, others are similar to/no worse than anchor |  |
| CE1-1.3 | S. Iwamura | Y | Y | Y | N | Y | Improvements on texture area can be observed in some sequences. For others, no worser than anchor | Viewed in full speed with professional monitor for some SDR/HDR sequences |
| CE1-1.4 | K. Andersson | Y | Similar as anchor | Y | N | Y | Improves on some of problem sequences but still remaining problems |  |

these comments, CE1-1.1 seems most promising in terms of improvement among those which would require a change of spec. CE1-1.4 which is non-normative also seems to improve on some cases.

There are also some HDR sequences but there is no viewing equipment for HDR -> restrict the viewing to SDR sequences.

In previous rounds of viewing, there was a problem that selected sequences had different resolutions.

Among the SDR sequences, 4 1920x1080 are available. Investigate the possibility of conducting a viewing session with 4 sequences at QP32/37 for CE1-1.1 and CE1-1.4. If possible, 2 LDB and 2 RA sequences. It was requested to make a preliminary pre-check with relevant people involved in previous viewing actions and report back if involvement of more experts makes sense.

It was reported on Thu. 9 that differences are there, but it highly depends on the view direction if they are seen or not. Very likely, a similar test as used e.g. in Marrakesh (where the differences for the support of long deblocking filter were more evident) might not indicate benefit.

CE1-2 Deblocking for TPM [JVET-Q0084](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8909)

Set BS (Boundary Strength) for luma to be 1 if the boundary is between TPM blending area and another CU by adding one condition to the BS derivation process

Cross-checker’s comments:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CE1-2 | G. Li | Y | Y | Y | N | Y | Mostly equal visual quality when playing in full speed. Some slight differences can be observed when doing side-by-side viewing of single frames, sometimes better details than anchor. |  |

It does seem to be difficult to see improvements according to the cross-checkers comments. It was requested to perform an informal viewing with relevant people involved in previous viewing actions and report back if involvement of more experts makes sense.

It was reported back (Thu. 1400) that it would be even less likely that differences are seen than for case of CE1-1. The independent experts were not able to see different artifacts caused by different encoder decisions, without clear tendency. It would not make sense to involve more experts in a more formal viewing exercise.

CE1-3.1 Deblocking for blocks with different BCW weights [JVET-Q0063](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8888)

In VTM6.0, the deblocking bS derivation process does not consider the cases when the prediction weights of the two adjacent blocks are not the same. For example, if the two adjacent blocks both have all-zero prediction residuals, the same motion vectors, and the same reference pictures, but one block is coded with unequal weighted bi-prediction (e.g., nonzero BCW index or TPM) and the other block is coded with an equal weighted bi-prediction, a potential block artifact would appear at the current edge. In VTM6.0, the bS value is set to 0 (i.e., no deblocking) for the edge of the given example.

CE1-3.2 Aspect 2: Boundary strength derivation for CUs with BCW [JVET-Q0096](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8921)

Neighbouring CUs can have different BCW weights which can cause blocking artifacts.

The proposed modification of the specification [1] of the BS derivation.

Cross-checker’s comments:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CE1-3.1 | K. Misra |  |  |  |  |  |  |  |
| CE1-3.2 | C.-M. Tsai | Y | Y | Y | N | Y | Mostly equal visual quality by viewing in full speed |  |

It does seem to be difficult to see improvements according to the cross-checkers comments. It was requested to perform an informal viewing with relevant people involved in previous viewing actions and report back if involvement of more experts makes sense.

It was reported back (Thu. 1400) that it would be even less likely that differences are seen than for case of CE1-1. The independent experts were not able to see different artifacts caused by different encoder decisions, without clear tendency. It would not make sense to involve more experts in a more formal viewing exercise.

Revisit: Organize an informal viewing session regarding CE1-1, CE1-2, CE1-3, record opinion of more experts. Proponents and cross-checkers should also be present.

CE1-4: Deblocking on affine sub-PU with PROF

Proposal in this sub-CE investigates disabling deblocking on affine sub-PU boundaries when the PROF tool is used.

Cross-checker’s comments:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CE1-4 | X. Meng | Y | Similar as anchor | Y | N | Y | No obvious harm on visual quality |  |

There seems to be no impact on visual quality. The intent of this proposal is simplification. It is however not obvious that the saving of computation would be relevant, and even more specific condition check would be necessary whether deblocking is to be applied or not at a given subblock level. Does not decrease the worst case complexity. For hardware, there would be no benefit. The decoding runtime is increased to 99%. The benefit is too small to justify an adoption.

[JVET-Q0054](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8879) CE1: CE1-1.1 to CE1-1.3: Fixes for long luma deblocking filter decision [K. Andersson, J. Enhorn (Ericsson)]

[JVET-Q0063](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8888) CE1-3.1: Deblocking for blocks with different BCW weights [C.-M. Tsai, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek), A. M. Kotra, S. Esenlik, B. Wang, H. Gao, E. Alshina (Huawei), X. Meng, S. Wang, S. Ma (PKU), X. Zheng (DJI)]

[JVET-Q0084](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8909) CE1-2: Deblocking for TPM (Triangular Partition Mode) [X.W. Meng, S.S. Wang, S.W. Ma (PKU), S. Iwamura, S. Nemoto, A. Ichigaya(NHK), X.Zheng (DJI)]

[JVET-Q0094](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8919) CE1-4: Disable deblocking for affine sub-PU edges when PROF is applied [G. Li, X. Li, X. Xu, S. Liu (Tencent)]

[JVET-Q0096](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8921) CE1-3.2: Boundary strength derivation for blocks with BCW [S. Iwamura, S. Nemoto, A. Ichigaya (NHK), K. Andersson, R. Yu, J. Enjorn (Ericsson)]

## CE2: Palette mode coding (5)

Contributions in this category were discussed Tuesday 8 Jan. 1900–2150 in Track B (chaired by JRO).

[JVET-Q0022](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9259) CE2: Summary Report on Palette Mode Coding [X. Xu, Y.-H. Chao, Y.-C. Sun, J. Xu]

Initially discussed Jan. 07, 1900-2150

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test** | **Tester** | **Document** | **Tool description** | **Cross checker** |
| CE2-1.1 | W. Zhu  (ByteDance) | JVET-Q0075 | QP dependent fixed-length binarization for escape coding | D. Luo  (Alibaba) |
| CE2-1.2 | H.-J. Jhu  (Kwai) | JVET-Q0066 | Escape value is binarized by fixed-length code with a length determine by maximum quantized value no change on escape de-quantization | Y.-H. Chao  (Qualcomm) |
| CE2-1.3 | H.-J. Jhu  (Kwai)  S. Yoo  (LGE) | JVET-Q0067 | Escape value is binarized by truncated binary code with a length determine by maximum quantized value | Y.-H. Chao  (Qualcomm) |
| CE2-2.1 | W. Zhu  (ByteDance)  H. Jang  (LGE) | JVET-Q0076 | Resetting predictor palette at CTU row | M.G. Sarwer  (Alibaba) |
| CE2-3.1a | Y.-H. Chao  (Qualcomm) | JVET-Q0064 | Simplified palette predictor update process for small blocks: restrict entries allowed for prediction to the first W x H entries | H.-J. Jhu  (Kwai) |
| CE2-3.1b | Y.-H. Chao | JVET-Q0064 | Simplified palette predictor update process for small blocks: restrict entries allowed for prediction to the first (W x H ) / 2 entries | H.-J. Jhu  (Kwai) |
| CE2-3.1c | Y.-H. Chao | JVET-Q0064 | Simplified palette predictor update process for small blocks: Bypass predictor update for CU size < 8x8 | H.-J. Jhu  (Kwai) |
| CE2-3.1d | Y.-H. Chao | JVET-Q0064 | Simplified palette predictor update process for small blocks: Bypass predictor update for CU size <= 8x8 | H.-J. Jhu  (Kwai) |

CE2-1.x is on escape coding modification. Results:

Table 3: CE2-1.x test results with VTM-7.0+DualTree=1, normal QP range

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **AI Over VTM-7.0** | | | | | | **RA Over VTM-7.0** | | | | | |
|  | **Test#** | **Y** | **U** | **V** | **EncT** | **DecT** | **Y** | | **U** | **V** | **EncT** | **DecT** |
| TGM 1080p | CE2-1.1 | 0.07% | 0.00% | 0.01% | 99% | 100% | 0.07% | | -0.06% | -0.06% | 99% | 100% |
| CE2-1.2 | -0.09% | -0.07% | -0.06% | 101% | 100% | -0.03% | | -0.06% | -0.04% | 100% | 100% |
| CE2-1.3 | -0.10% | -0.07% | -0.05% | 97% | 99% | -0.05% | | -0.11% | -0.06% | 100% | 102% |
| TGM 720p | CE2-1.1 | 0.00% | -0.01% | 0.07% | 100% | 99% | 0.05% | | 0.00% | -0.09% | 100% | 100% |
| CE2-1.2 | -0.01% | -0.08% | -0.02% | 100% | 100% | 0.01% | | -0.01% | 0.09% | 100% | 100% |
| CE2-1.3 | -0.02% | -0.08% | -0.05% | 97% | 96% | 0.00% | | 0.00% | 0.09% | 100% | 100% |
| Animation | CE2-1.1 | -0.01% | 0.00% | 0.02% | 99% | 99% | 0.07% | | 0.07% | 0.06% | 99% | 99% |
| CE2-1.2 | -0.03% | -0.01% | 0.03% | 101% | 99% | 0.05% | | 0.03% | 0.11% | 99% | 100% |
| CE2-1.3 | -0.03% | -0.03% | 0.00% | 98% | 95% | 0.00% | | 0.00% | 0.04% | 100% | 101% |
| Mixed Content | CE2-1.1 | 0.05% | 0.04% | -0.01% | 99% | 99% | 0.11% | | -0.01% | 0.02% | 100% | 100% |
| CE2-1.2 | -0.04% | 0.02% | -0.03% | 100% | 100% | 0.14% | | 0.29% | 0.28% | 100% | 100% |
| CE2-1.3 | -0.03% | 0.01% | -0.02% | 98% | 97% | 0.06% | | 0.14% | 0.20% | 100% | 99% |
| Camera-Captured | CE2-1.1 | -0.01% | -0.01% | 0.00% | 100% | 99% | 0.01% | | 0.00% | 0.04% | 99% | 99% |
| CE2-1.2 | 0.00% | -0.01% | 0.00% | 100% | 101% | 0.01% | | -0.03% | 0.02% | 100% | 101% |
| CE2-1.3 | 0.00% | -0.01% | 0.01% | 98% | 97% | 0.01% | | -0.03% | 0.02% | 100% | 102% |

Table 4: CE2-1.x test results with VTM-7.0+DualTree=0, normal QP range

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **AI Over VTM-7.0** | | | | | | **RA Over VTM-7.0** | | | | | |
|  | **Test#** | **Y** | **U** | **V** | **EncT** | **DecT** | **Y** | | **U** | **V** | **EncT** | **DecT** |
| TGM 1080p | CE2-1.1 | -0.02% | -0.18% | -0.16% | 100% | 100% | -0.10% | | -0.38% | -0.29% | 100% | 99% |
| CE2-1.2 | -0.20% | -0.08% | -0.04% | 100% | 99% | -0.15% | | 0.04% | -0.09% | 100% | 100% |
| CE2-1.3 | -0.24% | -0.22% | -0.16% | 98% | 98% | -0.16% | | 0.02% | -0.09% | 100% | 101% |
| TGM 720p | CE2-1.1 | -0.02% | -0.03% | -0.03% | 100% | 100% | -0.06% | | -0.09% | -0.28% | 100% | 99% |
| CE2-1.2 | -0.04% | -0.03% | -0.01% | 101% | 100% | -0.03% | | 0.05% | -0.02% | 100% | 100% |
| CE2-1.3 | -0.07% | -0.03% | -0.05% | 97% | 96% | -0.03% | | 0.09% | 0.03% | 100% | 102% |
| Animation | CE2-1.1 | 0.01% | -0.02% | -0.04% | 100% | 100% | 0.08% | | 0.08% | 0.04% | 100% | 100% |
| CE2-1.2 | -0.01% | 0.04% | 0.00% | 100% | 100% | 0.09% | | 0.05% | 0.07% | 100% | 100% |
| CE2-1.3 | -0.04% | 0.01% | -0.02% | 97% | 98% | 0.07% | | 0.09% | 0.09% | 100% | 102% |
| Mixed Content | CE2-1.1 | -0.08% | -0.16% | -0.21% | 100% | 99% | -0.20% | | -0.42% | -0.57% | 99% | 99% |
| CE2-1.2 | -0.05% | 0.02% | 0.03% | 100% | 100% | 0.01% | | 0.09% | 0.01% | 99% | 100% |
| CE2-1.3 | -0.06% | -0.02% | -0.02% | 97% | 96% | -0.03% | | 0.13% | 0.01% | 100% | 101% |
| Camera-Captured | CE2-1.1 | 0.00% | 0.00% | 0.00% | 100% | 99% | 0.00% | | 0.00% | -0.01% | 99% | 100% |
| CE2-1.2 | 0.00% | 0.00% | 0.00% | 100% | 101% | 0.00% | | 0.00% | -0.01% | 101% | 100% |
| CE2-1.3 | 0.00% | 0.00% | 0.00% | 98% | 96% | 0.00% | | 0.00% | -0.01% | 100% | 100% |

5: CE2-1.x test results with VTM-7.0+DualTree=1, low QP range

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **AI Over VTM-7.0** | | | | | | **RA Over VTM-7.0** | | | | | |
|  | **Test#** | **Y** | **U** | **V** | **EncT** | **DecT** | **Y** | | **U** | **V** | **EncT** | **DecT** |
| TGM 1080p | CE2-1.1 | -1.10% | -1.46% | -1.54% | 100% | 100% | -1.28% | | -1.58% | -1.48% | 100% | 99% |
| CE2-1.2 | -1.40% | -1.26% | -1.31% | 101% | 100% | -1.23% | | -1.23% | -1.25% | 100% | 100% |
| CE2-1.3 | -1.47% | -1.32% | -1.38% | 97% | 99% | -1.42% | | -1.51% | -1.48% | 100% | 101% |
| TGM 720p | CE2-1.1 | -0.57% | -0.63% | -0.50% | 100% | 100% | -0.73% | | -0.29% | -0.39% | 100% | 100% |
| CE2-1.2 | -0.46% | -0.42% | -0.44% | 100% | 100% | -0.30% | | -0.19% | -0.34% | 100% | 100% |
| CE2-1.3 | -0.54% | -0.47% | -0.46% | 98% | 96% | -0.28% | | -0.20% | -0.32% | 100% | 101% |
| Animation | CE2-1.1 | -0.33% | -0.33% | -0.38% | 99% | 100% | -0.21% | | -0.39% | -0.37% | 99% | 99% |
| CE2-1.2 | -0.31% | -0.18% | -0.17% | 100% | 100% | -0.24% | | -0.34% | -0.33% | 100% | 100% |
| CE2-1.3 | -0.42% | -0.26% | -0.32% | 98% | 99% | -0.24% | | -0.37% | -0.38% | 102% | 102% |
| Mixed Content | CE2-1.1 | -1.02% | -1.38% | -1.47% | 100% | 100% | -0.84% | | -0.07% | -0.16% | 100% | 99% |
| CE2-1.2 | -0.94% | -1.08% | -1.13% | 100% | 99% | -0.39% | | 0.30% | 0.24% | 100% | 100% |
| CE2-1.3 | -0.96% | -1.12% | -1.15% | 98% | 98% | -0.52% | | 0.29% | 0.25% | 100% | 103% |
| Camera-Captured | CE2-1.1 | 0.00% | -0.01% | -0.02% | 99% | 100% | -0.01% | | -0.01% | 0.02% | 99% | 100% |
| CE2-1.2 | 0.00% | 0.00% | -0.02% | 101% | 99% | -0.01% | | -0.01% | 0.03% | 100% | 101% |
| CE2-1.3 | 0.00% | 0.00% | -0.02% | 97% | 99% | -0.01% | | -0.01% | 0.04% | 103% | 105% |

6: CE2-1.x test results with VTM-7.0+DualTree=0, low QP range

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **AI Over VTM-7.0** | | | | | | **RA Over VTM-7.0** | | | | | |
|  | **Test#** | **Y** | **U** | **V** | **EncT** | **DecT** | **Y** | | **U** | **V** | **EncT** | **DecT** |
| TGM 1080p | CE2-1.1 | -2.80% | -3.63% | -3.46% | 100% | 100% | -2.08% | | -2.45% | -2.27% | 99% | 98% |
| CE2-1.2 | -2.58% | -3.03% | -2.93% | 99% | 101% | -1.80% | | -1.95% | -1.84% | 100% | 100% |
| CE2-1.3 | -2.83% | -3.28% | -3.19% | 98% | 102% | -2.10% | | -2.27% | -2.17% | 100% | 100% |
| TGM 720p | CE2-1.1 | -1.06% | -1.13% | -1.33% | 100% | 98% | -0.75% | | -0.95% | -0.99% | 99% | 98% |
| CE2-1.2 | -0.91% | -0.79% | -1.13% | 101% | 99% | -0.42% | | -0.32% | -0.57% | 100% | 100% |
| CE2-1.3 | -0.93% | -0.84% | -1.16% | 98% | 97% | -0.52% | | -0.43% | -0.69% | 100% | 102% |
| Animation | CE2-1.1 | -0.36% | -1.27% | -1.22% | 99% | 100% | -0.31% | | -0.51% | -0.56% | 100% | 98% |
| CE2-1.2 | -0.37% | -0.63% | -0.69% | 100% | 101% | -0.29% | | -0.36% | -0.40% | 100% | 100% |
| CE2-1.3 | -0.52% | -0.87% | -0.92% | 98% | 100% | -0.34% | | -0.47% | -0.47% | 102% | 105% |
| Mixed Content | CE2-1.1 | -1.75% | -2.35% | -2.38% | 99% | 98% | -1.09% | | -1.43% | -1.33% | 99% | 100% |
| CE2-1.2 | -1.39% | -1.74% | -1.71% | 100% | 100% | -0.63% | | -0.55% | -0.49% | 99% | 101% |
| CE2-1.3 | -1.48% | -1.81% | -1.78% | 99% | 96% | -0.79% | | -0.65% | -0.59% | 101% | 102% |
| Camera-Captured | CE2-1.1 | 0.00% | 0.00% | -0.01% | 100% | 100% | 0.00% | | 0.00% | 0.02% | 99% | 100% |
| CE2-1.2 | 0.00% | 0.01% | 0.00% | 101% | 99% | -0.01% | | -0.01% | 0.00% | 100% | 101% |
| CE2-1.3 | 0.00% | 0.01% | 0.00% | 98% | 98% | 0.00% | | -0.01% | 0.01% | 104% | 105% |

The benefit at normal QP range is negligible.

For low QP, the BD rates indicate higher gain. From the RD plots, this is mostly contributed at the very low end, where palette escape coding would be lossless for QP=2. However, BD rates may be misleading here, as the PSNR values are extremely high with large fluctuations over the sequence, such that the averaging of PSNR in the BD computation is misleading (and still, gains in the range of 2% are relatively low for screen content classes).

The current results therefore do not allow a real quantification of the benefit. Revisit: Report results that compute BD rate for low QP range based on sequence PSNR (i.e. compute average MSE and then PSNR), as e.g. suggested in JVET-P0393.

The current method of EG3 coding of escape is likely not optimum for low QP. On the other hand, the range of binarization is made QP dependent in the CE2-1.x proposals, which is also undesirable (as currently QP is currently not required in parsing, such that in particular with local QP adaptation this is highly undesirable. It is mentioned that there are non-CE contributions that resolve this issue.

Beyond that, it is also suggested to study the potential benefit of palette for lossless coding of screen content.

CE2-2.1 (JVET-Q0076)

Predictor palette is reset at the beginning of decoding each CTU row to enable parallel processing. The setting of using multiple tile columns are used to test to evaluate the performance changes caused by resetting. Furthermore, a picture is divided into 4 tile columns. The version “\*” has 4 tile columns, the other version 1 tile column.

7: CE2-2.1 test results with VTM-7.0+DualTree=1, normal QP range

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **AI Over VTM-7.0** | | | | | | **RA Over VTM-7.0** | | | | | |
|  | **Test#** | **Y** | **U** | **V** | **EncT** | **DecT** | **Y** | | **U** | **V** | **EncT** | **DecT** |
| TGM 1080p | CE2-2.1 | 0.09% | 0.11% | 0.08% | 99% | 99% | 0.36% | | 0.52% | 0.46% | 99% | 99% |
| CE2-2.1\* | 0.37% | 0.50% | 0.34% | 99% | 100% | 0.47% | | 0.64% | 0.52% | 99% | 100% |
| TGM 720p | CE2-2.1 | 0.35% | 0.06% | 0.11% | 100% | 99% | 0.37% | | 0.42% | 0.64% | 99% | 98% |
| CE2-2.1\* | 0.33% | 0.20% | 0.43% | 99% | 101% | 0.41% | | 0.42% | 0.67% | 100% | 101% |
| Animation | CE2-2.1 | 0.10% | 0.25% | 0.32% | 98% | 98% | -0.03% | | 0.22% | 0.36% | 98% | 99% |
| CE2-2.1\* | 0.08% | 0.29% | 0.23% | 100% | 100% | 0.00% | | 0.18% | 0.33% | 100% | 100% |
| Mixed Content | CE2-2.1 | 0.07% | 0.41% | 0.31% | 98% | 99% | 0.21% | | 0.57% | 0.53% | 98% | 100% |
| CE2-2.1\* | 0.16% | 0.46% | 0.38% | 99% | 101% | 0.27% | | 0.71% | 0.64% | 100% | 101% |
| Camera-Captured | CE2-2.1 | 0.00% | -0.01% | 0.00% | 98% | 100% | -0.02% | | -0.04% | 0.03% | 98% | 100% |
| CE2-2.1\* | 0.01% | -0.03% | 0.00% | 97% | 98% | 0.00% | | 0.01% | -0.01% | 101% | 101% |

"\*" refer to using 4 tile columns per picture setting.

8: CE2-2.1 test results with VTM-7.0+DualTree=0, normal QP range

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **AI Over VTM-7.0** | | | | | | **RA Over VTM-7.0** | | | | | |
|  | **Test#** | **Y** | **U** | **V** | **EncT** | **DecT** | **Y** | | **U** | **V** | **EncT** | **DecT** |
| TGM 1080p | CE2-2.1 | 0.74% | 1.09% | 0.98% | 100% | 99% | 0.53% | | 0.85% | 0.69% | 99% | 99% |
| CE2-2.1\* | 1.90% | 2.34% | 2.15% | 100% | 101% | 0.94% | | 1.20% | 1.03% | 100% | 100% |
| TGM 720p | CE2-2.1 | 1.00% | 1.43% | 2.05% | 97% | 95% | 0.76% | | 1.25% | 1.96% | 98% | 96% |
| CE2-2.1\* | 1.36% | 1.97% | 2.08% | 97% | 98% | 1.14% | | 1.71% | 2.30% | 100% | 99% |
| Animation | CE2-2.1 | 0.77% | 1.71% | 1.75% | 98% | 100% | 0.14% | | 0.74% | 0.93% | 98% | 98% |
| CE2-2.1\* | 0.71% | 1.47% | 1.60% | 99% | 100% | 0.10% | | 0.62% | 0.76% | 101% | 101% |
| Mixed Content | CE2-2.1 | 0.67% | 0.90% | 0.68% | 98% | 98% | 0.52% | | 0.92% | 0.70% | 97% | 100% |
| CE2-2.1\* | 1.09% | 1.40% | 1.35% | 100% | 101% | 0.72% | | 1.03% | 0.73% | 100% | 101% |
| Camera-Captured | CE2-2.1 | 0.00% | 0.00% | 0.00% | 99% | 102% | 0.00% | | 0.00% | 0.00% | 97% | 98% |
| CE2-2.1\* | 0.00% | 0.00% | 0.00% | 100% | 101% | 0.00% | | 0.00% | 0.00% | 101% | 101% |

"\*" refer to using 4 tile columns per picture setting.

The reset is done as for WPP, but the proposal is doing it always (even if WPP is not used). Benefit is not clear, it causes some loss under CTC, and it could also be done as encoder choice (see JVET-Q0502).

CE2-3.x (JVET-Q0064)

Two methods are tested to simplify the palette predictor update for small coding units in order to solve the issue of pipeline latency. In the first method, the elements in the palette predictor that are allowed to be used in predicting palette table is restricted to the first W x H elements (W and H stands for width and height of the CU). In the second method, palette predictor update is bypasses for CU size < T.

Subtests:

* Restrict the entries in the palette predictor that are allowed to be used in prediction to the first W x H elements
* Restrict the entries in the palette predictor that are allowed to be used in prediction to the first ( W x H ) / 2 elements
* Palette predictor update is bypassed for CU size (W x H ) < 64
* Palette predictor update is bypassed for CU size (W x H ) <= 64

9: CE2-3.1x test results with VTM-7.0+DualTree=1, normal QP range

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **AI Over VTM-7.0** | | | | | | **RA Over VTM-7.0** | | | | | |
|  | **Test#** | **Y** | **U** | **V** | **EncT** | **DecT** | **Y** | | **U** | **V** | **EncT** | **DecT** |
| TGM 1080p | CE2-3.1a | -0.04% | -0.01% | -0.01% | 100% | 101% | 0.01% | | 0.00% | 0.02% | 100% | 100% |
| CE2-3.1b | -0.06% | -0.01% | -0.02% | 100% | 102% | 0.07% | | 0.06% | 0.10% | 101% | 101% |
| CE2-3.1c | 0.05% | 0.04% | 0.04% | 100% | 105% | 0.12% | | 0.14% | 0.13% | 100% | 101% |
| CE2-3.1d | 0.15% | 0.09% | 0.09% | 100% | 102% | 0.24% | | 0.30% | 0.24% | 101% | 101% |
| TGM 720p | CE2-3.1a | 0.02% | -0.01% | 0.05% | 99% | 102% | -0.01% | | -0.01% | 0.05% | 100% | 98% |
| CE2-3.1b | 0.04% | -0.04% | -0.03% | 100% | 102% | 0.09% | | 0.07% | 0.08% | 101% | 99% |
| CE2-3.1c | 0.04% | -0.01% | 0.07% | 100% | 101% | 0.07% | | 0.08% | 0.09% | 100% | 102% |
| CE2-3.1d | 0.14% | -0.04% | 0.10% | 100% | 100% | 0.19% | | 0.13% | 0.22% | 100% | 101% |
| Animation | CE2-3.1a | 0.01% | 0.01% | 0.00% | 100% | 102% | 0.00% | | 0.03% | 0.00% | 100% | 99% |
| CE2-3.1b | -0.01% | 0.03% | 0.02% | 101% | 102% | -0.05% | | 0.00% | -0.02% | 100% | 99% |
| CE2-3.1c | 0.02% | 0.06% | 0.07% | 100% | 100% | 0.05% | | 0.07% | 0.06% | 100% | 101% |
| CE2-3.1d | 0.05% | 0.11% | 0.14% | 101% | 98% | 0.01% | | 0.02% | 0.09% | 100% | 99% |
| Mixed Content | CE2-3.1a | -0.02% | 0.01% | 0.01% | 100% | 100% | 0.07% | | 0.11% | 0.14% | 100% | 100% |
| CE2-3.1b | 0.01% | 0.01% | -0.01% | 100% | 102% | 0.09% | | 0.10% | 0.22% | 101% | 100% |
| CE2-3.1c | 0.02% | 0.05% | 0.02% | 100% | 99% | 0.09% | | 0.12% | 0.22% | 99% | 100% |
| CE2-3.1d | 0.06% | 0.08% | 0.06% | 100% | 101% | 0.13% | | 0.13% | 0.16% | 102% | 101% |
| Camera-Captured | CE2-3.1a | 0.00% | 0.00% | 0.00% | 100% | 107% | 0.00% | | 0.00% | 0.00% | 101% | 99% |
| CE2-3.1b | 0.00% | 0.00% | 0.00% | 101% | 104% | 0.00% | | 0.00% | 0.00% | 101% | 100% |
| CE2-3.1c | 0.00% | -0.02% | -0.01% | 100% | 104% | -0.01% | | -0.01% | 0.03% | 101% | 101% |
| CE2-3.1d | 0.00% | -0.02% | -0.01% | 101% | 101% | -0.01% | | 0.00% | 0.00% | 101% | 102% |

* 10: CE2-3.1x test results with VTM-7.0+DualTree=0, normal QP range

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **AI Over VTM-7.0** | | | | | | **RA Over VTM-7.0** | | | | | |
|  | **Test#** | **Y** | **U** | **V** | **EncT** | **DecT** | **Y** | | **U** | **V** | **EncT** | **DecT** |
| TGM 1080p | CE2-3.1a | 0.08% | 0.09% | 0.12% | 101% | 100% | 0.06% | | 0.06% | 0.05% | 100% | 99% |
| CE2-3.1b | 0.47% | 0.48% | 0.48% | 102% | 100% | 0.33% | | 0.33% | 0.30% | 101% | 100% |
| CE2-3.1c | 0.13% | 0.19% | 0.16% | 101% | 102% | 0.12% | | 0.17% | 0.13% | 100% | 100% |
| CE2-3.1d | 0.41% | 0.55% | 0.47% | 101% | 99% | 0.38% | | 0.49% | 0.40% | 101% | 100% |
| TGM 720p | CE2-3.1a | 0.04% | 0.00% | 0.05% | 100% | 101% | 0.02% | | 0.09% | 0.16% | 100% | 103% |
| CE2-3.1b | 0.13% | 0.14% | 0.20% | 100% | 99% | 0.17% | | 0.16% | 0.26% | 100% | 100% |
| CE2-3.1c | 0.03% | 0.12% | 0.11% | 100% | 99% | 0.03% | | 0.09% | 0.18% | 100% | 99% |
| CE2-3.1d | 0.22% | 0.34% | 0.42% | 100% | 99% | 0.07% | | 0.15% | 0.30% | 100% | 99% |
| Animation | CE2-3.1a | -0.02% | -0.01% | -0.04% | 100% | 103% | 0.02% | | 0.06% | 0.02% | 100% | 99% |
| CE2-3.1b | 0.04% | 0.02% | 0.01% | 101% | 103% | 0.03% | | 0.02% | -0.01% | 101% | 100% |
| CE2-3.1c | 0.10% | 0.20% | 0.18% | 100% | 102% | 0.09% | | 0.21% | 0.30% | 101% | 99% |
| CE2-3.1d | 0.21% | 0.35% | 0.38% | 100% | 100% | 0.10% | | 0.14% | 0.19% | 101% | 99% |
| Mixed Content | CE2-3.1a | 0.08% | 0.01% | 0.00% | 100% | 102% | 0.02% | | 0.07% | 0.11% | 100% | 100% |
| CE2-3.1b | 0.33% | 0.25% | 0.21% | 101% | 101% | 0.28% | | 0.29% | 0.15% | 101% | 100% |
| CE2-3.1c | 0.06% | 0.03% | 0.06% | 100% | 102% | 0.00% | | 0.01% | 0.00% | 100% | 100% |
| CE2-3.1d | 0.13% | 0.23% | 0.20% | 100% | 100% | 0.22% | | 0.27% | 0.24% | 101% | 100% |
| Camera-Captured | CE2-3.1a | 0.00% | 0.00% | 0.00% | 99% | 96% | 0.00% | | 0.00% | 0.00% | 101% | 97% |
| CE2-3.1b | 0.00% | 0.00% | 0.00% | 101% | 98% | 0.00% | | 0.00% | 0.00% | 101% | 98% |
| CE2-3.1c | 0.00% | 0.00% | 0.00% | 100% | 97% | 0.00% | | 0.00% | 0.00% | 101% | 97% |
| CE2-3.1d | 0.00% | 0.00% | 0.00% | 101% | 96% | 0.00% | | 0.00% | 0.00% | 101% | 98% |

The current design requires checking maximum 64 predictors regardless of the block size. Worst case would be 4x4 blocks with this regard.

- Method a restricts the number of checks to 16 for 4x4, 32, for 4x8/8x4, 64 for >=64 samples.

- Methods b is even more restrictive, but also has slightly more loss

- Methods c and d completely inhibit the update for small blocks

Method a is the most appropriate solution in terms of complexity benefit vs. compression.

It is however not obvious that the latency problem in palette mode is really severe, compared to other elements of VVC with 4x4 block size (in particular, intra and IBC).

No need for action.

[JVET-Q0064](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8889) CE2-3.1: Simplification of palette predictor update for small CUs [Y.-H. Chao, T. Hsieh, W.-J. Chien, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-Q0066](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8891) CE2-1.2: Fixed-length binarization of palette escape value [H.-J. Jhu, X. Xiu, Y.-W. Chen, T.-C. Ma, X. Wang (Kwai Inc.)]

[JVET-Q0067](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8892) CE2-1.3: Truncated binarization of palette escape value [H.-J. Jhu, X. Xiu, Y.-W. Chen, T.-C. Ma, X. Wang (Kwai Inc.), S. Yoo, J. Zhao, J. Nam, J. Choi, S. H. Kim, J. H. Lim (LGE)]

[JVET-Q0075](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8900) CE2-1.1: QP dependent fixed-length binarization for escape coding [W. Zhu, J. Xu, L. Zhang (Bytedance)]

[JVET-Q0076](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8901) CE2-2.1: Resetting palette predictor at CTU row [W. Zhu, L. Zhang, J. Xu (Bytedance), H. Jang, J. Nam, S. Kim, J. Lim (LGE)]

## CE3: Lossless coding (12)

Contributions in this category were discussed Wednesday 8 Jan. 2150–2250 and Thursday 9 Jan. 0800-1015 in Track B (chaired by JRO).

[JVET-Q0023](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9302) CE3: Summary Report on Lossless Coding [T. Nguyen, T.-C. Ma, A. Nalci]

Initially discussed Jan. 08, 2150-2250

CE3-1: Regular and TS residual coding (RRC, TSRC) for lossless coding, and modifications to RRC and TSRC for lossless and lossy operation modes

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tester** | **Tool** | **Cross checker** |
| CE3-1.1\* | H. Wang (Qualcomm) | JVET-P0559: Modified RRC and TSRC for lossless   1. modification to RRC as discussed in JVET-P0559-m1 2. modification to rice parameter as discussed in JVET-P0559-m1, without the normalization 3. modification to TSRC as discussed in JVET-P0559-m2 4. similar modification to TSRC as 3 without normalization | T. Nguyen (HHI) ST 1 & 2  M. Sarwer (Alibaba) ST 2 & 3 |
| CE3-1.2\* | H. Wang (Qualcomm) | JVET-P1028: Modified TSRC for lossless | Z.-Y. Lin (MediaTek) |
| CE3-1.3 | T.-C. Ma (Kwai)  Z.-Y. Lin (MediaTek)  A. Nalci (Qualcomm)  M. Sarwer (Alibaba) | JVET-P0148/JVET-P0258: Using RRC for lossless coding without state transition | T. Tsukuba (Sony) |
| CE3-1.4 | T. -C. Ma (Kwai) | JVET-P0528: On residual scanning order for lossless coding | J. Choi (LGE) |
| CE3-1.5\* | M. Sarwer (Alibaba) | JVET-P0463/JVET-P0072: Rice parameter derivation of TSRC for lossless | T.-C Ma (Kwai) |

Tests with \* modified the RRC, and had also to report on CTC normal range

(Insert new results tables including RExt as were provided in v3)

Results on lossless:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Overall** | **All Intra (AI)** | | | | | **Random Access (RA)** | | | | | **Low Delay B (LB)** | | | | |
| CR-A | CR-T | BRS | Enc | Dec | CR-A | CR-T | BRS | Enc | Dec | CR-A | CR-T | BRS | Enc | Dec |
| **CE3-1.1a** | 2.1 | 2.3 | -5.75% | 96% | 104% | 2.2 | 2.4 | -5.88% | 101% | 101% | 2.6 | 2.7 | -4.98% | 97% | 105% |
| **CE3-1.1b** | 2.1 | 2.2 | -5.38% | 93% | 105% | 2.2 | 2.3 | -5.64% | 98% | 100% | 2.6 | 2.7 | -4.98% | 97% | 105% |
| **CE3-1.1c** | 2.1 | 2.2 | -5.09% | 104% | 105% | 2.2 | 2.3 | -3.49% | 105% | 104% | 2.6 | 2.6 | -2.48% | 103% | 105% |
| **CE3-1.1d** | 2.1 | 2.2 | -4.51% | 101% | 104% | 2.2 | 2.3 | -3.01% | 103% | 104% | 2.6 | 2.6 | -2.31% | 102% | 106% |
| **CE3-1.2** | 2.1 | 2.2 | -4.31% | 93% | 103% | 2.2 | 2.3 | -2.94% | 100% | 101% | 2.6 | 2.6 | -2.29% | 100% | 103% |
| **CE3-1.3** | 2.1 | 2.2 | -5.23% | 93% | 102% | 2.2 | 2.3 | -5.58% | 97% | 97% | 2.6 | 2.7 | -4.97% | 98% | 106% |
| **CE3-1.4** | 2.1 | 2.3 | -5.63% | 98% | 105% | 2.2 | 2.4 | -5.72% | 97% | 100% | 2.6 | 2.7 | -5.09% | 100% | 110% |
| **CE3-1.5** | 2.1 | 2.2 | -2.52% | 98% | 104% | 2.2 | 2.2 | -0.82% | 99% | 107% | 2.6 | 2.6 | -0.91% | 101% | 108% |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Class F** | **All Intra (AI)** | | | | | **Random Access (RA)** | | | | | **Low Delay B (LB)** | | | | |
| CR-A | CR-T | BRS | Enc | Dec | CR-A | CR-T | BRS | Enc | Dec | CR-A | CR-T | BRS | Enc | Dec |
| **CE3-1.1a** | 5.3 | 5.4 | -1.72% |  |  | 33.7 | 34.0 | -2.64% |  |  | 50.7 | 50.4 | -2.27% |  |  |
| **CE3-1.1b** | 5.3 | 5.3 | -1.53% |  |  | 33.7 | 33.9 | -2.50% |  |  | 50.7 | 50.2 | -2.19% |  |  |
| **CE3-1.1c** | 5.3 | 5.6 | -4.21% |  |  | 33.7 | 35.0 | -3.30% |  |  | 50.7 | 52.4 | -3.06% |  |  |
| **CE3-1.1d** | 5.3 | 5.5 | -3.94% |  |  | 33.7 | 34.9 | -3.14% |  |  | 50.7 | 52.3 | -2.94% |  |  |
| **CE3-1.2** | 5.3 | 5.5 | -3.67% |  |  | 33.7 | 34.8 | -2.97% |  |  | 50.7 | 52.1 | -2.83% |  |  |
| **CE3-1.3** | 5.3 | 5.3 | -1.33% |  |  | 33.7 | 33.8 | -2.35% |  |  | 50.7 | 50.8 | -2.36% |  |  |
| **CE3-1.4** | 5.3 | 5.4 | -1.86% |  |  | 33.7 | 33.8 | -2.45% |  |  | 50.7 | 50.8 | -2.40% |  |  |
| **CE7-1.5** | 5.3 | 5.5 | -2.67% |  |  | 33.7 | 34.5 | -2.38% |  |  | 50.7 | 51.8 | -2.28% |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **TGM** | **All Intra (AI)** | | | | | **Random Access (RA)** | | | | | **Low Delay B (LB)** | | | | |
| CR-A | CR-T | BRS | Enc | Dec | CR-A | CR-T | BRS | Enc | Dec | CR-A | CR-T | BRS | Enc | Dec |
| **CE3-1.1a** | 11.8 | 11.8 | -0.17% |  |  | 107.1 | 107.3 | -0.46% |  |  | 124.9 | 122.9 | 0.68% |  |  |
| **CE3-1.1b** | 11.8 | 11.6 | 1.10% |  |  | 107.1 | 106.4 | 0.36% |  |  | 124.9 | 122.9 | 0.97% |  |  |
| **CE3-1.1c** | 11.8 | 12.5 | -5.09% |  |  | 107.1 | 116.7 | -6.75% |  |  | 124.9 | 137.0 | -6.89% |  |  |
| **CE3-1.1d** | 11.8 | 12.4 | -4.53% |  |  | 107.1 | 116.2 | -6.37% |  |  | 124.9 | 136.6 | -6.63% |  |  |
| **CE3-1.2** | 11.8 | 12.3 | -3.79% |  |  | 107.1 | 115.7 | -5.96% |  |  | 124.9 | 136.0 | -6.16% |  |  |
| **CE3-1.3** | 11.8 | 11.8 | 0.00% |  |  | 107.1 | 107.1 | 0.00% |  |  | 124.9 | 124.9 | 0.00% |  |  |
| **CE3-1.4** | 11.8 | 11.8 | 0.00% |  |  | 107.1 | 107.1 | 0.00% |  |  | 124.9 | 124.9 | 0.00% |  |  |
| **CE3-1.5** | 11.8 | 12.3 | -3.40% |  |  | 107.1 | 114.8 | -5.36% |  |  | 124.9 | 135.0 | -5.67% |  |  |

CE3-2 switches on BDPCM in different ways, luma only, luma+chroma.

With CE3-1, no method is better than RExt (probably because the latter is using RDPCM)

6 different methods of residual coding. All indicate additional gain when BDPCM is enabled, best results when it is done for both luma and chroma.

Best results are in the range of 8%/6% rate saving versus VTM7 anchor (without BDPCM) in case of AI, whereas RExt has 6%/4.8% rate saving

CE3-2.2 enables BDPCM in VTM7 both for luma and chroma, which saves around 2.7%/0.8% (still worse than RExt lossless, but indicates that Chroma BDPCM is beneficial for 4:2:0 as well).

Revisit: Adopt CE3-2.2 chroma BDPCM for 4:2:0 upon availability of complete results under CTC, indicating that there would be no loss. This would be an adoption of JVET-Q0089, which is a superset of JVET-Q0088

The CE shows that it is possible to have VVC compression that is better than HEVC in lossless mode, it is however coming at extreme increase of encoder run time, and approximately doubling decoder run time. From this, it may be questionable if applications of lossless coding such as archiving would ever use VVC. However, the option of lossless compression is rather important to be used locally in pictures. Even though it can be concluded that the gain observed here would also partially be observed in case of local usage, it would probably be less (depending on the portion of the picture that is lossless coded, and its content).

The best performing methods are 2-8a-2 (8.2%/6.5%), 2-8b-2 (7.8%/6.3%), 2-4 (7.7%/6.2%)

CE2-4 uses regular residual coding instead of TS residual coding, invoked by HL

CE2-8a-2 is changing the Rice parameter derivation for regular residual coding. This is improving the performance of RRC for lossless and low QP, but does not have impact on CTC.

CE2-8b-2 is doing an additional change omitting the normalization in the remainder coding (so it is simpler)

CE2-8c-2 is applying the same modification on Rice parameter derivation of CE2-8a-2 to TS residual coding, and uses that for lossless. CE2-8d-2 corressponds similarly to the CE2-8b-2, c/d don’t have a high-level switch

These modifications applied to TS residual coding are giving worse results for natural content in lossless mode, but different for screen content (AI/RA -0.7%/+0.3% class F, -2.8%/-6% for TGM)

For screen content, CE2-8a/b is also using the modified RRC in lossless case, but in lossy case (also near lossless) still uses the TS residual coding.

It can be concluded from these results, that TS residual coding is mainly good for screen content, however for lossless coding it would require a modification of Rice parameter derivation for being competitive with RRC (even the non-modified RRC of CE2-4) even for screen content.

If two different methods of residual coding are kept, some kind of switching (not implicitly coupled to TS) is needed to achieve reasonable performance in lossless coding.

Question: What is the gain of TSRC currently in CTC?

JVET-Q0363 provides results that indicates that diabling it would end up in 3.8% loss in class F, but also some loss for natural content. This indicates that the existence of an alternative entropy coding for screen content is still beneficial, even though it only performs good in lossy mode. For achieving te desited performance for lossless, CE3-2.3/4 (high-level switch between one and the other method of RC for TS) is a simple change and achieves the desirable performance.

Decision: Adopt JVET-Q0088. However, only a slice-level flag should be implemented (no SPS/PPS) Revisit: This decision may be superceded by a decision on chroma DPCM (JVET-Q0089 is a superset).

[JVET-Q0068](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8893) CE3-1.3: Using RRC for lossless coding without state transition [T.-C. Ma, H.-J. Jhu, X. Xiu, Y.-W. Chen, X. Wang (Kwai Inc.), Z.-Y. Lin, T.-D. Chuang, C.-Y. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek), A. Nalci, H. E. Egilmez, M. Coban, M. Karczewicz (Qualcomm), M. G. Sarwer, R. Liao, J. Luo, Y. Ye (Alibaba)]

[JVET-Q0069](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8894) CE3-1.4: On residual scanning order for lossless coding [T.-C. Ma, H.-J. Jhu, X. Xiu, Y.-W. Chen, X. Wang (Kwai Inc.)]

[JVET-Q0070](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8895) CE3-2.5: Residual coding selection signaling for lossless coding [T.-C. Ma, H.-J. Jhu, X. Xiu, Y.-W. Chen, X. Wang (Kwai Inc.), Z.-Y. Lin, T.-D. Chuang, C.-Y. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek), A. Nalci, H. E. Egilmez, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-Q0071](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8896) CE3-2.10: Luma BDPCM for lossless coding with RRC and residual rotation [T.-C. Ma, H.-J. Jhu, X. Xiu, Y.-W. Chen, X. Wang (Kwai Inc.), A. Nalci, H. E. Egilmez, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-Q0072](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8897) CE3-2.11: Luma and Chroma BDPCM for lossless coding with RRC and residual rotation [[T.-C. Ma](mailto:tsung-chuanma@kwai.com), [H.-J. Jhu](mailto:jhuhong-jheng@kwai.com), [X. Xiu](mailto:xiaoyuxiu@kwai.com), [Y.-W. Chen](mailto:yiwenchen@kwai.com), [X. Wang (Kwai Inc.)](mailto:xianglinwang@kwai.com), A. Nalci, H. E. Egilmez, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-Q0080](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8905) CE3-1.5: Rice parameter derivation of transform skip residual coding [M. G. Sarwer, R. -L. Liao, Y. Ye, J. Luo (Alibaba)]

[JVET-Q0081](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8906) CE3-2.6: Luma BDPCM and IBC with TSRC for lossless coding [J. Choi, H. Jang, S. Yoo, J. Heo, J. Lim, S. Kim (LGE)]

[JVET-Q0082](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8907) CE3-2.7: Luma and chroma BDPCM and IBC with TSRC for lossless coding [J. Choi, H. Jang, S. Yoo, J. Heo, J. Lim, S. Kim (LGE), A. Nalci, H. Wang, M. Coban, M. Karczewicz (Qualcomm), Z.-Y. Lin, T.-D. Chuang, C.-Y. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0086](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8911) CE3-2.1 and CE3-2.2: Luma/Chroma BDPCM for Lossless Coding with Transform Skip Residual Coding [A. Nalci, H. Wang, M. Coban, M. Karczewicz (Qualcomm), J. Choi, H. Jang, S. Yoo, J. Heo, J. Lim, S. Kim (LGE), Z.-Y. Lin, T.-D. Chuang, C.-Y. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0088](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8913) CE3-2.3: Luma BDPCM for Lossless Coding with Regular Residual Coding [A. Nalci, H. Wang, M. Coban, M. Karczewicz (Qualcomm), T. Tsukuba, M. Ikeda, Y. Yagasaki, T. Suzuki (Sony), Z.-Y. Lin, T.-D. Chuang, C.-Y. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek), M. G. Sarwer, R. Liao, Y. Ye, J. Luo (Alibaba), T.-C. Ma, H.-J. Jhu, X. Xiu, Y.-W. Chen, X. Wang (Kwai), H. Jang, J. Choi, S. Kim, J. Lim (LGE)]

[JVET-Q0089](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8914) CE3-2.4: Luma and Chroma BDPCM for Lossless Coding with Regular Residual Coding [A. Nalci, H. Wang, M. Coban, M. Karczewicz (Qualcomm), T. Tsukuba, M. Ikeda, Y. Yagasaki, T. Suzuki (Sony), Z.-Y. Lin, T.-D. Chuang, C.-Y. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek), T.-C. Ma, H.-J. Jhu, X. Xiu, Y.-W. Chen, X. Wang (Kwai)]

[JVET-Q0092](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8917) CE3: Modified Rice Parameter Derivation for Residual Coding (CE3-1.1, CE3-1.2, CE3-2.8 and CE3-2.9) [H. Wang, M. Karczewicz, A. Nalci, Y.-H. Chao, M. Coban (Qualcomm)]

## CE4: Inter prediction with geometric partitioning (7)

Contributions in this category were discussed Wednesday 8 Jan. 1640–XXXX in Track A (chaired by GJS).

[JVET-Q0024](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9353) CE4: Summary report on inter prediction with geometric partitioning [C.-C. Chen, R.-L. Liao, X. Xiu, H. Yang]

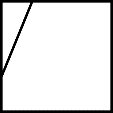
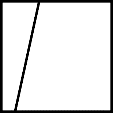
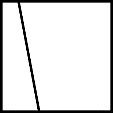
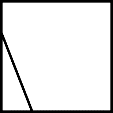
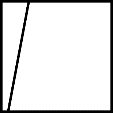
This contribution provides a summary report of Core Experiment 4 on inter prediction with geometric partitioning.

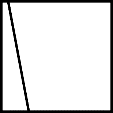
The technique proposed in JVET-P0884/JVET-P0885 was suggested to be the common base for this core experiment. All other techniques to be tested is implemented on top of the common base.

For performance evaluation, the common base is requested to be compared with both VTM-7.0 and VTM-7.0 with TPM off. All other tests is requested to be compared with the common base.

***Common base in JVET-Q0079 (Huawei, Alibaba, Qualcomm, RWTH Aachen)***

*VVC-7.0 TPM Generalized as GEO*

Ein Bild, das Objekt enthält.

Automatisch generierte Beschreibung

……**…**

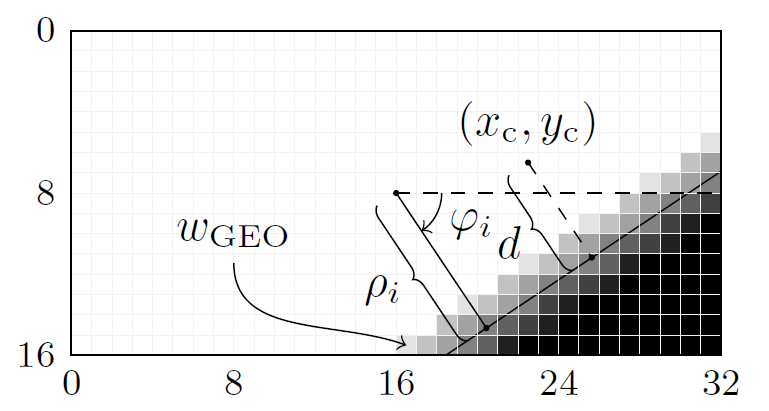
Examples for GEO modes

The common base of geometric partitioning is defined as the method descripted in JVET-P0884&JVET-P0885. The total number of geometric partitioning mode is 82, which is composed with 24 slope based angle and 4 distance for each angle. For angles larger than or equal to slope -1, the distance 0 is redundant and is removed. Besides, the horizontal and vertical angles with distance 0 is removed since it is overlapped with binary tree split. Therefore, the total number of geometric partitioning mode is 24×4 − 12 – 2 = 82. Note that the VTM-7.0 TPM is harmonized into the design of the common base as the two diagonal partitioning modes.



Angles distribution of GEO partitions in the common base

The GEO mode is applied to a merge block whose width and height are larger than or equal to 8. When a block coded using GEO mode, an index is signaled to indicate which one of 82 partitioning modes is used to split the block into two partitions. Each partition is inter predicted with its own motion vector. After predicting each of the partition, the sample values along the partitioning edge are adjusted using a blending processing with weights. This is the prediction signal for the whole block, and transform and quantization process will be applied to the whole block as in other prediction modes.



An example of blending mask for GEO

|  |  |  |
| --- | --- | --- |
| **Test #** | **Description** | **Source** |
| Common base | Geometric partitioning for merge mode as in JVET-P0884&JVET-P0885 | JVET-Q0079 |
| 4-1 | Common base simplification by reducing the number of partition mode to e.g. 64 | JVET-Q0059 |
| 4-2.1 | Block size restriction of GEO, disable GEO for block size greater than 64×64 | JVET-Q0077 |
| 4-2.2 | Block size restriction of GEO, disable GEO for block size greater than 32×32 | JVET-Q0077 |
| 4-3.1 | Disallow SBT for GEO mode | JVET-Q0062 |
| 4-3.2 | Disallow SBT for GEO mode when displacement is 0 | JVET-Q0062 |
| 4-4 | Adaptive blending for screen content | JVET-Q0060 |
| 4-5 | GEO with a single mode for 4xN and Nx4 CU | JVET-Q0091 |
| 4-6 | Combination of geometric partitioning and CIIP | JVET-Q0078 |
| Combined test 1\* | CE4-1+CE4-2.1+CE4-3.1 | JVET-Q0061 |
| Combined test 2\* | CE4-1+CE4-2.1+CE4-3.2 | JVET-Q0061 |

\* It was requested by the proponents and agreed on CE reflector to include the results of combined tests of test 4-1, 4-2 and 4-3 in CE4 report for providing more information for consideration.

The common base is compared against two anchors, VTM-7.0 and VTM-7.0 with TPM off. The two sets of results are shown in the table below.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random Access Main 10** | | | | | **Low delay B Main10** | | | | |
| **Anchor** | **Y** | **U** | **V** | **EncT** | **DecT** | **Y** | **U** | **V** | **EncT** | **DecT** |
| VTM-7.0 | -0.28% | -0.35% | -0.34% | 103% | 100% | -0.70% | -0.67% | -0.77% | 103% | 100% |
| VTM-7.0 w/o TPM | -0.66% | -0.98% | -1.01% | 104% | 99% | -1.61% | -1.93% | -1.98% | 106% | 98% |

All other tests are compared against the common base.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random Access Main 10** | | | | | **Low delay B Main10** | | | | |
| **Test#** | **Y** | **U** | **V** | **EncT** | **DecT** | **Y** | **U** | **V** | **EncT** | **DecT** |
| 4-1 | 0.00% | -0.01% | 0.03% | 99% | 100% | 0.00% | 0.10% | 0.10% | 99% | 99% |
| 4-2.1\* | -0.01% | -0.01% | -0.03% | 99% | 99% | 0.06% | -0.06% | 0.06% | 100% | 98% |
| 4-2.2\* | 0.00% | -0.03% | -0.03% | 99% | 99% | 0.22% | 0.10% | 0.24% | 99% | 99% |
| 4-3.1 | 0.04% | 0.08% | 0.04% | 96% | 95% | 0.11% | -0.04% | -0.05% | 95% | 98% |
| 4-3.2 | -0.01% | 0.01% | 0.00% | 97% | 95% | 0.07% | 0.05% | 0.19% | 96% | 97% |
| 4-4 | / | / | / | / | / | / | / | / | / |  |
| 4-5 | -0.05% | -0.02% | -0.09% | 100% | 97% | -0.03% | -0.10% | 0.13% | 100% | 95% |
| 4-6 | -0.05% | 0.00% | 0.01% | 102% | 101% | -0.08% | -0.21% | -0.19% | 102% | 103% |
| Combined test 1 | 0.03% | 0.01% | 0.02% | 98% | 98% | 0.12% | 0.07% | 0.39% | 98% | 96% |
| Combined test 2 | -0.01% | 0.04% | 0.06% | 98% | 98% | 0.06% | 0.15% | 0.24% | 98% | 97% |

\* It was pointed out in the CE4 reflector that the number of SATD and RDO checkings are increased to 60 and 8.

Results for Class F and Class SCC is shown for CE4-4 since the test applies to screen content only. The performance compared against the common base, VTM-7.0, and VTM-7.0 without TPM are shown separately, since the data reflecting the behaviour of the common base on screen content are not provided elsewhere in CE4 report.

CE4-4 test results for SCC-oriented content

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Random Access Main 10** | | | | | **Low delay B Main10** | | | | |
| **Anchor** | **Sequence** | Y | U | V | EncT | DecT | Y | U | V | EncT | DecT |
| VTM-7.0 | Class F | -0.51% | -0.51% | -0.46% | 100% | 99% | -0.70% | -1.03% | -0.27% | 102% | 98% |
|  | TGM420 | -2.50% | -2.19% | -2.12% | 99% | 99% | -3.26% | -2.95% | -2.94% | 101% | 99% |
| VTM-7.0 | Class F | -0.76% | -0.92% | -0.85% | 102% | 100% | -1.14% | -1.10% | -1.43% | 105% | 99% |
| w/o TPM | TGM420 | -2.54% | -2.33% | -2.27% | 101% | 99% | -3.33% | -3.08% | -3.02% | 103% | 99% |
| Common | Class F | -0.19% | -0.12% | -0.13% | 100% | 100% | -0.20% | -0.12% | 0.03% | 100% | 101% |
| base | TGM420 | -2.03% | -1.52% | -1.46% | 99% | 99% | -2.82% | -2.19% | -2.10% | 99% | 100% |

From an implementation perspective, the generalized scheme was said to not be substantially more difficult to implement than the triangle-only method in the VTM.

A proponent asserted that the generalized scheme has a subjective benefit. At the previous meeting, there had been some benefit preliminarily reported from snapshot viewing, but testing of video sequences was inconclusive.

Another participant commented that if the scheme was optimized for subjective quality rather than PSNR maximization, this tool has more potential for benefit than others, as it improves the ability to align segmentation boundaries with true object boundaries.

A similar method, known as wedge coding, has been used for depth coding in 3D-HEVC, and was helpful for its edge alignment benefit.

It was commented that real-time encoders may choose to use edge detection to assist with determining the wedge segmentation with the scheme.

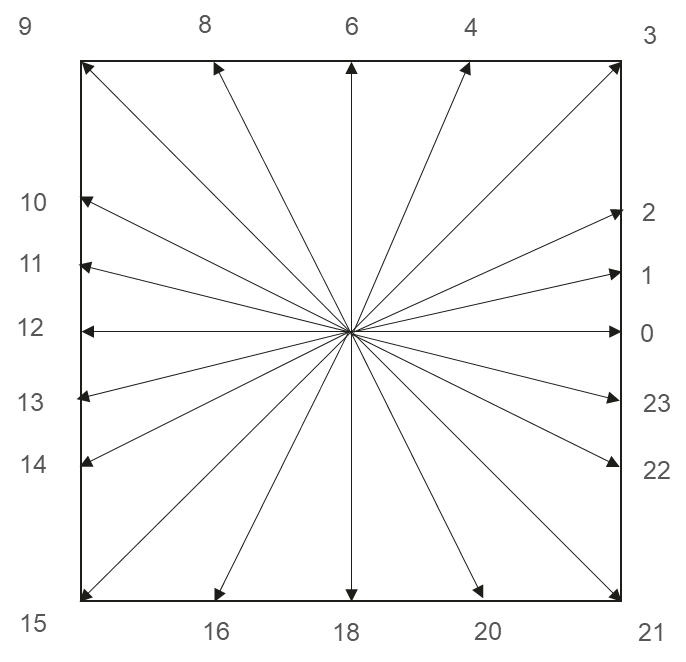
The benefit in the low-delay case, as well as potential subjective benefit, was emphasized by some participants.

At the previous meeting, the tested CE proposal had been to have a separate mode from TPM rather than a replacement with a generalized mode. The generalized scheme, referred to here as the “common base”, had then been established as one of two anchors for this CE cycle.

A concern was expressed about verification effort. However, the implementation impact of this is otherwise not significant. The text impact is also minor. Aside from removing the use of TPM as a separate mode, the design of the geometric partitioning has been stable for two meeting cycles.

Among the schemes tested in the CE, it was agreed to adopt some form of the generalized geometric partitioning with 64 modes and no CUs with width or height greater than 64 or with width or height less than 8, and allow SBT in geometric partitioned CUs, with no flag for disabling blending and with no CIIP combination scheme. This corresponds to the common base plus 4-1 and 4-2.1 (i.e., 4-1 with a block size restriction). Text is in Q0059 and the block restriction text (a single conditioning test in a syntax table) is in Q0077. Decision: Adopt Q0059 with the block size restriction of Q0077. The Q0059 proponent will provide the software.

***Test 4-1 in JVET-Q0059 (Huawei, Alibaba, Qualcomm RWTH Aachen)***

(a) 82 partition modes in the common base (b) 64 partition modes in test 4-1

Figure: Angles distribution of GEO partitions

In test 4-1, the number of GEO partitions of the common base is reduced from 82 modes to 64 modes. i.e. 20 angles and 4 distances. Comparing to the common base, the angles {5, 7, 17, 19} are removed since in nature video sequences the motion objects are mostly vertical layout and the near horizontal split modes are less frequently used. Besides, the horizontal angles {0, 12} and vertical angles {6, 18} with distance index 0 are removed since these partitioning are overlapped with ternary tree splitting. The total number of geometric partitioning mode can be calculated as 20×3 + 10×3 − 4 − 2 = 64.

***Test 4-2.1 & 4-2.2 in JVET-Q0077 (Bytedance)***

In test 4-2.1, GEO mode is disabled for a block which width or height is greater than 64.

In test 4-2.2, GEO mode is disabled for a block which width or height is greater than 32.

***Test 4-3.1 & 4-3.2 in JVET-Q0062 (Qualcomm, Hikvision)***

In test 4-3.1, SBT is disabled for GEO mode.

In test 4-3.2, SBT is disabled for GEO mode when displacement is 0.

***Test 4-4 in JVET-Q0060 (Huawei, RWTH Aachen)***

In test 4-4 the blending process is turned off for SCC in order to avoid over smoothing the sharp edges of screen contents. A SPS-level control flag and a picture header blending-off flag is introduced to control the blending process on and off.

***Test 4-5 in JVET-Q0091 (Nokia)***

In test 4-5, the GEO of common base is extended to support 4xN and Nx4 CU. For these CU dimensions, GEO skips wedge\_partition\_idx syntax, and allows one partitioning angle (either horizontal or vertical) and one distance. For 4xN CU, GEO employs vertical angle blending weights. For Nx4 CU, GEO employs horizontal angle blending weights. Motion vector prediction and blending operation of GEO with a single mode for 4xN and Nx4 CU are aligned with the GEO of common base.

***Test 4-6 in JVET-Q0078 (BBC)***

An intra predictor and an inter predictor are computed for a block. The inter predictor and the intra predictor are combined using the geometric partitioning scheme as in the common base. The intra predictor is generated as Planar mode and is used in one of the two GEO partitions, and the inter predictor is used in the other GEO partition. The blending scheme as used in GEO is used to blend the two GEO partitions.

There are four candidate GEO partition modes available and the syntax geo\_ciip\_mode is signalled for indication. The set of the four candidates is adaptively selected based on whether the above and the left neighbouring CU is intra coded or not, using a pre-computed LUT.

[JVET-Q0079](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8904) CE4 Common Base: Geometric inter prediction [H. Gao, S. Esenlik, E. Alshina, A. M. Kotra, B. Wang (Huawei), K. Reuze, C.-C. Chen, H. Huang, W.-J. Chien, V. Seregin, M. Karczewicz (Qualcomm), R.-L. Liao, J. Chen, Y. Ye, J. Luo (Alibaba), M. Bläser, J. Sauer (RWTH Aachen)]

[JVET-Q0059](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8884) CE4-1: Geometric Inter Prediction with 64 Modes [H. Gao, S. Esenlik, E. Alshina, A. M. Kotra, B. Wang (Huawei), R.-L. Liao, J. Chen, Y. Ye, J. Luo (Alibaba), K. Reuzé, C.-C. Chen, H. Huang, W.-J. Chien, V. Seregin (Qualcomm), M. Bläser, J. Sauer (RWTH Aachen)]

[JVET-Q0060](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8885) CE4-4: Geometric Inter Prediction with Adaptive Blending for SCC [H. Gao, S. Esenlik, E. Alshina, A. M. Kotra, B. Wang (Huawei), M. Bläser, J. Sauer (RWTH Aachen)]

[JVET-Q0062](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8887) CE4-3: Constrain SBT for GEO mode [H. Huang, T. Hsieh, V. Seregin, K. Reuze, C.-C. Chen, H.E. Egilmez, W.-J. Chien, M. Karczewicz (Qualcomm), L. Xu, X. Cao, Y. Sun, F. Chen, L. Wang (Hikvision)]

[JVET-Q0077](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8902) CE4-2: Block size restriction of GEO [Z. Deng, L. Zhang, H. Liu, K. Zhang, Y. Wang (Bytedance)]

[JVET-Q0078](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8903) CE4-6: Combination of geometric partitioning and CIIP [S. Blasi, G. Kulupana (BBC)]

[JVET-Q0091](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8916) CE4-5: Single mode partition for 4xN and Nx4 CU [K. Panusopone, S. Hong, L. Wang (Nokia)]

## CE5: Cross-component adaptive loop filtering (7)

Contributions in this category were discussed Wednesday 8 Jan. 1750–1900 in Track B (chaired by JRO).

[JVET-Q0025](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9317) CE5: Summary Report on Cross Component Adaptive Loop Filtering [C.-Y. Chen, A. Segall]Formularende

Initially presented Wed. 8 Jan. 1750-1900

|  |  |  |
| --- | --- | --- |
| **Test #** | **Description** | **Source** |
| Common base | Cross-component Adaptive Loop Filter as in JVET-P1008 (Option 1) | JVET-Q0058 |
| CE5-1 (Alternative Filter Shapes) | | |
| CE5-1.1 | 5x4 filter shape with 8 coefficients | JVET-Q0085 |
| CE5-1.2 | 3x2 filter shape with 6 coefficients | JVET-Q0097 |
| CE5-1.3 | 3x4 filter shape with 6 coefficients | JVET-Q0093 |
| CE5-1.4 | Joint Cb/Cr CC-ALF with one additional weight and CTU level selection | JVET-Q0229 |
| CE5-1.5 | Joint Cb/Cr CC-ALF with one additional weight and block level selection | Withdrawn |
| CE5-2 (Complexity reduction of the filtering process) | | |
| CE5-2.1 | Multiplication removal with coefficient range in [-64, 64] | JVET-Q0073 |
| CE5-2.2 | Multiplication removal with coefficient range in [-8, 8] | JVET-Q0095 |
| CE5-3 (Combination Tests) | | |
| CE5-3.1 | CE5-2.1 + 5x5 filter shape with 13 coefficients | JVET-Q0073 |
| CE5-3.2 | CE5-1.4 + CE5-2.1  Joint Cb/Cr CC-ALF with one additional weight and CTU-level selection combined with multiplication removal with coefficient range in [-64,64] | JVET-Q0229 |
| CE5-Supplemental | | |
| S1 | Performance of CE5 common base with 8-bit dynamic range | JVET-Q0074 |

Results on AI and RA

The common base is compared against VTM-7.0 and results are shown in the table below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **All Intra Main 10** | | | | | | | | | | **Random Access Main10** | | | | | | | | | |
| **Anchor** | | **Y** | | **U** | | **V** | | **EncT** | | **DecT** | | **Y** | | **U** | | **V** | **EncT** | | | **DecT** | |
| VTM-7.0 | | 0.17% | | -8.31% | | -7.06% | | 99% | | 101% | | 0.14% | | -10.14% | | -9.82% | 102% | | | 101% | |
|  | **All Intra Main 10** | | | | | | | | | | **Random Access B Main10** | | | | | | | | | |
| **Test#** | **Y** | | **U** | | **V** | | **EncT** | | **DecT** | | **Y** | | **U** | | **V** | | | **EncT** | **DecT** | |
| CE5-1 (Alternative Filter Shapes) | | | | | | | | | | | | | | | | | | | | |
| CE5-1.1 | 0.00% | | 0.13% | | 0.01% | | 100% | | 98% | | 0.01% | | -0.43% | | -0.35% | | | 100% | 100% | |
| CE5-1.2 | -0.02% | | 0.69% | | 0.88% | | 100% | | 100% | | -0.02% | | 0.93% | | 1.08% | | | 100% | 98% | |
| CE5-1.3 | -0.02% | | 0.39% | | 0.26% | | 99% | | 98% | | -0.01% | | 0.22% | | 0.31% | | | 99% | 99% | |
| CE5-1.4 | -0.06% | | 2.15% | | 2.03% | | 100% | | 99% | | 0.01% | | 1.34% | | 1.34% | | | 100% | 99% | |
| CE5-2 (Complexity reduction of the filtering process) | | | | | | | | | | | | | | | | | | | | |
| CE5-2.1 | -0.03% | | 0.53% | | 0.36% | | 100% | | 100% | | 0.01% | | 0.08% | | 0.06% | | | 100% | 100% | |
| CE5-2.2 | -0.03% | | 0.74% | | 0.60% | | 100% | | 100% | | 0.00% | | 0.35% | | 0.45% | | | 100% | 100% | |
| CE5-3 (Combination Tests) | | | | | | | | | | | | | | | | | | | | |
| CE5-3.1 | 0.01% | | -0.20% | | -0.61% | | 100% | | 101% | | 0.01% | | -0.55% | | -0.71% | | | 100% | 101% | |
| CE5.3.2 | -0.07% | | 2.59% | | 2.28% | | 99% | | 97% | | 0.01% | | 1.44% | | 1.48% | | | 99% | 97% | |
| CE5-Supplemental | | | | | | | | | | | | | | | | | | | | |
| S1 | 0.02% | | -0.08% | | 0.12% | | 100% | | 100% | | 0.00% | | 0.05% | | 0.13% | | | 100% | 101% | |

Results on low delay

The common base is compared against VTM-7.0 and results are shown in the table below.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Low Delay B Main 10** | | | | | **Low Delay P Main10** | | | | |
| VTM-7.0 | 0.12% | -13.00% | -9.48% | 99% | 98% | 0.13% | -12.89% | -9.29% | 98% | 100% |

All other tests are compared against the common base.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Low Delay B Main 10** | | | | | **Low Delay P Main10** | | | | |
| **Test#** | **Y** | **U** | **V** | **EncT** | **DecT** | **Y** | **U** | **V** | **EncT** | **DecT** |
| CE5-1 (Alternative Filter Shapes) | | | | | | | | | | |
| CE5-1.1 | -0.03% | -0.50% | -0.81% | 101% | 101% | -0.01% | -0.70% | -0.93% | 101% | 101% |
| CE5-1.2 | -0.01% | 1.95% | 1.54% | 101% | 102% | - | - | - | - | - |
| CE5-1.3 | 0.01% | 0.22% | 0.23% | 100% | 99% | - | - | - | - | - |
| CE5-1.4 | -0.01% | 0.25% | -0.01% | 100% | 100% | -0.01% | 0.12% | -0.03% | - | - |
| CE5-2 (Complexity reduction of the filtering process) | | | | | | | | | | |
| CE5-2.1 | -0.01% | -0.24% | -0.13% | 100% | 101% | 0.02% | -0.17% | -0.31% | 100% | 99% |
| CE5-2.2 | 0.02% | -0.08% | -0.10% | 100% | 99% | 0.00% | -0.13% | -0.25% | 100% | 99% |
| CE5-3 (Combination Tests) | | | | | | | | | | |
| CE5-3.1 | -0.01% | -1.52% | -1.82% | 100% | 101% | 0.01% | -1.52% | -1.73% | 99% | 99% |
| CE5.3.2 | -0.01% | 0.16% | -0.08% | 99% | 97% | - | - | - | - | - |
| CE5-Supplemental | | | | | | | | | | |
| S1 | -0.02% | 0.31% | 0.70% | 100% | 100% | 0.01% | 0.33% | 0.56% | 100% | 99% |

These results indicate that the additional parameters cause some rate increase reflected by the luma loss, whereas the chroma components have significant gain.

In previous, there had been experiments shifting back some of the chroma gain to luma (by QP adjustment), which suggested an overall gain around 1% AI, 1.16% RA, 0.5% LDB/LDP

To address the unequal balance of luma/chroma gains, the method established in AHG 13 (Y/Cb/Cr weighted averaging of BD rates with 8:1:1) was used additionally, giving the following results, whoch are somewhat suggesting higher overall gains:

The common base is compared against VTM-7.0 and results are shown in the table below.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **YUV Metric** | | | | **EncT** | | **DecT** | |
| **Anchor** | **AI** | **RA** | **LDB** | **LDP** | **Min** | **Max** | **Min** | **Max** |
| VTM-7.0 | -1.40% | -1.88% | -2.15% | -2.11% | 98% | 102% | 98% | 101% |

All other tests are compared against the common base.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **YUV Metric** | | | | **EncT** | | **DecT** | |
| **Test #** | **AI** | **RA** | **LDB** | **LDP** | **Min** | **Max** | **Min** | **Max** |
| CE5-1 (Alternative Filter Shapes) | | | | | | | | |
| CE5-1.1 | 0.01% | -0.07% | -0.16% | -0.17% | 100% | 101% | 98% | 101% |
| CE5-1.2 | 0.14% | 0.19% | 0.34% | - | - | - | - | - |
| CE5-1.3 | 0.05% | 0.05% | 0.05% | - | 99% | 100% | 98% | 99% |
| CE5-1.4 | 0.37% | 0.28% | 0.02% | - | - | - | - | - |
| CE5-2 (Complexity reduction of the filtering process) | | | | | | | | |
| CE5-2.1 | 0.07% | 0.02% | -0.05% | -0.03% | 100% | 100% | 99% | 101% |
| CE5-2.2 | 0.11% | 0.08% | 0.00% | -0.04% | 100% | 100% | 99% | 100% |
| CE5-3 (Combination Tests) | | | | | | | | |
| CE5-3.1 | -0.07% | -0.12% | -0.34% | -0.32% | 99% | 100% | 99% | 101% |
| CE5.3.2 | 0.43% | 0.30% | 0.00% | - | - | - | - | - |
| CE5-Supplemental | | | | | | | | |
| S1 | 0.02% | 0.02% | 0.09% | 0.10% | 100% | 100% | 99% | 101% |

Additional results shown for HDR:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **wYUV Metric** | | **YUV Metric** | | **EncT** | | **DecT** | |
| **Anchor** | **AI** | **RA** | **AI** | **RA** | **Min** | **Max** | **Min** | **Max** |
| VTM-7.0 | -3.01% | -3.32% | -3.19% | -3.38% | 100% | 101% | 102% | 102% |
|  |  |  |  |  |  |  |  |  |
|  | **wYUV Metric** | | **YUV Metric** | | **EncT** | | **DecT** | |
| **Test #** | **AI** | **RA** | **AI** | **RA** | **Min** | **Max** | **Min** | **Max** |
| CE5-1 (Alternative Filter Shapes) | | |  |  |  |  |  |  |
| CE5-1.1 | 0.19% | 0.12% | 0.20% | 0.07% | 100% | 100% | 98% | 99% |

Notes from discussion:

- CE5-1.1 has a larger filter shape – even though having same number of coefficient values (and side information to be coded) as the common base, it increases the complexity of CCALF in terms of number of operations, as the filter shape is larger. This may not be justified by the small additional benefit in compression.

- CE5-1.2 and CE5-1.3 are both reducing number of operations (6 instead of 8 multiplications), and alse need less parameters. For CE5-1.3, the loss is marginal (0.05%), for CE5-1.2, somewhat high (0.15-0.2%) compared to the common base.

- CE5-1.4 uses only one filter for Cb and Cr, but in the end applies an addional weight on one of them. This requires less parameters and also less operations (significant reduction of number of multiplications). However, the loss is larger than for the other two (0.3%-0.4% compared to common base).

More detailed complexity analysis is being prepared. Revisit on this

Since the last meeting, a mechanism has been implemented in the base encoder which disables CCALF locally in cases where it might produce artifacts. All proposals are using this, however it is noted that some of the proponents were not aware that the common base had such a mechanism.

Prepare visual testing preferably with highest possible QP (37/42), however exclude cases where the encoder has made a decision disabling the tool in most CUs

It is asserted that the difference between common base (CB), 5-1.1, 5-1.2 and 5-1.3 would be marginal in terms of the threat of visual artifacts. 5-1.4 might cause more chroma artifacts.

Revisit:

- Provide data about the percentage use of encoder disabling CCALF (separate fore frame types)

- Prepare viewing sessions for CB and 5-1.4, excluding cases where CCALF would be disabled for the vast majority of regions.

CE5-2: Complexity reduction in filtering process

Both of the following proposals are replacing multiplications by shift operations. At the same time the coding of the coefficients is modified from 6 bit to 4 bit or zero flag with subsequent 3 bit for non-zero.

CE5-2.1: Multiplication removal for cross component adaptive loop filter (JVET-P0557)

Filter coefficients are restricted to have values: {-64, -32, -16, -8, -4, -2, -1, 0, 1, 2, 4, 8, 16, 32, 64}, which are signalled as {-7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7} respectively before binarization in order to reduce the signalling overhead. Fixed length codes of 3 bits are used to signal the absolute values of the coefficients. Another sign bit is signalled for non-zero coefficients.

CE5-2.2: Multiplication removal for cross component adaptive loop filter (JVET-P0666)

Filter coefficients are restricted to have values: {-8, -4, -2, -1, 0, 1, 2, 4, 8}. A bit is first signalled to indicate whether it is a zero coefficient. If not, a fixed length code of 2 bits is used to signal the absolute value of the coefficient followed by a sign bit.

Both come with loss, but the loss of CE5-2.1 is less, and the additional complexity advantage is low. CE5-2.1 could be interesting as additional complexity reduction, but it is not necessary to conduct viewing, as the source of artifacts is likely not due to quantization of filter coefficients. Could be an interesting candidate as add-on to whatever base is used.

CE5-3-1 is not really a combination test, but using a 5x5 filter shape (larger than CB, and even larger than 5-1.1), and also sends 13 coefficients instead of 8. This increases the overall number of operations, and in particular for software could decrease the throughput.

CE5-3-2 combines the complexity reduction of 5-1.4 and 5-2.1. This is the most aggressive reduction of complexity that is investigated in this CE, however also decreasing the performance (0.3-0.4% relative to CB). Better investigate this in terms of visual quality rather than 5-1.4.

Revisit after further complexity analysis, and after conducting the visual investigation of CB and 5-3.2. Provided that there are no visual problems, further decision for possible adoption to be made on basis of tradeoff objective performance vs. complexity.

[JVET-Q0058](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8883) CE5 Common Base: Cross Component Adaptive Loop Filter [K. Misra, F. Bossen, P. Cowan, A. Segall (Sharp Labs of America), N. Hu, J. Dong, V. Seregin, M. Karczewicz (Qualcomm), P. Onno, C. Gisquet, G. Laroche (Canon), J. Li, C.S. Lim, C.-W. Kuo (Panasonic), J. Nam, J. Choi, J. Lim, S. Kim (LGE), O. Chubach, C.-Y. Lai, C.-Y. Chen, T.-D. Chuang, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0073](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8898) CE5-2.1, CE5-3.1: Multiplication removal for cross component adaptive loop filter and 5x5 filter shape [N. Hu, J. Dong, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-Q0085](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8910) CE5-1.1: CCALF with 5x4 filter shape and 8 filter coefficients [A. M. Kotra, S. Esenlik, B. Wang, H. Gao, E. Alshina (Huawei)]

[JVET-Q0093](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8918) CE5-1.3: CCALF with 6 filter coefficients [Y. Zhao, A.M. Kotra, H. Yang (Huawei)]

[JVET-Q0095](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8920) CE5-2.2: Multiplication removal for CCALF with coefficient range in [-8, 8] [G. Li, X. Li, X. Zhao, L. Zhao, Y. Du, S. Liu (Tencent), N. Hu, J. Dong, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-Q0097](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8922) CE5-1.2: Cross-component ALF simplification with 6-tap filter [J. Li, C. S. Lim (Panasonic)] [late]

[JVET-Q0229](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9054) CE5: Report of CE5-1.4 and CE5-3.2 on Joint chroma cross-component adaptive loop filtering [Y. He, F. Le Léannec, E. François (InterDigital)] [late]

# Non-CE Technology proposals

## CE1 related – Deblocking filtering (4)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

[JVET-Q0141](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8966) Non-CE1/Non-CE3: Deblocking filter control for lossless blocks [K. Unno, K. Kawamura, S. Naito (KDDI)]

[JVET-Q0321](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9146) Non-CE1: Deblocking filter decision simplification [H.-B. Teo, C. Wang, C.-S. Lim, H.-W. Sun (Panasonic)]

[JVET-Q0734](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9580) Crosscheck of JVET-Q0321 (Non-CE1: Deblocking filter decision simplification) [X.W. Meng (PKU)] [late]

[JVET-Q0322](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9147) CE1-related: Long luma deblocking filter decision modification [H.-B. Teo, C. Wang, C.-S. Lim (Panasonic)]

[JVET-Q0733](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9579) Crosscheck of JVET-Q0322 (CE1-related: Long luma deblocking filter decision modification) [X.W. Meng (PKU)] [late]

[JVET-Q0325](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9150) CE1-related: Deblocking modification for GEO [X. W. Meng (PKU), X. Zheng (DJI), S. S. Wang, S. W. Ma (PKU)]

[JVET-Q0634](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9480) Crosscheck of JVET-Q0325 (CE1-related: Deblocking modification for GEO) [H.-B. Teo, C. Wang (Panasonic)] [late]

[JVET-Q0478](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9305) Non-CE1: QP fix for deblocking [W. Zhu, L. Zhang, J. Xu (Bytedance)]

## CE2 related – Palette mode coding (14)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

[JVET-Q0291](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9116) CE2-related: On maximum palette size of VVC [M. G. Sarwer, Y. Ye, J. Luo, R. -L. Liao (Alibaba)]

[JVET-Q0637](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9483) Crosscheck of JVET-Q0291: CE2-related: On maximum palette size of VVC [W. Zhu (Bytedance)] [late]

[JVET-Q0435](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9261) CE8-related: Modification of palette coding syntax structure [W. Lim, G. Bang (ETRI)] [late]

[JVET-Q0445](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9271) AHG9/Non-CE2: On predictor palette initialization [J. Luo, Y. Ye, R. Liao, M. Sarwer, J. Chen (Alibaba)]

[JVET-Q0605](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9451) Crosscheck of JVET-Q0445 (Non-CE2: On predictor palette initialization) [T. Lu (Dolby)] [late]

[JVET-Q0477](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9304) Non-CE2: Modified coding order of syntax elements in palette mode [W. Zhu, L. Zhang, J. Xu, H-C. Chuang (Bytedance)]

[JVET-Q0621](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9467) Crosscheck report for JVET-Q0477 (Non-CE2: Modified coding order of syntax elements in palette mode) [H. Jang (LGE)] [late]

[JVET-Q0491](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9319) CE2-related: Palette escape binarization [H.-J. Jhu, X. Xiu, Y.-W. Chen, T.-C. Ma, X. Wang (Kwai Inc.)]

[JVET-Q0715](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9561) Crosscheck of JVET-Q0491 (CE2-related: Palette escape binarization) [Y.-H. Chao (Qualcomm)] [late]

[JVET-Q0492](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9320) Non-CE2: Palette encoding with high QPs [H.-J. Jhu, X. Xiu, Y.-W. Chen, T.-C. Ma, X. Wang (Kwai Inc.)]

[JVET-Q0717](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9563) Crosscheck of JVET-Q0492 (Non-CE2: Palette encoding with high QPs) [Y.-C. Nien, T.-H. Li, Y.-C. Yang (Foxconn)] [late]

[JVET-Q0493](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9321) Non-CE2: Palette encoder improvements for lossless coding [H.-J. Jhu, X. Xiu, Y.-W. Chen, T.-C. Ma, X. Wang (Kwai Inc.)]

[JVET-Q0587](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9433) Crosscheck of JVET-Q0493 (Non-CE2: Palette encoder improvements for lossless coding) [R.-L. Liao (Alibaba)] [late]

[JVET-Q0501](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9329) Non-CE2: On palette predictor initialization in WPP [Y.-H. Chao, C.-H. Hung, W.-J. Chien, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-Q0656](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9502) Cross-check of JVET-Q0501 (Non-CE2: On palette predictor initialization in WPP) [Y.-W. Chen (Kwai Inc.)] [late]

[JVET-Q0502](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9330) Non-CE2: Encoder only approach for CTU row palette predictor initialization [Y.-H. Chao, W.-J. Chien, C.-H. Hung, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-Q0657](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9503) Cross-check of JVET-Q0502 (Non-CE2: Encoder only approach for CTU row palette predictor initialization) [Y.-W. Chen (Kwai Inc.)] [late]

[JVET-Q0503](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9331) CE2-related: Encoder improvement for palette mode [Y.-H. Chao, C.-H. Hung, W.-J. Chien, V. Seregin, M. Karczewicz (Qualcomm), R.-L. Liao, M. Sarwer, J. Chen, Y. Ye, J. Luo (Alibaba)]

[JVET-Q0596](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9442) Crosscheck of JVET-Q0503 (CE2-related: Encoder improvement for palette mode) [H.-J. Jhu (Kwai Inc.)] [late]

[JVET-Q0504](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9332) CE2-related: Palette mode for non 4:4:4 color format [R.-L. Liao, M. Sarwer, J. Chen, Y. Ye, J. Luo (Alibaba), Y.-H. Chao, C.-H. Hung, W.-J. Chien, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-Q0658](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9504) Cross-check of JVET-Q0504 (CE2-related: Palette mode for non 4:4:4 color format) [Y.-W. Chen (Kwai Inc.)] [late]

[JVET-Q0509](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9338) CE2-1.1-related: Encoder optimization with adjusted palette clustering steps [M. Wang, J. Li, L. Zhang, J. Xu, K. Zhang, H. Liu, S. Wang (Bytedance)]

[JVET-Q0762](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9608) Crosscheck of JVET-Q0509: CE2-1.1-related: Encoder optimization with adjusted palette clustering steps [J. Luo (Alibaba)]

[JVET-Q0519](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9348) Non-CE2: On signaling of maximum palette size and maximum palette predictor size [X. Xiu, H.-J. Jhu, Y.-W. Chen, T.-C. Ma, X. Wang (Kwai)]

[JVET-Q0716](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9562) Crosscheck of JVET-Q0519 (Non-CE2: On signaling of maximum palette size and maximum palette predictor size) [Y.-H. Chao (Qualcomm)] [late]

[JVET-Q0629](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9475) CE2-related: Palette mode excluding small blocks [H.-J. Jhu, X. Xiu, Y.-W. Chen, T.-C. Ma, X. Wang (Kwai Inc.)] [late]

[JVET-Q0718](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9564) Crosscheck of JVET-Q0629 (CE2-related: Palette mode excluding small blocks) [Y.-C. Nien, T.-H. Li, Y.-C. Yang (Foxconn)] [late]

[JVET-Q0702](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9548) Non-CE2: On palette predictor initialization in WPP [Y.-H. Chao, C.-H. Hung, WChien, V. Seregin, M. Karczewicz (Qualcomm), J. Luo, Y. Ye, [R.-L.](mailto:Liao) Liao, M. Sarwer, J. Chen (Alibaba)] [late]

[JVET-Q0742](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9588) Crosscheck of JVET-Q0702 (Non-CE2: On palette predictor initialization in WPP) [T. Lu (Dolby)] [late]

[JVET-Q0712](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9558) Non-CE2: Extension of JVET-Q0503 to high QP [Y.-H. Chao, C.-H. Hung, W.-J. Chien, V. Seregin, M. Karczewicz (Qualcomm), HJhu, X. Xiu, YChen, T.-C. Ma, X. Wang (Kwai), R.-L. Liao, M. Sarwer,Chen, Y. Ye, J. Luo (Alibaba)] [late]

## CE3 related – Lossless coding (25)

Contributions in this category were discussed Thursday 9 Jan. 1100–1300 and 1430-1600 in Track B (chaired by JRO).

[JVET-Q0056](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8881) CE3-related: Level prediction for transform skip samples [J. Lainema (Nokia)]

Current draft VVC standard uses level prediction for transform skip samples when entropy coding is in non-bypass mode. In the current approach, the absolute value of a transform skip sample is predicted by selecting the maximum of the absolute values of its top and left neighbors. In bypass mode this “absLevel prediction” is disabled as in that case the prediction process was already earlier reported to have a negative impact on coding efficiency.

This contribution proposes to use an average based prediction for the values of transform skip coefficients when entropy coding engine is in bypass mode. This is reported to have -3.07 %, -1.05 % and -0.87 % BD-rate impact in lossless AI, RA and LD-B configurations, respectively. In lossy coding, for both standard QP range and low QP range, all configurations are reported have average coding efficiency impact within 0.01 % from the anchors.

Additional results with different configurations of the proposed change and CE3 tests are provided. For example, when the proposed change is applied together with CE3-2.8c and the VTM absLevel prediction for non-bypass transform skip samples is switched off, the lossless coding results are reported as -8.67 %, -5.20 % and -4.60 % for AI, RA and LD-B configurations, respectively.

This method has benefit for TSRC only for lossless. It would still not make TSRC competitive with RRC in lossless mode. On top on of the CE3-2.3 adoption, it would not give benefit.

Though in combination with changes of Rice parameter coding (CE3-2.8..) the method would make modified TSRC competitive with modified RRC in AI case for natural content, this would still not apply for RA, so a switch would still be needed.

No action.

[JVET-Q0706](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9552) Crosscheck of JVET-Q0056 (CE3-related: Level prediction for transform skip samples) [Y. Kato (Panasonic)] [late]

[JVET-Q0107](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8932) CE3-related: Flag-free Lossless Coding in VVC [A. Nalci, M. Karczewicz, H. Wang, H. E. Egilmez, M. Coban (Qualcomm)]

This document proposes a flag-free approach for lossless coding in VVC. Currently, lossless coding is possible via existing syntax with TS residual coding. However, TS residual coding has lesser bit-rate savings as compared to regular coefficient coding as observed in the 16th Geneva meeting. In this document, it is proposed to use regular coefficient coding without additional lossless-specific syntax or signaling. In this case, a lossless coded block or an explicit residual coding switch flag (e.g. as in CE3-2.5) are not signaled but inferred based on the value of the quantization parameter (QP) and TS mode. Based on this inference, RRC coding is used instead of TSRC for lossless.

• The simulation results show overall bit-rate savings of -5.23% AI, -5.58% RA, and -4.96% LDB with Class F: -1.39% AI, -2.40% RA, and -2.12% LDB and Class TGM: 1.54% AI, 0.59% RA, and 1.18% LDB.

• The simulation results with Luma BDPCM enabled show overall bit-rate savings of -6.76% AI, -5.96% RA, and -5.54% LDB with Class F: -5.74% AI, -4.37% RA, and -3.70% LDB and Class TGM: -1.59% AI, -0.71% RA, and 0.16% LDB.

• The simulation results with Luma and Chroma BDPCM enabled show overall bit-rate savings of -7.70% AI, -6.21% RA, and -5.84% LDB with Class F: -7.60% AI, -5.22% RA, and -4.33% LDB and Class TGM: -4.78% AI, -1.90% RA, and -0.05% LDB.

It is suggested to invoke a QP dependent decision on usage of the RC method at block level. There are however some concerns that such dependency would be undesirable.

No action.

[JVET-Q0615](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9461) Crosscheck of JVET-Q0107 (CE3-related: Flag-free Lossless Coding in VVC) [T. Tsukuba (Sony)] [late]

[JVET-Q0108](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8933) CE3-related: On signaling overhead for low-level lossless flags in CE3-2.5 [M. Karczewicz, A. Nalci, H. Wang, H. E. Egilmez, M. Coban (Qualcomm)]

In CE3-2.5 low-level (CU or TU) based flags are discussed for lossless coding. These flags allow switching between the two residual coding methods: (1) transform-skip residual coding and (2) regular residual coding for lossless. The signaling of these low-level flags for lossy case are disabled if the high-level (PPS) option is disabled as “TransformSkipResidualCoding=0”. However, it is important to see the effect of these low-level flags in CE3-2.5 on lossy case if PPS-level flag is not disabled in config (e.g. when “TransformSkipResidualCoding=1”). This document summarizes the signaling overhead of the lossless related flags in CE3-2.5 (sub tests 1, 2, 3). This is achieved by signaling the low-level flags in CE3-2.5 for the lossy case. This document also proposes a modification to sub test 2 of CE3-2.5 (TU-based signaling) to remove the signaling overhead of the TU-based flag for the lossy case.

No need to consider after the CE3 decision.

[JVET-Q0616](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9462) Crosscheck of JVET-Q0108 (CE3-related: On signaling overhead for low-level lossless flags in CE3-2.5) [T. Tsukuba (Sony)] [late]

[JVET-Q0109](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8934) CE3-related: On Last Position Signaling for Lossless Coding [M. Karczewicz, A. Nalci, H. Wang, H. E. Egilmez, M. Coban (Qualcomm)]

In VTM7, lossless coding is possible via existing syntax with transform skip (TS) residual coding. Core experiment (CE3) is investigating high-level (SPS/PPS) and low-level (CU/TU) alternatives for lossless coding for higher bit-rate savings. In this document, it is proposed to disable last position coding when lossless coding uses regular residual coding (RRC) instead of TS residual coding. Here, 3 variants are discussed with the following bit-rate savings:

• For variant 1, the simulation results show overall bit-rate savings of -0.39% AI, -0.43% RA, and -0.52% LD with Class F: 0.23% AI, 0.13% RA, and 0.19% LD and Class TGM: 1.32% AI, 1.08% RA, and 1.42% LD. Max encoder time 104%, max decoder time 101%.

• For variant 2, the simulation results show overall bit-rate savings of -0.39% AI, -0.43% RA, and -0.52% LD with Class F: -0.02% AI, -0.14% RA, and -0.18% LD and Class TGM: 0.36% AI, 0.34% RA, and 0.69% LD. Max encoder time 95%, max decoder time 88%.

• For variant 3, the simulation results show overall bit-rate savings of -0.39% AI, -0.43% RA, and -0.52% LD with Class F: -0.02% AI, -0.13% RA, and -0.10% LD and Class TGM: 0.34% AI, 0.36% RA, and 0.47% LD. Max encoder time 105%, max decoder time 100%.

This approach would likely have a disadvantage for mixed lossy/lossless, as discarding the last position signalling would increase the bitrate for lossy coded regions.

No action.

[JVET-Q0137](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8962) CE3-related: Rice Parameter Derivation with Unified Lookup Table [T. Tsukuba, M. Ikeda, Y. Yagasaki, T. Suzuki (Sony)]

This contribution proposes a rice parameter derivation using a unified lookup table for regular residual coding and transform skip residual coding to simplify CE3-1.1-subset3.

It is reported that, at common QP condition, proposed method provides average BD-rate differences of (-0.01 %, 0.00 %, -0.02 %) for AI, (-0.02 %, -0.01 %, 0.02 %) for RA, and (-0.02%, -0.01%, 0.02%) for LB; For ClassF, (-0.16%, -0.17%, -0.04%) for AI, (-0.18%, -0.03%, -0.17%) for RA, and (-0.13%, -0.58%, 0.62%) for LB; For ClassTGM, (-0.39%, -0.30%, -0.32%) for AI, (-0.19%, -0.20%, -0.16%) for RA, and (-0.20%, -0.35%, -0.26%) for LB.

It is reported that, at low QP condition, proposed method provides average BD-rate differences of (-0.07%, -0.10%, -0.12%) for AI, (-0.02xx%, -0.02yy%, -0.04zz%) for RA, and (-0.02%, -0.02%, -0.01%) for LB; For ClassF, (-1.41%, -0.90%, -0.90%) for AI, (-1.84%, -0.73%, -0.86%) for RA, and (-0.63%, -0.55%, -0.70%) for LB; For ClassTGM, (-1.58%, -1.44%, -1.45%) for AI, (-2.13%, -1.40%, -1.39%) for RA, and (-1.44%, -1.17%, -1.20%) for LB.

It is reported that, at lossless condition, average bitrate differences of -5.08 % for AI, -3.73% for RA, and -2.58% for LB; For ClassF, -3.97% for AI, -3.06% for RA, and -2.78% for LB; For ClassTGM, -4.35% for AI, -6.33% for RA, -6.57% for LB.

In v3, simulation results for ClassA2/RA at low QP condition were updated.

No need to consider after the CE3 decision.

[JVET-Q0707](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9553) Crosscheck of JVET-Q0137 (CE3-related: Rice Parameter Derivation with Unified Lookup Table) [Y. Kato (Panasonic)] [late]

[JVET-Q0139](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8964) CE3-related: Lookup Table Free Rice Parameter Derivation [T. Tsukuba, M. Ikeda, Y. Yagasaki, T. Suzuki (Sony)]

This contribution proposes a lookup table free rice parameter derivation for regular residual coding and transform skip residual coding, where rice parameter is derived simple bit-shift operation.

It is reported that, at common QP condition, proposed method provides average BD-rate differences of (0.00 %, 0.01 %, -0.02 %) for AI, (0.00%, -0.01 %, 0.01%) for RA, and (-0.04%, -0.22 %, -0.15%) for LB; For ClassF, (-0.14%, -0.25%, -0.04%) for AI, (-0.10%, 0.04%, -0.07%) for RA, and (-0.10%, -0.50%, 0.57%) for LB; For ClassTGM, (-0.35%, -0.27%, -0.28%) for AI, (-0.17%, -0.20%, -0.15%) for RA, and (-0.17%, -0.20%, -0.26%) for LB.

It is reported that, at low QP condition, proposed method provides average BD-rate differences of (-0.04%, -0.05%, -0.08%) for AI, (0.xx%, 0.yy%, 0.zz%) for RA, and (0.02%, 0.05%, 0.06%) for LB; For ClassF, (-1.61%, -0.99%, -0.98%) for AI, (-2.02%, -0.89%, -0.96%) for RA, and (-0.62%, -0.58%, -0.73%) for LB; For ClassTGM, (-1.98%, -1.74%, -1.77%) for AI, (-2.47%, -1.54%, -1.53%) for RA, and (-1.51%, -1.27%, -1.26%) for LB.

It is reported that, at lossless condition, average bitrate differences of -5.20 % for AI, -3.57% for RA, and -2.54% for LB; For ClassF, -4.30% for AI, -3.25% for RA, and -3.02% for LB; For ClassTGM, -5.35% for AI, -6.90% for RA, -7.09% for LB.

This proposal replaces the table-based derivation of Rice parameter by a shift operation, which from the results does not seem to provide benefit for the RRC (no gain for natural video). It also introduces Rice parameter derivation in TSRC (which currently has fixed EG1). This introduces a small gain for screnn content, would however also increase the complexity. It is also noted that the BD results in low QP range for screen content may not be conclusive due to the large PSNR values (see discussion under CE2).Question is raised if it provides complexity benefit when only introduced in RRC. The general opinion is that there is no problem with the current table lookup.

No action.

[JVET-Q0638](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9484) Crosscheck of JVET-Q0139 (CE3-related: Lookup Table Free Rice Parameter Derivation) [M. G. Sarwer (Alibaba)] [late]

[JVET-Q0143](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8968) Non-CE3: Issue of Level mapping in transform skip residual [Y. Kato, K. Abe, T. Toma (Panasonic)]

In this contribution, it is proposed to define a new flag in SPS to enable or disable Level mapping in transform skip residual coding. According to the results reported in this contribution, Level mapping has coding loss on camera captured contents for whole QP range including LossLess setting, while it has good coding gain on screen contents. Therefore, this contribution proposes to disable Level mapping from ClassA to ClassE and enable it on ClassF and ClassTGM in all test conditions. Simulation results of Lossless coding, CTC, and LowQP are reportedly shown as follows:

Lossless:

Overall (ClassA-E): -0.54%AI, -0.68%RA, -1.32%LB

CTC:

Overall: 　　　　　-0.00%AI, -0.02%RA, -0.02%LB

LowQP:

Overall: 　　　　　-0.03%AI, -0.XX%RA, -0.01%LB

Provides benefit when TSRC is used in lossless mode. Not relevant after decision of adopting CE3-2.3/4.

No action.

[JVET-Q0622](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9468) Cross-check of JVET-Q0143 (CE3-related: Issue of Level mapping in transform skip residual) in lossless configuration [J. Choi, J. Lim (LGE)] [late]

[JVET-Q0144](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8969) Non-CE3: Contexts in Chroma transform skip residual coding [Y. Kato, K. Abe, T. Toma (Panasonic)]

In this contribution, it is proposed to introduce individual contexts for luma and chroma in all syntaxes of transform skip residual (TSRC) to improve coding gains of Lossless coding. Derivation process for ctxInc for chroma TSRC contexts is completely the same as those for luma TSRC contexts. Simulation results of Lossless coding, CTC, and LowQP are reportedly shown as follows:

Lossless:

Overall: -0.23%AI, -0.65%RA, -0.93%LB

CTC:

ClassF: 0.00%AI, -0.02%RA, 0.00%LB

ClassTGM: -0.11%AI, 0.00%RA, -0.02%LB

LowQP

ClassF: -0.09%AI, -0.05%RA, -0.05%LB

ClassTGM: -0.28%AI, 0.06%RA, -0.20%LB

Provides benefit when TSRC is used in lossless mode. Not relevant after decision of adopting CE3-2.3/4.

No action.

[JVET-Q0646](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9492) Cross-check of JVET-Q0144 (Non-CE3: Contexts in Chroma transform skip residual coding) [T.-C. Ma (Kwai Inc.)] [late]

[JVET-Q0145](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8970) CE3-related: Unified rice parameter derivation of transfrom skip residual [Y. Kato, K. Abe, T. Toma (Panasonic)]

In this contribution, it is proposed to derive Rice parameter in transform skip residual coding (TSRC) in an unified way with transform regular residual coding (RRC). This method is based on adopted rice parameter derivation of CE7-.1.3b-alt [2] in the last meeting. The same Rice parameter table as transform residual coding (RRC) is used for TSRC, and sum value used in deriving Rice parameter is normalized based on the number of reference neighbor coefficients.

Simulation results of Lossless coding, CTC, and LowQP reportedly are shown as follows:

Lossless:

Overall (ClassA-E): -4.87%AI, -3.39%RA, -2.29%LB

ClassF: -3.81%AI, -3.00%RA, -2.74%LB

ClassTGM: -3.80%AI, -6.00%RA, -5.98%LB

CTC:

Overall: -0.01%AI, -0.00%RA, -0.02%LB

ClassF: -0.14%AI, -0.15%RA, -0.15%LB

ClassTGM: -0.36%AI, -0.18%RA, -0.25%LB

LowQP:

Overall: -0.07%AI, -0.02%RA, -0.02%LB

ClassF: -1.30%AI, -1.63%RA, -0.58%LB

ClassTGM: -1.17%AI, -1.83%RA, -1.02%LB

No need for consideration after decision of adopting CE3-2.3/4. Though the combination ofQ0143, Q0144 and Q0145 would make the TSRC competitive with RRC for lossless and would avoid a high level switch of CE3-2.3/4, it would make the TSRC more complex which is undesirable.

No action.

[JVET-Q0548](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9394) Crosscheck of JVET-Q0145 (CE3-related: Unified rice parameter derivation of transform skip residual) [J. Lainema (Nokia)] [late]

[JVET-Q0186](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9011) CE3-related: TB-level residual coding selection for lossless coding [Z.-Y. Lin, T.-D. Chuang, C.-Y. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek)]

In the current VVC, lossless coding is achieved by always choosing transform skip (TS) mode by signalling TS flag equal to 1 for each transform block (TB), where the TS mode is always combined with transform skip residual coding (TSRC). In the 16th JVET meeting, it was observed that always choosing TS mode by signalling TS flag equal to 1 for each TB and always combining TS mode with regular residual coding (RRC) can bring more bit savings for lossless coding some sequences, especially for camera captured videos. Therefore, to improve lossless coding gain, slice-level switch between TSRC and RRC for lossless coding by signalling TS flag equal to 1 for each TB is planned in CE3. In this contribution, transform block (TB) level switch between TSRC and RRC for lossless coding is proposed to further improve lossless coding gain. First, a new “slice transform disabled flag” is signalled or inferred at slice level, and it is used to indicate whether transform is disabled for the slice. When the slice transform disabled flag is true, the transform process and quantization process are the same as those when TS is applied, and the TS flag is still signalled at TB level but used to select TSRC or RRC. Second, since in VTM7.0 block-wise differential pulse code modulation (BDPCM) blocks are always combined with TS and TSRC, to remove this combination so as to make BDPCM blocks be able to choose between TSRC and RRC, a new “slice BDPCM infer transform skip disabled flag” is signalled or inferred at slice level, and it is used to indicate whether TS and TSRC are combined with BDPCM blocks. If the slice BDPCM infer transform skip disabled flag is true, the TS flag is still signalled for each BDPCM block, and TS is still applied to all BDCM blocks, but the TS flag is used to select TSRC or RRC. Lossless coding bit savings are as follows.

[Anchor: VTM7.0 with BDPCM disabled; Test: Proposed method with BDPCM disabled]

TGM sequences => -3.88% (AI), -4.52% (RA), -4.53% (LB)

CTC sequences (Classes A1, A2, B, C, E) => -5.46% (AI), -5.73% (RA), -5.06% (LB)

[Anchor: VTM7.0 with BDPCM disabled; Test: Proposed method with luma and chroma BDPCM enabled]

TGM sequences => -8.50% (AI), -6.37% (RA), -5.45% (LB)

CTC sequences (Classes A1, A2, B, C, E) => -7.86% (AI), -6.33% (RA), -5.91% (LB)

The proposal is to introduce a slice level flag which would enforce TS for the entire slice, and in that case re-use the TS flag at block level for switching between RRC and TSRC (unmodified versions).

This is only effective for entire-slice lossless coding (no mixed lossy/lossless, which would be the more relevant case). The benefit relative to the adoption (with high-level switch RRC/TSRC) is minor (0.1%) overall, higher for TGM. Encoder runtime is significantly increased due to block level switching. Furthermore, the approach of changing the semantics of TS flag for that purpose is not clean in terms of spec definition.

No action.

[JVET-Q0649](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9495) Cross-check of JVET-Q0186 (CE3-related: TB-level residual coding selection for lossless coding) [T.-C. Ma (Kwai Inc.)] [late]

[JVET-Q0187](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9012) CE3-related: Rice parameter derivation in residual coding [Z.-Y. Lin, T.-D. Chuang, C.-Y. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek)]

In the current VTM7.0, the rice parameter is always set to 1 in transform skip residual coding (TSRC), which decreases the bit savings in lossless coding since using rice parameter equal to 1 is not efficient especially when the coefficients (i.e., residuals) tend to be larger. This contribution proposes four methods to improve TSRC by using rice parameter other than 1.

Method 1.1 reuses the rice parameter table of regular residual coding (RRC) in the rice parameter derivation of TSRC, the rice parameter derivation is as below.

rice\_tsrc = RRC\_rice\_table[ Clip3(0, 31, absSum – 2\*baseLevel + 5)]

Based on Method 1.1, Method 1.2 applies normalization to the sum of the absolute coefficients in the local template for TSRC, which further considers the number of in-the-same-TB coefficients in the local template.

rice\_tsrc = RRC\_rice\_table[ Clip3(0, 31, ((numAvail == 1)? 2\* absSum: absSum) – 2\*baseLevel + 5)]

Method 2.1 removes the rice parameter table in RRC. The rice parameter derivation is as below.

rice\_rrc = Clip3(0, 39, absSum – 5\*baseLevel) >> 3

rice\_tsrc = Clip3(0, 39, absSum – 2\*baseLevel + 5) >> 3

Based on Method 2.1, Method 2.2 applies normalization to the sum of the absolute coefficients in the local template for TSRC, which further considers the number of in-the-same-TB coefficients in the local template.

rice\_rrc = Clip3(0, 39, absSum – 5\*baseLevel) >> 3

rice\_tsrc = Clip3(0, 39, ((numAvail == 1)? 2\* absSum: absSum) – 2\*baseLevel + 5) >> 3

The compression performance of the four tests are listed below.

Method 1.1:

[classes CTC including A1, A2, B, C, E]

VTM7.0 - standard QPs: { luma BD-rate = -0.01%(AI), 0.00%(RA), -0.02%(LB) }

VTM7.0 - low QPs: { luma BD-rate = -0.07%(AI), -0.02%(RA), -0.02%(LB) }

VTM7.0 - lossless: { bit-rate = -4.90%(AI), -3.69%(RA), -2.39%(LB) }

[class TGM]

VTM7.0 - standard QPs: { luma BD-rate = -0.37%(AI), -0.18%(RA), -0.27%(LB) }

VTM7.0 - low QPs: { luma BD-rate = -1.09%(AI), -1.82%(RA), -0.94%(LB) }

VTM7.0 - lossless: { bit-rate = -3.80%(AI), -6.00%(RA), -6.00%(LB) }

Method 1.2:

[classes CTC including A1, A2, B, C, E]

VTM7.0 - standard QPs: { luma BD-rate = -0.01%(AI), -0.01%(RA), -0.04%(LB) }

VTM7.0 - low QPs: { luma BD-rate = -0.07%(AI), -0.02%(RA), -0.02%(LB) }

VTM7.0 - lossless: { bit-rate = -5.15%(AI), -3.92%(RA), -2.35%(LB) }

[class TGM]

VTM7.0 - standard QPs: { luma BD-rate = -0.35%(AI), -0.21%(RA), -0.29%(LB) }

VTM7.0 - low QPs: { luma BD-rate = -1.33%(AI), -1.97%(RA), -1.14%(LB) }

VTM7.0 - lossless: { bit-rate = -4.20%(AI), -6.26%(RA), -6.33%(LB) }

Method 2.1:

[classes CTC including A1, A2, B, C, E]

VTM7.0 - standard QPs: { luma BD-rate = 0.01%(AI), 0.00%(RA), 0.01%(LB) }

VTM7.0 - low QPs: { luma BD-rate = -0.01%(AI), -0.06%(RA), -0.06%(LB) }

VTM7.0 - lossless: { bit-rate = -4.89%(AI), -3.32%(RA), -2.49%(LB) }

[class TGM]

VTM7.0 - standard QPs: { luma BD-rate = -0.37%(AI), -0.16%(RA), -0.28%(LB) }

VTM7.0 - low QPs: { luma BD-rate = -1.45%(AI), -2.14%(RA), -1.18%(LB) }

VTM7.0 - lossless: { bit-rate = -4.69%(AI), -6.63%(RA), -6.75%(LB) }

Method 2.2:

[classes CTC including A1, A2, B, C, E]

VTM7.0 - standard QPs: { luma BD-rate = 0.01%(AI), -0.01%(RA), 0.01%(LB) }

VTM7.0 - low QPs: { luma BD-rate = -0.02%(AI), X.XX%(RA), -0.06%(LB) }

VTM7.0 - lossless: { bit-rate = -5.19%(AI), -3.58%(RA), -6.94%(LB) }

[class TGM]

VTM7.0 - standard QPs: { luma BD-rate = -0.38%(AI), -0.10%(RA), -0.11%(LB) }

VTM7.0 - low QPs: { luma BD-rate = -1.69%(AI), -2.33%(RA), -1.27%(LB) }

VTM7.0 - lossless: { bit-rate = -5.08%(AI), -6.89%(RA), -6.94%(LB) }

Similar to JVET-Q0139 – no need for action.

[JVET-Q0263](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9088) CE3-related: Bit-exact simplification of Rice parameter selection for regular residual coding [C. Auyeung, X. Li, X. Zhao, S. Liu (Tencent)]

This contribution proposes editorial changes to the VVC Draft 7 to remove the Rice parameter lookup table for regular residual coding and associated software changes to VTM-7.0 to reduce encoding time and decoding time. The proposed modifications to VTM-7.0 result in identical bitstreams from VTM-7.0. For CTC-QP AI/RA/LB configurations, the overall CTC encoding time is 99%/99%/99%, and the decoding time is 98%/98%/100%, respectively. For low-QP AI/RA/LB configurations, the overall CTC encoding time is 99%/xxx/100%, and the decoding time is 98%/xxx/99%, respectively. More accurate decoding timing, by decoding the bitstream multiple times in a single computer, shall be updated in a later revision of this document. This contribution is also applicable to other CE3 and CE3-related proposals with Rice parameter lookup tables.

Purely editorial. To the discretion of editors if that is useful. Current table may be better to understand than the formula.

[JVET-Q0545](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9391) Crosscheck of JVET-Q0263 (CE3-related: Bit-exact simplification of Rice parameter selection for regular residual coding) [Z.-Y. Lin (MediaTek)] [late]

[JVET-Q0264](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9089) CE3-related: Computation reduction in the derivation of Rice parameter for abs\_remainder[ ] in regular residual coding [C. Auyeung, X. Li, X. Zhao, S. Liu (Tencent)]

This contribution proposes to reduce the computation in the derivation of Rice parameter for abs\_remainder[ ] in residual coding without transform skip by replacing the calculation of locSumAbs in VVC Draft 7. Three variants of the proposal (A,B,C) with similar performance are presented.

For proposal A with CTC-QP AI/RA/LB configurations, the BDR is 0.03%/0.03%/-0.01%, the encoding time is 100%/100%/100%, and the decoding time is 99%/99%/101%, respectively. For proposal A low-QP AI/RA/LB configurations, the BDR is 0.17%/0.05%/0.02%, the encoding time is 99%/99%/99%, and the decoding time is 97%/97%/98%, respectively.

For proposal B with CTC-QP AI/RA/LB configurations, the BDR is 0.00%/0.00%/-0.02%, the encoding time is 100%/100%/99%, and the decoding time is 99%/99%/100%, respectively. For proposal B low-QP AI/RA/LB configurations, the BDR is -0.02%/0.00%/0.00%, the encoding time is 100%/100%/100%, and the decoding time is 96%/97%/97%, respectively.

For proposal C with CTC-QP AI/RA/LB configurations, the BDR is 0.00%/0.00%/-0.02%, the encoding time is 99%/99%/99%, and the decoding time is 97%/97%/98%, respectively. For proposal C low-QP AI/RA/LB configurations, the BDR is -0.02%/0.00%/0.01%, the encoding time is 99%/99%/99%, and the decoding time is 96%/96%/95%, respectively.

More accurate decoding timing, by decoding the bitstream multiple times in a single computer, shall be updated in a later revision of this document.

According to the proponent, proposal C is the most robust solution (retaining larger range of variation of Rice parameter).

One expert expresses opinion that due to introducing some sequential dependency on previous decoded value, though the number of operations is reduced, parallel computation of the current design would not be possible, so there may even be worse throughput.

There is no real complexity problem at that stage of entropy coding.

No action.

[JVET-Q0553](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9399) Crosscheck of JVET-Q0264: CE3-related: Computation reduction in the derivation of Rice parameter for abs\_remainder[ ] in regular residual coding [T. Nguyen (HHI)] [late]

[JVET-Q0269](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9094) CE3-related: On transform skip residual coding [M. G. Sarwer, Y. Ye, J. Luo (Alibaba)]

This contribution proposes to reduce the computation in the derivation of Rice parameter for abs\_remainder[ ] in residual coding without transform skip by replacing the calculation of locSumAbs in VVC Draft 7. Three variants of the proposal (A,B,C) with similar performance are presented.

For proposal A with CTC-QP AI/RA/LB configurations, the BDR is 0.03%/0.03%/-0.01%, the encoding time is 100%/100%/100%, and the decoding time is 99%/99%/101%, respectively. For proposal A low-QP AI/RA/LB configurations, the BDR is 0.17%/0.05%/0.02%, the encoding time is 99%/99%/99%, and the decoding time is 97%/97%/98%, respectively.

For proposal B with CTC-QP AI/RA/LB configurations, the BDR is 0.00%/0.00%/-0.02%, the encoding time is 100%/100%/99%, and the decoding time is 99%/99%/100%, respectively. For proposal B low-QP AI/RA/LB configurations, the BDR is -0.02%/0.00%/0.00%, the encoding time is 100%/100%/100%, and the decoding time is 96%/97%/97%, respectively.

For proposal C with CTC-QP AI/RA/LB configurations, the BDR is 0.00%/0.00%/-0.02%, the encoding time is 99%/99%/99%, and the decoding time is 97%/97%/98%, respectively. For proposal C low-QP AI/RA/LB configurations, the BDR is -0.02%/0.00%/0.01%, the encoding time is 99%/99%/99%, and the decoding time is 96%/96%/95%, respectively.

More accurate decoding timing, by decoding the bitstream multiple times in a single computer, shall be updated in a later revision of this document.

No need for presentation upon adoption from CE3.

[JVET-Q0619](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9465) Crosscheck of JVET-Q0269 (CE3-related: On transform skip residual coding) [T. Tsukuba (Sony)] [late]

[JVET-Q0294](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9119) CE3-related: CTU level local lossless coding of VVC [M. G. Sarwer, Y. Ye, J. Luo, J. Chen (Alibaba)]

In order to achieve efficient compression in mixed lossy and lossless coding, this contribution proposes to signal a flag at each coding tree unit (CTU) to indicate whether a CTU is coded as either in lossless or in lossy mode. If a CTU is lossless coded, an additional CTU level flag is signaled to specify the residual coding method, either regular residual coding or transform skip residual coding, used for that CTU.

Following results of are reported as compared to VTM-7.0.

 Test 1: All lossless CTUs use transform skip residual coding (TSRC):

 Overall: -0.01% (AI), -0.01% (RA), -0.01% (LB) bit rate saving

 TGM: -0.01% (AI), 0.09% (RA), -0.09% (LB) bit rate saving

 Test 2: All lossless CTUs use TSRC with rice parameter derivation method proposed in JVET-Q0269:

 Overall: -4.33% (AI), -2.61% (RA), -1.99% (LB) bit rate saving

 TGM: -5.20% (AI), -6.61% (RA), -6.80% (LB) bit rate saving

 Test 3: All lossless CTUs of class F & TGM sequences are coded with TSRC with rice parameter derivation method proposed in JVET-Q0269. All lossless CTUs of other sequences are coded with regular residual coding (RRC):

 Overall: -5.24% (AI), -5.59% (RA), -4.98% (LB) bit rate saving

 TGM: -5.20% (AI), -6.61% (RA), -6.80% (LB) bit rate saving

 Test 4: Test3 + luma BDPCM on

 Overall: -6.77% (AI), -5.97% (RA), -5.55% (LB) bit rate saving

 TGM: -7.01% (AI), -7.44% (RA), -7.39% (LB) bit rate saving

The results do not indicate the benefit for mixed lossy/lossless coding. Therefore, no evidence that a local switch (which should not be called “lossless”) would provide benefit.

Further study – AHG on lossless coding should investigate test cases and conditions for local lossless coding.

[JVET-Q0665](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9511) Cross-check of JVET-Q0294 (CE3-related: CTU level local lossless coding of VVC) [A. Nalci (Qualcomm)] [late]

[JVET-Q0323](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9148) Non-CE3: Encoder optimization for chroma BDPCM [C.-C. Kuo, S.-P. Wang, C.-C. Lin, C.-L. Lin (ITRI)]

Chroma BDPCM can provide benefit on coding efficiency especially for lossless test condition. This contribution proposed 2 methods of encoder optimization for chroma BDPCM. Both methods were implemented on top of CE3-2.2 and CE3-2.4a source codes and compared over the results of them.

When using CE3-2.2 as anchor, the overall bit-rate savings for the proposed method 1 are 0.87% and 0.24%, with encoding time savings -11% and -2% for AI and RA, respectively. For the proposed method 2, the overall bit-rate savings are 0.36% and 0.20%, with encoding time savings -9% and -1% for AI and RA, respectively.

When using CE3-2.4a as anchor, the overall bit-rate savings for the proposed method 1 are 0.84% and 0.17%, with -8% and -1% encoding time saving for AI and RA, respectively. For the proposed method 2, the overall bit-rate savings are 0.38% and 0.14%, with encoding time savings -5% and -1% for AI and RA, respectively.

This reduces encoding time, but also reduces the the performance (gain drops from 7.7% to 7.35% for 5% encoding time saving in AI, whereas for RA no reduction of encoding time, but still some loss in performance). No good tradeoff.

No action.

[JVET-Q0603](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9449) Crosscheck of JVET-Q0323 (Non-CE3: Encoder optimization for chroma BDPCM) [M.-S. Chiang (MediaTek)] [late]

[JVET-Q0439](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9265) CE3 Related: Modified Rice Parameter derivation [S. Keating, K. Sharman (Sony)]

This contribution describes a modified method of deriving the Rice parameter for TS blocks based on CE3-1.1c. An overall gain of 5.76% (over CE3-1.1c gain of 5.09%) for lossless AI is reported, with a gain of 9.13% (over CE3-1.1c gain of 8.12%) for the TGM image class for lossless AI.

No need for presentation – obsolete after decision on CE3.

[JVET-Q0460](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9286) Non-CE3: Inter BDPCM for lossless video coding [G. Kulupana, S. Blasi (BBC)]

This contribution proposes to apply BDPCM on inter-predicted residuals for lossless coding. Identically to intra BDPCM, the proposed inter BDPCM works on quantized residuals. Therefore, the tool re-uses entirely the residual prediction operations used in the intra BDPCM pipeline. Furthermore, the proposed inter BDPCM operation is applied only to luma residuals. As with intra BDPCM, when inter BDPCM is used, residuals are not subjected to any transform operation (i.e., Transform Skip is used). Average BD-rates of -0.96% is reported for RA with 110% encoding time and 98% decoding time with respect to lossless VTM 7.0 anchor. Moreover, the when both inter and intra BDPCM are applied an Average BD-rates of -1.22% is obtained for RA with 114% encoding time and 98% decoding time with respect to lossless VTM 7.0 anchor.

Does not have any (or only minor) benefit for lossy coding. The abov gains are for BDPCM luma only. The additional gain relative to CE3-2.4 (then, including luma and chroma BDPCM in inter as well) is around 0.8% for RA config, with encoding time increase around 10%.

Question is raised how it would perform in CTC – proponent will provide those results, revisit.

Overall, the additional benefit in compression may not justify the additional complexity (both for encoding and the impact on the implementation on the inter decoding stage is not fully clear, would require more study). It is also noted that the modification of parsing may have some impact.

[JVET-Q0636](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9482) Crosscheck of JVET-Q0460 (Non-CE3: Inter BDPCM for lossless video coding) [T. Tsukuba (Sony)] [late]

[JVET-Q0462](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9288) CE3-related: Modified transform skip residual coding for lossless coding [T. Nguyen, B. Bross, H. Schwarz, D. Marpe, T. Wiegand (HHI)]

This input contribution proposes and describes changes to the Transform Skip Residual Coding (TSRC) to further improve the compression efficiency for the lossless operation mode in VTM/VVC. Three parts are changed: using the Rice parameter derivation for regular residual coding (RRC) for TSRC (aspect 1), the level mapping in TSRC is modified (aspect 2) and ZeroPos-based coefficient prediction from RRC is introduced in TSRC (aspect 3). All these changes are only applied if the QP indicates lossless coding and thus only lossless results are affected compared to VTM-7.0 as follows:

Lossless: -6.14% (AI), -3.93% (RA), -4.43% (LB)

The results without the QP dependency and with only the Rice parameter change (aspect 1) are as follows:

Lossless: -5.22% (AI), x.xx% (RA), x.xx% (LB)

Lossy (CTC): x.xx% Y x.xx% Cb x.xx% Cr (AI)

x.xx% Y x.xx% Cb x.xx% Cr (RA)

x.xx% Y x.xx% Cb x.xx% Cr (LB)

Enabling BDPCM on top of that is expected to bring additional gain.

No need for presentation – obsolete after decision on CE3.

[JVET-Q0463](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9289) CE3-related: Inter BDPCM with RRC for lossless video coding [G. Kulupana, S. Blasi (BBC)]

This contribution proposes to apply BDPCM on inter-predicted residuals for lossless coding. The proposed method is an extension to Regular Residual Coding (RRC) based BDPCM described in CE3-2.4 in JVET-Q0089 [1]. Identically to intra BDPCM, the proposed inter BDPCM works on quantized residuals. Therefore, the tool re-uses entirely the residual prediction operations used in the intra BDPCM pipeline. Furthermore, the proposed inter BDPCM operation is applied both for luma and chroma residuals. As with intra BDPCM, when inter BDPCM is used, residuals are not subjected to any transform operation (i.e., Transform Skip is used). When the proposed inter BDPCM is integrated into CE3-2.4, an average BD-rates of -6.97% is reported for RA with 122% encoding time and 99% decoding time with respect to lossless VTM 7.0 anchor.

Was included in the presentation of JVET-Q0460.

[JVET-Q0489](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9316) CE3-related: Modified TS residual coding [M. Karczewicz, H. Wang, M. Coban, A. Nalci (Qualcomm), C. Auyeung, X. Li, X. Zhao, S. Liu (Tencent)]

This document proposes modifications to transform skip coefficient coding to improve its coding efficiency for lossless coding. Level prediction is removed, the abs\_level\_gt2\_flag flag is moved to the 1st pass while the coeff\_sign\_flag is moved to the second pass, and the context derivation of sig\_coeff\_flag, abs\_level\_gt1\_flag and the abs\_level\_gt2\_flag flags are modified. The rice parameter value is calculated similarly as for transform coefficients with the normalization based on the number of available neighboring coefficients.

The coding results for the proposed method comparing to VTM-7.0 anchor (CTC) are summarized below:

* Natural: -0.03% (AI), -0.01% (RA), -0.06% (LB)
* Class F: 0.03% (AI), 0.02%% (RA), -0.22% (LB)
* TGM: 0.03% (AI), -0.05% (RA), -0.32% (LB)

The coding results for the proposed method comparing VTM-7.0 anchor (lossless) are summarized below:

* Natural: -6.48%, (AI), -6.08% (RA), -5.23% (LB)
* Class F: -4.37% (AI), -4.68% (RA), -4.52% (LB)
* TGM: -2.34% (AI), -3.36% (RA), -2.19% (LB)

When compared with VTM-7.0 using regular transform coefficient coding (RRC) as anchor, the lossless results are summarized below:

* Natural: -1.32% (AI), -0.54% (RA), -0.29% (LB)
* Class F: -3.00% (AI), -2.28% (RA), -2.39% (LB)
* TGM: -3.81%(AI), -3.92%(RA), -3.32%(LB)

The contribution shows that there are possibilities to make the performance of TSRC in lossless case competitive with RRC (both for natural and screen content, where it is even better for the latter). This would however have some impact on complexity and require various modifications – solution adopted from CE3 is simpler and not much worse.

[JVET-Q0551](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9397) Crosscheck of JVET-Q0489: CE3-related: Modified TS residual coding [T. Nguyen (HHI)] [late]

[JVET-Q0490](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9318) CE3-related: Simplification of rice parameter derivation [H. Wang, M. Karczewicz, M. Coban (Qualcomm)]

This document proposes rice parameter derivation methods without look-up table for regular transform residual coding (RRC) and transform-skip residual coding (TSRC). Instead of using the value locSumAbs (sum of absolute values with in the same local template) as a table index, the proposed method derives the rice parameter by performing arithmetic operations on locSumAbs.

The coding results for the proposed method comparing to VTM-7.0 anchor (CTC) are summarized below:

|  |  |  |
| --- | --- | --- |
|  | RRC change | RRC + TSRC change |
| Natural | 0.01% (AI), XX% (RA), XX% (LB) | 0.00% (AI), XX% (RA), XX% (LB) |
| Class F | 0.01% (AI), 0.00% (RA), XX% (LB) | -0.15% (AI), -0.12% (RA), XX% (LB) |
| TGM | 0.02% (AI), -0.01% (RA), XX% (LB) | -0.36% (AI), -0.18% (RA), XX% (LB) |

The coding results for the proposed method comparing VTM-7.0 anchor (lossless) are summarized below:

|  |  |  |
| --- | --- | --- |
|  | RRC change | TSRC change |
| Natural | -5.11% (AI), XX% (RA), -4.97% (LB) | -5.12% (AI), XX% (RA), -2.41% (LB) |
| Class F | -1.41% (AI), -2.42% (RA), -2.14% (LB) | -4.11% (AI), -2.91% (RA), -2.65% (LB) |
| TGM | 1.64% (AI), 0.74% (RA), 1.32% (LB) | -4.77% (AI), -6.65% (RA), -6.68% (LB) |

No need for presentation after the adoption of CE3-2.3/4

[JVET-Q0599](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9445) Crosscheck of JVET-Q0490 (CE3-related: Simplification of rice parameter derivation) [H.-J. Jhu (Kwai Inc.)] [late]

[JVET-Q0693](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9539) Crosscheck of JVET-Q0490: CE3-related: Simplification of rice parameter derivation [J. Ström (Ericsson)] [late]

[JVET-Q0498](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9326) Non-CE3: TB based Rice parameter selection for transform skip residual coding [Y.-W. Chen, T.-C. Ma, X. Xiu, H.-J. Jhu, X. Wang (Kwai Inc.)] [late]

In residual coding of a transform skip block, for each sample, the remaining absolute level “abs\_remainder” is binarized using the fixed rice parameter equal to 1. However, it is observed that using different rice parameters for different conditions (e.g. different sequences, different QPs) improves the coding efficiency especially for low QP and lossless conditions. In this proposal, it is proposed to explicitly signal the rice parameter for each TB to indicate the rice parameter for the binary codewords of abs\_remainder. Three tests are conducted including test 1: switching between rice parameters (0, 1, 2 or 3), test2: switching between rice parameters (0, 1, 2 or 4) and test 3: switching between rice parameters (0, 1, 2 or 4) with fast encoding. The results are summarized as below. The run time increase of the proposed method with fast encoding is around 105% for AI, RA and LDB cases.

The results of TB-level rice parameter compared to VTM7.0 on CTC sequences:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Rice (0,1,2,3) | | | Rice (0,1,2,4) | | | Rice (0,1,2,4) with Fast encoding | | |
|  | AI | RA | LDB | AI | RA | LDB | AI | RA | LDB |
| Standard QPs | 0.03% | 0.01% | -0.04% | 0.03% | 0.01% | -x.xx% | 0.03% | 0.01% | -0.04% |
| Low QPs | -0.04 % | -0.06% | -0.04 % | -0.04% | -x.xx% | -x.xx% | -0.03% | -x.xx% | -x.xx% |
| Lossless | -4.61% | -3.40% | -1.83% | -4.77% | -x.xx% | -1.96% | -4.15% | -x.xx% | -1.61% |

The results of TB-level rice parameter compared to VTM7.0 on Class F sequences:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Rice (0,1,2,3) | | | Rice (0,1,2,4) | | | Rice (0,1,2,4) with Fast encoding | | |
|  | AI | RA | LDB | AI | RA | LDB | AI | RA | LDB |
| Standard QPs | 0.03% | 0.05% | -0.05% | 0.00% | -0.05% | -x.xx% | 0.03% | 0.01% | -0.04% |
| Low QPs | -1.14 % | -1.20% | -0.49 % | -1.29% | -1.27% | -0.57% | -0.97% | -0.99% | -x.xx% |
| Lossless | -2.38% | -1.95% | -1.73% | -2.69% | -2.18% | -1.89% | -2.05% | -1.74% | -1.43% |

The results of TB-level rice parameter compared to VTM7.0 on TGM sequences:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Rice (0,1,2,3) | | | Rice (0,1,2,4) | | | Rice (0,1,2,4) with Fast encoding | | |
|  | AI | RA | LDB | AI | RA | LDB | AI | RA | LDB |
| Standard QPs | -0.18% | 0.00% | -0.04% | -0.23% | -0.07% | 0.00% | -0.18% | 0.00% | -0.04% |
| Low QPs | -2.43 % | -2.33% | -1.42 % | -3.16% | -2.92% | -1.70% | -2.22% | -2.06% | -0.96% |
| Lossless | -4.95% | -5.17% | -5.38% | -6.44% | -5.75% | -5.70% | -5.27% | -1.30% | -0.73% |

No need for presentation after the adoption of CE3-2.3/4

[JVET-Q0588](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9434) Crosscheck of JVET-Q0498 (Non-CE3: TB based Rice parameter selection for transform skip residual coding) [R.-L. Liao (Alibaba)] [late]

[JVET-Q0561](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9407) CE3-related: Transquant Bypass Mode for Lossless Coding [A. Nalci, M. Karczewicz, H. Wang, H. E. Egilmez, M. Coban (Qualcomm)] [late]

This document proposes to bring back HEVC like transquant bypass mode into VVC for lossless coding. Currently, lossless coding is possible via existing syntax with TS residual coding. However, TS residual coding has lesser bit-rate savings as compared to regular coefficient coding as observed in the 16th Geneva meeting. As a result, CE3 has many tests for signaling either a high-level flag or a low-level flag for switching between TS residual coding and regular residual coding. In the case of transquant bypass, transform and quantization steps are simply bypassed using a coding unit (CU) level flag. This flag does not only provide a CU level control for lossless coded blocks but is also more flexible for doing mixed lossy and lossless coding.

* The simulation results show overall bit-rate savings of -5.32% AI, -5.62% RA, and -5.00% LDB with Class F: -3.08% AI, -3.73% RA, and -3.54% LDB and Class TGM: -3.19% AI, -2.59% RA, and -2.84% LDB.
* The simulation results with Luma BDPCM enabled show overall bit-rate savings of -6.86% AI, X% RA, and -X% LDB with Class F: -6.94% AI, -5.23% RA, and X% LDB and Class TGM: -5.59% AI, -3.52% RA, and -3.09% LDB.

* The simulation results with Luma and Chroma BDPCM enabled show overall bit-rate savings of -7.79% AI, X% RA, and -X% LDB with Class F: -8.52% AI, -5.94% RA, and X% LDB and Class TGM: -8.26% AI, -4.50% RA, and -4% LDB.

Results indicate that a low-level flag switching between the two residual coding modes may have some benefit for screen content, for natural content similar to the solution adopted in CE3-2.4

No need for action

[JVET-Q0749](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9595) CE3-related: Additional Results with Luma and Chroma BDPCM on CE3-2.5 [A. Nalci, H. E. Egilmez, M. Coban, M. Karczewicz (Qualcomm), T.-C. Ma, H.-J. Jhu, X. Xiu, Y.-W. Chen, X. Wang (Kwai Inc.)] [late]

This document provides additional results with chroma BDPCM enabled on top of CE3-2.5 sub test 2.

• The simulation results show overall bit-rate savings of -7.69% AI, -6.20% RA, and -5.83% LDB with Class F: -7.99% AI, -5.80% RA, and -5.06% LDB and Class TGM: -7.86% AI, -5.25% RA, and -4.61% LDB.

Results indicate that a low-level flag switching between the two residual coding modes may have some benefit for screen content, for natural content similar to the solution adopted in CE3-2.4

No need for action

Overall conclusion: CE3 does not need to be continued.

## CE4 related – Inter prediction with geometric partitioning (33)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

[JVET-Q0061](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8886) CE4-related: Combined Test of CE4-1, CE4-2 and CE4-3 [H. Gao, S. Esenlik, E. Alshina, A. M. Kotra, B. Wang (Huawei), K. Reuzé, C.-C. Chen, H. Huang, W.-J. Chien, V. Seregin (Qualcomm), R.-L. Liao, J. Chen, Y. Ye, J. Luo (Alibaba), L. Xu, F. Chen, L. Wang (Hikvision), Z. Deng, L. Zhang, H. Liu, K. Zhang, Y. Wang (Bytedance), M Bläser, J. Sauer (RWTH Aachen)]

[JVET-Q0123](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8948) CE4-related: Modifications of GEO [J. Li (Panasonic)]

[JVET-Q0668](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9514) Crosscheck of JVET-Q0123 (CE4-related: Modifications of GEO) [Z. Deng (ByteDance)] [late]

[JVET-Q0127](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8952) Non-CE4: On merge list generation for geometric partitioning [Y. Kidani, K. Kawamura, K. Unno, S. Naito (KDDI)]

[JVET-Q0692](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9538) Crosscheck of JVET-Q0127: Non-CE4: On merge list generation for geometric partitioning [H. Gao (Huawei)] [late]

[JVET-Q0131](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8956) Non-CE4: GEO with mode reduction [T. Hashimoto, E. Sasaki, T. Ikai (Sharp)]

[JVET-Q0711](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9557) Crosscheck of Non-CE4: GEO with mode reduction [K. Reuzé, H. Huang, W.-J. Chen, V. Seregin, M. Karczewicz (Qualcomm)] [late]

[JVET-Q0132](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8957) Non-CE4: Separate syntax for GEO angle and distance [T. Zhou, E. Sasaki, T. Ikai (Sharp)]

[JVET-Q0667](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9513) Crosscheck of JVET-Q0132 (Non-CE4: Separate syntax for GEO angle and distance) [Z. Deng (Bytedance)] [late]

[JVET-Q0160](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8985) CE4-related: CE4-1 spec text with suggested fixes [M. Zhou (Broadcom)]

[JVET-Q0168](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8993) CE4-related: On GEO clean-ups [Y. Morigami, M. Ikeda, T. Suzuki (Sony)]

[JVET-Q0719](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9565) Crosscheck of JVET-Q0168 (CE4-related: On GEO cleanups) [A. Filippov, V. Rufitskiy (Huawei)] [late]

[JVET-Q0188](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9013) CE4-related: Simplification on geometric partitioning mode by replacing motion index calculation with subsampled weight information [Y.-L. Hsiao, C.-C. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0554](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9400) Crosscheck of JVET-Q0188: CE4-related: Simplification on geometric partitioning mode by replacing motion index calculation with subsampled weight information [H. Gao (Huawei)] [late]

[JVET-Q0189](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9014) CE4-related: Reducing GEO modes [O. Chubach, Y.-L. Hsiao, C.-Y. Chen, T.-D. Chuang, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0738](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9584) Cross-check result of JVET-Q0189: CE4-related: Reducing GEO modes [Z. Zhang (Ericsson)] [late]

[JVET-Q0268](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9093) CE4-related: GEO with 32 modes [K. Reuzé, H. Huang, W.-J. Chien, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-Q0714](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9560) Crosscheck of JVET-Q0268 (CE4-related: GEO with 32 modes) [T. Hashimoto, T. Ikai (Sharp)] [late]

[JVET-Q0307](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9132) CE4-related: Block-dimension based GEO mode selection [Z. Deng, L. Zhang, H. Liu, K. Zhang, Y. Wang (Bytedance)]

[JVET-Q0577](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9423) Crosscheck of JVET-Q0307 (CE4-related: Block-dimension based GEO mode selection) [L. Xu, H. Dou, Y.-J. Chiu (Intel)] [late]

[JVET-Q0309](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9134) CE4-related: Further constraints on block shapes for GEO [Z. Deng, L. Zhang, H. Liu, K. Zhang, Y. Wang (Bytedance)]

[JVET-Q0528](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9358) Crosscheck of JVET-Q0309 (CE4-related: Further constraints on block shapes for GEO) [J. Li (Panasonic)] [late]

[JVET-Q0312](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9137) CE4-related: On simplification for GEO weight derivation [Y. Sun, F. Chen, L. Wang (Hikvision)]

[JVET-Q0672](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9518) Crosscheck of JVET-Q0312 (CE4-related: On simplification for GEO weight derivation) [Z. Deng (ByteDance)] [late]

[JVET-Q0338](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9163) CE4-related: Harmonized conditions for CIIP and GEO [N. Park, J. Nam, H. Jang, J. Lim, S. Kim (LGE)]

[JVET-Q0575](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9421) Crosscheck of JVET-Q0338 (CE4-related: Harmonized conditions for CIIP and GEO) [N. Zhang (Bytedance)] [late]

[JVET-Q0339](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9164) CE4-related: Adjustment of the distance on the GEO mode [N. Park, J. Nam, H. Jang, J. Lim, S. Kim (LGE)]

[JVET-Q0677](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9523) Crosscheck of JVET-Q0339 (CE4-related: Adjustment of the distance on the GEO mode) [Y. Morigami, M. Ikeda (Sony)] [late]

[JVET-Q0348](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9173) CE4-related: Displacement Restriction on Geometric Inter Prediction [Y.-C. Yang, C.-Y. Teng (Foxconn)]

[JVET-Q0598](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9444) Crosscheck of JVET-Q0348 (CE4-related: Displacement Restriction on Geometric Inter Prediction) [H.-J. Jhu (Kwai Inc.)] [late]

[JVET-Q0364](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9189) CE4.4-related: Combination of GEO and Weighted-Prediction [P. Bordes, T. Poirier, F. Le Léannec (InterDigital)]

[JVET-Q0541](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9387) Crosscheck of JVET-Q0364 (CE4.4-related: Combination of GEO or TPM with Weighted-Prediction) [T. Chujoh (Sharp)] [late]

[JVET-Q0365](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9190) CE4-Related: On-the-fly Weighting Index to Sample Blending Weight Conversion without Table Look-Up in GEO [L.-F. Chen, X. Li, G. Li, S. Liu (Tencent)]

[JVET-Q0564](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9410) Crosscheck of JVET-Q0365: CE4-Related: On-the-fly Weighting Index to Sample Blending Weight Conversion without Table Look-Up in GEO [H. Gao (Huawei)] [late]

[JVET-Q0388](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9213) CE4-related: GEO memory reduction in weighting masks by fixed shifting [D. Liu, C. Hollmann, R. Yu, J. Ström (Ericsson)]

[JVET-Q0670](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9516) Crosscheck of JVET-Q0388 (CE4-related: GEO memory reduction in weighting masks by fixed shifting) [Z. Deng (ByteDance)] [late]

[JVET-Q0422](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9247) CE4 related: cleanup for signalling maximum number of triangle merge candidates [L. Li, X. Li, G. Li, S. Liu (Tencent)]

[JVET-Q0429](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9254) CE4-related: Geometric partitioning signaling [T. Poirier, F. Le Léannec, F. Urban, A. Robert (InterDigital)]

[JVET-Q0728](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9574) Crosscheck of JVET-Q0429 (CE4-related: Geometric partitioning signaling) [T. Zhou, T. Ikai (Sharp)] [late]

[JVET-Q0437](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9263) Non-CE4: Disabling MTS for Geo [K. Naser, F. Le Leannec, T. Poirier, F. Galpin (InterDigital)]

[JVET-Q0681](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9527) Crosscheck of JVET-Q0437 (Non-CE4: Disabling MTS for Geo) [X. Zhao (Tencent)] [late]

[JVET-Q0440](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9266) Non-CE4: Disabling TrSkip for Geo [K. Naser, F. Le Léannec, T. Poirier (InterDigital)]

[JVET-Q0721](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9567) Crosscheck of JVET-Q0440 (Non-CE4: Disabling TrSkip for Geo) [B. Ray (Qualcomm)] [late]

[JVET-Q0456](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9282) Non-CE4: reduced LUT for GEO blending weights generation [Y.-Z. Ma, Q.-H. Ran, R.-P. Qiu, M.-L. Zhang, J.-Y. Huo, F.-Z. Yang (Xidian Univ.), S. Wan (NPU)]

[JVET-Q0642](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9488) Crosscheck of JVET-Q0456 (Non-CE4: reduced LUT for GEO blending weights generation) [R.-L. Liao (Alibaba)] [late]

[JVET-Q0458](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9284) CE4-Related: On-the-fly Weighting Index to Sample Blending Weight Conversion without Table Look-Up on Top of Combine Test in Q0061 [L.-F. Chen, X. Li, G. Li, S. Liu (Tencent)]

[JVET-Q0565](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9411) Crosscheck of JVET-Q0458: CE4-Related: On-the-fly Weighting Index to Sample Blending Weight Conversion without Table Look-Up on Top of Combined Test in Q0061 [H. Gao (Huawei)] [late]

[JVET-Q0459](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9285) CE4-Related: Look-Up Table Free Weighting Index to Sample Blending Weight Calculation By Using Piecewise Constant Function in GEO [L.-F. Chen, X. Li, G. Li, S. Liu (Tencent)]

[JVET-Q0466](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9292) CE4-Related: On-the-fly Weighting Calculation in GEO [L.-F. Chen, X. Li, G. Li, S. Liu (Tencent)]

[JVET-Q0507](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9336) CE4-related: Quality scalable GEO [J. Li, C. S. Lim (Panasonic)]

[JVET-Q0669](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9515) Crosscheck of JVET-Q0507 (CE4-related: Quality scalable GEO) [Z. Deng (ByteDance)] [late]

[JVET-Q0508](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9337) CE4-related: Combined test of JVET-Q0123 and JVET-Q0268 [K. Reuzé, H. Huang, W.-J. Chien, V. Seregin, M. Karczewicz (Qualcomm), J. Li, C.S. Lim (Panasonic)] [late]

[JVET-Q0760](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9606) Crosscheck of JVET-Q0508 Test 1 (CE4-related: Combined test of JVET-Q0268 and JVET-Q0123) [R.-L. Liao (Alibaba)]

[JVET-Q0526](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9356) CE4-related: GEO support for 4xN and Nx4 CU [K. Panusopone, S. Hong, L. Wang (Nokia)] [late]

[JVET-Q0601](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9447) Non-CE4: Extension of JVET-P0325 [A. Robert, T. Poirier, F. Le Léannec (InterDigital)] [late]

[JVET-Q0710](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9556) Joint solution for GEO parameter adjustment (JVET-Q0168 and JVET-Q0336) [Y. Morigami, M. Ikeda, T. Suzuki (Sony), N. Park, J. Nam, H. Jang, J. Kim (LGE)] [late]

[JVET-Q0727](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9573) Non-CE4: simplified LUT for GEO blending weights generation [(?? (Xidian Univ.)] [late] [miss]

## CE5 related – Cross-component adaptive loop filtering (24)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

[JVET-Q0074](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8899) CE5-related: Performance of CE5 anchor with 8-bit dynamic range for CC-ALF coefficients [N. Hu, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-Q0124](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8949) CE5-related: JC-CCALF with Power of 2 Weight Values [C.-W. Kuo (Panasonic)]

[JVET-Q0653](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9499) Cross-check of JVET-Q0124 (CE5-related: JC-CCALF with Power of 2 Weight Values) [Y.-W. Chen (Kwai Inc.)] [late]

[JVET-Q0125](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8950) CE5-related: JC-CCALF with Alternative Filter Weight [C.-W. Kuo (Panasonic)]

[JVET-Q0585](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9431) CE5-related: cross-check report of JVET-Q0125 on JC-CCALF with Alternative Filter Weight [E. François (InterDigital)] [late]

[JVET-Q0165](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8990) CE5-related: On the CC-ALF filtering process [Z. Zhang, J. Ström, K. Andersson (Ericsson)]

[JVET-Q0544](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9390) Crosscheck of JVET-Q0165 Test 1 (CE5-related: On the CC-ALF filtering process) [O. Chubach (MediaTek)] [late]

[JVET-Q0607](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9453) Crosscheck of JVET-Q0165 (CE5-related: On the CC-ALF filtering process) [N. Hu (Qualcomm)] [late]

[JVET-Q0167](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8992) Non-CE5: Multiplication simplification for ALF and CC-ALF [J. Ström, Z. Zhang, K. Andersson (Ericsson)]

[JVET-Q0608](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9454) Crosscheck of JVET-Q0167 (Non-CE5: Multiplication simplification for ALF and CC-ALF) [N. Hu (Qualcomm)] [late]

[JVET-Q0190](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9015) CE5-related: On CC-ALF modifications related to coefficients and signalling [O. Chubach, C.-Y. Chen, C.-Y. Lai, T.-D. Chuang, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0648](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9494) Cross-check of JVET-Q0190 (CE5-related: On CC-ALF modifications related to coefficients and signaling) [T.-C. Ma (Kwai Inc.)] [late]

[JVET-Q0251](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9076) CE5-related: Unified cross component adaptive loop filter [N. Hu, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-Q0736](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9582) Cross-check result of JVET-Q0251: CE5-related: Unified cross component adaptive loop filter [Z. Zhang (Ericsson)] [late]

[JVET-Q0253](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9078) CE5-related: High level syntax modifications for CCALF [A. M. Kotra, S. Esenlik, B. Wang, H. Gao, E. Alshina (Huawei)]

[JVET-Q0296](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9121) Non-CE5: Adaptive precision for CCALF coefficients [L.-H. Xu, J. Yao, J.-Q. Zhu, K. Kazui (Fujitsu)]

[JVET-Q0301](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9126) CE5-related: CCALF filter for 4:2:2 and 4:4:4 color format [J. Choi, J. Nam, J. Heo, J. Lim, S. Kim (LGE)]

[JVET-Q0660](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9506) Crosscheck of JVET-Q0301 "CE5-related: CCALF filter for 4:2:2 and 4:4:4 color format" [G. Li (Tencent)] [late]

[JVET-Q0304](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9129) Non-CE5: Non-Linear Cross Component Adaptive Loop Filter [J. Yao, L.-H. Xu, J.-Q. Zhu, K. Kazui (Fujitsu)]

[JVET-Q0310](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9135) Non-CE5: Suggested text for CC-ALF padding process with raster scan slices [Y. Wang, H. Liu, L. Zhang, K. Zhang, Y. Wang (Bytedance)]

[JVET-Q0311](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9136) Non-CE5: On CC-ALF padding for ALF virtual boundaries [Y. Wang, H. Liu, L. Zhang, K. Zhang, Z. Deng, Y. Wang (Bytedance)]

[JVET-Q0537](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9383) Crosscheck of JVET-Q0311 (Non-CE5: On CC-ALF padding for ALF virtual boundaries) [T. Ikai (Sharp)] [late]

[JVET-Q0382](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9207) CE5-related: On high level syntax of CC-ALF [F. Chen, L. Xu, L. Wang (Hikvision)]

[JVET-Q0467](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9293) CE5-related: Simplified CCALF [G. Li, X. Li, X. Xu, S. Liu (Tencent)]

[JVET-Q0624](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9470) Crosscheck of JVET-Q0467 (CE5-related: Simplified CCALF) [J. Choi (LGE)] [late]

[JVET-Q0494](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9322) CE5-related: Joint clip operation for CCALF and chroma ALF [T.-C. Ma, X. Xiu, Y.-W. Chen, H.-J. Jhu, X. Wang (Kwai Inc.)]

[JVET-Q0531](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9377) Crosscheck of JVET-Q0494 (CE5-related: Joint clip operation for CCALF and chroma ALF) [O. Chubach (MediaTek)] [late]

[JVET-Q0673](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9519) Crosscheck of JVET-Q0494 (CE5-related: Joint clip operation for CCALF and chroma ALF) [J. Heo (LGE)] [late]

[JVET-Q0171](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8996) AHG9: On CC-ALF modifications related to HLS [O. Chubach, C.-Y. Chen, C.-Y. Lai, T.-D. Chuang, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0250](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9075) CE5-related: Removing number of filters for CC-ALF in slice and picture header [N. Hu, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-Q0326](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9151) CE5-related: On CC-ALF slice and picture header syntax [X. W. Meng (PKU), X. Zheng (DJI), S. S. Wang, S. W. Ma (PKU)]

[JVET-Q0580](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9426) Crosscheck report of JVET-Q0326 [X. Xu (Tencent)] [late]

[JVET-Q0520](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9349) AHG9: Cleanups on signaling for CC-ALF, BDPCM, ACT and Palette [Y. Wang, L. Zhang, K. Zhang, W. Zhu (Bytedance)]

Items 1 and 2 of this contribution belong to this category.

[JVET-Q0559](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9405) CE5-related: CCALF coefficient derivation using combined neighbors [K. Panusopone, S. Hong, L. Wang, J. Lainema (Nokia)] [late]

## Inter prediction and MV coding (27)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

[JVET-Q0105](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8930) nonCE4: BCW SIF Derivation for Pairwise Candidate [A. Robert, T. Poirier, F. Le Léannec (InterDigital)]

[JVET-Q0558](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9404) Crosscheck of JVET-Q0105 "BCW SIF Derivation for Pairwise Candidate" [G. Li (Tencent)] [late]

[JVET-Q0128](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8953) On clarification of applicable conditions of DMVR and BDOF [T. Chujoh, T. Hashimoto, E. Sasaki, T. Ikai (Sharp)]

[JVET-Q0589](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9435) Crosscheck of JVET-Q0128 (On clarification of applicable conditions of DMVR and BDOF) [P. Bordes (InterDigital)] [late]

[JVET-Q0129](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8954) On editorial improvements for specification of explicit weighted prediction [T. Chujoh, T. Hashimoto, E. Sasaki, T. Ikai (Sharp)]

[JVET-Q0242](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9067) Cleanup for TPM, CIIP, and GEO in the colour format of 4:0:0 [L. Pham Van, G. Van der Auwera, A. K. Ramasubramonian, H. Huang, W.-J. Chien, M. Karczewicz (Qualcomm)]

[JVET-Q0266](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9091) On TPM and GEO merge modes in presence of weighted prediction [A. Filippov, H. Chen, V. Rufitskiy, H. Yang, E. Alshina (Huawei)]

[JVET-Q0700](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9546) Cross-check of JVET-Q0266 on TPM and GEO merge modes in presence of weighted prediction [P. Onno (Canon)] [late]

[JVET-Q0748](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9594) Crosscheck of JVET-Q0266 (On TPM and GEO merge modes in presence of weighted prediction) [P. Bordes (InterDigital)] [late]

[JVET-Q0306](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9131) Non-CE4: Removal of MVD scaling process for 4x8/8x4 blocks in MMVD [N. Zhang, H. Liu, L. Zhang, K. Zhang, Y. Wang (Bytedance)]

[JVET-Q0635](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9481) Crosscheck of JVET-Q0306 (Non-CE4: Removal of MVD scaling process for 4x8/8x4 blocks in MMVD) [N. Park (LGE)] [late]

[JVET-Q0313](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9138) Non-CE4: Constraints on block size for ATMVP [Y. Sun, F. Chen, L. Wang (Hikvision)]

[JVET-Q0532](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9378) Crosscheck of JVET-Q0313 (Non-CE4: Constraints on block size for ATMVP) [H. Chen (Huawei)] [late]

[JVET-Q0315](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9140) Non-CE4: Triangular prediction mode with motion vector difference [K. Zhang, L. Zhang, H. Liu, Z. Deng, Y. Wang (Bytedance)]

[JVET-Q0691](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9537) Crosscheck of JVET-Q0315: Non-CE4: Triangular prediction mode with motion vector difference [J. Ström (Ericsson)] [late]

[JVET-Q0324](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9149) Simplification of MV derivation for affine chroma [S. H. Wang (PKU), X. Zheng (DJI), S. S. Wang, S. W. Ma (PKU)]

[JVET-Q0659](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9505) Crosscheck of JVET-Q0324 "Simplification of MV derivation for affine chroma" [G. Li (Tencent)] [late]

[JVET-Q0327](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9152) On IBC/ATMVP candidate list construction [X. W. Meng, S. H. Wang (PKU), X. Zheng (DJI), S. S. Wang, S. W. Ma (PKU)]

[JVET-Q0612](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9458) Crosscheck of JVET-Q0327: On IBC/ATMVP candidate list construction [J. Chen (Alibaba)] [late]

[JVET-Q0337](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9162) Non-CE4: On weight values of the chroma-component for TPM mode [N. Park, J. Nam, H. Jang, J. Lim, S. Kim (LGE)]

[JVET-Q0540](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9386) Crosscheck of JVET-Q0337 (Non-CE4: On weight values of the chroma-component for TPM mode) [T. Chujoh (Sharp)] [late]

[JVET-Q0340](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9165) Non-CE4: Cleanup of the MMVD offset derivation [N. Park, J. Nam, H. Jang, J. Lim, S. Kim (LGE)]

[JVET-Q0341](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9166) Non-CE4: Range of the motion vector [N. Park, J. Nam, H. Jang, J. Lim, S. Kim (LGE)]

[JVET-Q0535](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9381) Crosscheck of JVET-Q0341 (Non-CE4: Range of the motion vector) [J. Li (Panasonic)] [late]

[JVET-Q0349](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9174) Combination of TPM and Weighted-Prediction [P. Bordes, T. Poirier, F. LeLeannec (InterDigital)]

[JVET-Q0538](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9384) Crosscheck of JVET-Q0349 (Combination of TPM and Weighted-Prediction) [T. Chujoh (Sharp)] [late]

[JVET-Q0350](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9175) Non-CE: Enable CIIP for 4x8/8x4 block without SCIPU violation [H. Jang, J. Nam, N. Park, S. Kim, J. Lim (LGE)]

[JVET-Q0600](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9446) Crosscheck of JVET-Q0350 (Non-CE: Enable CIIP for 4x8/8x4 block without SCIPU violation) [K. Panusopone (Nokia)] [late]

[JVET-Q0354](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9179) Non-CE: Clean-up regarding syntaxes for prediction mode decision [H. Jang, J. Nam, N. Park, S. Kim, J. Lim (LGE)]

[JVET-Q0651](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9497) Cross-check of JVET-Q0354 (Non-CE: Clean-up regarding syntaxes for prediction mode decision) [T.-C. Ma (Kwai Inc.)] [late]

[JVET-Q0362](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9187) Non-normative aspects for cleanup of DMVR specification and software [S. Esenlik, B. Wang, A. M. Kotra, H. Gao, E. Alshina (Huawei), J. Arumugam, S. Kotecha, S. Ramamurthy (Ittiam)]

[JVET-Q0368](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9193) On context model for mvp\_flag and ref\_idx [H. Chen, H. Yang (Huawei)]

[JVET-Q0633](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9479) Crosscheck of JVET-Q0368 (On context model for mvp\_flag and ref\_idx) [X.-W. Li, J.-Y. Huo (Xidian Univ.), S. Wan (NPU)] [late]

[JVET-Q0370](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9195) On context model for merge indices [H. Chen, H. Yang (Huawei)]

[JVET-Q0534](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9380) Crosscheck of JVET-Q0370 (On context model for merge indices) [Y. Sun, F. Chen, L. Wang (Hikvision)] [late]

[JVET-Q0389](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9214) Non-CE4: SbTMVP harmonization [D. Liu, C. Hollmann, R. Yu (Ericsson)]

[JVET-Q0562](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9408) Crosscheck of JVET-Q0389 (Non-CE4: SbTMVP harmonization) [Y. Sun, F. Chen, L. Wang (Hikvision)] [late]

[JVET-Q0390](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9215) Non-CE4: SbTMVP simplification [D. Liu, C. Hollmann, R. Yu (Ericsson)]

[JVET-Q0431](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9256) Interaction between Affine and SBT [F. Le Léannec, K. Naser, T. Poirier, P. Bordes (InterDigital)]

[JVET-Q0666](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9512) Cross-check of JVET-Q0431 (Interaction between Affine and SBT) [A. Nalci (Qualcomm)] [late]

[JVET-Q0455](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9281) On CU-level BDOF enable condition [S. Wan, Y. Xue (NPU), J.-Y. Huo, Y.-Z. Ma, F.-Z. Yang (Xidian Univ.), Y.-F. Yu, Y. Liu (OPPO)]

[JVET-Q0613](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9459) Crosscheck of JVET-O0455: On CU-level BDOF enable condition [J. Chen (Alibaba)] [late]

[JVET-Q0483](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9310) On avoiding out of range motion vectors [F. Bossen, A. Segall (Sharp)]

[JVET-Q0522](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9351) Non-CE4: Early termination of DMVR and study of its pixel coverage [C.-C. Chen, H. Huang, W.-J. Chien, M. Karczewicz (Qualcomm)]

[JVET-Q0705](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9551) Crosscheck of JVET-Q0522 (Non-CE4: Early termination of DMVR and study of its pixel coverage) [H.-J. Jhu (Kwai Inc.)] [late]

[JVET-Q0524](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9354) Non-CE4: DC balancing in DMVR [A. Aminlou, M. Homayouni (Nokia)] [late]

[JVET-Q0675](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9521) Crosscheck of JVET-Q0524 (Non-CE4: DC balancing in DMVR) [K. Zhang (Bytedance)] [late]

[JVET-Q0525](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9355) Non-CE4: Support large rotation and flipping in affine and PROF [A. Aminlou, D. Naik (Nokia)] [late]

[JVET-Q0662](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9508) Cross-check of JVET-Q0525 Non-CE4: Support large rotation and flipping in affine and PROF [D. Liu (Ericsson)

## Intra prediction and mode coding (23)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

[JVET-Q0110](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8935) On Intra Prediction Mode and Chroma BDPCM [A. Nalci, L. Pham Van, H. Egilmez, G. Van der Auwera, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-Q0597](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9443) Crosscheck of JVET-Q0110 (On Intra Prediction Mode and Chroma BDPCM) [H.-J. Jhu (Kwai Inc.)] [late]

[JVET-Q0161](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8986) On constant shift and offset in MIP [K. Kondo, M. Ikeda, T. Suzuki (Sony)]

[JVET-Q0542](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9388) Crosscheck of JVET-Q0161 (On constant shift and offset of MIP) [J. Pfaff (HHI)] [late]

[JVET-Q0192](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9017) Chroma wide angle intra prediction mode mapping for 4:2:2 format [C.-M. Tsai, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0604](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9450) Crosscheck of JVET-Q0192 (Chroma wide angle intra prediction mode mapping for 4:2:2 format) [B. Wang (Huawei)] [late]

[JVET-Q0194](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9019) Cleanup for checking CTU row boundary location in CCLM [C.-M. Tsai, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0683](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9529) Crosscheck of JVET-Q0194 (Cleanup for checking CTU row boundary location in CCLM) [K. Andersson (Ericsson)] [late]

[JVET-Q0274](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9099) MIP with fixed-length mode coding and memory reduction [T. Biatek, L. Pham Van, A. K. Ramasubramonian, G. Van der Auwera, M. Karczewicz (Qualcomm)]

[JVET-Q0275](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9100) Suggested bugfixes for CCLM filtering in the VVC specification draft [A. Filippov, V. Rufitskiy, E. Alshina (Huawei)]

[JVET-Q0292](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9117) Cleanup of intra reference sample filter selection [J. Heo, J. Choi, J. Nam, H. Jang, J. Lim, S. Kim (LGE)]

[JVET-Q0650](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9496) Cross-check of JVET-Q0292 (Cleanup of intra reference sample filter selection) [T.-C. Ma (Kwai Inc.)] [late]

[JVET-Q0293](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9118) Removal of chroma Nx2 blocks in PDPC [J. Heo, H. Jang, J. Choi, J. Lim, S. Kim (LGE)]

[JVET-Q0698](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9544) Crosscheck of JVET-Q0293 (Removal of chroma Nx2 blocks in PDPC) [L. Li (Tencent)] [late]

[JVET-Q0302](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9127) Simplified contexts in intra prediction [J. Choi, J. Heo, J. Lim, S. Kim (LGE)]

[JVET-Q0697](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9543) Crosscheck of JVET-Q0302 (Simplified contexts in intra prediction) [L. Li (Tencent)] [late]

[JVET-Q0366](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9191) Non-CE3: Simplification of interpolation filtering for intra prediction [G. Rath, F. Galpin, F. Urban (InterDigital)]

[JVET-Q0371](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9196) Unification of intra reference sample generation [D.-Y. Kim (Chips&Media), S.-C. Lim, J. Lee, J. Kang (ETRI)]

[JVET-Q0380](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9205) LFNST restriction based on MIP [S. Shrestha, A. Kumar, B. Lee (Chosun Univ.), Y. Lee, J. Park (Humax)]

[JVET-Q0696](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9542) Crosscheck of JVET-Q0380 (LFNST restriction based on MIP) [L. Li (Tencent)] [late]

[JVET-Q0385](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9210) Simplification of intra prediction in CIIP mode [R. Ghaznavi-Youvalari, J. Lainema, K. Panusopone (Nokia)]

[JVET-Q0547](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9393) Crosscheck of JVET-Q0385 (Simplification of intra prediction in CIIP mode) [B. Ray (Qualcomm)] [late]

[JVET-Q0391](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9216) Unified PDPC for angular intra modes [B. Ray, G. Van der Auwera, M. Karczewicz (Qualcomm)]

[JVET-Q0543](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9389) Crosscheck of JVET-Q0391 (Unified PDPC for angular intra modes) [J. Pfaff (HHI)] [late]

[JVET-Q0392](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9217) On the coding of cclm\_mode\_flag [B. Ray, G. Van der Auwera, A. K. Ramasubramonian, M. Karczewicz (Qualcomm)]

[JVET-Q0555](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9401) Crosscheck of JVET-Q0392 (On the coding of cclm\_mode\_flag) [R. Ghaznavi-Youvalari (Nokia)] [late]

[JVET-Q0446](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9272) MIP with constant shifts and offsets [J. Pfaff, B. Stallenberger, M. Schäfer, P. Merkle, P. Helle, T. Hinz, H. Schwarz, D. Marpe, T. Wiegand (HHI), K. Kondo, M. Ikeda (Sony), J. Huo, H. Wang, Y. Ma, F. Yang (Xidian University), S. Wan (NPU), Y. Yu (OPPO)]

[JVET-Q0726](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9572) Cross-check of JVET-Q0446 (MIP with constant shifts and offsets) [F. Bossen (Sharp)] [late]

[JVET-Q0450](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9276) On fixed sW and fO in MIP [J.-Y. Huo, H.-X. Wang, Y. Sun, Y.-Z. Ma, F.-Z. Yang (Xidian Univ.), S. Wan (NPU), Y.-F. Yu, Y. Liu (OPPO)]

[JVET-Q0757](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9603) Crosscheck of JVET-Q0450 (On fixed sW and fO in MIP) [K. Kondo, M. Ikeda, (Sony)]

[JVET-Q0451](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9277) On mipSizeId modification for 8x8 blocks [J.-Y. Huo, H.-X. Wang, X.-W. Li, Y.-Z. Ma, F.-Z. Yang (Xidian Univ.), S. Wan (NPU), Y.-F. Yu, Y. Liu (OPPO)]

[JVET-Q0740](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9586) Crosscheck of JVET-Q0451 (On mipSizeId modification for 8x8 blocks) [J. Pfaff (HHI)] [late]

[JVET-Q0453](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9279) Modification of LFNST for MIP coded block [J.-Y. Huo, W.-H. Qiao, X.-W. Li, Y.-Z. Ma, F.-Z. Yang (Xidian Univ.), S. Wan (NPU), Y.-F. Yu, Y. Liu (OPPO)]

[JVET-Q0655](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9501) Cross-check of JVET-Q0453 (Modification of LFNST for MIP coded block) [Y.-W. Chen (Kwai Inc.)] [late]

[JVET-Q0582](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9428) Harmonization of JVET-Q0451 and JVET-Q0453 for MIP & LFNST design [J.-Y. Huo (Xidian Univ.), S. Wan (NPU), X.-W. Li, H.-X. Wang, F.-Z. Yang, Y.-Z. Ma (Xidian Univ.), Y.-F. Yu, Y. Liu (OPPO)] [late]

[JVET-Q0725](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9571) Crosscheck of JVET-Q0582 (Harmonization of JVET-Q0451 and JVET-Q0453 for MIP & LFNST design) [H. Chen, X. Ma (Huawei)] [late]

[JVET-Q0452](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9278) Modification of up-sampling in MIP [J.-Y. Huo, X.-W. Li, Q.-H. Ran, Y.-Z. Ma, F.-Z. Yang (Xidian Univ.), S. Wan (NPU), Y.-F. Yu, Y. Liu (OPPO)]

[JVET-Q0741](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9587) Crosscheck of JVET-Q0452 (Modification of up-sampling in MIP) [J. Pfaff (HHI)] [late]

[JVET-Q0457](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9283) MIP input value calculation unification [S. Wan (NPU), H.-X. Wang, J.-Y. Huo, D.-N. Wang, Y.-Z. Ma, F.-Z. Yang (Xidian Univ.), Y.-F. Yu, Y. Liu (OPPO)]

[JVET-Q0643](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9489) Crosscheck of JVET-Q0457 (MIP input value calculation unification) [R.-L. Liao (Alibaba)] [late]

[JVET-Q0464](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9290) On modifications of intra prediction process [A. Filippov, V. Rufitskiy, B. Wang, S. Esenlik, A.M. Kotra, H. Gao, E. Alshina (Huawei)]

[JVET-Q0746](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9592) Crosscheck of JVET-Q0464 (On modifications of intra prediction process) [S. De-Luxán-Hernández (HHI)] [late]

[JVET-Q0556](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9402) Aligning intra-prediction of TS blocks with BDPCM [Saverio Blasi, Gosala Kulupana (BBC)] [late]

[JVET-Q0758](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9604) Crosscheck of JVET-Q0556 (Aligning intra-prediction of TS blocks with BDPCM) [V. Rufitskiy, A. Filippov (Huawei)]

## Loop filtering (9)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

See also:

* Section 6.19.2:
  + Q0121 on deblocking control parameters
  + Q0175 on parameters override mechanism in slice header for in-loop filters
  + Q0248 on constraints for ALF APS
  + Q0254 on override for ALF related syntax elements in slice header
  + Q0352 on subpicture boundaries
  + Q0572 on ALF signalling
* Section 6.20.3:
  + Q0120 on control of loop filtering across subpicture/tile/slice boundaries
  + Q0317 which affects filtering control for subpictures
  + Q0352 on subpicture boundaries
  + Q0475 on subpicture signalling

[JVET-Q0150](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8975) Fix for ALF virtual boundary processing [K. Andersson, J. Ström, Z. Zhang, J. Enhorn (Ericsson)]

[JVET-Q0606](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9452) Crosscheck of JVET-Q0150 (Fix for ALF virtual boundary processing) [N. Hu (Qualcomm)] [late]

[JVET-Q0191](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9016) Deblocking filter process with considering dependent quantization [C.-M. Tsai, C.-W. Hsu, C.-Y. Lai, Z.-Y. Lin, O. Chubach, T.-D. Chuang, C.-C. Chen, C.-Y. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0678](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9524) Cross-check of JVET-Q0191 (Deblocking filter process with considering dependent quantization) [K. Andersson (Ericsson)] [late]

[JVET-Q0249](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9074) Clipping flag clean-up for chroma adaptive loop filters [N. Hu, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-Q0690](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9536) Crosscheck of JVET-Q0249: Clipping flag clean-up for chroma adaptive loop filters [J. Ström (Ericsson)] [late]

[JVET-Q0319](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9144) Non-CE5: On SEI for ALF [H.-B. Teo, H.-W. Sun, C.-S. Lim (Panasonic)]

[JVET-Q0378](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9203) Non-CE5: On the number of ALF Chroma filters [P. Onno, G. Laroche, N. Ouedraogo (Canon)]

[JVET-Q0720](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9566) Crosscheck of JVET-Q0378 (Non-CE5: On the number of ALF Chroma filters) [V. Rufitskiy, A. Filippov (Huawei)] [late]

[JVET-Q0427](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9252) AHG11: Picture/slice level deblocking control flag for IBC [X. Xu, G. Li, X. Li, S. Liu (Tencent)]

[JVET-Q0434](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9260) PRE-Sample Adaptive Offset Filter [W. Lim, C. Helmrich, J. Erfurt, H. Schwarz, D. Marpe, T. Wiegand (HHI)]

[JVET-Q0682](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9528) Crosscheck of JVET-Q0434 (Pre-Sample Adaptive Offset Filter) [K. Andersson (Ericsson)] [late]

[JVET-Q0441](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9267) SAO Modification for 12-bit [A. Browne, K. Sharman, S. Keating (Sony)]

[JVET-Q0470](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9296) Conditional signalling of SAO [G. Li, X. Li, X. Xu, S. Liu (Tencent)]

## Reference picture resampling (13)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

Probably more contributions currently allocated to HLS/scalability belong here

[JVET-Q0257](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9082) How to do 16:1 reference picture resampling in VVC [J. Samuelsson, S. Deshpande, A. Segall (Sharp)]

[JVET-Q0199](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9024) AHG8: Support of ROI (Region-Of-Interest) RPR [T. Lu, F. Pu, [P. Yin](mailto:pyin@dolby.com), S. McCarthy, W. Husak, T. Chen (Dolby)]

[JVET-Q0567](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9413) Crosscheck of JVET-Q0199 AHG8: Support of ROI (Region-Of-Interest) RPR [J. Luo (Alibaba)] [late]

[JVET-Q0178](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9003) AHG9: Bitstream conformance requirement related to RPR scaling ratio [T.-D. Chuang, O. Chubach, C.-Y. Chen, C.-W. Hsu, L. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0179](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9004) AHG9: Bitstream conformance requirement related to RPR scaling ratio for worst case MC memory bandwidth reduction [T.-D. Chuang, O. Chubach, C.-Y. Chen, C.-W. Hsu, L. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0262](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9087) AHG9: On reference picture resampling enabled flag [J. Samuelsson, S. Deshpande, A. Segall (Sharp)]

[JVET-Q0290](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9115) AHG9/AHG12: Modifications related to subpicture signalling and RPR [S.-T. Hsiang, C.-Y. Chen, T.-D. Chuang, L. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

Item 1 of this contribution belongs to this category.

[JVET-Q0318](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9143) AHG9: Constraints on RPR [K. Zhang, L. Zhang, Y.-K. Wang, H. Liu, J. Xu, Z. Deng (Bytedance)]

[JVET-Q0331](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9156) AhG8: Constraints on the picture scaling ratios [Y.-J. Chang, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

Item 1 of this contribution belongs to this category.

[JVET-Q0449](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9275) On smoothing filter with RPR in VVC [B. Bross, M. Winken, Y. Sanchez, R. Skupin, H. Schwarz, D. Marpe, T. Wiegand (HHI)]

[JVET-Q0756](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9602) Cross-check of JVET-Q0449 on smoothing filter with RPR [V. Seregin (Qualcomm)] [late]

[JVET-Q0486](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9313) AHG8: Constraints on Scaling Window Offset Parameters [T. Hellman, W. Wan, P. Chen, B. Heng, M. Zhou (Broadcom)]

[JVET-Q0487](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9314) AHG8: RPR Scaling Window Issues [W. Wan, T. Hellman, B. Heng, P. Chen (Broadcom)]

[JVET-Q0517](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9346) On RPR down-sampling filters for affine mode [X. Xiu, Y.-W. Chen, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai)]

[JVET-Q0568](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9414) Crosscheck of JVET-Q0517 On RPR down-sampling filters for affine mode [J. Luo (Alibaba)] [late]

[JVET-Q0518](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9347) Mismatch between text specification and reference software on RPR chroma down-sampling for affine mode [X. Xiu, Y.-W. Chen, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai)]

## Quantization control (15)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

See also Q0484.

[JVET-Q0126](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8951) Initializations and propagation of Chroma QP Offset [K. Kawamura, S. Naito (KDDI)]

[JVET-Q0148](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8973) AHG15: Additional coefficients for low frequency region of 64x64 scaling matrix [K. Abe, T. Toma (Panasonic)]

[JVET-Q0536](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9382) Crosscheck of JVET-Q0148 (AHG15: Additional coefficients for low frequency region of 64x64 scaling matrix) [T. Hashimoto, T. Ikai (Sharp)] [late]

[JVET-Q0209](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9034) [AHG9][AHG15]: On chroma Qp offsets [Hendry, J. Zhao, S. Kim (LGE)]

[JVET-Q0227](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9052) Dependent Quantization with Qp offset adaptation [P. de Lagrange, F. Hiron, F. Le Léannec, E. François (InterDigital)]

[JVET-Q0723](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9569) Crosscheck of JVET-Q0227: Dependent Quantization with Qp offset adaptation [H. Schwarz (Fraunhofer HHI)] [late]

[JVET-Q0267](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9092) On Propagation of Chroma CU QP Offsets [B. Heng, M. Zhou, W. Wan (Broadcom)]

[JVET-Q0421](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9246) AHG15: Clean up for signaling quantization matrix [L. Li, H. Zhang, X. Li, S. Liu (Tencent)]

[JVET-Q0425](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9250) AHG15: QP offsets for adaptive colour transform [R. Sjöberg, M. Pettersson, M. Damghanian, D. Saffar (Ericsson)]

[JVET-Q0472](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9298) AHG15: Quantization matrix signalling [P. de Lagrange, F. Le Léannec, E. François, K. Naser (InterDigital)]

[JVET-Q0474](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9300) AHG15: defining QP at TU level P. de Lagrange, F. Le Léannec, F. Urban, K. Naser (InterDigital)]

[JVET-Q0476](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9303) On chroma QP offsets for zero-CBF leading chroma coding blocks [A. K. Ramasubramonian, B. Ray, G. Van der Auwera, M. Karczewicz (Qualcomm)]

[JVET-Q0505](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9334) AHG15: Improvement for Quantization Matrix Signaling [H. Zhang, X. Li, G. Li, L. Li, S. Liu (Tencent)]

[JVET-Q0671](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9517) Crosscheck of JVET-Q0505 (AHG15: Improvement for Quantization Matrix Signaling) [Z. Deng (ByteDance)] [late]

[JVET-Q0570](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9416) AHG15: reset chroma QP offsets when starting a CTU [P. de Lagrange (InterDigital)] [late]

[JVET-Q0576](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9422) AHG15: history of local chroma QP offsets [P. de Lagrange (InterDigital)] [late]

## Transforms and transform signalling (28)

Contributions in this category were discussed Thursday 9 Jan. 1900–2200 and XXday X Jan. XXXX–XXXX in Track B (chaired by JRO).

### MTS

[JVET-Q0055](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8880) On MTS index signalling [J. Lainema (Nokia)]

Draft VVC standard allows MTS transform coefficients only inside the lowest frequency 16x16 area of a transform block. However, signalling of the mts\_idx is conditioned to the last coefficient position which does not guarantee existence of coefficients only inside the valid area. Thus, in some cases mts\_idx is signalled even though it could be inferred to be zero. There is also a possibility for a non-conforming encoder to signal MTS transform coefficients in positions outside the 16x16 area and still indicate one of the MTS modes to be active.

It is proposed to add normative checks to the transform coefficient parsing and indicate mts\_idx only if all non-zero transform coefficients are within the valid MTS coefficient area. Bitrate and complexity impact of the proposed change is asserted to be negligible. In the case of AI, RA and LD-B the average BD-rate changes are reported to be 0.00%, 0.00 % and 0.00 %, respectively.

Related/similar/identical proposals: JVET-Q0057 (identical), JVET-Q0136, JVET-Q0196 (one aspect), JVET-Q0430, JVET-Q0448 (with 2 solutions, one identical)

It is agreed that all those proposals are solving the problem in avoiding the bitstream restriction which is not straightforward.

It is further agreed that the solution proposed in JVET-Q0055 is the most straightforward with minimum changes of the spec.

Decision: Adopt JVET-Q0055

[JVET-Q0566](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9412) Crosscheck of JVET-Q0055 (On MTS index signalling) [S. De-Luxán-Hernández (HHI)] [late]

[JVET-Q0057](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8882) Coefficient group based restriction on MTS signaling [M. Coban, M. Karczewicz, H.E. Egilmez, V. Seregin (Qualcomm)]

This document proposes a coefficient group (CG) based restriction for signaling MTS. The proposed method replaces the bitstream restriction existing in current VVC draft with a syntax-based restriction. The proposed change can be viewed as a clean-up for the coefficient-level restriction in MTS signaling. The experimental results show that the proposed change has no impact in terms of average BD-rates.

See notes under JVET-Q0055

[JVET-Q0549](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9395) Crosscheck of JVET-Q0057 (Coefficient group based restriction on MTS signaling) [J. Lainema (Nokia)] [late]

[JVET-Q0136](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8961) Alignment of MTS index signalling condition with MTS zero-out [M. Koo, M. Salehifar, J. Lim, S. Kim (LGE)]

In the recent VVC working draft, MTS index is signalled only if last non-zero coefficient is not located outside of top-left 16x16 region in a Luma TB, which is motivated by MTS zero-out. However, this scheme cannot detect the case that last non-zero coefficient lies within the top-left 16x16 region outside of which at least one non-zero coefficient exists, as the case that MTS index does not need to be signalled. In this case, the associated MTS index could have been inferred to be zero, i.e. DCT-2 pair, which was reported via JVET bug tracker ticket #678. In the VVC WD, a constraint that MTS index must be signalled to be zero when that case occurs is described for bitstream conformance.

In this contribution, it is proposed that a variable, MtsZeroOutSigCoeffFlag should be determined by checking whether coded\_sub\_block\_flag or sig\_coeff\_flag outside of the top-left 16x16 region is zero or not, in order to indicate the existence of non-zero coefficients outside of the top-left 16x16 region. The Y/U/V BD-rate changes are 0.00%/0.00%/-0.01% (AI), 0.00%/-0.01%/0.02% (RA), and 0.00%/-0.10%/-0.03% (LD) under CTC. In overall, performance and complexity of the proposed method are almost the same as those of VTM 7.0 and design of MTS index signalling becomes more consistent with the existing MTS zeroing-out. Furthermore, the bitstream conformance constraint can be removed, which may reduce conformance testing burden.

See notes under JVET-Q0055

[JVET-Q0679](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9525) Cross-check of JVET-Q0136 (Alignment of MTS index signalling condition with MTS zero-out) [X. Zhao (Tencent)] [late]

[JVET-Q0196](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9021) MTS redundancy removal [M.-S. Chiang, C.-W. Hsu, C.-M. Tsai, T.-D. Chuang, C.-Y. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

In VVC Draft 7, when the last significant coefficient position of a luma transform block (TB) is in the multiple transform selection (MTS) zero-out region (i.e., the TB excluding the top left 16x16 region), this reveals that MTS is not selected at encoder, and therefore the MTS index is not signalled and inferred to 0 (i.e., indicating DCT-II) at decoder. However, redundant MTS index signalling is not avoided thoroughly by using this method. The MTS index is still signalled but always equal to 0 when there is any non-last significant coefficient in the MTS zero-out region. This contribution proposes a method of checking coefficient group (CG) significant flags to replace the current method of checking the last significant coefficient position. If any CG significant flag in the MTS zero-out region is true, the MTS index is not signalled and inferred to 0. With the proposed modification, the redundant MTS index signalling is totally avoided. Compared to VTM7.0 common test condition (CTC), the proposed method results in negligible BD-rate changes.

See notes under JVET-Q0055

[JVET-Q0550](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9396) Crosscheck of JVET-Q0196 (MTS redundancy removal) [J. Lainema (Nokia)] [late]

[JVET-Q0295](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9120) On residual coding for MTS [C. Rosewarne, J. Gan (Canon)]

In the VVC WD7 text mts\_idx is signalled in the CU footer, conditioned on the luma last position being within the upper-left 16×16 region of the TB. As this condition check could still allow significant coefficients outside the 16×16 region, either a conformance constraint was suggested to ensure such coefficients need to be zero when MTS is applied or additional decoder-side checks for further conditioning of mts\_idx. This contribution proposes a scan pattern such that the last position check is sufficient to ensure no significant coefficients are present outside of the 16×16 region.

No need to review, as the problem is solved via JVET-Q0055.

[JVET-Q0759](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9605) Crosscheck of JVET-Q0295 (On residual coding for MTS) [M. Koo (LGE)]

[JVET-Q0381](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9206) Block size restriction in MTS kernel for ISP and LFNST [S. Shrestha, A. Kumar, B. Lee (Chosun Univ.), Y. Lee, J. Park (Humax)]

In the 16-th JVET meeting, it has been decided that DCT-2 MTS kernel is used for the ISP block when both ISP and LFNST is ON [1] and DCT-2 or DST-7 are decided based on the block sizes when ISP is ON and LFNST is OFF. That is, DCT-2 is used for the sizes greater than 16 and less than 4, otherwise DST-7 is used in VTM7.0 [2]. In this contribution, it is proposed to use DCT-2 for blocks greater than 8 and less than 4 and DST-7 for other blocks when ISP is ON and LFNST is OFF.

There is no obvious benefit, neither on compression, nor on simplifying the design.

No action.

[JVET-Q0632](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9478) Crosscheck of JVET-Q0381 (Block size restriction in MTS kernel for ISP and LFNST) [J. Jung, D. Kim, G. Ko, J.-H. Son, J. Kwak (WILUS)] [late]

[JVET-Q0430](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9255) AHG16: Syntax based MTS zero out [F. Le Léannec)]

In VVC spec draft 7, the MTS index of a CU is signaled in case the last significant coefficient in scanning order has x- and y- coordinates lower than 16. However, it is possible to fulfill this condition and to have some non-zero transform coefficient(s) outside the top-left 16x16 TU region at the same time.

A bitstream conformance constraint imposes the MTS index to be zero in case at least one non-zero coefficient is outside the top-left 16x16 region. An AHG16 comment states a syntax-level restriction is more desirable than this conformance requirement.

This contribution proposes a syntax-level control of the existence of non-zero coefficients beyond the 16x16 top-left region, in case of non-TS residual coding. To do so, a CU-level mts\_zero\_out\_flag syntax element is introduced.

The mts\_zero\_out\_flag syntax element is then taken into account in the residual coding and in the coding of the MTS index. The BD-rate change over VTM-7.0 is reportedly equal to 0.04% and 0.03%, respectively in AI and RA configurations.

See notes under JVET-Q0055

[JVET-Q0745](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9591) Crosscheck of JVET-Q0430 (AHG16: Syntax based MTS zero out) [S. De-Luxán-Hernández (HHI)] [late]

[JVET-Q0442](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9268) Non-CE: Transform Selection for MIP in Implicit MTS [K. Naser, F. Le Léannec, T. Poirier, F. Galpin (InterDigital)]

Implicit MTS is a special configuration of transform selection where mts\_idx is not signaled and the transform pairs are implicitly selected. Unlike regular intra prediction mode, the implicit transform selection for MIP is the default DCT2 for both horizontal and vertical direction.

This contribution proposes an alternative method of selecting the transform pairs depending on block dimensions with the same condition as for regular intra prediction mode. This method achieves a luma coding gain of 0.03% and 0.02% in AI and RA configurations.

There is no obvious benefit, neither on compression, nor on simplifying the design.

No action.

[JVET-Q0739](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9585) Crosscheck of JVET-Q0442 (Non-CE: Transform Selection for MIP in Implicit MTS) [J. Pfaff (HHI)] [late]

[JVET-Q0448](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9274) MTS dependent coefficient subblock scanning for zero-out [S. De-Luxán-Hernández, T. Nguyen, B. Bross, H. Schwarz, D. Marpe, T. Wiegand (HHI)]

This contribution proposes two fixes to replace the bitstream restriction that requires the MTS index to be equal to 0 (DCT-II in both directions) in case there are non-zero coefficients outside the 16x16 zero-out area, by a syntax change. The first fix A checks for every coefficient subblock whether there are non-zero coefficients outside the 16x16 area and does not signal the MTS index if there are any and infers it to zero instead. The second fix B avoids checking each subblock by moving the MTS index signaling before the coefficient parsing in subblocks and adapting the subblock scan to cover only the 16x16 area in case the MTS index is greater than 0. Fix A results in 0.0% BD-rate Y for AI and RA, fix B results in -0.01% BD-rate Y for AI and 0.02% for RA with no measurable change in runtimes.

See notes under JVET-Q0055

[JVET-Q0730](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9576) Cross-check of JVET-Q0448 "MTS dependent coefficient subblock scanning for zero-out" [F. Le Léannec (InterDigital)] [late]

[JVET-Q0516](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9345) MTS signaling based on last significant coefficient position [X. Xiu, Y.-W. Chen, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai)]

In VVC draft 7, multiple transform selection (MTS) can be enabled when there is non-zero transform coefficient in luma transform block (TB). This is done by checking whether the luma coded-block-flag (CBF) is equal to one. In this contribution, it is proposed to replace such CBF based condition with one based on the position of last significant coefficient. More specifically, the signaling of the MTS index (i.e., mts\_idx) is conditioned on whether the position of last significant coefficient is less than one. Since the same condition is also used to determine the signaling of LFNST index lfnst\_idx, the proposed change incurs no extra complexity. Compared to VTM-7.0 anchors, the proposed change reportedly leads to BD-rate differences of -0.10% and -0.03% for AI and RA configurations, respectively, with no impacts on encoding and decoding runtimes.

Presentation deck not uploaded.

JVET-Q0685 is identical, however on top of JVET-Q0055 modification.

The benefit of harmonization is not too obvious, as it is just a part of conditions that invoke LFNST and/or MTS.

In terms of compression, the gain over CTC is relatively small and would not justify that action.

The powerpoint deck has additional non-CTC results where MTS is switched on for inter, the gain of the modification seems to be more relevant in that case. Currently, MTS is disabled for inter, as the runtime increase is not justified by the compression gain. However, those results are not complete.

Revisit: Report when results on inter MTS are complete. Unlike th powerpoint deck, results for enabling inter MTS with and without that modification should be reported compared to CTC.

[JVET-Q0557](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9403) Crosscheck of JVET-Q0516: MTS signaling based on last significant coefficient position [H. Gao (Huawei)] [late]

[JVET-Q0529](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9359) On LFNST index and MTS index signalling [Z.-Y. Lin, M.-S. Chiang, T.-D. Chuang, C.-Y. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek)] [late]

In VVC Draft 7, when the last significant coefficient position of a luma transform block (TB) is in the multiple transform selection (MTS) zero-out region (i.e., the TB excluding the top left 16x16 region), this reveals that MTS is not selected at encoder, so the MTS index is not parsed and inferred to 0 (i.e., indicating DCT-II) at decoder. However, redundant MTS index signalling is not avoided thoroughly by using the current design. The MTS index is still signalled but always equal to 0 when there is any non-last significant coefficient in the MTS zero-out region. This contribution proposes to parse low frequency non-separable transform (LFNST) index and MTS index right after parsing the first nonzero TB’s last significant coefficient position. If the MTS index is not equal to 0, coefficients in the MTS zero-out region will not be parsed and inferred to 0. In this way, there is no redundancy of MTS index signalling or coefficient signalling in MTS blocks. Since LFNST index is parsed in the first nonzero TB, the LFNST index parsing checks related to the last significant coefficient position are only considered for the first nonzero TB. Since both LFNST index and MTS index can be obtained right after parsing the first nonzero TB’s last significant coefficient position, the inverse transform process can be performed much earlier before parsing the entire coding unit (CU) as needed in the current VVC design. It is asserted that the proposed method can reduce the latency between inverse transform process and parsing stage and is beneficial to hardware implementation. In common test condition (CTC), the results shows 0.01%, 0.01% and 0.03% luma BD-rates under AI, RA, and LB, respectively.

The main target is reducing buffer size and latency that is existing in the current design, where the transform coefficients for luma and chroma need to be stored before MTS can be invoked. It is however somewhat dependent on specific implementation how large the benefit is, and the proposed change is relatively large. There is also some relation of the buffering problem with the problem of LFNST/TS in the next section.

Further, this contribution would make the decision on JVET-Q0055 unnecessary.

No action, problem is resolved by adoption of JVET-0106.

[JVET-Q0735](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9581) Crosscheck of JVET-Q0529 (On LFNST index and MTS index signalling) [C. Auyeung (Tencent)] [late]

[JVET-Q0685](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9531) On MTS Signaling [H.E. Egilmez, A. Nalci, M. Coban, V. Seregin, M. Karczewicz (Qualcomm)] [late]

This document proposes to extend the DC coefficient based restriction in LFNST for MTS signaling by combining with JVET-Q0057. The proposed additional change in this document can be viewed as a unification of the coefficient-level restriction in MTS and LFNST signaling. The experimental results show that the proposed changes achieve 0.10% AI, x.xx% RA and x.xx% LDB BD-rates under CTC.

Technically same as JVET-Q0516 built on top of JVET-Q0055. Proponents claim that their spec modification is cleaner than the version of 516.

[JVET-Q0747](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9593) Crosscheck of JVET-Q0685 (On MTS Signaling) [S. De-Luxán-Hernández (HHI)] [late]

### LFNST and TS

[JVET-Q0090](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8915) On constraint on DC only flag in LFNST [Y. Fujimoto, T. Tsukuba, M. Ikeda, T. Suzuki (Sony)]

In VVC, LFNST (Low frequency non-separable transform) is not allowed to use when non-zero coefficients after quantization is DcOnly with LfnstDcOnly=1. However, in most of encoder architecture, quantization is optimized for subjective quality, after determining encoding modes including LFNST. In the current spec, LfnstDcOnly may become 1, after determining QP, while QP is derived with LfnstDcOnly = 0. In order to fix this problem, encoder needs to store status prior to LFNST. When LfnstDcOnly = 1, encoder change LFNST to OFF and need to re-quantize. This affects on the encoder optimization (coding efficiency).

This contribution proposes to include a switch (flag) to disable the constraint on LFNST when LfnstDcOnly is equal to 1. When the flag is on, the loss is about 0.14%.

The problem exists, as an encoder has decided for LFNST, quantization is applied afterwards and then it turns out that only the DC coefficient is left, for which case LFNST shall not be invoked at the decoder. It is pointed out that instead of disabling the dependency, it might be simple for an encoder just storing the DC coefficient before LFNST, and if it is found that after LFNST only the DC position would remain, replacing it by the quantized DC coefficient. Another option would be artificially taking the next highest coefficient and quantizing into non-zero. The flag may not be needed, as the loss by the mentioned simple encoder methods may even be lower.

No action.

[JVET-Q0703](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9549) Crosscheck of JVET-Q0090 (On constraint on DC only flag in LFNST) [S. Iwamura, Y. Kondo, K. Iguchi (NHK)] [late]

[JVET-Q0099](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8924) On Interaction of LFNST and Transform Skip [T. Tsukuba, M. Ikeda, Y. Yagasaki, T. Suzuki (Sony)]

In WD/SW, lfnst\_idx signaling is dependent on usage of transform skip for luma. In case of SingleTree, LFNST for chroma is normatively restricted since lfnst\_idx signaling is skipped when transform skip for luma is used. In addition, in case of DualTreeChroma, lfnst\_idx can be signaled regardless of usage of transform skip for chroma, which is redundant signaling.

This contribution proposes two variants: proposal#1) omit lfnst\_idx signaling when transform skip is used at least for one component, and proposal#2) omit lfnst\_idx signaling when transform skip is used for all valid components.

It is reported that proposal#1 gives average BD-rate changes of (0.00 %, -0.01 %, 0.02 %) for AI, and (0.01 %, 0.06%, 0.06%) for RA.

It is reported that proposal#2 gives average BD-rate changes of (0.00%, 0.01%, 0.01%) for AI, and (0.00%, 0.00%, 0.00%) for RA.

Method 1 disables LFNST as soon as one of the three components uses TS.

Method 2 disables LFNST if all components use TS

It is noted that in principle there is no harm with the current design (decoder behaves well defined, no crash), but there may be some impact on buffer requirement (as per JVET-Q0106).

JVET-Q0106 and JVET-0193 also propose method 1. Method 2 would not resolve the buffer issue.

JVET-Q0103, JVET-Q0138, JVET-Q0328, and JVET-Q0499 also propose method 2.

[JVET-Q0701](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9547) Crosscheck of JVET-Q0099 (On Interaction of LFNST and Transform Skip) [S. Iwamura, Y. Kondo, K. Iguchi (NHK)] [late]

[JVET-Q0100](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8925) On Maximum Block Size for Chroma Transform Skip [T. Tsukuba, M. Ikeda, Y. Yagasaki, T. Suzuki (Sony)]

[JVET-Q0663](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9509) Crosscheck of JVET-Q0100 (On Maximum Block Size for Chroma Transform Skip) [A. Nalci (Qualcomm)] [late]

[JVET-Q0101](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8926) On Transform Skip in JointCbCr mode [T. Tsukuba, M. Ikeda, Y. Yagasaki, T. Suzuki (Sony)]

[JVET-Q0664](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9510) Crosscheck of JVET-Q0101 (On Transform Skip in JointCbCr mode) [A. Nalci (Qualcomm)] [late]

[JVET-Q0103](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8928) LFNST Signaling for Chroma based on Chroma Transform Skip Flags [H. E. Egilmez, A. Nalci, M. Coban, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-Q0652](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9498) Cross-check of JVET-Q0103 (LFNST Signaling for Chroma based on Chroma Transform Skip Flags) [T.-C. Ma (Kwai Inc.)] [late]

[JVET-Q0104](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8929) On worst-case complexity of LFNST [H. E. Egilmez, A. Nalci, M. Coban, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-Q0539](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9385) Crosscheck of JVET-Q0104 (On worst-case complexity of LFNST) [T. Zhou, T. Ikai (Sharp)] [late]

[JVET-Q0106](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8931) Combination of LFNST with transform skip [B. Heng, T. Hellman, M. Zhou, W. Wan (Broadcom)]

The signalling of LFNST index currently includes a condition preventing the use of LFNST when luma transform skip is enabled, but no corresponding condition was added for chroma transform skip. It is asserted that this is a design inconsistency. It may have been an unintentional oversight when chroma transform skip was added in JVET-P0058.

Given that LFNST is signalled at the very end of the CU, it is asserted that allowing mixed LFNST / transform‑skip CUs introduces a significant increase in buffering requirements. Therefore, this contribution recommends adding the corresponding conditions to prevent the use of LFNST with either luma or chroma transform skip. Experimental results reveal that the suggested changes do not impact coding efficiency.

It is agreed that method 1 could help reducing buffer in certain common pipeline architectures.

Method 1 appears beneficial for decoder implementations, and it is minimum change.

Decision: Adopt JVET-Q0106

[JVET-Q0530](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9360) Crosscheck of JVET-Q0106: AHG16: Combination of LFNST with transform skip [W. Zhu (Bytedance)] [late]

[JVET-Q0133](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8958) Fix on LFNST condition [T. Hashimoto, T. Chujoh, E. Sasaki, T. Ikai (Sharp)]

[JVET-Q0611](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9457) Crosscheck of JVET-Q0133 (Fix on LFNST condition) [K. Abe (Panasonic)] [late]

[JVET-Q0138](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8963) Separate transform skip checking of Luma and Chroma for LFNST index signalling [M. Koo, M. Salehifar, J. Lim, S. Kim (LGE)]

[JVET-Q0729](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9575) Cross-check of JVET-Q0138 (Separate transform skip checking of Luma and Chroma for LFNST index signalling [C.)] [late]

[JVET-Q0183](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9008) AHG9: High-level syntax related to transform skip mode [S.-T. Hsiang, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0193](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9018) LFNST signalling cleanup with TS checking [M.-S. Chiang, C.-W. Hsu, C.-M. Tsai, T.-D. Chuang, C.-Y. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0689](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9535) Crosscheck of JVET-Q0193 (LFNST signalling cleanup with TS checking) [Kuo, Lin (ITRI)] [late]

[JVET-Q0195](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9020) Maximum TS size considering chroma sampling ratio [M.-S. Chiang, C.-W. Hsu, C.-M. Tsai, T.-D. Chuang, C.-Y. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0623](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9469) Crosscheck of JVET-Q0195 (Maximum TS size considering chroma sampling ratio) [J. Choi (LGE)] [late]

[JVET-Q0303](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9128) LFNST signaling simplification [J. Yao, J.-Q. Zhu, K. Kazui (Fujitsu)]

[JVET-Q0578](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9424) Crosscheck of JVET-Q0303 (LFNST signaling simplification) [S. De-Luxán-Hernández (HHI)] [late]

[JVET-Q0314](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9139) Non-CE: Retrained LFNST Matrices [K. Fan, L. Zhang, K. Zhang, Y. Wang (Bytedance)]

[JVET-Q0744](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9590) Crosscheck of JVET-Q0314 (Non-CE: Retrained LFNST Matrices) [S. De-Luxán-Hernández (HHI)] [late]

[JVET-Q0763](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9609) Crosscheck of JVET-Q0314 (Non-CE: Retrained LFNST Matrices) [X. Z. Zheng (DJI)]

[JVET-Q0328](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9153) On LFNST signalling and transform skip [C. Rosewarne, J. Gan (Canon)]

[JVET-Q0499](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9327) On LFNST signaling with Transform-skip mode [T.-C. Ma, X. Xiu, Y.-W. Chen, H.-J. Jhu, X. Wang (Kwai Inc.)]

[JVET-Q0687](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9533) Crosscheck of JVET-Q0499 (On LFNST signaling with Transform-skip mode) [H.E. Egilmez (Qualcomm)] [late]

[JVET-Q0686](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9532) Chroma LFNST Simplification and Signaling [H.E. Egilmez, A. Nalci, M. Coban, V. Seregin, M. Karczewicz (Qualcomm)] [late]

[JVET-Q0731](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9577) Cross-check of JVET-Q0686 "Chroma LFNST Simplification and Signaling" [F. Le Léannec (InterDigital)] [late]

## Residual coding (7)

Contributions in this category were discussed Thursday 9 Jan. 1800–1900 in Track B (chaired by JRO).

[JVET-Q0146](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8971) Simplified bypass coding of transform regular residual [Y. Kato, K. Abe, T. Toma (Panasonic)]

This contribution proposes a simplified bypass coding of transform residual coding. Update of QState in bypass coding is removed and derivation of ZeroPos[n] is changed not to use QState. Two methods are proposed.

* Method 1: ZeroPos[n] is defined to (1 << rice).
* Method 2: On top of Method 1, ZeroPos[n] is changed depending on inter block or not.

Method 1 reportedly provides 0.01%, 0.01%, and 0.01% luma BD-rates for the AI, RA, and LB settings, respectively, over the VTM-7.0 anchor under CTC, and Method 2 reportedly provides 0.00%, 0.00%, and -0.01% luma BD-rates for the AI, RA, and LB settings, respectively.

It is commented that Qstate would still be needed for CABAC, so it cannot be entirely removed. It is not obvious that the proposed method is really solving a critical complexity problem, and it introduces some loss in particular in the low QP range.

No action.

[JVET-Q0617](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9463) Crosscheck of JVET-Q0146 (Simplified bypass coding of transform regular residual) [T. Tsukuba (Sony)] [late]

[JVET-Q0243](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9068) Additional support of dependent quantization with 8 states [H. Schwarz, S. Schmidt, P. Haase, T. Nguyen, D. Marpe, T. Wiegand (Fraunhofer HHI)]

This contribution proposes to support dependent quantization with 8 quantization states in addition to the current variant of dependent quantization with 4 quantization states. It is asserted that the implementation complexity for the decoder is virtually not increased. Reportedly, both variants of dependent quantization (4 and 8 states) can be implemented using a single unified decoding process; only the state transition table used depends on the variant chosen. Alternatively, both variants of dependent quantization could be implemented using a single state transition table of 12 states, in which case only the initial state for a transform block depends on the variant of dependent quantization selected.

The following average results are reported for dependent quantization with 8 states relative to VTM-7 (dependent quantization with 4 states) under common test conditions:

AI: –0.43%, 0.07%, 0.14% (Y, Cb, Cr) at 111% encoding time and 99% decoding time;  
 RA: –0.34%, 0.05%, 0.25% (Y, Cb, Cr) at 106% encoding time and 98% decoding time;  
 LB: –0.40%, 0.21%, 0.13% (Y, Cb, Cr) at 104% encoding time and 100% decoding time;  
 LP: –0.37%, 0.16%, –0.02% (Y, Cb, Cr) at 106% encoding time and 95% decoding time.

For the low QP test conditions (QPs 2, 7, 12, 17), the following results are reported:

AI: –0.38%, –0.34%, –0.35% (Y, Cb, Cr) at 120% encoding time and 97% decoding time;  
 RA: –0.72%, –0.96%, –1.30% (Y, Cb, Cr) at 115% encoding time and 97% decoding time;  
 LB: –0.78%, –0.30%, –0.22% (Y, Cb, Cr) at 115% encoding time and 95% decoding time;  
 LP: –0.70%, –0.23%, –0.18% (Y, Cb, Cr) at 117% encoding time and 96% decoding time.

The gain is 0.3-0.4%, but the encoder runtime also increases by 10% and more. It is obvious that the trellis search is duplicating in complexity. This is clearly a worse performance/complexity tradeoff compared to the 4-state version of DQ.

The changes in specification are not large, when some state numbering is modified.

Several experts expressed concern that the complexity/performance tradeoff is not attractive enough.

No action.

[JVET-Q0626](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9472) Cross-check report of JVET-Q0243 on Dependent Quantization with 8 states [E. François (InterDigital)] [late]

[JVET-Q0708](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9554) Crosscheck of JVET-Q0243 (Additional support of dependent quantization with 8 states) [M. Coban (Qualcomm)] [late]

[JVET-Q0627](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9473) On Dependent Quantization: combination of JVET-Q0243 and JVET-Q0227 [P. Le Léannec, E. François (InterDigital)] [late]

This contribution relates to Dependent Quantization and combines the proposals from JVET-Q0243 on using 8 quantization states instead of 4 states in the current VTM, and JVET-Q0227 on using an qP-dependent offset when applying the scaling process for transform coefficients.

The reported psnr-Y, U, V BD-rate variations compared to VTM7.0 when using 8 quantization states are:

AI: –0.47%, 0.42%, 0.43% (Y, Cb, Cr) at 109% encoding time and 100% decoding time  
 RA: –0.38%, –0.05%, –0.12% (Y, Cb, Cr) at 106% encoding time and 101% decoding time  
 LB: –0.58%, 0.18%, 0.36% (Y, Cb, Cr) at 106% encoding time and 101% decoding time

No need for presentation.

[JVET-Q0724](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9570) Crosscheck of JVET-Q0627: On Dependent Quantization: combination of JVET-Q0243 and JVET-Q0227 [H. Schwarz (Fraunhofer HHI)] [late]

[JVET-Q0298](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9123) Reports on level mapping off versus level mapping on [J. Choi, S. Yoo, J. Heo, J. Lim, S. Kim (LGE)]

This contribution investigates coding performance impact from the usage of level mapping. According to simulation results, disabling level mapping does not cause any coding loss for camera-captured contents, but some coding loss to sequences from Class F and TGM. In addition, when level mapping is disabled for the chroma blocks some coding gains are observed to sequences except TGM. This contribution proposes four methods regarding how to handle level mapping as follow.

- Method 1: disabling level mapping for all blocks

- Method 2: disabling level mapping for chroma blocks

- Method 3/4: SPS flag to indicate level mapping usage for all blocks/chroma blocks

Disabling level mapping:

Overall: 0.00% / -0.01% / 0.00% (AI), -0.02% / 0.00% / -0.04% (RA), -0.02% / -0.10% / -0.06% (LD)

Class F: 0.37% / 0.35% / 0.53% (AI), 0.24% / 0.43% / 0.32% (RA), -0.02% / 0.14% / 0.37% (LD)

TGM: 0.78% / 0.93% / 0.87% (AI), 0.51% / 0.66% / 0.68% (RA), 0.37% / 0.43% / 0.40% (LD)

Disabling level mapping (Low QP):

Overall: -0.03% / -0.05% / -0.06% (AI), -0.02% / -0.02% / -0.02% (RA), -0.01% / -0.01% / -0.01% (LD)

Class F: 0.11% / 0.17% / 0.18% (AI), 0.06% / 0.11% / 0.03% (RA), -0.06% / 0.06% / 0.05% (LD)

TGM: 1.48% / 1.26% / 1.34% (AI), 1.15% / 1.14% / 1.13% (RA), 0.93% / 1.01% / 1.02% (LD)

Disabling level mapping for chroma blocks:

Overall: 0.00% / -0.01% / 0.00% (AI), 0.00% / 0.03% / 0.01% (RA), -0.01% / -0.16% / -0.04% (LD)

Class F: 0.00% / 0.04% / 0.05% (AI), -0.04% / 0.02% / 0.03% (RA), -0.01% / -0.87% / 0.36% (LD)

TGM: 0.09% / 0.12% / 0.12% (AI), 0.03% / -0.01% / 0.05% (RA), -0.01% / -0.11% / -0.09% (LD)

Disabling level mapping for chroma blocks (Low QP):

Overall: -0.01% / -0.02% / -0.03% (AI), 0.00% / -0.01% / -0.02% (RA), 0.00% / -0.01% / 0.04% (LD)

Class F: 0.00% / -0.05% / -0.03% (AI), -0.05% / -0.01% / 0.03% (RA), 0.09% / 0.10% / -0.08% (LD)

TGM: 0.46% / 0.39% / 0.46% (AI), 0.22% / 0.26% / 0.33% (RA), 0.10% / 0.17% / 0.13% (LD)

No need for consideration after CE3 decision

[JVET-Q0546](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9392) Crosscheck of JVET-Q0298 (Reports on level mapping off versus level mapping on) [Z.-Y. Lin (MediaTek)] [late]

[JVET-Q0299](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9124) Residual coding simplification [J. Choi, S. Yoo, J. Heo, J. Lim, S. Kim (LGE)]

In current VVC draft, Rice parameter for transform skip is derived from the predetermined equation. However, a look-up table of 32 entries is still used to derive Rice parameter in regular residual coding. This contribution proposes a few candidate equations to derive the Rice parameter without the look-up table. The proposed equations require shift and additions, and it generates the exactly same or almost same Rice parameters as the look-up table. The coding performance of each proposed method is shown below:

Method 1:

Exactly same with the VTM-7.0 anchor

Method 2:

CTC QPs: 0.00% (AI), 0.00% (RA), -0.03% (LD)

Low QPs: -0.02% (AI), 0.08% (RA), 0.06% (LD)

Method 3:

CTC QPs: 0.00% (AI), 0.01% (RA), 0.02% (LD)

Low QPs: 0.00% (AI), 0.00% (RA), -0.01% (LD)

No need for consideration after CE3 decision

[JVET-Q0639](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9485) Crosscheck of JVET-Q0299 (Residual coding simplification) [M. G. Sarwer (Alibaba)] [late]

[JVET-Q0300](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9125) Unification of bypass coding between TSRC and RRC [J. Choi, S. Yoo, J. Heo, J. Lim, S. Kim (LGE)]

In the current transform skip residual coding, bypass coded bins are coded with the interleaved manner (residual sample by residual sample) after context-coded bin count reaches the maximally allowed number. This contribution proposes to change the coding order of bypass coded bins/syntaxes in transform skip residual coding so that bypass bins are coded together as regular residual coding. The proposed method has no coding efficiency change.

It is suggested to align the coding order of TSRC with RRC (i.e. group remainder and sign bits together). As sign bits are partially context in TSRC, the unification is not fully possible, in hardware and software these would anyway be implemented in separate processing structures. The benefit of the unification is not clear.

No support expressed, no action.

[JVET-Q0552](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9398) Crosscheck of JVET-Q0300: Unification of bypass coding between TSRC and RRC [T. Nguyen (HHI)] [late]

[JVET-Q0363](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9188) On transform skip residual coding [J. Gan, C. Rosewarne (Canon)]

This contribution proposes removing the second pass of context-coded syntax elements from TSRC. The remaining four context-coded syntax elements are decoded in a single pass, requiring only one CABAC budget check per coefficient. It is asserted that the proposed simplification aligns the CABAC utilisation of RRC and TSRC. Losses relative to VTM-7.0 are 0.01% luma in CTC RA, and 0.37% luma in Class F RA.

The proposal intends to make TSRC more similar to RRC in various aspects. However, a complete unification is not possible, e.g. in terms of scanning order, method of sign coding, etc., such that hardware implementations would likely use separate processing stages anyway. The method particularly loses compression performance in screen content, which is the area where TSRC has most benefit.

No action.

[JVET-Q0680](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9526) Crosscheck of JVET-Q0363 (On transform skip residual coding) [X. Zhao (Tencent)] [late]

[JVET-Q0497](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9325) Simplification of Rice parameter derivation for RRC [H.-J. Jhu, X. Xiu, Y.-W. Chen, T.-C. Ma, X. Wang (Kwai Inc.)]

In residual coding of a transform block, for each coefficient, the remaining absolute level is binarized using Golomb-Rice code whose rice parameter is adaptively derived depending on the neighbour coefficient levels and a lookup table. This contribution proposes two methods for deriving the rice parameters without using lookup table. The proposed method 1 reportedly provides 0.01%, 0.00%, and 0.00% luma BD-rate impact for the AI, RA, and LB settings respectively versus the VTM-7.0 anchor under the common test condition (CTC), and proposed method 2 reportedly provides 0.01%, -0.01%, and 0.01% luma BD-rate impact for the AI, RA, and LB settings respectively versus the VTM-7.0 anchor under the common test condition (CTC).

Very similar to JVET-Q0490 and JVET-Q0263.

No obvious benefit of such change.

[JVET-Q0688](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9534) Crosscheck of JVET-Q0497 (Simplification of Rice parameter derivation for RRC) [H. Wang (Qualcomm)] [late]

## Entropy coding (3)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

[JVET-Q0149](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8974) AHG14: Report of CABAC skip mode results on VTM-7.0 [K. Abe, T. Toma, [V. Drugeon (Panasonic)](mailto:virginie.drugeon@eu.panasonic.com)]

This contribution is an information contribution which reports the coding results of CABAC skip mode on VTM-7.0. CABAC skip mode was proposed by JVET-M0089, JVET-N0207, and JVET-O0308. It directly outputs binarized bins as a bitstream without CABAC processing, and can avoid CABAC throughput issue without any additional building blocks. Simulation results reportedly show that the CABAC skip mode can guarantee the fixed processing delay with the cost of 16%, 19%, and 24% bits increasing for AI, RA, and LDB on VTM-7.0, and 11%, 10%, and 11% bits increasing for AI, RA, and LDB on VTM-7.0-lossless.

Update on previous proposal with VTM7 and lossless results. No detailed presentation necessary.

[JVET-Q0436](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9262) CABAC zero word threshold [A. Browne, K. Sharman, S. Keating (Sony)]

This document presents an analysis of the need for padding with cabac\_zero\_word. Following on from JVET-P0395, where CTU-level statistics were analysed, in this contribution statistics are provided for tiles of CTUs, to examine the impact of averaging. It is concluded that padding is required on tiles for some sequences within both “High” and “Main” tiers of the current specification. In addition, figures are given which indicate that these results are not “averaged out” as tiles become larger. Two possible changes to the cabac\_zero\_word threshold are proposed if the impact of padding is to be reduced.

The analysis shows that the usage of CABAC zero word becomes less when the formula in terms of slope (beta) is changed. The same formula had been used since AVC, but may in particular not be as appropriate for high tier bitrate limits.

Decision: Adopt JVET-Q0436, only for high tier, “candidate 1”, change beta from 4/3 to 3/2.

[JVET-Q0461](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9287) QP-independent and slice type-independent initialization of context models for the high throughput CABAC mode of JVET-P0300 [H. Kirchhoffer, B. Bross, T. Nguyen, D. Marpe, H. Schwarz, T. Wiegand (HHI)]

A QP-independent and slice type-independent initialization method is proposed for the high throughput CABAC mode of JVET-P0300. This opens up the possibility for simplifications in a hardware or software implementation. For example, instead of deriving a context model index (for a certain bin), the context model state (which corresponds to a probability value) can directly be derived. For QPs 2-17, the BD-rates are 4.96% for AI, x.xx% for RA, 5.37% for LB, and 5.72% for LP. For the lossless setup, the bit rates increase by 7.78% for AI, 7.34% for RA, and 6.78% for LB.

Further study and better understanding of the problem is needed before considering specific technology. See notes under JVET-Q0387.

[JVET-Q0641](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9487) Crosscheck of JVET-P0461 (QP-independent and slice type-independent initialization of context models for the high throughput CABAC mode of JVET-P0300) [S. Esenlik (Huawei)] [late]

## Partitioning (7)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

[JVET-Q0174](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8999) AHG9: Fix on high-level syntax related to coding tree constraints [S.-T. Hsiang, C.-Y. Lai, C.-Y. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0226](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9051) AHG9: High-level syntax for signalling maximum TT size [S.-T. Hsiang, T.-D. Chuang, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0330](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9155) On block partitioning at picture boundary [R.-L. Liao, J. Chen, Y. Ye, J. Luo (Alibaba)]

[JVET-Q0432](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9257) On TT or BT split modes disabling [F. Le Léannec, T. Poirier, F. Urban (InterDigital)]

[JVET-Q0468](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9294) Constraint on minimum CU size [G. Li, X. Li, X. Xu, S. Liu (Tencent)]

[JVET-Q0674](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9520) Crosscheck of JVET-Q0468 (Constraint on minimum CU size) [K. Zhang (Bytedance)] [late]

[JVET-Q0469](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9295) On minimum chroma QT size derivation [G. Li, X. Li, X. Xu, S. Liu (Tencent)]

[JVET-Q0471](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9297) On chroma QT split [G. Li, X. Li, X. Xu, S. Liu (Tencent)]

[JVET-Q0753](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9599) Crosscheck of JVET-Q0471 (On chroma QT split) [S. H. Wang (PKU)] [late]

## Chroma formats and chroma related coding tools (25)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

[JVET-Q0098](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8923) On QP Adjustment for Adaptive Color Transform [T. Tsukuba, M. Ikeda, Y. Yagasaki, T. Suzuki (Sony)]

[JVET-Q0647](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9493) Cross-check of JVET-Q0098 (On QP Adjustment for Adaptive Color Transform) [T.-C. Ma (Kwai Inc.)] [late]

[JVET-Q0140](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8965) On chroma processing simplification [A. Filippov, V. Rufitskiy, E. Alshina (Huawei)]

[JVET-Q0676](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9522) Crosscheck of JVET-Q0140 (On chroma processing simplification for intra prediction) [M. Ikeda (Sony)] [late]

[JVET-Q0142](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8967) Clipping of minimum QP prime value [K. Unno, K. Kawamura, S. Naito (KDDI)]

[JVET-Q0162](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8987) A memory issue on adaptive color transform [K. Kondo, M. Ikeda, T. Suzuki (Sony)]

[JVET-Q0631](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9477) Crosscheck of JVET-Q0162 (A memory issue on adaptive color transform) [J. Jung, D. Kim, G. Ko, J.-H. Son, J. Kwak (WILUS)]

[JVET-Q0166](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8991) On the adaptive color transform [H. Huang, A. K. Ramasubramonian, C.-C. Chen, V. Seregin, T. Hsieh, Y.-H. Chao, W.-J. Chien, G. Van der Auwera, M. Karczewicz (Qualcomm)]

[JVET-Q0241](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9066) On QP adjustment in adaptive color transform [J. Jung, D. Kim, G. Ko, J.-H. Son, J. Kwak (WILUS)]

[JVET-Q0618](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9464) Crosscheck of JVET-Q0241 (On QP adjustment in adaptive color transform) [T. Tsukuba (Sony)] [late]

[JVET-Q0305](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9130) Disallowing JCCR mode for ACT coded CUs [H. Dou, L. Xu, Y.-J. Chiu (Intel)]

[JVET-Q0569](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9415) Crosscheck of JVET-Q0305: Disallowing JCCR mode for ACT coded CUs [W. Zhu (Bytedance)] [late]

[JVET-Q0351](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9176) Non-CE: Report on experimental result for fixing BDPCM Chroma mismatch [H. Jang, J. Nam, N. Park, S. Kim, J. Lim (LGE)]

[JVET-Q0353](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9178) Non-CE: Harmonization adaptive color transform with BDPCM chroma [H. Jang, J. Nam, N. Park, S. Kim, J. Lim (LGE)]

[JVET-Q0361](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9186) Cleanup of chroma BDPCM constraint [W.-T. Cai, J.-Q. Zhu, K. Kazui (Fujitsu)]

[JVET-Q0367](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9192) Cleanup on the adaptive color transform [W.-T. Cai, J.-Q. Zhu, K. Kazui (Fujitsu)]

[JVET-Q0369](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9194) Restricting MIP for ACT coded CUs [W.-T. Cai, J.-Q. Zhu, K. Kazui (Fujitsu)]

[JVET-Q0704](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9550) Crosscheck of JVET-Q0369 (Restricting MIP for ACT coded CUs) [S. Iwamura, Y. Kondo, K. Iguchi (NHK)] [late]

[JVET-Q0408](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9233) On the combination of JCCR and TS [B. Ray, G. Van der Auwera, M. Karczewicz (Qualcomm)]

[JVET-Q0423](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9248) Interaction between ACT and BDPCM chroma [L. Li, X. Li, S. Liu (Tencent)]

[JVET-Q0473](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9299) AHG15: Demultiplexing joint CbCr before dequantization [P. de Lagrange, F. Le Léannec, E. François, P. Bordes (InterDigital)]

[JVET-Q0506](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9335) Interaction between ACT and cross-component coding tools [H. Zhang, X. Li, L. Li, G. Li, S. Liu (Tencent)]

[JVET-Q0645](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9491) Crosscheck of JVET-Q0506: Interaction between ACT and cross-component coding tools [W. Zhu (Bytedance)] [late]

[JVET-Q0510](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9339) ACT color conversion for both lossless and lossy coding [X. Xiu, Y.-W. Chen, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai), J. Zhao, Hendry, S. Paluri, S.-H. Kim (LGE), W. Zhu, J. Xu, L. Zhang (Bytedance)]

[JVET-Q0699](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9545) Crosscheck of JVET-Q0510 (ACT color conversion for both lossless and lossy coding) [L. Li (Tencent)] [late]

[JVET-Q0737](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9583) Crosscheck of JVET-Q0510 (ACT color conversion for both lossless and lossy coding) [?? (Qualcomm)] [late]

[JVET-Q0511](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9340) On ACT QP clipping [J. Zhao, Hendry, S.-H. Kim (LGE), X. Xiu, Y.-W. Chen, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai), W. Zhu, J. Xu, L. Zhang (Bytedance)]

[JVET-Q0620](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9466) Crosscheck of JVET-Q0511 (On ACT QP clipping) [T. Tsukuba (Sony)] [late]

[JVET-Q0512](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9341) Enabling transform skip and BDPCM for chroma in ACT [X. Xiu, Y.-W. Chen, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai)]

[JVET-Q0661](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9507) Cross-check of JVET-Q0512: Enabling transform skip and BDPCM for chroma in ACT [J. Zhao (LGE)] [late]

[JVET-Q0513](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9342) AHG16: Clipping residual samples for JCCR [X. Xiu, Y.-W. Chen, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai)]

[JVET-Q0514](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9343) Encoder improvements on JCCR with chroma transform skip [X. Xiu, Y.-W. Chen, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai)]

[JVET-Q0581](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9427) Crosscheck report of JVET-Q0514 (AHG11: Encoder improvements for chroma transform skip mode) [X. Xu (Tencent)] [late]

[JVET-Q0515](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9344) Disabling chroma transform skip mode for ISP [X. Xiu, Y.-W. Chen, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai)]

[JVET-Q0644](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9490) Crosscheck of JVET-Q0515: Disabling chroma transform skip mode for ISP [W. Zhu (Bytedance)] [late]

[JVET-Q0521](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9350) Alignment of BDPCM for ACT [W. Zhu, L. Zhang, J. Xu (Bytedance), X. Xiu, Y.-W. Chen, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai), H. Jang, J. Nam, S.-H. Kim, J. Lim (LGE)]

[JVET-Q0584](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9430) Crosscheck of JVET-Q0521 (Alignment of BDPCM for ACT) [H. Dou, L. Xu, Y.-J. Chiu (Intel)] [late]

[JVET-Q0523](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9352) Redistribution of chroma information for improved HDR color representation [M. Azimi (U of Cambridge), M. T. Pourazad (TELUS), P. Nasiopoulos (UBC)]

[JVET-Q0695](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9541) Combined encoder improvements of JVET-Q0101/JVET-Q0408/JVET-Q0514 on JCCR with chroma transform skip [X. Ma, H.-J. Jhu, X. Wang (Kwai), B.Karczewicz (Qualcomm), [T. Tsukuba](mailto:Takeshi.Tsukuba@sony.com), M. Ikeda, Y. Suzuki (Sony)] [late]

[JVET-Q0750](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9596) Crosscheck of JVET-Q0695 (Combined encoder improvements of JVET-Q0101/JVET-Q0408/JVET-Q0514 on JCCR with chroma transform skip) [C. Helmrich, H. Schwarz (HHI)] [late]

## Lossless and near lossless coding (2)

Contributions in this category were discussed Thursday 9 Jan. 1630–XXXX in Track B (chaired by JRO). Merge this with 6.13 which is somehow related.

[JVET-Q0387](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9212) AHG14: Throughput and coding efficiency report of JVET-P0300 on VTM-7.0 [H. Kirchhoffer, B. Bross, T. Nguyen, D. Marpe, H. Schwarz, T. Wiegand (HHI)]

This contribution evaluates the throughput and coding efficiency of the high throughput CABAC mode proposed in JVET-P0300 based on VTM-7.0. The method was implemented into the throughput evaluation testbed of JVET-L1025 (CE5 subtest 2) in order to evaluate the coding engine outside of VTM-7.0. In this testbed, the coding engine of JVET-P0300 increases the throughput by approximately 70 to 100% compared to the VTM-7.0 engine. For three generalized bypass probability values (1/4, 1/8, and 1/16) and QPs 2-17, the BD-rates of the VTM-7.0-based implementation are 4.55% for AI, 5.22% for RA, 4.53% for LB, and 4.66% for LP. The corresponding throughput of the decoder (in mbit per second) is increased by 20% for AI, 18% for RA, 16% for LB, and 18% for LP.

Throughput of CABAC engine in current VVC is worse than HEVC, due to the modified CABAC engine.

It has also to be considered that the rate increases by the high-throughput method, which makes the throughput lower again.

It is further mentioned that throughput is not only dependent on the core engine, but also the context derivation has to be taken into account.

Also, it is mentioned that the gain of VVC over HEVC is significantly lower in the low QP range – so a loss of 5% may already be very significant there.

Questions raised:

- would a second entropy coding be desirable?

- if yes, what should be the advantage in terms of throughput?

- could some of these problems be resolved by parallelism, e.g. tiles?

- what are the use cases, and would VVC be competitive with HEVC at all for these cases?

Throughput is also highly dependent on hardware architecture.

Further study – requirements need to be clarified. Probably nothing for V1.

[JVET-Q0347](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9172) CE3 related: Fixed Rice parameters in transform residual coding [Y. Chen, F. Le Léannec, F. Galpin, T. Poirier (InterDigital)]

This contribution proposes to replace per-sample adaptive codeword derivation based on the levels of the bottom and right neighboring residual samples with a fixed codeword in transform residual coding. It is proposed to use a fixed rice parameter=0 for the syntax element abs\_remainder, and a fixed rice parameter=1 for the syntax element dec\_abs\_level.

The results of using fixed rice parameters show BD-rate change of 0.07% AI, 0.06% RA and 0.00% LB over VTM-7.0 for common test conditions.

No need for action for VVC1. In particular at low QP, the loss by using fixed Rice parameter is too large, it would probably for lossless coding revert some of the gain achieved in CE3.

More study is necessary, a) where are throughput problems in VCC, b) which are the applications that require high throughput, and c) is VVC or an extension of it attractive for such applications (in particular, in comparison against HEVC).

[JVET-Q0752](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9598) Crosscheck of JVET-Q0347 (CE3-related: Fixed rice parameters in transform residual coding) [H. Kirchhoffer (HHI)] [late]

## Screen content coding tools (4)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

[JVET-Q0571](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9417) IBC-Mirror mode for screen content coding [J. Cao, Z. Qiu, J. Wang, F. Liang (??), Y. Yu, Y. Liu (OPPO)] [late] [miss]

[JVET-Q0573](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9419) Intra-Affine mode for screen content coding [J. Cao, H. Wang, J. Wang, F. Liang (??), Y. Yu (OPPO)] [late] [miss]

## 360 degree video (0)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

## AHG9: General high-level syntax (135)

### Combinations of features (21) - BoG

#### Combination of RPR and subpictures (7)

[JVET-Q0594](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9440) AHG9: A summary of proposals on combination of RPR and subpictures [Y.-K. Wang (Bytedance)] [late]

[JVET-Q0043](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8868) AHG9: Constraint about usage of reference picture resampling and subpictures [T. Nishi, K. Abe, V. Drugeon (Panasonic)]

[JVET-Q0232](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9057) AHG8/AHG12 Subpicture-based reference picture resampling signalling [M. Hirabayashi, M. Katsumata, T. Suzuki (Sony)]

[JVET-Q0236](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9061) AHG8/AHG12: Subpicture-specific RPR [M. M. Hannuksela, A. Aminlou, R. Ghaznavi-Youvalari, K. Kammachi-Sreedhar (Nokia)]

[JVET-Q0290](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9115) AHG9/AHG12: Modifications related to subpicture signalling and RPR [S.-T. Hsiang, C.-Y. Chen, T.-D. Chuang, L. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

Item 2 of this contribution belongs to this category.

[JVET-Q0331](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9156) AhG8: Constraints on the picture scaling ratios [Y.-J. Chang, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

Item 2 of this contribution belongs to this category.

[JVET-Q0333](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9158) AhG12: On the subpicture scaling ratios [Y.-J. Chang, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-Q0334](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9159) AhG8/AhG12: On the reference picture resampling for the subpictures [Y.-J. Chang, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

#### Combination of RPR and reference wraparound (7)

[JVET-Q0595](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9441) AHG9: A summary of proposals on combination of RPR and reference wraparound [Y.-K. Wang (Bytedance)] [late]

[JVET-Q0134](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8959) AHG8: Disabling reference wraparound for reference picture resampling [B. Heng, P. Chen, T. Hellman, W. Wan, M. Zhou (Broadcom)]

[JVET-Q0184](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9009) AHG9: On signalling of wrap-around motion compensation [C.-Y. Chiu, C.-C. Chen, C.-W. Hsu, L. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0238](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9063) AHG8/AHG9: On reference picture wraparound [M. M. Hannuksela (Nokia)]

[JVET-Q0316](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9141) AHG9: On signaling of the wraparound offset [K. Zhang, L. Zhang, Y.-K. Wang, H. Liu, J. Xu, Z. Deng (Bytedance)]

[JVET-Q0287](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9112) AHG9: On wrap-around motion compensation [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-Q0335](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9160) AhG9: On the wraparound offsets [Y.-J. Chang, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

Items 1 and 2 of this contribution belong to this category.

[JVET-Q0416](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9241) AHG8/AHG9: On horizontal wrap-around motion compensation [J. Chen, Y. Ye, R.-L Liao, J. Luo (Alibaba)]

Item 2 of this contribution belongs to this category.

#### Combination of subpictures and reference wraparound (4)

[JVET-Q0212](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9037) [AHG9/AHG12] On sub-picture wrap around signaling [Y. He, A. Hamza (InterDigital), B. Choi, S. Wenger (Tencent)]

[JVET-Q0335](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9160) AhG9: On the wraparound offsets [Y.-J. Chang, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

Item 3 of this contribution belongs to this category.

[JVET-Q0344](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9169) AHG6/AHG9: Signalling wrap-around for subpictures [Y.-H. Lee, J.-L. Lin, Y.-J. Chen, C.-C. Ju (MediaTek)]

[JVET-Q0403](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9228) AHG12: On subpicture specific MV wraparound [R. Skupin, Y. Sanchez, K. Sühring, T. Schierl (HHI)]

#### Combination of subpictures and scalability (3)

[JVET-Q0279](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9104) AHG8/AHG9: On alignment across layers [B. Choi, S. Wenger, S. Liu (Tencent)]

Item 4 of this contribution belongs to this category.

[JVET-Q0402](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9227) AHG12: On subpicture and scalability [R. Skupin, Y. Sanchez, K. Sühring, T. Schierl (HHI)]

[JVET-Q0405](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9230) AHG12: On subpicture and OLS [R. Skupin, Y. Sanchez, K. Sühring, T. Schierl (HHI)]

### High level tool control (11) - BoG

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

Note: Probably more contributions belong here which are allocated to AHGs 8/9/12.

Add mention in relevant other agenda categories.

[JVET-Q0121](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8946) AHG9: On deblocking control parameters [J. Xu, Y.-K. Wang, L. Zhang, W. Zhu, K. Zhang, H. Liu (Bytedance)]

[JVET-Q0175](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9000) AHG9: On parameters override mechanism in slice header for in-loop filters [C.-M. Tsai, C.-W. Hsu, C.-Y. Lai, O. Chubach, T.-D. Chuang, C.-Y. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0248](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9073) AHG9: On constraints for ALF APS [N. Hu, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-Q0254](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9079) [AHG9]: Override mechanism for ALF related syntax elements in slice header [A. M. Kotra, S. Esenlik, B. Wang, H. Gao, E. Alshina (Huawei)]

[JVET-Q0352](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9177) AHG9/AHG12: On subpicture boundary [H. Jang, J. Nam, N. Park, S. Kim, J. Lim (LGE)]

Items 2 and 3 of this contribution belongs to this category.

[JVET-Q0336](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9161) AhG9: Cleanup in high level syntax [Y.-J. Chang, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

[Move to 6.19.5] Which features are affected by this?

[JVET-Q0346](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9171) AHG9: On slice header control for LMCS and scaling lists [J. Samuelsson, S. Deshpande, A. Segall (Sharp)]

[JVET-Q0360](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9185) AHG9: Slice level control of coding tools for DMVR, BDOF and PROF [S. Esenlik, A. M. Kotra, H. Gao, B. Wang, A. Filippov, V. Rufitskiy, E. Alshina (Huawei)]

[JVET-Q0444](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9270) Non-CE: Clean-up of High-Level Syntax Related to AMVR [K. Naser, M. Kerdranvat, T. Poirier, A. Robert, F. Galpin, F. Le Léannec (InterDigital)]

[JVET-Q0484](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9311) AHG9: HLS control of chroma QP offset [W. Wan, B. Heng, P. Chen, T. Hellman, M. Zhou (Broadcom)]

[JVET-Q0572](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9418) AHG9: On ALF Signalling [K. Misra, S. Deshpande, A. Segall (Sharp)] [late]

### Misc. general HLS topics (7)

[JVET-Q0113](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8938) AHG9/AHG8/AHG12: Some general HLS syntax clean-ups [Y.-K. Wang (Bytedance)]

Item 1 of this contribution belongs to this category.

[JVET-Q0278](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9103) AHG9/AHG8: On random access related flags [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-Q0114](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8939) AHG9: A few more general constraints flags [Y.-K. Wang (Bytedance)]

[JVET-Q0256](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9081) AHG9: Temporal sublayer level indication and conformance [J. Samuelsson, S. Deshpande, A. Segall (Sharp)]

[JVET-Q0276](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9101) AHG9: On EOB NAL unit out of band [S. Wenger, B. Choi (Tencent)]

[JVET-Q0282](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9107) AHG9: On temporal sub-layer switching [B. Choi, S. Wenger, S. Liu (Tencent)] [late]

[JVET-Q0398](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9223) AHG9: Sub-layer wise dependency in multi-layer [Y. Sanchez, R. Skupin, K. Sühring, T. Schierl (HHI)]

### Parameter sets cleanups (20) - BoG

[JVET-Q0593](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9439) AHG9: A summary of proposals on parameter sets cleanups [Y.-K. Wang (Bytedance)] [late]

[JVET-Q0045](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8870) AHG9: On DPS identifier [V. Drugeon (Panasonic)]

[JVET-Q0117](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8942) AHG9: Cleanups on parameter sets [Y.-K. Wang, J. Xu (Bytedance)]

[JVET-Q0280](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9105) AHG8/AHG9: On video parameter set ID [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-Q0355](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9180) AHG8/AHG9: Cleanup on multi-layer coding [X. Ma, H. Yang (Huawei)]

Item 3 of this contribution belongs to this category.

[JVET-Q0357](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9182) AHG9: On clarification of DPS [X. Ma, H. Yang (Huawei)]

[JVET-Q0147](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8972) AHG9: On JCCR signaling [K. Abe, T. Toma (Panasonic)]

[JVET-Q0152](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8977) AHG9/AHG12: Miscellaneous HLS topics [M. Coban, V. Seregin, Y.-J. Chang, M. Karczewicz (Qualcomm)]

Item 2 of this contribution belongs to this category.

[JVET-Q0155](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8980) AHG9: On separate colour plane coding [V. Seregin, B. Ray, A. K. Ramasubramonian, Y.-J. Chang, M. Coban, G. Van der Auwera, M. Karczewicz (Qualcomm)]

Item 2 of this contribution belongs to this category.

[JVET-Q0265](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9090) Modifications to VVC Draft 7 [C. Auyeung, X. Li, X. Zhao, S. Liu (Tencent)]

[JVET-Q0329](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9154) AHG9: Syntax cleanup of chroma coding tools in 444 color format [R.-L. Liao, J. Chen, Y. Ye, J. Luo (Alibaba)]

[JVET-Q0520](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9349) AHG9: Cleanups on signalling for CC-ALF, BDPCM, ACT and Palette [Y. Wang, L. Zhang, K. Zhang, W. Zhu (Bytedance)]

Item 3 of this contribution belongs to this category.

[JVET-Q0173](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8998) AHG9: On signalling the DPB parameters with delta values [C.-Y. Lai, C.-M. Tsai, T.-D. Chuang, O. Chubach, C.-Y. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0176](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9001) AHG9: Overhead reduction for picture header [S.-T. Hsiang, Y.-W. Huang, S.-M. Lei (MediaTek)]

Item 2 of this contribution belongs to this category.

[JVET-Q0210](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9035) [AHG9]: Miscellaneous HLS clean-ups [Hendry, S. Paluri (LGE)]

Items 8 and 9 of this contribution belong to this category.

[JVET-Q0285](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9110) AHG9: On adaptation parameter set ID [B. Choi, S. Wenger, S. Liu (Tencent)] [late]

Item 2 of this contribution belongs to this category.

[JVET-Q0374](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9199) AHG9: Cleanups on redundant signalling in HLS [D. Kim, G. Ko, J. Jung, J. Son, J. Kwak (WILUS)]

[JVET-Q0399](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9224) AHG8: On conformance window and scaling window [Y. Sanchez, R. Skupin, K. Sühring, T. Schierl (HHI)]

[JVET-Q0416](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9241) AHG8/AHG9: On horizontal wrap-around motion compensation [J. Chen, Y. Ye, R.-L Liao, J. Luo (Alibaba)]

Item 1 of this contribution belongs to this category.

[JVET-Q0420](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9245) AHG12: Signaling of chroma presence in PPS and APS [L. Li, X. Li, C. Auyeung, B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-Q0481](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9308) AHG9: Ordering of partition constraints syntax elements in the sequence parameter set and picture header [W. Wan, B. Heng (Broadcom)]

The SPS aspect of this contribution belongs to this category.

### Constant slice header parameters signalling (4)

[JVET-Q0153](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8978) AHG9: On picture header [M. Coban, V. Seregin, Y.-J. Chang, M. Karczewicz (Qualcomm)]

Item 3 of this contribution belongs to this category.

[JVET-Q0240](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9065) AHG9: Additional constant slice header parameters [M. M. Hannuksela (Nokia)]

[JVET-Q0419](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9244) AHG 9: On picture header [L. Li, B. Choi, X. Xu, X. Li, S. Wenger, S. Liu (Tencent)]

Item 3 of this contribution belongs to this category.

[JVET-Q0482](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9309) AHG9: Signalling of constant parameter values [W. Wan, P. Chen, [B. Heng](mailto:brian.heng@broadcom.com), [T. Hellman](mailto:tim.hellman@broadcom.com), [M. Zhou (Broadcom)](mailto:minhua.zhou@broadcom.com)]

### Picture header, slice header, and AUD (27)

[JVET-Q0684](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9530) AHG9: A summary of HLS contributions on picture header, slice header, and access unit delimiter [Hendry (LGE)] [late]

3pm thurs 9 Jan (GJS)

*On PH properties*

1. Do we allow PH repetition?
   1. No. Keep the current design that does not allow PH repetition within a picture

JVET-Q0115 aspect 1 & 2: No PH repetition within a picture; consequently remove AUD.

* 1. Yes. Allow PH repetition (JVET-Q0177):
* Signal POC LSB in PH to identify it in temporal domain. – deferred to discussion below.
* Differentiate PH that is repeated. To do this, the following flags may be present: sps\_ph\_repetition\_enabled\_flag in SPS; ph\_repetition\_present\_flag in PH.

AUD is currently optional, and PH is required. If there are multiple layers in an AU, detection of the AU boundary may involve checking the layer ID.

It was discussed whether we care about PH for the purpose of loss resilience.

It was commented that the PH was created for bit efficiency reasons, while the AUD is for AU boundary detection. They appear at different locations in the NAL unit stream – e.g., a common sequence of NAL units would be AUD, SPS, PPS, SEI, APS, PH, Slice, … Since AUD is optional anyway, we don’t have a clear need to remove it.

It was asked, if we allow PH repetition, why we wouldn’t just have a flag in the PH that identifies whether the current PH is a repeated one or is the first one?

PH repetition could also be inside an SEI message. Such an SEI message would not need to be defined in v1 of the standard.

The motivation for PH repetition would be partial-picture decoding when there are lost NAL units in a picture.

No action was taken on the repetition question, so repetition remains prohibited.

1. Where to signal PH. Currently PH is signalled in a NAL unit, 1 PH NAL unit is mandatory for a coded picture. Is it allowed that PH syntax structure is contained in a slice VCL NAL unit (JVET-Q0255, JVET-Q0419, JVET-Q0426)?
   1. If Yes, how the VCL NAL unit carry the PH syntax structure?

* Option 1 (JVET-Q0255): Specify a new NAL unit type Coded Picture. Coded Picture NAL unit contains a syntax element pic\_type, a PH syntax structure, an SH syntax structure, and a slice data syntax.
* Option 2 (JVET-Q0419 aspect #1): In slice layer RBSP, signal ph\_present\_flag. If this flag is equal to 1, signal PH syntax structure in the slice VCL NAL unit.
* Option 3 (JVET-Q0426): The following is proposed:
* Signal sps\_picture\_header\_enabled\_flag. When this flag is equal to 0, PH is not in PH NAL unit; syntax elements in PH are present in SH (which can be put in separate common syntax structure).
* When sps\_picture\_header\_enabled\_flag is equal to 0, signal first\_vcl\_nal\_unit\_in\_picture\_flag in SH. It is recommended that sps\_picture\_header\_enabled\_flag is equal to 1 for bitstream that may be extracted / merged.

JVET-Q0426 was revised; in the new version, there would always be a flag in the SH for whether a PH NAL unit present for the picture or not. If not, that syntax is in the SH (of every slice in the picture). There might be a restriction that this could only happen when there is only one slice in the picture.

Option 1 would change the function of the NAL unit type, such that properties such as IRAP indication would not be indicated by the NAL unit type.

Options 2 and 3 are rather similar in concept.

It was commented that when we measure CTC results, the BD rates include start code overhead.

It was commented that for the LB case, with one of the 720p test sequences in the CTC (“Johnny”), this could have a BD impact of 1.4%.

We can’t remove the whole idea of allowing a PH to be a separate NAL unit, since that is needed for BEAM.

A suggested minimum approach:

* There was discussion of limiting the combined slice header to a special case for when there is only one slice per picture without subpicture support.
  + There could be an SPS flag indicating that the whole CLVS always has one slice per picture. This might or might not be necessary
* At a minimum, a flag would need to be added to the header of every slice (regardless of whether is being used or not) that would indicate whether the PH data are in the SH or not.
  + There should be a constraint that this flag must be 0 for the entire CLVS or 1 for the entire CLVS.
  + The flag would be required to be 0 unless there is only one slice per picture and no subpicutures.
* The POC LSBs would be in the PH, regardless of wether that is in a separate NAL unit or not.
* The presence of the four flags that control whether something is in the PH or SH could be conditioned on the that added flag. These flags could be grouped together.

Revisit after side activity to draft proposed text.

On PH / SH override mechanism

1. Change the current PH / SH override mechanism as follow (JVET-Q0200, JVET-Q0259):
   1. The flags that specify whether a syntax element of a related coding tool is present in PH or in SH (but not both) are proposed to be moved from the PH to the PPS.
   2. This mechanism may be applied for signalling of syntax element related to the following tools:

* reference picture lists, SAO, ALF (JVET-Q0200 & JVET-Q0259)
* deblocking (JVET-Q0200).

It was commented that since the PPS ID can change on every picture anyway, moving the control from the PH to the PPS doesn’t make much of a difference unless this is motivated by a desire for coding efficiency by saving bits in the PH. So this is a matter of saving bits in the PH.

It was commented that this makes particular sense if we allow the PH to be combined into the SH, because in that case we could require a particular location by requiring a value for these flags.

It was commented that it is a question of usage of these tools – whether it is envisioned that there should be a switching of the decision from picture to picture (with other aspects of the PPS staying constant) for whether the controlled syntax is in the PH or SH.

Decision (cleanup): Adopt. Text in Q0200, Hendry resp. for software.

1. JVET-Q0270 aspect 3, 4, and 5:
   1. Replace pic\_deblocking\_filter\_override\_present\_flag and pic\_deblocking\_filter\_override\_flag with a pic\_deblocking\_filter\_override\_idc syntax element specifying whether deblocking filter parameters are not overridden in picture header or slice header, deblocking filter parameters may be overridden in picture header or deblocking filter parameters may be overridden in slice header.
   2. Replace pic\_sao\_enabled\_present\_flag and pic\_sao\_luma\_enabled\_flag with a pic\_sao\_enabled\_idc syntax element specifying whether SAO is disabled for the whole picture, SAO is enabled for the whole picture or SAO may be enabled per slice. Similar way is proposed for ALF aspect.

This is no longer relevant due to the action on Q0200.

*On specific coding tool related signalling in PH / SH*

1. JVET-Q0182: allow scaling list and LMCS to be signalled at slice level, instead of at picture level only. The asserted benefit is for the case of hybrid picture where a picture is a composition of different scenes (e.g., in a video conf showing multiple people and a PC screen).

Two options how to do this:

* Option 1: SL/LMCS syntax elements are signalled either at PH or slice header (SH) level. If SL/LMCS syntax elements are signalled in a PH, they cannot be signalled in any SH of the coded picture associated with the PH.
* Option 2: overriding the PH SL/LMCS settings at SH level is allowed. If overriding is enabled by an overriding flag, additional SL/LMCS information is signalled in the SH; otherwise, the PH SL/LMCS settings are used for the current slice.

This was addressed in a BoG; see Q0625.

1. On signalling of TMVP collocated ref pic.
2. Move signalling of TMVP collocated ref pic from SH to PH

* JVET-Q0207 option 1: when TMVP is enabled for picture associated with the PH, identify the collocated reference picture using its delta POC relative to the current picture’s POC.
* JVET-Q0259 aspect 5: indicate information about collocated picture in picture header when RPL information is signalled in the picture header.

Decision (cleanup): Adopt Q0259 aspect 5; proponent resp. for SW.

1. Keep the signalling of TMVP reference picture in SH and change the signalling for the case when there is only one reference picture in the DPB with the same spatial resolution as the current picture (JVET-Q0207 option 2).

It was commented that this conditions the parsing on a complicated condition, and thus should not be done.

1. JVET-Q0207 aspect 1: Update the constraint for the value of pic\_temporal\_mvp\_enabled\_flag when there is no reference picture in the DPB with the same spatial resolution with the current picture. Rather than considering all reference pictures in the DPB, the constraint should be expressed more precisely by considering only the active reference picture(s) of the picture.

It was commented that this change is not necessary and that the constraint expression may not even be needed; no action unless not resolved offline.

1. JVET-Q0130: Modify semantics of collocated\_ref\_idx.

The contribution expressed a concern over the possibility that a non-conforming could be created that would actually be decodable. The contribution proposes that the decoder override the indicated use of temporal MVP if certain conditions are violated (instead of requiring the encoder to not indicate the use of temporal MVP under those conditions).

The group did not like that this would add extra processing to the decoder and would allow the encoder to provide a misleading indication of what the decoder would be doing. No action was thus taken on the proposal.

1. It is proposed to disallow weighted prediction with customized weights at the slice level and to move the signalling of the prediction weight table from SH to PH (JVET-Q0247). The proposed aspects include:
2. Combine pps\_weighted\_pred\_flag (which) and pps\_weighted\_bipred\_flag in PPS into one flag to specify whether weighted prediction may be applied to pictures referring to the PPS.
3. When weighted prediction is enabled, a flag in picture header (i.e., pic\_weighted\_pred\_present\_flag) would be present to specify whether weighted prediction is applied to the picture or not. When pic\_weighted\_pred\_present\_flag is equal to 1, prediction weight table is present in the picture header.
4. When weighted prediction is enabled for a picture, all slices of the picture would be required to have the same reference picture lists. (And it would be required to send the RPL at the picture level.)
5. In the prediction weight table signalling, explicitly signal the number of reference pictures to be weighted for L0 and L1. This is designed to remove dependency of the prediction weight table signalling to the number of active reference pictures that may be present in slice header.

This proposes the removal of a coding tool functionality and it was agreed we should not do that without careful study, which there probably isn’t time to do.

It does seem strange that the weight table cannot be shared by all slices of the same picture. Decision (cleanup): Make the prediction weight table a fifth type of data that can be signalled either in the PH or SH (like ALF, deblocking, RPL, and SAO). Text to be included in the text being prepared for the other four. Hendry resp. for SW.

*On changes for signalling of syntax elements in PH / SH and additional features*

1. Condition the presence of inter-/intra- related syntax elements.
   1. Using a flag to condition the presence of some syntax elements in PH

JVET-Q0116 aspect 1:

* A new syntax element ph\_all\_intra\_slices\_flag is proposed to be signalled in PH, and all the inter-related syntax elements in PH that are not needed for intra slices are conditioned on ph\_all\_intra\_slices\_flag not equal to 1.
* The slice\_type in slice header (SH) is inferred to be equal to 2 (i.e., intra slice) when the ph\_all\_intra\_slices\_flag is equal to 1.
* This flag (ph\_all\_intra\_slices\_flag) is asserted to be useful not only for reducing PH size but also may be used by system for some features (e.g., trick mode).
  1. Using two flags (or 2 syntax elements) and use them to condition the presence of some syntax elements in PH
* JVET-Q0153 aspect 2 & JVET-Q0428 option 3: Have 2 flags such to specify whether intra related syntax element is present and whether inter related syntax elements are present.
* JVET-Q0245: In addition to JVET-Q0153, define some constraints for the values of the two flags and to anticipate bitstream extration and merging cases.
* JVET-Q0176 aspect 1: Signal new syntax element mixed\_slice\_types\_in\_pic\_flag in PPS. If this flag is equal to 0, signal slice type (i.e., B / P / I) in PH.
* JVET-Q0259 aspect 1: Signal two separate flags for indication of partition constraint override.
* JVET-Q0376 aspect 2: change override flag for partitioning parameters from 1 flag to 2 flags (one of inter and one for intra).
* JVET-Q0428 has 2 options for the definition the the 2 flags (the presence of the second flag is condition upon the value of the first flag):
  + Option 1: pic\_single\_coding\_type\_flag and pic\_intra\_picture\_pred\_only\_flag.
  + Option 2: pic\_inter\_slice\_only\_flag and pic\_intra\_slice\_only\_flag
  1. Allowing dependent PH

JVET-Q0198: A dependent PH skips the signalling of some syntax elements which are inferred from the preceeding PH. A flag pps\_dependent\_pic\_header\_enabled\_flag is proposed in PPS and dependent\_pic\_header\_flag is proposed in PH.

It was agreed to have a two-flag approach. One flag that indicates the presence of intra parameters and one that indicates the presence of inter parameters. When the first flag is 0, no inter slices can be present. When the second flag is 0, no intra slices can be present. If the first flag is 0, the second flag is not present and inferred to be equal to 1. When the first flag is 0, the SH would not contain a slice\_type. This is very close to Q0428 option 2. Text will be developed and provided in a revision of Q0428. Revisit for review of that approach.

Hypothetically, a third flag could distinguish B-only and P-only from a mixture when I slices are indicated not to be present. Hypothetically, slice\_type could become a flag or be absent under relevant conditions.

JVET-Q0176 has a somewhat different proposal that enables sending slice\_type in the PH when the PPS indicates that there is only one slice type in the picture. (As originally proposed, it would not allow skipping when intra syntax elements when the picture contains a mixture of P and B slices.) Interest was not expressed by others in this sort of PPS special casing.

[Track A stopped here Thurs pm.]

1. Rearranging the ordering of syntax elements in PH (also possibly other parameter set as well)
   1. JVET-Q0481: Reordering syntax elements in PH and SPS related to intra and inter coded picture. Also, group the partition constraint syntax elements by type (intra, inter, dual-tree chroma).
2. Allowing signalling of extra bits in PH.
   1. JVET-Q0400: Add reserved extra bits to the picture header similar to extra slice header bits in HEVC. It is asserted that the proposal, however, differs from the HEVC design in that the presence of the flags in the picture header is controlled by the sequence parameter set.
3. On the gdr picture indication in PH.
   1. JVET-Q0270 aspect 1 & JVET-Q0414 Option 1: Condition gdr\_pic\_flag in picture header on gdr\_enabled\_flag in SPS such that gdr\_pic\_flag is not present and inferred to 0 when gdr\_enabled\_flag is equal to 0.
   2. JVET-Q0414 Option 2: Imposing a constraint on the value of gdr\_pic\_flag
   3. JVET-Q0154 aspect 1: Have a IRAP or GDR picture indicator at the beginning of PH.

* Option 1: irap\_or\_gdr\_pic\_flag in the beginning of PH and use it to condition the presence of gdr\_pic\_flag.
* Option 2: irap\_or\_gdr\_pic\_idc in the beginning of PH. 1 means the pic associated with the PH is IDR pic, 2 means CRA, and 3 means GDR picture. Remove gdr\_pic\_flag and condition the presence of recovery\_poc\_cnt only when irap\_gdr\_idc is equal to 3.

1. JVET-Q0154 aspect 3: Signalling slice layer NUTs as PH\_NUTs at picture header. Slice layer NUTs are replaced by SLICE\_NUT. For this piece, the following changes is proposed:
   1. If mixed\_nalu\_types\_in\_pic\_flag is equal to 1, signal irap\_gdr\_idc in PH
   2. Semantics of irap\_gdr\_idc is as follows: 0 indicates IDR\_W\_RADL picture. 1 indicates IDR\_N\_LP picture. 2 indicates CRA picture. 3 indicates GDR picture.
2. JVET-Q0154 aspect 4: Recovery picture poc count signalling for mixed mixed nal unit type pictures. Signal the recovery\_poc\_cnt at subpicture/slice level or change the definition of the gdr\_pic\_flag to include mixed nal unit type in picture that has GDR slices
3. On POC LSB signalling
   1. Move POC LSB signalling from SH to PH (JVET-Q0115 aspect 3, JVET-Q0153 aspect 1)
   2. Add POC LSB signalling in PH (JVET-Q0198 aspect 2). This is asserted to be useful to identify whether the PH is a repeated PH.
4. JVET-Q0116 aspect 2: Change PH extension mechanism to be the like the mechanism for extension of other parameter set. Note that currently it is like SH extension mechanism.
5. JVET-Q0155 aspect 1: move colour\_plane\_id to SH.
6. JVET-Q0270 aspect 2: signal an se(v) pic\_qp\_delta syntax element in the picture header and derive SliceQpY = 26 + init\_qp\_minus26 + pic\_qp\_delta + slice\_qp\_delta. The presence of pic\_qp\_delta is gated by a sps\_pic\_qp\_delta\_present\_flag syntax element signaled in SPS.

SliceQpY = 26 + init\_qp\_minus26 + pic\_qp\_delta + slice\_qp\_delta

1. JVET-Q0358: add the TemporalId constraint between the ALF\_APS NAL unit and the the picture associated with PH.
2. JVET-Q0376 aspect 1: parameters related to delta QP signaling for Inter and Intra are merged into single parameters.
3. JVET-Q0379: move the syntax elements related to the APS ID at an early stage of the Picture header and Slice header. This involves APS ID of ALF, LMCS and Scaling list. Suggested location is just after poc\_msb\_val syntax element.
4. JVET-Q0419 aspect 2: the value of slice\_type in slice\_header () could be constrained by or inferred from syntax elements signaled in PH. Note that this may be paired with JVET-Q0428
5. JVET-Q0426 aspect 5: Move mvd\_l1\_zero\_flag from the picture header to the slice header since that is only relevant for the B slice type.

[JVET-Q0115](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8940) AHG9: On AU and picture start detection [Y.-K. Wang (Bytedance)]

[JVET-Q0177](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9002) AHG9: On picture identification and PH repetition [L. Chen, C.-Y. Chen, C.-Y. Lai, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0116](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8941) AHG9: PH and SH syntax clean-ups [Z. Deng, L. Zhang, Y.-K. Wang (Bytedance)]

[JVET-Q0130](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8955) On improvement of collocated\_ref\_idx [T. Chujoh, T. Hashimoto, E. Sasaki, T. Ikai (Sharp)]

[JVET-Q0153](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8978) AHG9: On picture header [M. Coban, V. Seregin, Y.-J. Chang, M. Karczewicz (Qualcomm)]

Items 1 and 2 of this contribution belong to this category.

[JVET-Q0154](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8979) AHG9: On picture header IRAP/GDR signalling [M. Coban, V. Seregin, A. K. Ramasubramonian, Y.-J. Chang, M. Karczewicz (Qualcomm)]

[JVET-Q0155](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8980) AHG9: On separate colour plane coding [V. Seregin, B. Ray, A. K. Ramasubramonian, Y.-J. Chang, M. Coban, G. Van der Auwera, M. Karczewicz (Qualcomm)]

Item 1 of this contribution belongs to this category.

[JVET-Q0176](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9001) AHG9: Overhead reduction for picture header [S.-T. Hsiang, Y.-W. Huang, S.-M. Lei (MediaTek)]

Item 1 of this contribution belongs to this category.

[JVET-Q0198](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9023) AHG9: On picture header dependency [L. Chen, C.-Y. Chen, C.-Y. Lai, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0182](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9007) AHG9: Allowing slice-level scaling list and LMCS [C.-Y. Lai, T.-D. Chuang, O. Chubach, C.-Y. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0200](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9025) [AHG9]: On picture level and slice level tool parameters [Hendry, S. Kim, S. Lee (LGE)]

[JVET-Q0207](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9032) [AHG9]: On signalling of TMVP enabled flag and collocated reference picture [Hendry, S. Kim, J. Nam, J. Lim (LGE)]

[JVET-Q0208](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9033) [AHG9]: On TMVP collocated reference picture [Hendry (LGE)]

[JVET-Q0245](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9070) [AHG9]: On signalling slice type information in the picture header [S. Paluri, Hendry, J. Zhao, S.H. Kim (LGE)]

[JVET-Q0247](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9072) [AHG9]: Signalling the prediction weight table in the picture header [S. Paluri, Hendry, J. Zhao, S. H. Kim (LGE)]

[JVET-Q0255](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9080) AHG9: Coded Picture NAL unit [J. Samuelsson, S. Deshpande, A. Segall (Sharp)]

[JVET-Q0259](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9084) AHG9: On picture header [J. Samuelsson, S. Deshpande, A. Segall (Sharp)]

[JVET-Q0270](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9095) AHG9: On Picture Header Modifications [M. Pettersson, R. Sjöberg, M. Damghanian (Ericsson)]

[JVET-Q0358](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9183) AHG9: Constraints on ALF APS [X. Ma, H. Yang (Huawei)]

[JVET-Q0376](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9201) AhG9: Picture header refinement [G. Laroche, N. Ouedraogo, P. Onno (Canon)]

[JVET-Q0379](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9204) AhG9: On the position of APS IDs in Picture Header [G. Laroche, N. Ouedraogo, P. Onno (Canon)]

[JVET-Q0400](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9225) AHG9: On extra picture header bits in VVC [K. Sühring, R. Skupin, Y. Sanchez, T. Schierl (HHI)]

[JVET-Q0414](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9239) AHG9: A fix for GDR signalling [J. Chen, R.-L Liao, Y. Ye, J. Luo (Alibaba)]

[JVET-Q0419](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9244) AHG 9: On picture header [L. Li, B. Choi, X. Xu, X. Li, S. Wenger, S. Liu (Tencent)]

Items 1 and 2 of this contribution belong to this category.

[JVET-Q0426](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9251) AHG9: Picture header enabled flag [R. Sjöberg, M. Pettersson, M. Damghanian, D. Saffar (Ericsson)]

[JVET-Q0428](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9253) AHG 9: Picture header syntax clean-ups [X. Xu, B. Choi, L. Li, X. Li, S. Wenger, S. Liu (Tencent)]

[JVET-Q0481](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9308) AHG9: Ordering of partition constraints syntax elements in the sequence parameter set and picture header [W. Wan, B. Heng (Broadcom)]

The PH aspect of this contribution belongs to this category.

### Mixed NAL unit types within a coded picture (7)

[JVET-Q0163](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8988) AHG9: On mixed NAL unit types in a video picture [P. Wu (ZTE)]

[JVET-Q0206](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9031) AHG9: On picture with mixed NAL unit types [Hendry (LGE)]

[JVET-Q0239](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9064) AHG9: On mixed NAL unit types in a coded picture [M. M. Hannuksela (Nokia)]

[JVET-Q0261](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9086) AHG9: On mixed NAL unit types [J. Samuelsson, S. Deshpande, A. Segall (Sharp)]

[JVET-Q0284](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9109) AHG9: On mixed NAL unit type [B. Choi, S. Wenger, S. Liu (Tencent)] [late]

[JVET-Q0289](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9114) AHG9/AHG12: Comments on miscellaneous HLS text [L. Chen, C.-W. Hsu, C.-C. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

Item 2 of this contribution belongs to this category.

[JVET-Q0751](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9597) AHG9: On mixed NAL unit types [J. Samuelsson, S. Deshpande (Sharp), M. M. Hannuksela (Nokia), Hendry, S. Paluri (LGE)] [late]

[JVET-Q0396](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9221) AHG9: On mixing NAL unit types in a coded picture [R. Skupin, Y. Sanchez, K. Sühring, T. Schierl (HHI)]

### Reference picture list (RPL) signalling (2)

[JVET-Q0197](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9022) AHG9: Miscellaneous fixes for HLS in Specification [B. Wang, S. Esenlik, A. M. Kotra, H. Gao, E. Alshina (Huawei)]

[JVET-Q0217](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9042) AHG9: On Reference Picture List Information Signalling [S. Deshpande (Sharp)]

### Virtual boundary signalling (5)

[JVET-Q0181](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9006) AHG9: On signalling of virtual boundary [C.-Y. Chiu, C.-C. Chen, C.-W. Hsu, L. Chen, C.-Y. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0210](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9035) [AHG9]: Miscellaneous HLS clean-ups [Hendry, S. Paluri (LGE)]

Items 6 and 7 of this contribution belong to this category.

[JVET-Q0246](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9071) [AHG9]: On virtual boundary signalling [S. Paluri, Hendry (LGE)]

[JVET-Q0258](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9083) AHG9: On virtual boundary signalling [J. Samuelsson, S. Deshpande, A. Segall (Sharp)]

[JVET-Q0417](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9242) AHG8/AHG9: On SPS level virtual boundary [J. Chen, Y. Ye, R.-L. Liao, J. Luo (Alibaba)]

### Gradual decoding refresh (2)

[JVET-Q0527](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9357) AHG9: Gradual Decoding Refresh for VVC [L. Wang, S. Hong, K. Panusopone (Nokia)] [late]

[JVET-Q0754](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9600) Crosscheck report for JVET-Q0527 (AHG9: Gradual Decoding Refresh for VVC) [?? (??)] [late]

[JVET-Q0560](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=9406) AHG9: Gradual Decoding Refresh without Forcing Intra Area [L. Wang, S. Hong, K. Panusopone (Nokia)] [late]

[JVET-Q0755](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9601) Crosscheck report for JVET-Q0560 (AHG9: Gradual Decoding Refresh without Forcing Intra Area) [?? (??)] [late]

### Hypothetical reference decoder (HRD) (10)

[JVET-Q0743](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9589) AHG9: A summary of proposals on HRD [Y. Sanchez (HHI)] [late]

[JVET-Q0048](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8873) AHG9: On order of HRD related SEI messages [V. Drugeon (Panasonic)]

[JVET-Q0216](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9041) AHG9: On Picture Timing Information Signalling [S. Deshpande (Sharp)]

[JVET-Q0219](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9044) AHG9: On Alternative Timing Information Signalling [S. Deshpande (Sharp)]

[JVET-Q0221](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9046) AHG9: On Decoding Unit Parameters Signalling [S. Deshpande (Sharp)]

[JVET-Q0283](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9108) AHG9: On subbitstream extraction [B. Choi, S. Wenger, S. Liu (Tencent)] [late]

[JVET-Q0393](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9218) AHG9: On DU based HRD with temporal scalability [Y. Sanchez, R. Skupin, K. Sühring, T. Schierl (HHI)]

[JVET-Q0394](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9219) AHG9: On OLS extraction and scalable nesting SEI message [Y. Sanchez, R. Skupin, K. Sühring, T. Schierl (HHI)]

[JVET-Q0397](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9222) AHG12: On subpicture extraction [R. Skupin, Y. Sanchez, K. Sühring, T. Schierl (HHI)]

[JVET-Q0404](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9229) AHG12: On CBR subpicture extraction [R. Skupin, Y. Sanchez, K. Sühring, T. Schierl (HHI)]

[JVET-Q0407](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9232) AHG9: On alternative HRD timing and temporal sub-layers [Y. Sanchez, R. Skupin, K. Sühring, T. Schierl (HHI)]

### VUI and SEI (13)

[JVET-Q0042](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8867) AHG9: On Video Usability Information [V. Drugeon (Panasonic)]

[JVET-Q0159](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8984) AHG8: Indication for output picture size [V. Seregin, A. K. Ramasubramonian, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-Q0260](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9085) AHG9: Intended display resolution [J. Samuelsson, S. Deshpande, A. Segall (Sharp)]

[JVET-Q0288](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9113) AHG9: On picture output [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-Q0214](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9039) [AHG 9/AHG12] Subpicture reposition indication SEI message [Y. He, A. Hamza (InterDigital)]

[JVET-Q0234](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9059) AHG12 SEI message signalling of display region in picture for merged picture [M. Hirabayashi, M. Katsumata, T. Suzuki (Sony)]

[JVET-Q0272](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9097) AHG9: Compact Region-Wise Packing SEI message [M. Pettersson, R. Sjöberg, M. Damghanian (Ericsson)]

[JVET-Q0281](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9106) AHG12: Independently coded regions output window SEI message [B. Choi, S. Wenger, S. Liu (Tencent)] [late]

[JVET-Q0343](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9168) AHG6/AHG9: Signalling guard band type for generalized cubemap projection [Y.-H. Lee, J.-L. Lin, Y.-J. Chen, C.-C. Ju (MediaTek)]

[JVET-Q0345](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9170) AHG6/AHG9: Signalling EAP via the ERP SEI message [Y.-H. Lee, J.-L. Lin, Y.-J. Chen, C.-C. Ju (MediaTek)]

[JVET-Q0395](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9220) AHG12: On subpicture level information SEI message [R. Skupin, Y. Sanchez, K. Sühring, T. Schierl (HHI)]

[JVET-Q0443](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9269) Independent Subpictures [K. Sharman, S. Keating, A. Browne (Sony)]

Item 2 (the SEI message aspect) of this contribution belongs to this category.

[JVET-Q0488](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9315) AHG9: Bounding redundant SEI messages [W. Wan, B. Heng (Broadcom)]

## AHG12: high-level parallelism and coded picture regions (54)

### Subpictures (30)

[JVET-Q0694](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9540) AHG12: A summary of proposals on subpicture extraction [R. Skupin (HHI)] [late]

TBP.

[JVET-Q0630](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9476) AHG9: Parsing dependency for subpicture level information SEI (Ticket 775) [K. Sühring, R. Skupin, Y. Sanchez, T. Schierl (HHI)] [late]

TBP – This had accidentally been moved to transform category.

#### General and misc. subpicture aspects (10)

[JVET-Q0592](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9438) AHG12: A summary of proposals on general and misc. subpicture aspects [Y.-K. Wang (Bytedance)] [late]

This contribution was discussed Tuesday 7 January 2020 at 1400 (chaired by GJS).

This contribution provides a summary of all proposals on general and misc. subpicture aspects submitted to this JVET meeting. It is suggested that this summary is used for the reviewing of these proposals, such that the discussions can be in a more structured and efficient manner.

The summary was used to structure the notes and discussion.

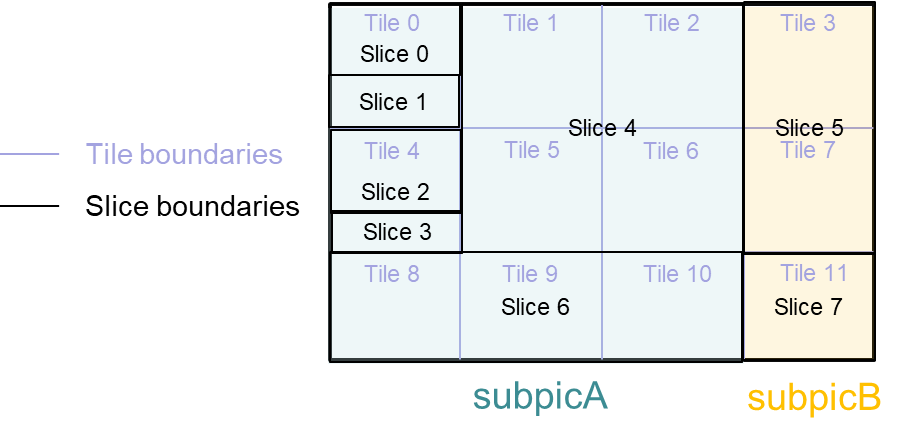
[JVET-Q0044](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8869) AHG9/AHG12: Simplification of slice index with subpictures [T. Nishi, V. Drugeon (Panasonic)]

This contribution was discussed Tuesday 7 January 2020 at 1405 (chaired by GJS).

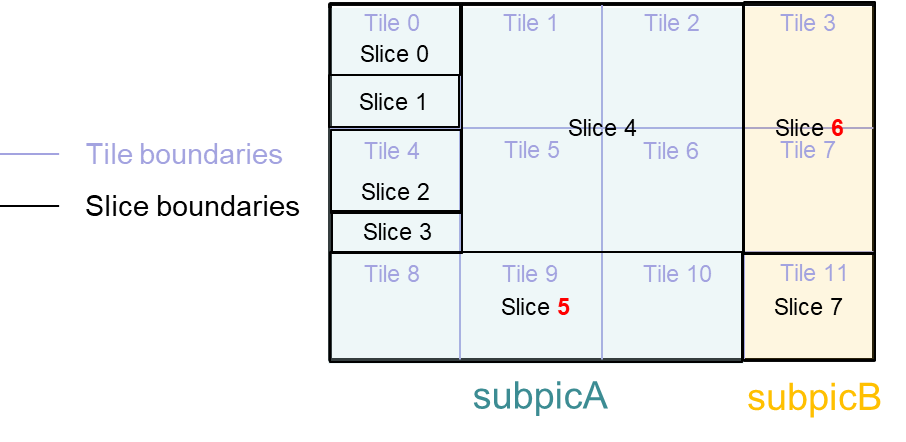
It is suggested to simplify the indexing of slices by aligning the picture level slice index to the subpicture level slice index, thereby removing the need to map the subpicture level slice index to the picture level slice index.

That means, disallow the picture-level slice index values allocated as shown in the first figure below. For the same picture partitioning (into subpictures, slices and tiles), use the picture-level slice index values as in the second figure below.

In other words, picture-level slice index values for slices within a subpicture are required to be continuous. In other words, for any two slices sliceA and sliceB belonging to different subpictures subpicA and subpicB, respectively, when the subpicture index of subpicA is less than that of subpicB, the picture-level slice index value of sliceA shall be less than that sliceB.



**Picture divided in 12 tiles, 8 slices and 2 subpictures**



**Picture divided in 12 tiles, 8 slices and 2 subpictures with slices indexed according to their decoding order**

It was commented that it is only an editorial matter what slice numbers are assigned to the slices in the text, and that the proposal does simplify the concept in the text by removing a LUT concept.

The proponent indicated that they intended for the text to also align the slice index values with the slice order, i.e., that the slice index values within each subpicture are consecutive. Decision: Adopted in principle (text to be provided and checked in a revisit).

[JVET-Q0113](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8938) AHG9/AHG8/AHG12: Some general HLS syntax clean-ups [Y.-K. Wang (Bytedance)]

Item 2 of this contribution belongs to this category.

This contribution was discussed Tuesday 7 January 2020 at 1430 (chaired by GJS).

1. Text changes for the blank clause for specifying the order of VCL NAL units and association to coded pictures and related. Besides some editorial changes for reorganization of the clauses and addition of a clause on order of PUs and their association to AUs, the proposed text changes include the following aspects:
   1. The terms picture-level slice index and subpicture-level slice index are defined, as the order of the slices within a picture and subpicture, respectively, being signalled in the PPS when rect\_slice\_flag is equal to 1. Note that the term slice index and picture-level slice index are currently used but not defined.
   2. When rect\_slice\_flag is equal to 1, the decoding order of VCL NAL units within a subpicture is specified to be in increasing order of their subpicture-level slice index values, i.e., the slice\_address values. See the notes for JVET-Q0044 for this aspect.
   3. It is required that the values of subpicture IDs are increasing in increasing order of the subpicture indices. It was commented that this constraint would harm some BEAM functionality. The draft already contains a uniqueness constraint, that the combination of slice\_subpic\_id and slice\_address shall be unique among the slices of a picture. No action was thus needed for this.
   4. When slice\_subpic\_id is not present, the value of slice\_subpic\_id is inferred to be equal to 0. The proponent indicated that, following the discussion of item c, this change is not needed.

Decision (expression of existing intent): The general editorial contribution was appreciated. The specification of the decoding order of the VCL NAL units in the picture should use the subpicture index and slice address rather than the subpicture ID and slice address.

[JVET-Q0119](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8944) AHG12: Cleanups on signalling of subpictures, tiles, and rectangular slices [Y.-K. Wang (Bytedance)]

This contribution was discussed Tuesday 7 January 2020 at 1450 (chaired by GJS).

Item 1 of this contribution belongs to this category.

1. The contribution proposes to change the coding of sps\_num\_subpics\_minus1 from u(8) to ue(v), and the value of sps\_num\_subpics\_minus1 is restricted to be in the range of 0 to Ceil( pic\_width\_max\_in\_luma\_samples ÷ CtbSizeY ) \* Ceil( pic\_height\_max\_in\_luma\_samples ÷ CtbSizeY ) − 1, inclusive.

Byte alignment is not an issue, since there is already some other variable-length syntax before it.

Aside from adding the flexibility to use larger numbers, this could save a few bits when the number of subpictures is small.

Decision (cleanup): Adopt (item 1).

It was commented that profile/level constraints are needed, regardless of the specifics of this proposal.

[JVET-Q0222](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9047) AHG12: On Subpicture Signalling [S. Deshpande (Sharp)]

This contribution was discussed Tuesday 7 January 2020 at 1500 (chaired by GJS).

Item 4 of this contribution belongs to this category.

Proposal 4: Either reserve or allow the value 255 for sps\_num\_subpics\_minus1.

This is just basically a text bug report. The specific issue is resolved by the action taken on Q0119.

[JVET-Q0157](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8982) AHG12: On motion compensation for sub-pictures [V. Seregin, Y.-J. Chang, M. Coban, M. Karczewicz (Qualcomm)]

This contribution was discussed Tuesday 7 January 2020 at 1845 (chaired by GJS).

1. To fix an asserted decoding problem of repositioned sub-pictures by considering boundaries of a reference sub-picture in the motion compensation process and TMVP derivation.

In the current text, inter prediction does not check the subpicture ID of the collocated region in the reference picture.

It was commented that it is intended that when the subpicture ID of a position in the picture changes in bitstream order, the slices of the subpicture would need to be IRAP slices, although this is not currently expressed in the text.

The proposal is to offset the position in the reference picture by the difference in position of the subpicture with the same subpicture ID. (A constraint would be needed that the reference picture must contain a subpicture with the same ID.)

It was commented that we should also think about whether the subpicture would have the same size in the reference picture.

It was commented that the proposed scheme could avoid the need for some post-decoding repositioning of the decoded regions – for example, the decoded picture could be made more spatially sensible, rather than using some post-decoding operation to rearrange the regions into a spatially sensible picture. However, another participant indicated that post-decoding rendering work is ordinarily needed anyway.

This would have an offset per subpicture for the motion compensation position calculation, which has some low-level decoding process change. The range of values of MVs could become larger than what it would otherwise be unless there is some additional constraint.

Temporal MVP would also involve considering the spatial offset relative to the corresponding position in the collocated picture.

While some participants liked the idea, we need to be very conservative about introducing changes to the low-level decoding process.

Further study of this was encouraged.

Revisit to review text of the IRAP constraint to be prepared by YKW.

1. Additionally, it is proposed to replace a current picture size with a reference picture size in the clipping (motion padding) since the reference picture may have different size than the current picture when reference picture resampling is enabled.

Decision (bug fix of existing intent): Adopt this aspect.

[JVET-Q0169](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8994) AHG9/AHG12: Bitstream conformance requirements on subpicture ID [C.-Y. Lai, C.-Y. Chen, T.-D. Chuang, O. Chubach, L. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

This contribution was discussed Tuesday 7 January 2020 at 1505 (chaired by GJS).

This contribution proposes two constraints:

1. The maximum value of subpicture ID derived by the signalled subpicture ID length shall be greater than or equal to the number of subpicture IDs.

In the discussion, it was commented that it would be better to send only the amount by which the ID length exceeds what is necessary, rather than to send the entire ID length and constrain its value to be sensible. Some participants liked this suggestion, while others said it might be more complicated to understand.

Decision (Ed.): Adopt as originally proposed. (This is not strictly necessary, since there are other constraints that prevent this problem, but it is desirable to limit the allowed range to sensible values.)

1. For each signalled subpicture ID, it shall be different from all other subpicture IDs in the same picture. Decision (Ed.): Adopt, either as a NOTE or as a requirement. (Expressing this as a requirement is not strictly necessary, since there is already an existing constraint that would require this, but it seems helpful to have it clearly expressed.)

[JVET-Q0210](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9035) [AHG9]: Miscellaneous HLS clean-ups [Hendry, S. Paluri (LGE)]

This contribution was discussed Tuesday 7 January 2020 at 1535 (chaired by GJS).

Items 1, 3, and 4 of this contribution belong to this category.

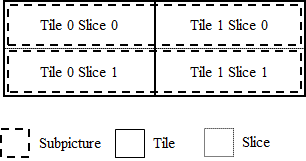
1. Prohibit rectangular slices in a tile belonging to different subpictures.

Specify a constraint as follows: When a picture is partitioned onto two or more subpictures, one or both of the following conditions shall be fulfilled for each subpicture and tile:

* 1. All CTUs in a tile belong to the same subpicture.
  2. All CTUs in a subpicture belong to the same tile.

It was discussed whether there is a real problem caused by the lack of this constraint. One use case was described in which it would be desirable to violate the constraint, which is an ERP viewport-dependent streaming (figs. D.8 and D.9 of OMAF).

The lack of this constraint involves potentially having NAL units of the same tile that not contiguous in decoding order. The scan order of CTUs within a slice is in tile scan order. Slices are ordered consecutively within a subpicture.



In the above picture, the order of slices in the bitstream is 1) tile 0 slice 0, 2) tile 1 slice 0, 3) tile 0 slice 1, then tile 1 slice 1.

Further study was encouraged to determine whether there are additional use cases in which this constraint would be desirable to violate, and to determine whether the lack of the constraint really causes a problem. The relationship of this to the subpicture level information SEI message should also be studied.

1. Specify a constraint such that when subpicture signalling is present, there shall be at least one subpicture that is an independently coded subpicture.

It was commented that this doesn’t really seem necessary. (And some subpicture characteristics may not be fully expressed within the bitstream – e.g., encoder-side MCTS referencing restrictions.) No action was taken on this.

1. Specify a constraint such that when subpicture ID is signalled in PPS or picture header, all subpictures are independently coded subpictures.

It was commented that although bitstream merging would likely be done at boundaries that are independent, some subpicture boundaries that are not at those boundaries may not need to be treated as picture boundaries. There is no clear need for the constraint, so no action was taken on this.

[JVET-Q0271](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9096) AHG9: On Subpicture Ordering [M. Damghanian, R. Sjöberg, M. Pettersson (Ericsson)]

This contribution was discussed Tuesday 7 January 2020 at 1800 (chaired by GJS).

This contribution proposes the following changes:

1. To define an independent subpicture as a subpicture for which the subpicture boundaries are treated as picture boundaries in the decoding process and no loop filtering across the subpicture boundaries is done. (Editorial)

It was commented that this does not really seem necessary (esp. since aspect #3 is not adopted), but the question can be left to the editors for consideration.

1. To add a syntax element sps\_independent\_subpics\_flag in the SPS. When equal to 1 it specifies that all subpicture boundaries in the CLVS are treated as picture boundaries and there is no loop filtering across the subpicture boundaries. subpic\_treated\_as\_pic\_flag[ i ] and loop\_filter\_across\_subpic\_enabled\_flag[ i ] are signalled only when sps\_independent\_subpics\_flag is equal to 0. (Signalling efficiency)

This is just a syntax optimization, but it would be a shortcut for a common use case. It was commented that a common example for viewport-dependent streaming uses 96 subpictures, and this would avoid the need to send 2\*96 flags.

Decision (cleanup): Adopt this aspect.

1. To specify that the subpicture availability rule applies only when sps\_independent\_subpics\_flag is equal to 0. (Functionality)

This change would allow arbitrary subpicture order in the bitstream when the subpictures are independent. Currently, subpicture order is constrained by the availability rule.

It was commented that this would impose a substantial buffering burden on decoder implementations with some architectures. Some decoders are envisioned to operate most of the decoding process in raster order. No action was taken on this.

[JVET-Q0406](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9231) AHG12: On CABAC zero words for subpictures [R. Skupin, Y. Sanchez, K. Sühring, T. Schierl (HHI)]

TBP.

This contribution asserts that subpicture extraction could result in violating the bin-to-bit ratio constraint as CABAC zero words are not associated to subpictures. Therefore, it is proposed to add a bitstream constraint for the VCL NAL units of subpictures to fulfil the bin-to-bit ratio constraint individually in addition to the picture unit level constraint when the following conditions apply:

– a subpicture has subpic\_treated\_as\_pic\_flag[ ] equal to 1.

– a subpicture level information SEI message is present in the CLVS.

[either or both?]

[JVET-Q0443](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9269) Independent Subpictures [K. Sharman, S. Keating, A. Browne (Sony)]

TBP.

Item 1 (the aspect on CABAC zero words and MinCR constraints) of this contribution belongs to this category.

Subpictures allow regions of a picture to be independently decodable, with care to handle edges of subpictures and describe the subpicture requirements at different levels via a dedicated SEI message.

1. This contribution proposes that constrains are added to subpictures so that CABAC zero words and MinCR picture level constraints are also applied at a subpicture level.

#### Subpicture layout signalling (6)

[JVET-Q0591](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9437) AHG12: A summary of proposals on subpicture layout signalling [Y.-K. Wang (Bytedance)] [late]

This contribution was discussed Tuesday 7 January 2020 at 2000 (chaired by GJS).

This contribution provides a summary of all proposals on subpicture layout signalling submitted to this JVET meeting. It is suggested that this summary is used for the reviewing of these proposals, such that the discussions can be in a more structured and efficient manner.

The proposed changes in this category were summarized as follows:

1. Modify the signalling (in the SPS) for subpicture layout by signalling the bottom-right CTU position and deriving other information needed for a subpicture (i.e., the top-left CTU position, the width, and the height). The reported bit saving is 60% for subpicture signalling. (JVET-Q0202)

This would make the signalling similar to what was previously used to identify bricks in rectangular slices. It would use a map (tileToSliceMap[ m ][ n ]) of the CTUs to derive the subpicture rectangles.

There was a similar contribution JVET-P0143 at the previous meeting. One participant commented that we should avoid needing a complicated derivation scheme. Another participant expressed a general sympathy with that type of concern. No action was thus taken on this.

1. When subpicture signalling is present but there is only one subpicture (e.g., due to extraction of a single subpicture from a larger bitstream), omit the signalling of subpicture layout and the syntax elements subpic\_treated\_as\_pic\_flag[ 0 ], and loop\_filter\_across\_subpic\_enabled\_flag[ 0 ]. (JVET-Q0210, JVET-Q0215, JVET-Q0413).

Decision (cleanup): Adopt. Hendry is responsible for the software. Revisit for text to be prepared (coordinated by Hendry).

1. Remove the following constraint: When subpics\_present\_flag is equal to 0, single\_slice\_per\_subpic\_flag shall be equal to 0, and use the flag to change some derivation equations suitably for this case. (JVET-Q0210, a similar proposal is said to be in Q0224)

It was commented (by those who wrote that sentence) that this sentence had been put into the text by mistake.

Removing the constraint would skip some unnecessary slice syntax elements by setting single\_slice\_per\_subpic\_flag equal to 1.

Decision (cleanup): Adopt. Hendry is responsible for the software. Revisit for text to be prepared (coordinated by Hendry). Editorially, it was suggested to also consider renaming the flag to make it clear that that the flag is not irrelevant when subpics\_present\_flag is equal to 0.

1. Skip the signalling and infer the top-left position for the first subpicture. (JVET-Q0215, JVET-Q0222)

The first one is required to be the top-left one by the availability constraint.

Decision (cleanup): Adopt. S. Deshpande is responsible for the software. Text is in Q0222.

1. Skip the signalling and infer the size of the last subpicture. (JVET-Q0215, JVET-Q0222, JVET-Q0413)

Decision (cleanup): Adopt. S. Deshpande is responsible for the software. Text is in Q0222 (alternative text is in Q0413, and the proponents will check offline whether that is editorially better).

1. Skip the signalling and infer the upper-left corner of the last subpicture position (JVET-Q0215)

Text was not provided for this. It was commented that the text might not be so straightforward. Revisit for review of candidate text.

1. Remove subpicture signalling from SPS, and signal subpicture layout in PPS based on the layout of rectangular slices instead. (JVET-P0475)

The motivation for this would be alignment of the signalling of subpicture layout with slice structure, since slices are a partitioning of subpictures. It was commented that the subpicture structure is required to be constant for a CLVS; with this proposal, that property would need to be achieved by a constraint on the PPS-level syntax. With the current scheme, that constraint cannot be violated.

It was remarked that if multiple PPSs are used in the bitstream, this would require repeating the identical subpicture map information in all of them.

No action was taken on this.

[JVET-Q0202](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9027) [AHG12]: On signalling of subpicture and rectangular slice [Hendry, S. Paluri (LGE)]

The subpicture layout signalling part of this contribution belongs to this category.

[JVET-Q0210](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9035) [AHG9]: Miscellaneous HLS clean-ups [Hendry, S. Paluri (LGE)]

Items 2 and 5 of this contribution belong to this category.

[JVET-Q0215](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9040) AHG9/AHG12: Comments on signalling subpicture layout [L. Chen, C.-C. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0222](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9047) AHG12: On Subpicture Signalling [S. Deshpande (Sharp)]

Items 1-2 of this contribution belong to this category.

[JVET-Q0413](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9238) AHG9/AHG12: On subpicture partitioning signaling [J. Chen, R.-L. Liao, Y. Ye, J. Luo (Alibaba)]

[JVET-Q0475](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9301) [AHG9/AHG12] On subpicture signaling [Y. He, A. Hamza (InterDigital)]

Items 1 and 2 of this contribution belong to this category.

#### Subpicture ID signalling (9)

[JVET-Q0590](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9436) AHG12: A summary of proposals on subpicture ID signalling [Y.-K. Wang (Bytedance)] [late]

This contribution was discussed Tuesday 7 January 2020 at 2145 (chaired by GJS).

This contribution provides a summary of all proposals on subpicture ID signalling submitted to this JVET meeting. It is suggested that this summary is used for the reviewing of these proposals, such that the discussions can be in a more structured and efficient manner.

1. When subpics\_present\_flag is equal to 0, i.e., there is no subpicture layout informaton signalled and no subpicture ID signalled in SHs, the current draft allows subpicture ID mapping to be explicitly signalled in the SPS/PPS/PH. A subpicture map can be sent even when there are no subpicture IDs in the slice headers, which doesn’t make sense. Proposals to fix this bug are:
   1. Condition slice\_subpic\_id on "if( subpics\_present\_flag  | |  sps\_subpic\_id\_present\_flag )"? (JVET-Q0222)
   2. Condition sps\_subpic\_id\_present\_flag on "if( subpics\_present\_flag )" and infer the value of sps\_subpic\_id\_present\_flag to be equal to 0 when it is not present. (JVET-Q0119, JVET-Q0290, JVET-Q0222)
   3. Constrain the value of sps\_subpic\_id\_present\_flag to be equal to 0 when subpics\_present\_flag is equal to 0.

Decision (BF): Adopt approach “b”. Y.-K. Wang is responsible for the software. Text is in Q0119.

1. Remove signalling of the subpicture ID mapping from PH? (JVET-Q0119)

If the mapping is in the PH, then subpicture-based extraction would have to change PHs.

Decision (cleanup): Adopt. Y.-K. Wang is responsible for the software. Text is in Q0119 (but may need separation from other proposed changes).

1. There is a bug in the text where SubpicIdList[ i ] is used without being defined in some cases. Proposals to fix this bug are:
   1. Require signalling in the SPS or PPS when sps\_subpic\_id\_present\_flag is equal to 1. (JVET-Q0119, JVET-Q0222, JVET-Q0375, JVET-Q0412)
   2. Infer a value for pps\_subpic\_id[ i ] when sps\_subpic\_id\_present\_flag is equal to 1 but the subpicture ID mapping is not signalled in SPS, PPS or PH. This is said to be what the software does. (JVET-Q0412)

It was remarked that approach b is not especially useful since it is just a description of what happens when sps\_subpic\_id\_present\_flag is equal to 0, saying that sps\_subpic\_id\_present\_flag equal to 1 was intended to indicate that explicit signalling was present. There was discussion of whether this remark was correct or not.

This was further discussed in Track A Wednesday 8 January 2020 at 1935 (chaired by GJS).

A difference between the two described cases was pointed out, which was that the SPS applies more globally than the PPS. In approach b, it would be possible to have the inference switched on and off at the PPS level. There was further discussion of whether this ability to switch inference on and off at the PPS level is useful or not, and there was no clear use case that was described for this switching. Another participant commented that a presence flag would ordinarily be expected to mean that something is actually present rather than that it might be present. Other than the proponent of approach b, participants preferred approach a. Decision (BF): Adopt approach a. The text change is trivial, and can be found in Q0119 and in the other proposals of approach a. There is no necessary software impact, since this is just a conformance requirement that is not violated by the current software. Y.-K. Wang is responsible for any potential software work for this, such as adding a decoder-side conformance check.

The next aspect was discussed in Track A Wednesday 8 January 2020 at 1920 (chaired by GJS).

1. There is a bug in the current text. When subpicture IDs are not explicitly signalled, the slice header syntax element slice\_subpic\_id still needs to be signalled as long as subpics\_present\_flag is equal to 1, including when sps\_num\_subpics\_minus1 is equal to 0. However, subpicture IDs are not explicitly signalled, the subpicture length is not explicitly signalled, either, and the length of slice\_subpic\_id is currently specified as Ceil( Log2 ( sps\_num\_subpics\_minus1 + 1 ) ) bits, which has two issues. The first issue is that the length would be 0 bits when sps\_num\_subpics\_minus1 is equal to 0. The second issue is that, when the original bitstream of the CLVS has subpics\_present\_flag equal to 1 and sps\_num\_subpics\_minus1 greater than 0, when the subpicture ID length is not explicitliy signalled, extraction of a subset of the subpictures would require changing of the slice headers. To fix these problems, it is proposed that when subpics\_present\_flag is equal to 1, the subpicture ID length would be explicitly signalled in the SPS regardless of whether subpicture IDs are explicitly signalled, and the length of slice\_subpic\_id is always specified by that length. (JVET-Q0119)

Decision (BF): Adopt. Y.-K. Wang is responsible for the software. Text is in Q0119 (but may need separation from other proposed changes).

Remaining aspects were discussed in Track A Wednesday 8 January 2020 at 2010 (chaired by GJS).

1. It is proposed to restrict explicit subpicture ID signalling to the case where all signalled subpictures are treated as pictures. (JVET-Q0152)

Arguing against this proposal, a participant suggested a use case where parts of the picture consist of one or more extractable subpictures or extractable groups of subpictures but other parts of the picture are not intended to be extractable by themselves. The extractable subpictures would treat their boundaries as picture boundaries but the other subpictures would not. Only the extractable subpictures would be used for BEAM operations.

It was also commented that extractability can be achieved by encoder referencing restrictions without treating subpicture boundaries as picture boundaries, and the restriction would not allow sending subpicture ID for such a usage.

No action was taken on this aspect.

1. It is proposed to do something to allow different CLVSs referring to the same SPS to have different subpicture information, including subpicture ID mappings, such that subpicture ID mapping redundancy can be avoided/reduced. Two approaches for enabling this were proposed. (JVET-Q0213)
   1. Variation 1: Signal subpicture sets in SPS, in which each subpicture set would identify a number of subpictures applying to a CLVS of the CVS referring to the SPS. (JVET-Q0213)
   2. Variation 2: Signal the subpicture ID mapping for those subpictures in a coded picture associated with the PPS and/or PH. (JVET-Q0213)

After discussion, a problem was identified in variation 1. Variation 2 was not understood. It was suggested for offline discussion to be held and to revisit if needed.

1. It is proposed to replace the sps\_subpic\_id\_present\_flag with a new flag indicating whether to describe subpicture ID mapping in SPS. (JVET-Q0235)

There was a missing constraint or inference bug in the proposed semantics. If that bug is fixed, this has the same syntax and the same functionality as item 3 option a, which was agreed previously in the meeting. It would have different semantics, using different flag combinations for indicating particular cases. It would signal two flags in the SPS to indicate implicit subpicture ID mapping, while the other approach would use one flag in that case. It otherwise seems the same. After discussion, item 3 option a was (very slightly) preferred and seemed to have better draft text, so no action was taken on this.

1. It is proposed to signal, in each APS, the list of the subpicture IDs of subpictures that reference that APS. This information would be used by the decoder to distinguish between APSs that have the same APS ID, and could also be used by an extractor to identify APSs that can be discarded when performing an extraction. (JVET-Q0285)

The signalling of the list would be optional. Subpictures that have subpicture IDs that are not found in any signalled list would use the APS that does not contain a list.

There was discussion of whether this list would just be metadata or would be used in the decoding process, and the proposal did use the data in the decoding process, to establish a different value space for APSs with the same APS type and the same APS ID. It was commented that the decoder-side identification aspect would conflict with the prior intent of how APSs would be identified, adding extra decoder-side operations to identify the APS to be applied during the decoding process. It was commented that we would already expect encoding to be operated in a sufficiently coordinated fashion that clashes of APS ID values would be prevented in the original encoding process.

It was commented that if the decoder aspect is removed so that the list just becomes metadata, then it is not appropriate to put this in the APS, since it could be carried in some other way, such as an SEI message.

No action was taken on this. It was remarked that further study might develop an alternate approach such as carrying such information in SEI messages.

[JVET-Q0119](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8944) AHG12: Cleanups on signalling of subpictures, tiles, and rectangular slices [Y.-K. Wang (Bytedance)]

Items 2-5 of this contribution belong to this category.

[JVET-Q0290](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9115) AHG9/AHG12: Modifications related to subpicture signalling and RPR [S.-T. Hsiang, C.-Y. Chen, T.-D. Chuang, L. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

Item 3 of this contribution belongs to this category.

[JVET-Q0152](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8977) AHG9/AHG12: Miscellaneous HLS topics [M. Coban, V. Seregin, Y.-J. Chang, M. Karczewicz (Qualcomm)]

Item 1 of this contribution belongs to this category.

[JVET-Q0213](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9038) [AHG9/AGH12] On subpicture ID mapping signaling [Y. He, A. Hamza (InterDigital)]

[JVET-Q0222](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9047) AHG12: On Subpicture Signalling [S. Deshpande (Sharp)]

Item 3 and 5 of this contribution belong to this category.

[JVET-Q0235](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9060) AHG12 Simplifying the nesting condition of subpicIdList[i] [M. Hirabayashi, M. Katsumata, T. Suzuki (Sony)]

[JVET-Q0285](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9110) AHG9: On adaptation parameter set ID [B. Choi, S. Wenger, S. Liu (Tencent)] [late]

Item 1 of this contribution belongs to this category.

[JVET-Q0375](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9200) AHG9: A cleanup on the signalling of subpicture IDs [D. Kim, G. Ko, J. Jung, J. Son, J. Kwak (WILUS)]

[JVET-Q0412](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9237) AHG9/AHG12: A syntax and semantics fix for subpicture ID mapping [J. Chen, R.-L. Liao, Y. Ye, J. Luo (Alibaba)]

#### Subpicture based bitstream merging (5)

[JVET-Q0233](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9058) AHG17 Signalling subpicture without slice for merged and other use cases [M. Hirabayashi, M. Katsumata, T. Suzuki (Sony)]

[JVET-Q0401](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9226) AHG9/AHG12: On bitstream merging [R. Skupin, Y. Sanchez, K. Sühring, T. Schierl (HHI)]

[JVET-Q0409](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9234) AHG12: On APS id for bitstream merging for VVC [N. Ouedraogo, E. Nassor, F. Denoual, F. Mazé (Canon)]

[JVET-Q0410](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9235) AHG12: Bitstream merging with variable initial Qp [N. Ouedraogo, E. Nassor, G. Kergourlay, F. Mazé (Canon)]

[JVET-Q0411](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9236) AHG12: On Subpictures merging for VVC [N. Ouedraogo, F. Denoual, F. Mazé (Canon)]

### Slices and tiles (19)

#### General

[JVET-Q0586](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9432) AHG9/AHG12: A summary of HLS contributions on tiles and slices [Hendry (LGE)] [late]

This contribution was discussed in Track A Wednesday 8 January 2020 at 2200 (chaired by GJS).

This contribution is an information contribution summarizing contributions on tiles and slices.

*On tiles*:

1. JVET-Q0244 aspect #1: signal a flag in the PPS to specify whether the widths of the tile columns are the same as the heights of the tile rows, with an exception for the last column and last row. If true, tile row information can be derived from tile column information.

It was commented that this is a high degree of customization for a very specialized use, motivated by bit savings at the PPS level and that the bit savings would likely not be very large. No action was taken on this.

1. JVET-Q0244 aspect 6: Proposed fixes for out of bound bugs in the derivation of CtbToTileColBd[ ] and CtbToTileRowBd[ ]. The proposed fixes are shown below:

The list CtbToTileColBd[ ctbAddrX ] for ctbAddrX ranging from 0 to PicWidthInCtbsY − 1, inclusive, specifying the conversion from a horizontal CTB address to a left tile column boundary in units of CTBs, is derived as follows:

tileX = 0  
for( ctbAddrX = 0; ctbAddrX < PicWidthInCtbsY; ctbAddrX++ ) {  
 if( tileX < NumTileColumns – 1 && ctbAddrX = = tileColBd[ tileX + 1 ] ) (27)  
 tileX++  
 CtbToTileColBd[ ctbAddrX ] = tileColBd[ tileX ]  
}

The list CtbToTileRowBd[ ctbAddrY ] for ctbAddrY ranging from 0 to PicHeightInCtbsY − 1, inclusive, specifying the conversion from a vertical CTB address to a top tile column boundary in units of CTBs, is derived as follows:

tileY = 0  
for( ctbAddrY = 0; ctbAddrY < PicHeightInCtbsY; ctbAddrY++ ) {  
 if( tileY < NumTileRows – 1 && ctbAddrY = = tileRowBd[ tileY + 1 ] ) (28)  
 tileY++  
 CtbToTileRowBd[ ctbAddrY ] = tileRowBd[ tileY ]  
}

Decision (BF): Adopted.

1. JVET-Q0359 aspect 1: proposes a constraint that the syntax shall not indicate a sum of tile widths/heights that is wider than the picture width/height.

Decision (editorial BF): Adopted. The editors are given discretion to finalize how this is expressed. It was suggested to express this as a constraint on the value range of the width and height syntax elements rather than as a constraint on the sum.

1. JVET-Q0359 aspect 2: Add the following: for i in the range of 0 to num\_slices\_in\_pic\_minus1-1, inclusive , the sum of tile\_idx\_delta[ i ] shall less than NumTilesInPic.

This proposed change was not necessary because of existing constraints expressed on syntax elements in the text, so no action was needed on this.

*On rectangular slices containing one or more tile*

This contribution was further discussed in Track A Thursday 9 January 2020 at 0810 (chaired by GJS).

1. Rectangular slice layout signalling:
   1. Keep the current signalling method (i.e., signalling slice width, slice height, and tile idx delta). If we do this, we’ll need to consider all proposed miscellaneous changes in the next list below.
   2. Go back to previous signalling method such as for each rectangular slice, signal only the information about the bottom-right tile index (JVET-Q0202). If we do this, we can skip discussing most proposed improvements in the next list below below, except item h.

The subpicture aspect of this proposal was discussed earlier in the meeting with no action. Due to a need for consistency in the signalling schemes, no action was taken on this.

1. Proposed additional features for rectangular slices:
   1. Allow the possibility to define rectangular slice in PPS based on CTU height. This is asserted will allow defining rectangular slice within subpicture without tiles (JVET-Q0164).

A participant commented that the current scheme can do essentially what is proposed, although it is not customized to be especially efficient in that case.

With the current scheme, vertical slice boundaries must be tile boundaries. (What about single\_slice\_per\_subpic\_flag? Revisit after double-checking that – it was commented that the design intent was to not have vertical cuts within a tile in that case either. That flag was just proposed as a signalling shortcut – not with an intent to provide alternative functionality. See the definition of *slice* in the text for an expression of this.)

It is not allowed to have vertical subpicture boundaries within a tile.

The contributor agreed that this proposal was not mature for action at this meeting, because it would pose implementation difficulties as proposed. However, the contributor wanted to raise awareness of the limitation in the design, such that the current scheme requires the use of tiles to achieve some subpicture layouts.

There is a current specified limit on the number of tile cuts as a function of level (Annex A), for example HD 60 fps would ordinarily use level 4, in which there is a limit of 5 tiles vertically and 5 tiles horizontally. It was asked whether, if vertical boundaries are the primary problem, why not allow more horizontal cuts than vertical cuts? There should be additional study to check that. It was commented that not a lot of thought went into whether the numbers that were put into the draft were appropriate in the VVC context, as they came from HEVC.

* 1. To have a signalling shortcut single\_tile\_per\_slice\_flag in the PPS and use it to condition further signalling of syntax elements in the PPS related to rectangular slices. Also to condition the presence of single\_tile\_per\_slice\_flag on the value of single\_slice\_per\_subpic\_flag (JVET-Q0204, JVET-Q218 aspect 2, and JVET-Q0289 aspect 1)

It was commented that we already have a shortcut for a single slice per subpicture. This proposed flag would be for when that does not apply. For example, when there are tiles but there are no subpictures, and each tile is a slice. A potential use case that was mentioned was ultra-low-delay using tiles. Using raster scan slices with one tile per slice was suggested as the more likely approach for this.

It was not clear that this is needed for a common use case. There was also a concern that adding another special case complicates the scheme for determining the segmentations. No action was thus taken.

* + 1. loop\_filter\_across\_tiles\_enabled\_flag is proposed to not be present when the value of single\_tile\_per\_slice\_flag is equal to 1 (JVET-Q0289 aspect 1)

No action was taken on this since there was no action on the above item.

* 1. Replace num\_slice\_in\_pic\_minus1 with num\_slice\_in\_subpic\_minus1[ i ] (JVET-Q0377 aspect 1).

This would be a change in the PPS, based on information from the SPS. A revision of the proposal fixed the parsing dependency by ensuring that the number of subpictures is available in the PPS for use by this signal.

This is one part of a larger proposal that also includes another item below. See the notes on the aspect 2 of JVET-Q0377.

1. Misc proposed changes for rectangular slice signalling:
   1. Condition the presence of tile\_idx\_delta\_present\_flag on the value of num\_slices\_in\_pic\_minus1. It is asserted that tile\_idx\_delta\_present\_flag is not necessary to be present when the value of num\_slices\_in\_pic\_minus1 is equal to 0 (JVET-Q0218 aspect 1).

This is just a syntax table presence conditioning for a case where a flag is not relevant.

Decision (cleanup): Adopt. Text is in the proposal document (proposal #1).

* 1. Add inference value for single\_slice\_per\_subpic\_flag when not present to be equal to 0. This is asserted to be needed since the flag is used in the conditioning of syntax elements in PPS and also in the derivation of CTB raster scanning, tile scanning, and subpicture scanning processes. (JVET-Q0218 aspect 3).

This is just a little spec bug fix for the sake of making sure that anything that is referred to has a value. It may not be really necessary but is desirable for the sake of completeness, so that there is a defined value for anything that is checked in any “if” statement, regardless of whether its value matters or not.

Decision (Ed. BF): Adopt. Text is in the proposal document (proposal #3).

* 1. Replace tile\_idx\_delta[ i ] with tile\_idx\_delta\_minus1[ i ] and tile\_idx\_delta\_sign[ i ]. tile\_idx\_delta\_sign[ i ] is not present for the first slice (JVET-Q0228 aspect 1).

This is just an alternative to se(v) coding that complicates the syntax table and doesn’t seem necessary, so no action was taken on this.

* 1. Signal the following two new flags (JVET-Q0230):
* multiple\_slice\_in\_tile\_present\_flag to indicate whether at least one tile is composed of more than slice or not
* multiple\_slice\_in\_tile\_flag[ i ] to indicates whether a tile is composed of more than one slice or not.

This would be a syntax shortcut. The proponent said it would save about 17 bits per PPS in an example OMAF use case. It was commented that this seems like over-optimization with additional checks for a very specialized case, and that bit savings in the PPS is not especially high priority. So no action was taken on this.

* 1. Signal a flag for each rectangular slice in the picture to indicate if the slice height in tiles is the same as the slice width in tiles. If this flag is false, then the slice height would explicitly signalled (JVET-Q0244 aspect 2).

This would be a syntax shortcut for a special case that doesn’t seem important to optimize for. No action was taken on this.

* 1. Signal rectangular slice width in tiles only when number of tile column is greater than 1; likewise, signal rectangular slice height only when the number of tile row is greater than 1 (JVET-Q0244 aspect 3).

This is a typical logic flow adjustment to avoid sending something that is required to have a specific value. Decision (cleanup): Adopt. Text in JVET-Q0244 aspect 3 and software responsibility to be from its proponent.

* 1. Remove the second condition that guards the presence of tile\_idx\_delta[ i ] (i.e., i < num\_slices\_in\_pic\_minus1) is not really needed as it is always true anyway (JVET-Q0244 aspect 5).

After some offline discussion, this was withdrawn as not valid.

* 1. Replace the signalling of the number of slices in picture with the signalling of the delta between the number of subpictures in picture and the number of slices in picture. Instead of num\_slices\_in\_pic\_minus1, signal num\_slices\_in\_pic\_minus\_num\_subpics (JVET-Q0332).

The proposal had a parsing dependency bug, and was revised to fix the bug. The fix would involve moving pps\_num\_subpics\_minus1 outside of a condition check, which would not provide a bit savings (and would likely have a bit penalty) in the case where pps\_num\_subpics\_minus1 would not have been sent (since sending *a* and *b* tends to require sending more bits than sending *a+b*). This didn’t seem to be substantially beneficial, so no action was taken on it.

* 1. Propose that when in raster rectangular slice mode (tile\_idx\_delta\_present\_flag equals 0), only specify the slice\_height\_in\_tiles\_minus1 syntax element at the start of each rectangular slice row. If it is asserted that this would prevent possibility to signal a slice height that is illegal (JVET-Q0480)

It was asked whether the current design allows rectangular slices that have a decreasing height within a row. There are two modes of signalling rectangular slices based on the tile\_idx\_delta\_present\_flag; this contribution deals with the shortcut case when that flag is 0. In that shortcut case, it is not possible to have this behaviour.

This proposal is a typical logic flow adjustment to avoid sending something that is required to have a specific value and to more clearly define when the shortcut case can be used.

Decision (BF & cleanup): Adopt. Text in JVET-Q0480 (needing an editorial adjustment to not set a syntax element to a value in an equation) and software responsibility to be from its proponent.

* 1. Editorial changes for semantics of tile\_idx\_delta[ i ] and num\_tiles\_in\_slice\_minus1 (JVET-Q0289 aspect 3).

Decision (Ed.): The first aspect is editorial and was delegated to the editors for consideration.

The second part of this (an inference) is only really needed if it is possible to have a raster scan slice when no\_pic\_partition\_flag is equal to 0 but there is only one tile. It was remarked that there is a ticket about this case and there had been email reflector discussion. It was agreed that this combination should not be supported, since the intent is that rectangular slice mode should be used instead in this case.

Decision (BF): If NumTilesInPic is equal to 1, don’t signal the rect\_slice\_flag and infer its value to be 1. Text and software (which are minor) to be provided by Ye-Kui Wang.

*On rectangular slices within a tile*

1. Remove signalling of slices within a tile. It is asserted initial concept of “tile-fraction” slices targets bitstream extraction and merging operations for omnidirectional content for which subpictures where adopted in VVC (JVET-Q0377 aspect 2).

If we do this, we would not need to discuss the proposed items 2 and 3 below.

Currently SPS defines the subpicture layout, PPS defines the slice layout, with semantics constraint so that each subpicture contains a number of complete slices. (The slice address specifies the slice index within the subpicture.)

This contribution proposes to change the syntax so that, rather being a matter of semantics constraint, it would not be possible to express a violation of that semantics constraint. Instead, the PPS syntax would have a loop on the number of subpictures, and then describe the slices as a subset of each subpicture.

The relationship to Q0044 was discussed. A participant said that this proposal would be helpful as syntax cleanup, but that the action taken on Q0044 already accomplishes that goal, so this proposal becomes appropriate only if some additional allowed cases are desirable to prohibit by syntax design.

* A side effect of the proposal is that it would not be possible to have a subpicture that contains multiple incomplete tiles – i.e., it would enforce the constraint proposed in item 1 of Q0210.
* A second side effect is that it would not be possible to have a subpicture that is a subset of a tile to contain multiple slices.

It was commented that if a constraint is imposed by syntax rather than semantics, it would not be possible to use profiling to enable or disable the constraint.

The second side effect was considered more serious than the first one. Some participants objected to the proposal, saying there are some scenarios where it would be desirable to use the disallowed combination. Thus, no action was taken on this.

1. In the PPS, for signalling of slices within a tile, instead of signalling all the slice heights, except for the last slice in that tile, signal explicit slice height, which may be less than the number of slices within that tile minus 1, and the height of the rest of slices in that tile is derived (JVET-Q0203, JVET-Q0228 aspect 2, and JVET-Q0373 aspect 3).

This is a syntax modification to establish a shortcut for slice structure signalling (in the PPS) that is similar to a shortcut used for tile structure signalling (also in the PPS). This would improve design consistency.

Decision (cleanup): Adopt based on text for Q0203. Hendry responsible for software.

1. Signal the number of rectangular slices in a tile only when the number of CTU rows within the tile is greater than 1 (JVET-Q0244 aspect 4 and JVET-Q0373 aspect 2).

This is consistent with the idea of not signalling things that are required to have a specific value.

Decision (cleanup): Adopt based on text for Q0244. Hendry responsible for software.

1. Propose to infer the syntax element of slice\_height\_in\_ctu\_minus1 as value of 0 when the corresponding tile’s height is the same as the number of slice in the tile in the unit of CTU (JVET-Q0373 aspect 1). This was no longer needed due to the action on item 2 above.

*On other aspects of slices*

1. JVET-Q0119 aspect 6: When rect\_slice\_flag is equal to 1, the length of slice\_address is specified to be Max( Ceil( Log2( NumSlicesInSubpic[ SubPicIdx ] ) ), 1 ) bits, as opposed to be Ceil( Log2( NumSlicesInSubpic[ SubPicIdx ] ) ) bits. This is a bug fix proposal.

Decision (cleanup): Instead, condition the presence of the slice\_address on NumSlicesInSubpic[ SubPicIdx ] being greater than 1 (in addition to the other presence conditions). Ye-Kui Wang responsible for text and software.

1. The following may need to be discussed (See summary for each contribution in section 5):
   1. JVET-Q0201: Asserted that there are some problems with slice\_data signalling and proposes fixes for them

It was commented that the three proposed bug reports may not be valid, so it was agreed not to take action unless offline study indicates otherwise.

* 1. JVET-Q0223: Proposes having dependent slices.

The motivation for having dependent slices is to have a fragmentation of a slice into multiple NAL units (at a coding-level feature, rather than depending on system-level fragmentation), primarily for delay optimization (so the encoder can send a NAL unit without first generating the data for the remaining CTUs), without breaking prediction processes.

The proposal did not provide complete text.

It was commented that the picture header can be used to reduce the overhead of slice headers, which is somewhat similar to the abbreviated slice header design used in dependent slices.

In addition to saving header overhead, dependent slice segments (in HEVC) do not reset decoder state and have prediction processes that can cross slice segment boundaries. This has a coding efficiency benefit relative to using separate slices.

Each slice segment is proposed to be composed of an integer number of tiles. It was pointed out that prediction across tile boundaries is not allowed, so the claimed coding efficiency benefit is not really provided.

The slice segment header would say how many tiles of the slice are in the slice segment.

The proposed syntax includes indicating in the slice header the number of dependent slices. It was commented that this may be undesirable as it may not have been been determined in advance.

Since this was a large proposed change and the proposal was incomplete and had readily apparent problems in its design and claimed benefits, no action was taken on this.

* 1. JVET-Q0224 & JVET-Q0225: Allow CTU-based raster-scan slices, in addition to tile-based raster-scan slice.

Text for the decoding process was not provided. Since this was a large proposed change and the proposal was incomplete, no action was taken on this.

#### Tile and rectangular slice signalling in the PPS (14)

[JVET-Q0164](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8989) AHG9: On indication of rectangular slice height in video subpictures [P. Wu (ZTE)]

[JVET-Q0202](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9027) [AHG12]: On signalling of subpicture and rectangular slice [Hendry, S. Paluri (LGE)]

The rectangular slice signalling part of this contribution belongs to this category.

[JVET-Q0203](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9028) [AHG12]: On signalling of multiple rectangular slices in a tile [Hendry, S. Paluri (LGE)]

[JVET-Q0204](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9029) [AHG12]: On single tile per slice flag [Hendry, S. Paluri (LGE)]

[JVET-Q0218](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9043) AHG12/ AHG9: On Slice Signalling [S. Deshpande (Sharp)]

[JVET-Q0228](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9053) AHG12: Signalling of rectangular slices [B.-K. Lee (Xris), D. Jun (Kyungnam University)]

[JVET-Q0230](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9055) AHG12: Signalling of multiple slices in a tile [B.-K. Lee (Xris), D Jun (Kyungnam University)]

[JVET-Q0244](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9069) [AHG12]: Misc improvements to tile and rectangular slice signalling [S. Paluri, Hendry (LGE)]

[JVET-Q0289](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9114) AHG9/AHG12: Comments on miscellaneous HLS text [L. Chen, C.-W. Hsu, C.-C. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

Items 1 and 3 of this contribution belong to this category.

[JVET-Q0332](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9157) AhG12: On the numbers of slices and subpictures [Y.-J. Chang, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-Q0359](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9184) AHG12: Constraints on tile signaling [X. Ma, H. Yang (Huawei)]

[JVET-Q0373](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9198) AHG12: On signalling of slice [J. H. Do, Y.-U. Yoon, D. H. Park, J.-G. Kim (KAU)]

[JVET-Q0377](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9202) AHG12: On "tile-fraction" slices and signaling of slices per subpicture [N. Ouedraogo, G. Laroche, P. Onno (Canon)]

[JVET-Q0480](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9307) AHG9: A More Robust Syntax for Raster Rectangular Slices [W. Wan, T. Hellman, B. Heng (Broadcom)]

#### Other aspects of slices (5)

[JVET-Q0119](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8944) AHG12: Cleanups on signalling of subpictures, tiles, and rectangular slices [Y.-K. Wang (Bytedance)]

Item 6 of this contribution belongs to this category.

[JVET-Q0201](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9026) [AHG12]: On slice data signalling [Hendry, S. Paluri (LGE)]

[JVET-Q0223](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9048) AHG9/AHG12: On dependent slice and slice header [L. Chen, C.-C. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0224](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9049) AHG9/AHG12: On raster scan slice within a picture [L. Chen, C.-C. Chen, C.-W. Hsu, Y.-L. Hsiao, Y.-W. Huang, S.-M. Lei (MediaTek)]

See also the notes for Q0210 aspect #5 (section 6.20.1.2) for one aspect of this contribution.

[JVET-Q0579](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9425) Crosscheck report of JVET-Q0224 [X. Xu (Tencent)] [late]

[JVET-Q0225](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9050) AHG9/AHG12: On raster scan slice within a tile [L. Chen, C.-C. Chen, C.-W. Hsu, Y.-L. Hsiao, Y.-W. Huang, S.-M. Lei (MediaTek)]

### Control of loop filtering across subpicture/tile/slice boundaries (4)

See also

[JVET-Q0120](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8945) AHG12: Control of loop filtering across subpicture/tile/slice boundaries [L. Zhang, Y.-K. Wang, K. Zhang (Bytedance)]

[JVET-Q0317](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9142) AHG9: A cleanup on de-blocking filtering between subpictures [K. Zhang, L. Zhang, Y.-K. Wang, H. Liu, J. Xu, Z. Deng (Bytedance)]

This includes some changes to the deblocking filtering process.

[JVET-Q0352](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9177) AHG9/AHG12: On subpicture boundary [H. Jang, J. Nam, N. Park, S. Kim, J. Lim (LGE)]

Item 1 of this contribution belongs to this category.

[JVET-Q0475](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9301) [AHG9/AHG12] On subpicture signaling [Y. He, A. Hamza (InterDigital)]

Item 3 of this contribution belongs to this category.

### Tile/WPP entry point offset signalling (2)

[JVET-Q0151](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8976) AHG12: On entry point offset signalling [M. Coban, Y.-J. Chang, V. Seregin, A. K. Ramasubramonian, M. Karczewicz (Qualcomm)]

[JVET-Q0205](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9030) [AHG12]: On the presence of entry point signalling [Hendry, S. Kim, S. Lee (LGE)]

## AHG8: layered coding and resolution adaptivity (19)

### Scalability specific HLS (19)

#### VPS scalability information signalling (5)

[JVET-Q0046](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8871) AHG9: On signalling of PTL/HRD parameters for single layer OLSs and DPB parameters for independent layers [T. Nishi, K. Abe, V. Drugeon (Panasonic)]

[JVET-Q0047](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8872) AHG9: Unified signalling of PTL and HRD parameters in VPS [T. Nishi, K. Abe, V. Drugeon (Panasonic)]

[JVET-Q0118](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8943) AHG8/AHG9: Scalability HLS clean-ups [Y.-K. Wang (Bytedance)]

[JVET-Q0122](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8947) AHG9/AHG8: Some HRD clean-ups [Y.-K. Wang (Bytedance)]

[JVET-Q0220](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9045) AHG8/ AHG9: On VPS and Output Layer Set Signalling [S. Deshpande (Sharp)]

#### DPB operation for multi-layer OLSs (2)

[JVET-Q0158](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8983) AHG8: Clarification on DPB structure and picture output [V. Seregin, A. K. Ramasubramonian, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-Q0308](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9133) [AHG9]: On DPB parameter for output layer set [Hendry (LGE)]

#### STSA picture related (3)

[JVET-Q0156](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8981) AHG8: Enabling inter-layer prediction for STSA pictures [V. Seregin, A. K. Ramasubramonian, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-Q0237](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9062) AHG8/AHG9: On STSA pictures in dependent layers [M. M. Hannuksela (Nokia)]

[JVET-Q0279](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9104) AHG8/AHG9: On alignment across layers [B. Choi, S. Wenger, S. Liu (Tencent)]

Item 2 of this contribution belongs to this category.

#### Colour format and bit depth cross layers (3)

[JVET-Q0172](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8997) AHG9: Chroma format and bitdepth constraint for multi-layer structure [T.-D. Chuang, L. Chen, O. Chubach, C.-Y. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0279](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9104) AHG8/AHG9: On alignment across layers [B. Choi, S. Wenger, S. Liu (Tencent)]

Item 2 of this contribution belongs to this category.

[JVET-Q0355](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9180) AHG8/AHG9: Cleanup on multi-layer coding [X. Ma, H. Yang (Huawei)]

Item 2 of this contribution belongs to this category.

#### Misc. scalability HLS topics (6)

[JVET-Q0170](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8995) AHG9: On inter-layer referencing of ALF [O. Chubach, C.-Y. Lai, C.-Y. Chen, L. Chen, T.-D. Chuang, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0180](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9005) AHG9: On inter-layer referencing of scaling list and LMCS [C.-Y. Lai, O. Chubach, C.-Y. Chen, L. Chen, T.-D. Chuang, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-Q0277](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9102) AHG8/AHG9: Layer dependency constraints for parameter set reference [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-Q0279](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9104) AHG8/AHG9: On alignment across layers [B. Choi, S. Wenger, S. Liu (Tencent)]

Item 1 of this contribution belongs to this category.

[JVET-Q0342](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9167) AHG9: on signaling inter-layer dependency information in SPS [B. Wang, S. Esenlik, A. M. Kotra, H. Gao, E. Alshina (Huawei)]

[JVET-Q0355](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9180) AHG8/AHG9: Cleanup on multi-layer coding [X. Ma, H. Yang (Huawei)]

Item 1 of this contribution belongs to this category.

### Reference picture resampling (RPR) specific HLS (0)

# Complexity analysis (3)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

[JVET-Q0049](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8874) Bit Stream Feature Analyzer (BSFA) for Coding Tool Statistics Based on VTM-7.0 [C. J. Herglotz, M. Kränzler, A. Kaup]

[JVET-Q0051](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8876) Analysis of the Energy-Time Relationship for VVC and HEVC Software Video Decoders [M. Kränzler, C. J. Herglotz, A. Kaup]

[JVET-Q0052](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8877) Modeling of the Decoding Energy for VTM-7.0 with a Bit Stream Feature-Based Model [M. Kränzler, C. J. Herglotz, A. Kaup]

# Encoder optimization (2)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

[JVET-Q0433](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9258) Encoder only: On unbalanced luma/chroma gains for dependent quantization [H. Schwarz (Fraunhofer HHI)]

[JVET-Q0447](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9273) Encoder estimation of weighted\_prediction parameters [P. Bordes, T. Poirier, F. Le Léannec (InterDigital)]

# Metrics and evaluation criteria (0)

Contributions in this category were discussed XXday X Jan. XXXX–XXXX in Track X (chaired by XXX).

# Withdrawn (18)

Section kept for future use.

JVET-Q0083 Withdrawn

JVET-Q0087 Withdrawn

JVET-Q0135 Withdrawn

JVET-Q0231 Withdrawn

JVET-Q0252 Withdrawn

JVET-Q0286 Withdrawn

JVET-Q0383 Withdrawn

JVET-Q0372 Withdrawn

JVET-Q0384 Withdrawn

JVET-Q0415 Withdrawn

JVET-Q0418 Withdrawn

JVET-Q0454 Withdrawn

JVET-Q0465 Withdrawn

JVET-Q0563 Withdrawn

JVET-Q0574 Withdrawn

JVET-Q0602 Withdrawn

JVET-Q0709 Withdrawn

JVET-Q0713 Withdrawn

JVET-Q0722 Withdrawn

JVET-Q0732 Withdrawn

# Plenary meetings, joint meetings, BoG reports, and summary of actions taken

## High-level syntax / systems relation meeting

This planned session was cancelled due to a lack of identified need, as communicated by the relevant MPEG AHG chair.

## Plenary meeting XXday X Jan. XXXX-XXXX

Reports of the tracks were presented as follows:

The general status of tracks A and B was presented and discussed, which particularly included the following aspects:

Decisions recommended from trackA and B were agreed and approved, unless otherwise noted:

Conformance testing was discussed (see section 4.6).

Profile, tier and level were discussed (see section 4.6).

Need more consideration of potential removal of low-coding-gain stuff.

## Closing Plenary meeting Friday 17 Jan.

… .

## Joint meeting XXday XX March XXXX-

JVET with … .

## BoGs (X)

[JVET-Q0625](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9471) Report of BoG on high level tool control and feature combinations [J. Boyce]

[JVET-Q0761](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9607) BoG report of CE4 related contributions on inter prediction with geometric partitioning [H. Yang]

## List of actions taken affecting the draft text of VVC, the VTM, and 360Lib

The following is a summary, in the form of a brief list, of the actions taken at the meeting that affect the text of the VVC draft text, VTM or 360Lib description. Both technical and editorial issues are included. This list is provided only as a summary – details of specific actions are noted elsewhere in this report and the list provided here may not be complete and correct. The listing of a document number only indicates that the document is related, not that it was adopted in whole or in part. The description given in the “Tool” column is a best effort for the sake of understanding but may not precisely reflect the functionality of the tool. It is also noted that in cases where several contributions proposed the same method, usually only one of the is listed as adoption below; refer to the meeting notes about the adoption to see which other contributions are related.

…

# Project planning

## Core experiment planning

See final planning under JVET-Q2021…Q202X.

## Drafting of specification text, encoder algorithm descriptions, and software

The following agreement has been established: the editorial team has the discretion to not integrate recorded adoptions for which the available text is grossly inadequate (and cannot be fixed with a reasonable degree of effort), if such a situation hypothetically arises. In such an event, the text would record the intent expressed by the committee without including a full integration of the available inadequate text.

## Plans for improved efficiency and contribution consideration

The group considered it important to have the full design of proposals documented to enable proper study.

Adoptions need to be based on properly drafted working draft text (on normative elements) and HM encoder algorithm descriptions – relative to the existing drafts. Proposal contributions should also provide a software implementation (or at least such software should be made available for study and testing by other participants at the meeting, and software must be made available to cross-checkers in EEs).

Suggestions for future meetings included the following generally-supported principles:

* No review of normative contributions without draft specification text
* VTM algorithm description text is strongly encouraged for non-normative contributions
* Early upload deadline to enable substantial study prior to the meeting
* Using a clock timer to ensure efficient proposal presentations (5 min) and discussions

The document upload deadline for the next meeting was planned to be XXday XX Apr 2020.

As general guidance, it was suggested to avoid usage of company names in document titles, software modules etc., and not to describe a technology by using a company name.

## General issues for experiments

It was emphasized during the opening plenary on January 9 that those rules which had been set up or refined during the 12th meeting should be observed. In particular, for some CEs, results were available late, and some changes in the experimental setup (particularly in CE4) were not discussed on the JVET reflector.

Group coordinated experiments have been planned as follows:

* “Core experiments” (CEs) are the coordinated experiments on coding tools which are deemed to be interesting but require more investigation and could potentially become part of the draft standard by the next meeting.
* A CE is a test of a specific fully described technology in a specific agreed way. It is not a forum for thinking of new ideas (like an AHG). The CE coordinators are responsible for making sure tha the CE description is complete and correct and has adequate detail. Reflector discussions about CE description clarity and other aspects of CE plans are encouraged.
* A description of each experiment is to be approved at the meeting at which the experiment plan is established. This should include the issues that were raised by other experts when the tool was presented, e.g., interference with other tools, contribution of different elements that are part of a package, etc. The experiment description document should provide the names of individual people, not just company names.
* Software for tools investigated in a CE will be provided in one or more separate branches of the software repository. Each CE will have a “fork” of the software, and within the CE there may be multiple branches established by the CE coordinator. The software coordinator will help coordinate the creation of these forks and branches and their naming. All JVET members will have read access to the CE software branches (using shared read-only credentials; the method for members to obtain the credentials is TBA on the reflector).
* During the experiment, revisions of the experiment plans can be made, but not substantial changes to the proposed technology.
* The CE description must match the CE testing that is done. The CE description needs to be revised if there has been some change of plans.
* The CE summary report must describe any changes that were made in the process of finalizing the CE.
* By the next meeting it is expected that at least one independent cross-checker will report a detailed analysis of each proposed feature that has been tested and confirm that the implementation is correct. Commentary on the potential benefits and disadvantages of the proposed technology in cross-checking reports is highly encouraged. Having multiple cross-checking reports is also highly encouraged (especially if the cross-checking involves more than confirmation of correct test results). The reports of cross-checking activities may (and generally should) be integrated into the CE report rather than submitted as separate documents.

It is possible to define sub-experiments within particular CEs, for example designated as CEX.a, CEX.b, etc., where X is the basic CE number.

As a general rule, it was agreed that each CE should be run under the same testing conditions using one software codebase, which should be based on the group test model software codebase. An experiment is not to be established as a CE unless there is access given to the participants in (any part of) the CE to the software used to perform the experiments.

The general agreed common conditions for single-layer coding efficiency experiments are described in the output document JVET-N1010.

Experiment descriptions should be written in a way such that it is understood as a JVET output document (written from an objective “third party perspective”, not a proponent perspective – e.g. not referring to methods as “improved”, “optimized”, etc.). The experiment descriptions should generally not express opinions or suggest conclusions – rather, they should just describe what technology will be tested, how it will be tested, who will participate, etc. Responsibilities for contributions to CE work should identify individuals in addition to company names.

CE descriptions contain a basic description of the technology under test, but should not contain excessively verbose descriptions of a technology (at least not unless the technology is not adequately documented elsewhere). Instead, the CE descriptions should refer to the relevant proposal contributions for any necessary further detail. However, the complete detail of what technology will be tested must be available – either in the CE description itself or in documents that are referenced in the CE description that are also available in the JVET document archive.

Any technology must have at least one cross-check partner to establish a CE – a single proponent is not enough. It is highly desirable have more than just one proponent and one cross-checker.

[Add info on software access.]

Some agreements relating to CE activities were established as follows:

* Only qualified JVET members can participate in a CE.
* Participation in a CE is possible without a commitment of submitting an input document to the next meeting. Participation is requested by contacting the CE coordinator.
* All software, results, and documents produced in the CE should be announced and made available to JVET in a timely manner.
* A JVET CE reflector will be established and announced on the main JVET reflector. Discussion of logistics arrangements, exchange of data, minor refinement of the test plans, and preparation of documents shall be conducted on the JVET CE reflector, with subject lines prefixed by “[CEx: ]”, where “x” is the number of the CE. All substantial communications about a CE other than such details shall take place on main JVET reflector. In the case that large amounts of data are to be distributed, it is recommended to send a link to the data rather than the data itself, or upload the data as an input contribution to the next meeting.

General timeline for CEs

T1= 3 weeks after the JVET meeting: To revise the CE description and refine questions to be answered. Questions should be discussed and agreed on JVET reflector. Any changes of planned tests after this time need to be announced and discussed on the JVET reflector. Initially assigned description numbers shall not be changed later. If a test is skipped, it is to marked as “withdrawn”.

T2 = Test model software release + 2 weeks or X XX, whichever is earlier: Integration of all tools into a separate CE branch of the VTM is completed and announced to JVET reflector.

* Initial study by cross-checkers can begin.
* Proponents may continue to modify the software in this branch until T3
* 3rd parties are encouraged to study and make contributions to the next meeting with proposed changes

T3: 3 weeks before the next JVET meeting or T2 + 1 week, whichever is later: Any changes to the CE test branches of the software must be frozen, so the cross-checkers can know exactly what they are cross-checking. A software version tag should be created at this time. The name of the cross-checkers and list of specific tests for each tool under study in the CE plan description shall be documented in an updated CE description by this time.

T4: Regular document deadline – 1 week: CE contribution documents including specification text and complete test results shall be uploaded to the JVET document repository (particularly for proposals targeting to be promoted to the draft standard at the next meeting).

The CE summary reports shall be available by the regular deadline. This shall include documentation about crosscheck of software, matching of CE description and confirmation of the appropriateness of the text change, as well as sufficient crosscheck results to create evidence about correctness (crosscheckers must send this information to the CE coordinator at least 3 days ahead of the document deadline). Furthermore, any deviations from the timelines above shall be documented. The numbers used in the summary report shall not be changed relative to the description document.

CE reports may contain additional information about tests of straightforwared combinations of the identified technologies. Such supplemental testing needs to be clearly identified in the report if it was not part of the CE plan.

New branches may be created which combine two or more tools included in the CE document or the VTM (as applicable).

It is not necessary to formally name cross-checkers in the initial version of the CE description document. To adopt a proposed feature at the next meeting, we would like see comprehensive cross-checking done, with analysis that the description matches the software, and recommendation of value of the tool given tradeoffs.

The establishment of a CE does not indicate that a proposed technology is mature for adoption or that the testing conducted in the CE is fully adequate for assessing the merits of the technology, and a favourable outcome of CE does not indicate a need for adoption of the technology.

Availability of spec text is important to have a detailed understanding of the technology and also to judge what its impact on the complexity of the spec will be. There must also be sufficient time to study it in detail. CE contributions without sufficiently mature draft spec text in the CE input document should not be considered for adoption.

Lists of participants in CE documents should be pruned to include only the active participants. Read access to software will be available to all members.

## Software development and anchor generation (update)

The planned timeline for software releases was established as follows:

* VTM7.0 will be released by 2019-11-11 including all adoptions necessary for CTC and CE basis references. VTM7.1 with non-CTC adoptions will be released later. Further versions of VTM may be released for additional bug fixing, as appropriate.
* Preparation of the VTM software will include immediate removal of macros that were added in the previous meeting cycle. The software coordinator has the discretion to retain some such macros.
* No change of of 360lib or HDRTools was noted in response to meeting.

# Establishment of ad hoc groups

The ad hoc groups established to progress work on particular subject areas until the next meeting are described in the table below. The discussion list for all of these ad hoc groups was agreed to be the main JVET reflector ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de)).

|  |  |  |
| --- | --- | --- |
| **Title and Email Reflector** | **Chairs** | **Mtg** |
| **Project Management (AHG1)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Coordinate overall JVET interim efforts. * Supervise CE and AHG studies. * Report on project status to JVET reflector. * Provide a report to the next meeting on project coordination status. | J.-R. Ohm, G. J. Sullivan (co-chairs) | N |
| **Draft text and test model algorithm description editing (AHG2)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Produce and finalize JVET-P2001 VVC text specification draft 7. * Produce and finalize JVET-P2002 VVC Test Model 7 (VTM 7) Algorithm and Encoder Description. * Gather and address comments for refinement of these documents. * Coordinate with test model software development AhG to address issues relating to mismatches between software and text. | B. Bross, J. Chen (co-chairs), J. Boyce, S. Kim, S. Liu, Y.-K. Wang, Y. Ye (vice-chairs) | N |
| **Test model software development (AHG3)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Coordinate development of test model (VTM) software and associated configuration files. * Produce documentation of software usage for distribution with the software. * Discuss and make recommendations on the software development process. * Propose improvements to the guideline document for developments of the test model software. * Perform tests of VTM behaviour relative to HEVC and the previous VTM using the VTM common test conditions. * Coordinate with AHG on Draft text and test model algorithm description editing (AHG2) to identify any mismatches between software and text, and make further updates and cleanups to the software as appropriate. * Coordinate with AHG6 for integration with 360lib software. | F. Bossen, X. Li, K. Sühring (co-chairs) | N |
| **Test material and visual assessment (AHG4)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Maintain the video sequence test material database for development of the VVC standard. * Identify and recommend appropriate test materials for use in the development of the VVC standard. * Identify missing types of video material, solicit contributions, collect, and make available a variety of video sequence test material. * Evaluate new test sequences. * Maintain and update the directory structure for the test sequence repository as necessary. * Prepare availability of viewing equipment and facilities arrangements for the next meeting, and prepare testing upon consultation with CE coordinators. * Begin planning for verification testing of VVC capability. * Coordinate with AHG11 on test material for screen content coding. | V. Baroncini, T. Suzuki, M. Wien (co-chairs), R. Chernyak, A. Norkin (vice-chairs) | N |
| **Conformance testing (AHG5)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the requirements of VVC conformance testing to ensure interoperability. * Propose a work plan, including timeline, for preparation of a conformance testing specification and conformance bitstream database. * Study potential testing methodology to fulfil the requirements of VVC conformance testing. | J. Boyce and W. Wan (co-chairs), E. Alshina, I. Moccagatta, K. Kawamura, S. McCarthy, K. Sühring (vice-chairs) | N |
| **360° video coding tools, software and test conditions (AHG6)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the effect on compression and subjective quality of different projections formats, resolutions, and packing layouts. * Discuss refinements of common test conditions, test sequences, and evaluation criteria. * Solicit additional test sequences, and evaluate suitability of test sequences on head-mounted displays and normal 2D displays. * Study coding tools dedicated to 360° video, their impact on compression, and implications to the core codec design, including consideration of subpicture segmentations and adaptive viewport usage. * Study the effect of viewport resolution, field of view, and viewport speed/direction on visual comfort. * Study complexity of GPU rendering of projection formats. * Study syntax for signalling of projection formats, cubeface layouts, spherical rotations. * Prepare and deliver the 360Lib-10 software version and common test condition configuration files according to JVET-M1012. * Generate CTC anchors and PERP results for the VTM according to JVET-M1012 within two weeks of availability of SDR CTC anchors. * Produce documentation of software usage for distribution with the software. | J. Boyce and Y. He (co-chairs), K. Choi, J.-L. Lin, Y. Ye (vice-chairs) | N |
| **Coding of HDR/WCG material (AHG7)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study and evaluate available HDR/WCG test content. * Study objective metrics for quality assessment of HDR/WCG material, including investigation of the correlation between subjective and objective results. * Compare the performance of the VTM and HM for HDR/WCG content. * Generate CTC anchors for the VTM according to JVET-P2011 within two weeks of availability of SDR CTC anchors. * Prepare for expert viewing of HDR content at the next JVET meeting if feasible. * Coordinate implementation of HDR anchor aspects in the test model software with AHG3. * Study additional aspects of coding HDR/WCG content. | A. Segall (chair), E. François, W. Husak, S. Iwamura, D. Rusanovskyy (vice-chairs) | N |
| **Layered coding and resolution adaptivity (AHG8)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study adaptive-resolution coding approaches for real-time communication, adaptive streaming, and 360-degree viewport-dependent streaming, including subpicture-based resampling, reference picture management and related scope and signalling. * Study approaches for temporal scalability to avoid temporal judder when temporal scalability sub-bitstream extraction is used for achieving lower frame rate, and consider whether this should have a normative impact. * Develop software for layered coding and resolution adaptivity modalities in the context of the VTM software. * Propose common test conditions for layered coding and resolution adaptivity. * Study approaches for support of layered coding scalability including spatial, temporal, quality, view, and region-of-interest scalability; and analyse their coding efficiency and complexity characteristics | S. Wenger and A. Segall (co-chairs), M. M. Hannuksela, Hendry, S. McCarthy, Y.-C. Sun, P. Topiwala, M. Zhou (vice-chairs) | N |
| **High-level syntax (AHG9)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study NAL unit header, decoding parameter set, video parameter set, sequence parameter set, picture parameter set, adaptation parameter set, picture header, and slice header syntax designs. * Study reference picture buffering and list construction. * Study random access signalling and random access approaches. * Study detection of AU and picture boundaries and properties. * Study the appropriate syntax level and signalling approaches for high-level signalling of control information for lower-level coding tools. * Coordinate with AHG2 and AHG3 for text drafting and software development for the high-level syntax in the VVC design. * Study syntax approaches for interoperability point signalling. * Study selection of constraint flags and their impact on syntax, semantics, and decoding process. | R. Sjöberg, J. Boyce (co-chairs), B. Choi, S. Deshpande, M. M. Hannuksela, R. Skupin, A. Tourapis, Y.-K. Wang, W. Wan (vice-chairs) | N |
| **Encoding algorithm optimization (AHG10)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the impact of using techniques such as GOP structures and perceptually optimized adaptive quantization for encoder optimization. * Study quality metrics for measuring subjective quality using e.g. the CfP response MOS scores. * Study the impact of adaptive quantization on individual tools in the test model. * Investigate other methods of improving objective and/or subjective quality, including adaptive coding structures and multi-pass encoding. * Study methods of rate control and their impact on performance, subjective and objective quality. | A. Duenas, A. Tourapis (co-chairs), S. Ikonin, A. Norkin, R. Sjöberg, J. Le Tanou, J.-M. Thiesse (vice-chairs) | N |
| **Screen content coding (AHG11)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Investigate coding tools targeted at screen content in terms of compression benefit and implementation complexity. * Identify test materials, discuss testing conditions for screen content coding, and propose associated updated common test conditions. * Study the impact of loop filters on screen content coding. | S. Liu (chair), J. Boyce, A. Filippov, Y.-C. Sun, J. Xu, H. Yang (vice-chairs) | N |
| **High-level parallelism and coded picture regions (AHG12)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study wavefront processing including the relationship with tiles and low delay characteristics. * Study flexible loop filter control and tile size restrictions, including identifying implications on coding tools and implementation. * Study support of independently coded picture regions, including easy extraction and merging of such regions into conforming bitstreams. * Prepare software and configurations for the test model to facilitate parallel processing tests. * Study the coding efficiency impact of parallel processing and coded picture regions. | S. Deshpande (chair), B. Choi, M. M. Hannuksela, R. Sjöberg, R. Skupin, W. Wan, Y.-K. Wang (vice-chairs) | N |
| **Tool reporting procedure and testing (AHG13)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Prepare output document JVET-P2005, which describes the methodology of tool-off testing and a list of tools to be tested by identified testers, including non-CTC configurations as appropriate. * Provide configurations files, bitstreams, and results of tool-on/tool-off testing. * Maintain VTM software aspects for memory bandwidth analysis in coordination with AHG3. * Use the tool usage counts and memory bandwidth usage to study the decoder complexity of features in on/off testing. * Prepare a report with results of the tests. | W.-J. Chien, J. Boyce (co-chairs), W. Chen, Y.-W. Chen, R. Chernyak, K. Choi, R. Hashimoto, Y.**-**W. Huang, H. Jang, R.-L. Liao, S. Liu (vice-chairs) | N |
| **Lossless and near-lossless coding (AHG14)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study lossless and near-lossless coding, including transform skip, BDPCM, and other potential technologies. * Consider the interaction between coding tools and other processing such as loop filtering and LMCS for lossless and near-lossless coding. * Develop proposals for lossless and near-lossless coding for chroma and non-YCbCr colour space content. * Consider throughput bottlenecks for lossless and near-lossless coding at high resolutions and frame rates. | T. Nguyen and T.-C. Ma (co-chairs), M. Ikeda, H. Jang, X. Zhao (vice-chairs) | N |
| **Quantization control (AHG15)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Identify methods for quantization step size control for luma and chroma, including spatially and frequency-adaptive approaches. * Develop methods for evaluating quantization step size control operation. * Study the association between transforms and quantization scaling matrices. * Develop testing conditions for evaluating QP signalling improvements including rate control and perceptual optimization strategies as appropriate. * Evaluate the performance of the current VVC QP design using the adaptive quantization control techniques currently available in the VTM. | R. Chernyak (chair), E. François, C. Helmrich, S. McCarthy, A. Segall (vice-chairs) | N |
| **Implementation studies (AHG16)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study current and proposed coding tools to identify implementation issues relating to decoder pipelines, decoder throughput, and other aspects of implementation difficulty. * Solicit hardware analysis of complex tools. * Provide feedback on potential solutions to address identified issues. | M. Zhou (chair), J. An, E. Chai, K. Choi, S. Sethuraman, T. Hsieh, X. Xiu (vice-chairs) | N |

# Output documents (update)

The following documents were agreed to be produced or endorsed as outputs of the meeting. Names recorded below indicate the editors responsible for the document production. Where applicable, dates of planned finalization and corresponding parent-body document numbers are also noted.

It was reminded that in cases where the JVET document is also made available as MPEG output document, a separate version under the MPEG document header should be generated. This version should be sent to GJS and JRO for upload.

[JVET-P2000](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8865) Meeting Report of the 16th JVET Meeting [G. J. Sullivan, J.-R. Ohm] (2020-xx-xx, near next meeting)

Initial versions of the meeting notes (d0 … dA) were made available on a daily basis during the meeting.

[JVET-P2001](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8857) Versatile Video Coding (Draft 7) [B. Bross, J. Chen, S. Liu, Y.-K. Wang] [WG 11 DIS 23090-3, N18873] (2019-11-09)

Disposition of comments: WG11 N18875 also output by MPEG.

(Initial version planned to be made available by 2019-10-18.)

(Resolution impact: Adding Y.-K. Wang as editor)

DoCR also output by MPEG.

See the list of elements under section 11.7, [revisit to check].

[JVET-P2002](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8858) Algorithm description for Versatile Video Coding and Test Model 7 (VTM 7) [J. Chen, Y. Ye, S. Kim] [WG 11 N 18874] (2019-11-22)

(Initial version planned to be made available by 2019-10-31.)

Remains valid – not updated: [JVET-N1003](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=6638) Guidelines for VVC reference software development [K. Sühring] (2019-04-01)

Remains valid – not updated: [JVET-M1004](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=5757) Algorithm descriptions of projection format conversion and video quality metrics in 360Lib (Version 9) [Y. Ye, J. Boyce] (2019-02-15)

[JVET-P2005](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8859) Methodology and reporting template for coding tool testing [W.-J. Chien and J. Boyce] (2019-11-25)

Initial version to be available by 2019-10-25; final version expected by two weeks after VTM 7 availability.

Remains valid – not updated: [JVET-M1006](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=5758) Methodology and reporting template for neural network coding tool testing [Y. Li, S. Liu, K. Kawamura] (2019-02-01)

This output was produced to capture aspects specific to enable study of neural network techniques.

[JVET-P2007](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8860) Supplemental enhancement information messages for coded video bitstreams [J. Boyce, G. J. Sullivan, Y.-K. Wang] [WG 11 DIS ISO/IEC 23002-7, N18873] (2019-11-09)

Disposition of comments: WG11 N18872 also output by MPEG.

See the list of elements under section 11.8 [revisit to check].

[JVET-P2008](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8861) Conformance testing for versatile video coding (Draft 1) [J. Boyce, E. Alshina, K. Kawamura, S. McCarthy, I. Moccagatta, W. Wan] [WG 11 N18927] (2019-11-22)

List volunteers (may be recruited later also).

No output P2009

Remains valid – not updated: [JVET-N1010](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=6643) JVET common test conditions and software reference configurations for SDR video [F. Bossen, J. Boyce, X. Li, V. Seregin, K. Sühring] (2019-04-12)

[JVET-P2011](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8862) JVET common test conditions and evaluation procedures for HDR/WCG video [A. Segall, E. François, W. Husak, S. Iwamura, D. Rusanovskyy] (2019-07-31)

(Will include correction of description of quantization aspects.)

Remains valid – not updated: [JVET-L1012](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=4840) JVET common test conditions and evaluation procedures for 360° video [P. Hanhart, J. Boyce, K. Choi, J.-L. Lin] (2018-10-26)

Drafts of CE plans were not reviewed during the meeting due to lack of time.

[JVET-P2021](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8855) Description of Core Experiment 1 (CE 1): Deblocking filtering [K. Andersson, A. Norkin]

See track A notes under JVET-P1033 about what to test.

[JVET-P2022](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8854) Description of Core Experiment 2 (CE2): Palette mode coding [X. Xu, Y.-H. Chao, Y.-C. Sun, J. Xu]

See track A notes under JVET-P0999 about what to test.

[JVET-P2023](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8856) Description of Core Experiment 3 (CE3): Lossless coding [T.-C. Ma, A. Nalci, T. Nguyen]

See track A notes under JVET-P0606 about what to test.

[JVET-P2024](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8863) Description of Core Experiment 4 (CE4): Inter prediction with geometric partitioning [C.-C. Chen, R.-L. Liao, X. Xiu, H. Yang]

To test P0884/P0885; also to test current design with TPM off

Combination with CIIP P0071 to also test

(P0174 and P0250 were not reviewed in detail, not to be tested in the CE, more complex)

P0583 (which part of P0248) disallows SBT with GEO, to also test.

It was suggested and agreed to test P0449

Also test blending disabling

[JVET-P2025](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8864) Description of Core Experiment 5 (CE5): Cross-component adaptive loop filtering [C.-Y. Chen, A. Segall]

See track A notes under JVET-P1033 about what to test.

# Future meeting plans, expressions of thanks, and closing of the meeting

Future meeting plans were established according to the following guidelines:

* Meeting under ITU-T SG 16 auspices when it meets (ordinarily starting meetings on the Tuesday of the first week and closing it on the Wednesday of the second week of the SG 16 meeting – a total of 9 meeting days), and
* Otherwise meeting under ISO/IEC JTC 1/SC 29/WG 11 auspices when it meets (ordinarily starting meetings on the Tuesday prior to such meetings and closing it at lunchtime on the last day of the WG 11 meeting – a total of 9.5 meeting days).

In cases where an exceptionally high workload is expected for a meeting, an earlier starting date may be defined.

Some specific future meeting plans (to be confirmed) were established as follows:

* Wed. 15 – Fri. 24 April 2020, 18th meeting under WG 11 auspices in Alpbach, AT.
* Tue. 23 June – Wed. 1 July 2020, 19th meeting under ITU-T auspices in Geneva, CH.
* Wed. 7 – Fri. 16 October 2020, 20th meeting under WG 11 auspices in Rennes, FR.
* Wed. 6 – Fri. 15 January 2021, 21st meeting under WG 11 auspices in Capetown, ZA.

The agreed document deadline for the 18th JVET meeting was planned to be Tuesday 7 April 2020. CE proposal documents are due one week ahead of that date. HLS only on 1st day if Tuesday.

University of Brussels (VUB) was thanked for the excellent hosting of the 17th meeting of the JVET.

Barco, GBTech, Philips, and Sharp Labs of America were thanked for providing equipment used for subjective viewing during the 17th JVET meeting. Kenneth Andersson, Vittorio Baroncini, Andrey Norkin, Andrew Segall, and Mathias Wien were thanked for preparing and conducting the subjective test efforts. The experts who participated in the role as test subjects were also thanked.

The 17th JVET meeting was closed at approximately XXXX hours on Friday 17 Jan. 2020.

# Annex A to JVET report: List of documents

# Annex B to JVET report: List of meeting participants

The participants of the sixteenth meeting of the JVET, according to an attendance sheet circulated during the meeting sessions (approximately 319 people in total), were as follows: