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| **Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11**  38th Meeting: Brussels, BE, 10–17 January 2020 | Document: JCTVC-AL\_Notes\_d2 |

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| *Title:* | **Meeting report of the 38th meeting of the Joint Collaborative Team on Video Coding (JCT-VC), Brussels, BE, 10–17 January 2020** | | |
| *Status:* | Report document from chairs of JCT-VC | | |
| *Purpose:* | Report | | |
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| *Source:* | Chairs | | |

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**Summary**

The Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T WP3/16 and ISO/IEC JTC 1/‌SC 29/‌WG 11 held its thirty-eighth meeting during 10–17 January 2020 at Square – Brussels Convention Center in Brussels, BE. The JCT-VC 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 1.14 of this document.

The JCT-VC meeting began at approximately 0900 hours on Friday 10 January 2020 with a half-day of meeting sessions. An additional meeting session was held at 1230 on Wednesday 15 January 2020. The meeting was closed at approximately 1400 hours on Wednesday 15 January 2020. Approximately 30 people attended the JCT-VC meeting, and 4 input documents and 5 AHG reports were discussed. The meeting took place in a collocated fashion with a meeting of WG11 – one of the two parent bodies of the JCT-VC. The subject matter of the JCT-VC meeting activities consisted of work on the video coding standardization project known as High Efficiency Video Coding (HEVC) and its extensions, and the development of associated conformance test sets, reference software, verification testing, and non-normative guidance information. Further work was performed on the specification of coding-independent code points related to video data. Maintenance and minor enhancement work on the Advanced Video Coding (AVC) standard were also conducted.

One primary goal of the meeting was to review the work that was performed in the interim period since the 37th JCT-VC meeting in producing the outputs of that meeting:

* For HEVC SEI message development:
  + Draft 3 of annotated regions and fisheye video information SEI messages (JCTVC-AK1012)
  + Draft 1 of a shutter interval SEI message (JCTVC-AK1005)
* For HEVC, AVC, and Video CICP text specification maintenance, a description of current errata report items (JCTVC-AK1004)
* For non-normative guidance on HEVC encoding practices, Update 12 of the HEVC Model (HM) 16 encoding algorithm description (JCTVC-AK1002)
* For video code points coordination, Draft 6 toward version 2 of the technical report on usage of video signal type code points (JCTVC-AK1003).

The other most important goals were to review the work on new SEI messages, encoder optimization, and non-normative guidance, and to review other technical input documents. Possible needs for corrections to the prior HEVC specification text were also considered.

The JCT-VC produced 3 output documents from the meeting:

* For HEVC SEI message development, Draft 2 of a shutter interval SEI message (JCTVC-AL1005)
* For HEVC, AVC, Video CICP, and video code points TR, text specification maintenance, a description of current errata report items (JCTVC-AL1004)
* For non-normative guidance on HEVC encoding practices, Update 13 of the HEVC Model (HM) 16 encoding algorithm description (JCTVC-AL1002)

For the organization and planning of its future work, the JCT-VC established 5 "ad hoc groups" (AHGs) to progress the work on particular subject areas. The next four JCT-VC meetings were planned for Sat. 18 – Fri. 24 April 2020 under WG 11 auspices in Alpbach, AT (post-meeting note: the planned Alpbach meeting was later converted to a teleconference-based meeting in response to the COVID-19 pandemic), during Thu. 25 June – Wed. 1 July 2020 under ITU-T SG16 auspices in Geneva, CH, during Fri. 9 – Fri. 16 October 2020 under WG 11 auspices in Rennes, FR, and during Fri. 8 – Fri. 15 January 2021 under WG 11 auspices in Capetown, ZA.

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

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

# Administrative topics

## Organization

The ITU-T/ISO/IEC Joint Collaborative Team on Video Coding (JCT-VC) 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 JCT-VC are ITU-T WP3/16 and ISO/IEC JTC 1/SC 29/WG 11.

The Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T WP3/16 and ISO/IEC JTC 1/‌SC 29/‌WG 11 held its thirty-eighth meeting during 10–17 January 2020 at Square – Brussels Convention Center in Brussels, BE. The meeting took place in a collocated fashion with a meeting of WG11 – one of the two parent bodies of the JCT-VC. The JCT-VC meeting was held under the chairmanship of Dr Gary Sullivan (Microsoft/USA) and Dr Jens-Rainer Ohm (RWTH Aachen/Germany).

## Meeting logistics

The JCT-VC meeting began at approximately 0900 hours on Friday 10 January 2020 with a half-day of meeting sessions. An additional meeting sessions was held at 1230 on Wednesday 15 January 2020. The meeting was closed at approximately 1400 hours on Wednesday 15 January 2020. Approximately 30 people attended the JCT-VC meeting, and 4 input documents and 5 AHG reports were discussed. The meeting took place in a collocated fashion with a meeting of WG11 – one of the two parent bodies of the JCT-VC. The subject matter of the JCT-VC meeting activities consisted of work on the video coding standardization project known as High Efficiency Video Coding (HEVC) and its extensions, and the development of associated conformance test sets, reference software, verification testing, and non-normative guidance information. Further work was performed on the specification of coding-independent code points related to video data. Maintenance and minor enhancement work on the Advanced Video Coding (AVC) standard were also conducted.

Some statistics are provided below for historical reference purposes:

* 1st "A" meeting (Dresden, 2010-04): 188 people, 40 input documents
* 2nd "B" meeting (Geneva, 2010-07): 221 people, 120 input documents
* 3rd "C" meeting (Guangzhou, 2010-10): 244 people, 300 input documents
* 4th "D" meeting (Daegu, 2011-01): 248 people, 400 input documents
* 5th "E" meeting (Geneva, 2011-03): 226 people, 500 input documents
* 6th "F" meeting (Turin, 2011-07): 254 people, 700 input documents
* 7th "G" meeting (Geneva, 2011-11) 284 people, 1000 input documents
* 8th "H" meeting (San Jose, 2012-02) 255 people, 700 input documents
* 9th "I" meeting (Geneva, 2012-04/05) 241 people, 550 input documents
* 10th "J" meeting (Stockholm, 2012-07) 214 people, 550 input documents
* 11th "K" meeting (Shanghai, 2012-10) 235 people, 350 input documents
* 12th "L" meeting (Geneva, 2013-01) 262 people, 450 input documents
* 13th "M" meeting (Incheon, 2013-04) 183 people, 450 input documents
* 14th "N" meeting (Vienna, 2013-07/08) 162 people, 350 input documents
* 15th "O" meeting (Geneva, 2013-10/11) 195 people, 350 input documents
* 16th "P" meeting (San José, 2014-01) 152 people, 300 input documents
* 17th "Q" meeting (Valencia, 2014-03/04) 126 people, 250 input documents
* 18th "R" meeting (Sapporo, 2014-06/07) 150 people, 350 input documents
* 19th "S" meeting (Strasbourg, 2014-10) 125 people, 300 input documents
* 20th "T" meeting (Geneva, 2015-02) 120 people, 200 input documents
* 21st "U" meeting (Warsaw, 2015-06) 91 people, 150 input documents
* 22nd "V" meeting (Geneva, 2015-10) 155 people, 75 input documents
* 23rd "W" meeting (San Diego, 2016-02) 159 people, 125 input documents
* 24th "X" meeting (Geneva, 2016-05/06) 162 people, 60 input documents
* 25th "Y" meeting (Chengdu, 2016-10) 93 people, 40 input documents
* 26th "Z" meeting (Geneva, 2017-01) 95 people, 30 input documents
* 27th "AA" meeting (Hobart, 2017-03/04) 76 people, 25 input documents
* 28th "AB" meeting (Turin, 2017-07) 71 people, 25 input documents
* 29th "AC" meeting (Macao, 2017-10) 107 people, 21 input documents
* 30th "AD" meeting (Gwangju, 2018-01) 85 people, 4 input documents
* 31st "AE" meeting (San Diego, 2018-04) 37 people, 11 input documents
* 32nd "AF" meeting (Ljubljana, 2018-07) 38 people, 8 input documents
* 33rd "AG" meeting (Macao, 2018-10) 32 people, 9 input documents
* 34th "AH" meeting (Marrakech, 2019-01) 34 people, 7 input documents
* 35th "AI" meeting (Geneva, 2019-03) 29 people, 4 input documents
* 36th "AJ" meeting (Gothenburg, 2019-07) 63 people, 11 input documents
* 37th "AK" meeting (Geneva, 2019-10) 40 people, 12 input documents
* 38th "AL" meeting (Brussels, 2020-01) 30 people, 4 input documents

Information regarding logistics arrangements for the meeting had been provided via the email reflector [jct-vc@lists.rwth-aachen.de](mailto:jct-vc@lists.rwth-aachen.de) and at <http://wftp3.itu.int/av-arch/jctvc-site/2020_01_AL_Brussels/>.

## Primary goals

One primary goal of the meeting was to review the work that was performed in the interim period since the 37th JCT-VC meeting in producing:

* For HEVC SEI message development:
  + Draft 3 of annotated regions and fisheye video information SEI messages (JCTVC-AK1012)
  + Draft 1 of a shutter interval SEI message (JCTVC-AK1005)
* For HEVC, AVC, and Video CICP text specification maintenance, a description of current errata report items (JCTVC-AK1004)
* For non-normative guidance on HEVC encoding practices, Update 12 of the HEVC Model (HM) 16 encoding algorithm description (JCTVC-AK1002)
* For video code points coordination, Draft 6 toward version 2 of the technical report on usage of video signal type code points (JCTVC-AK1003).

The other most important goals were to review the work on new SEI messages, encoder optimization, and non-normative guidance, and to review other technical input documents. Possible needs for corrections to the prior HEVC specification text were also considered.

## Documents and document handling considerations

### General

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

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 done using the keyword “Decision”, e.g., as follows:

* Decisions made by the group that affect the normative content of the draft standard are identified by prefixing the description of the decision with the string "Decision:".
* Decisions that affect the reference software but have no normative effect on the text are marked by the string "Decision (SW):".
* Decisions that fix a "bug" in the specification (an error, oversight, or messiness) are marked by the string "Decision (BF):".
* Decisions regarding things that correct the text to properly reflect the design intent, add supplemental remarks to the text, or clarify the text are marked by the string "Decision (Ed.):".
* Decisions regarding simplification or improvement of design consistency are marked by the string "Decision (Simp.):".
* Decisions regarding complexity reduction (in terms of processing cycles, memory capacity, memory bandwidth, line buffers, number of entropy-coding contexts, number of context-coded bins, etc.) … "Decision (Compl.):".

This meeting report is based primarily on notes taken by the chairs and projected for real-time review by the participants during the meeting discussions. The preliminary notes were also circulated publicly by ftp and http during the meeting for information and coordination purposes. 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 may not be 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 Friday, 3 January 2020.

Non-administrative documents uploaded after 2359 hours in Paris/Geneva time Saturday 4 January 2020 were to be considered "officially late". Two contributions to this meeting were registered and submitted late:

* JCTVC-AL0022 (submitted 7 Jan.), a contribution on film grain synthesis support in AVC and HEVC.
* JCTVC-AL0023 (submitted 10 Jan.), a contribution on proposed modifications of shutter interval SEI message.

In some cases, contributions were 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 submissions for contributions is recorded in the list of documents in Annex A of this report and is also generally noted in the section discussing each contribution in this report.

Ad hoc group interim activity reports, CE summary results reports, break-out activity reports, and information documents containing the results of experiments requested during the meeting were not subject to the above-described deadline, as these are considered administrative report documents and they may not be possible to produce until after the availability of other input documents.

As a general policy, missing documents were not to be presented, and late documents (and substantial revisions) could only be presented when sufficient time for studying was given after the upload. 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 for this meeting.

It is noted that documents that are substantially revised after the initial upload are also a problem, as this becomes confusing, interferes with study, and puts an extra burden on synchronization of the discussion. This is especially 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 this field has seldom been used and is often not checked by our participants).

"Placeholder" contribution documents that are basically empty of content, with perhaps only a brief abstract and some expression of an intent to provide a more complete submission as a revision, are considered unacceptable and were to be rejected in the document management system, as has been agreed since the third meeting. The initial uploads of such contribution documents are rejected as "placeholders" if they are uploaded without any significant content and are not corrected until after the upload deadline. Such “placeholder” cases did not occur at this meeting.

In some cases in recent history, a few contributions have had some problems relating to IPR declarations in the initial uploaded versions (missing declarations, declarations saying they were from the wrong companies, etc.). Any such issues have been corrected by later uploaded versions in a reasonably timely fashion in all cases (to the extent of the awareness of the chairs).

Some other errors may also have been noticed in other initial document uploads (wrong document numbers in headers, uploading of corrupted unreadable files, etc.) which have generally been sorted out in a reasonably timely fashion. The document web site contains an archive of each upload, along with a record of uploading times.

### Outputs of the preceding meeting

The output documents of the previous meeting, particularly including the meeting report JCTVC-AK1000, the Update 12 of the HEVC Model (HM) 16 encoding algorithm description JCTVC-AK1002, the description of current errata report items in AVC, HEVC and Video CICP (JCTVC-AK1004), the Shutter interval SEI message for HEVC (Draft 1) (JCTVC-AK1005), and the Annotated regions and fisheye video information SEI messages for HEVC (Draft 3) (JCTVC-AK1012), were approved.

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

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

The chairs asked if there were any issues regarding potential mismatches between perceived technical content prior to adoption and later integration efforts. It was also asked whether there was adequate clarity of precise description of the technology in the associated proposal contributions.

It was remarked that, regarding software development efforts – for cases where "code cleanup" is a goal as well as integration of some intentional functional modification, it was emphasized that these two efforts should be conducted in separate integrations, so that it is possible to understand what is happening and to inspect the intentional functional modifications.

The need for establishing good communication with the software coordinators was also emphasized.

At some previous meetings, it had been remarked that in some cases the software implementation of adopted proposals revealed that the description that had been the basis of the adoption apparently was not precise enough, so that the software unveiled details that were not known before (except possibly for CE participants who had studied the software). Issues of combinations between different features (e.g., different adopted features) also tend to sometimes arise in the work. There should be time to study combinations of different adopted tools with more detail prior to adoption.

## Attendance

The list of participants in the JCT-VC 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 by the Chairs 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 Chairs.

## Agenda

The agenda for the JCT-VC meeting, for development of the High Efficiency Video Coding (HEVC) standard and its format range (RExt), scalability (SHVC), multi-view (MV-HEVC), 3D (3D-HEVC), screen content coding (SCC), and high-dynamic-range (HDR) extensions, and associated conformance test sets, reference software, verification testing, non-normative guidance information, and coding-independent code point specifications was as follows:

* Opening remarks and review of meeting logistics and communication practices
* IPR policy reminder and declarations
* Contribution document allocation
* Reports of *ad hoc* group activities
* Review of results of previous meeting
* Consideration of contributions and communications on project guidance
* Consideration of errata reports and needs for maintenance and enhancements of the HEVC standard and its associated conformance test specification and reference software
* Consideration of errata reports and needs for maintenance and enhancements of the specification of coding-independent code points for video signal type identification
* Consideration of proposals and preparations toward finalization of in-progress draft specifications of additional supplemental enhancement information metadata for the HEVC standard
* Consideration of errata reports and needs for maintenance and enhancements of supplemental enhancement information and video usability information metadata for the HEVC standard
* Consideration of proposed content toward revision of the technical report on usage of video signal type code point identifiers
* Consideration of information contributions and non-normative guidance relevant to the HEVC standard
* Consideration of agreed related aspects of the AVC standard (esp. regarding supplemental enhancement information)
* Coordination activities relating to the work of the JCT-VC
* Approval of output documents and associated editing periods
* Future planning: Determination of next steps, discussion of working methods, communication practices, establishment of coordinated experiments (if any), establishment of AHGs, meeting planning, refinement of expected standardization timelines, other planning issues
* Other business as appropriate for consideration

## IPR policy reminder

Participants were reminded of the IPR policy established by the parent organizations of the JCT-VC 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 JCT-VC as 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://wftp3.itu.int/av-arch/jctvc-site> (JCT-VC contribution templates)
* <http://www.itu.int/ITU-T/studygroups/com16/jct-vc/index.html> (JCT-VC general information and founding charter)
* <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 chairs invited participants to make any necessary verbal reports of previously-unreported IPR in draft standards under preparation, and opened the floor for such reports: No such verbal reports were made.

## Software copyright disclaimer header reminder

It was noted that, as had been agreed at the 5th meeting of the JCT-VC and approved by both parent bodies at their collocated meetings at that time, the HEVC reference software copyright license header language is the BSD license with a preceding sentence declaring that other contributor or third party rights, such as patent rights, may exist that are not granted by the license, as recorded in N10791 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 HEVC standard and its extensions, and for evaluating proposals for technology to be included in the design. After finalization of the draft, the software will be published by ITU-T and ISO/IEC as an example implementation of the HEVC standard and for use as the basis of products to promote adoption of the technology.

The same applies for the HDRTools and 360Lib codebases.

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.

The JM and other AVC codebases are handled similarly.

## Communication practices

The documents for the meeting can be found at <http://phenix.it-sudparis.eu/jct/>. For the first two JCT-VC meetings, the JCT-VC documents had been made available at <http://wftp3.itu.int/av-arch/jctvc-site>, and documents for the first two JCT-VC meetings remain archived there as well. That site was also used for distribution of the contribution document template and circulation of drafts of this meeting report.

The JCT-VC email list is managed through the site <https://lists.rwth-aachen.de/postorius/lists/jct-vc.lists.rwth-aachen.de/>, and to send email to the reflector, the email address is [jct-vc@lists.rwth-aachen.de](mailto:jct-vc@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 JCT-VC 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 adequately to basic inquiries regarding the nature of their interest in the work.

It was emphasized that usually discussions concerning CEs and AHGs should be performed using the JCT-VC email reflector.

Currently, JCT-VC is not running any CEs. When such CEs are conducted, CE internal discussions should primarily be concerned with organizational issues. Substantial technical issues that are not reflected by an original CE plan should be openly discussed on the reflector. Any new developments that are result of private communication cannot be considered to be the result of the CE.

For the headers and registrations of CE documents and AHG reports, email addresses of participants and contributors may be obscured or absent (and will be on request), although these will be available (in human readable format – possibly with some "obscurification") for primary CE coordinators and AHG chairs.

## Terminology

Some terminology used in this report is explained below:

* **3D-HEVC**: A set of extensions of HEVC that includes the combined coding of depth and texture information for 3D video coding.
* **ACT**: Adaptive colour transform.
* **Additional Review**: The stage of the ITU-T "alternative approval process" that follows a Last Call if substantial comments are received in the Last Call, during which a proposed revised text is available on the ITU web site for consideration as a candidate for final approval.
* **AHG**: Ad hoc group.
* **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.
* **APS**: Active parameter sets.
* **ARC**: Adaptive resolution conversion (synonymous with DRC, and a form of RPR).
* **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**: May refer either to block copy (see CPR or IBC) or backward compatibility. In the case of backward compatibility, this often refers to what is more formally called forward compatibility.
* **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).
* **BL**: Base layer.
* **BoG**: Break-out group.
* **BR**: Bit rate.
* **BV**: Block vector (MV used for intra BC prediction, not a term used in the standard).
* **CABAC**: Context-adaptive binary arithmetic coding.
* **CBF**: Coded block flag(s).
* **CC**: May refer to context-coded, common (test) conditions, or cross-component.
* **CCP**: Cross-component prediction.
* **CD**: Committee draft – a draft text of an international standard for the first formal ballot stage of the approval process in ISO/IEC – corresponding to a PDAM for amendment texts.
* **CE**: Core experiment – a coordinated experiment for which there is a draft design and associated test model software that have been established, e.g., as in experiments conducted after the 3rd or subsequent JCT-VC meeting and approved to be considered a CE by the group (see also SCE and SCCE, and TE).
* **CGS**: Colour gamut scalability (historically, also coarse-grained scalability).
* **CL-RAS**: Cross-layer random-access skip.
* **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 sometimes called a block vector, in a manner basically the same as motion-compensated prediction.
* **Consent**: A step taken in the ITU-T to formally move forward a text as a candidate for final approval (the primary stage of the ITU-T "alternative approval process").
* **CTC**: Common test conditions – a set of agreed conditions for coding experiments.
* **CVS**: Coded video sequence.
* **DAM**: Draft amendment – a draft text of an amendment to an international standard for the second formal ballot stage of the approval process in ISO/IEC – corresponding to a DIS for complete texts.
* **DCT**: Discrete cosine transform (sometimes used loosely to refer to other transforms with conceptually similar characteristics).
* **DCTIF**: DCT-derived interpolation filter.
* **DIS**: Draft international standard – the second formal ballot stage of the approval process in ISO/IEC – corresponding to a DAM for amendment texts.
* **DF**: Deblocking filter.
* **DRC**: Dynamic resolution conversion (synonymous with ARC, and a form of RPR).
* **DT**: Decoding time.
* **ECS**: Entropy coding synchronization (typically synonymous with WPP).
* **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 of AVC or HEVC).
* **EL**: Enhancement layer.
* **ET**: Encoding time.
* **ETM**: Experimental test model (design and software used for prior HDR/WCG coding experiments in MPEG).
* **FDAM**: Final draft amendment – a draft text of an amendment to an international standard for the third formal ballot stage of the approval process in ISO/IEC – corresponding to an FDIS for complete texts.
* **FDIS**: Final draft international standard – a draft text of an international standard for the third formal ballot stage of the approval process in ISO/IEC – corresponding to an FDAM for amendment texts.
* **HDR**: High dynamic range – referring to video content having a brightness range that includes values greater than approximately 100 nits (often implicitly including WCG as well, since HDR video is typically also WCG video).
* **HDR10**: A term that refers to the single-layer coding of HDR/WCG video content using the HEVC Main 10 profile with a Y′CbCr 4:2:0 10 bit per sample colour representation with ITU-R BT.2020 colour primaries and the PQ transfer characteristics EOTF.
* **HEVC**: High Efficiency Video Coding – the video coding standard developed and extended by the JCT-VC, formalized in ITU-T as Rec. ITU-T H.265 and in ISO/IEC as ISO/IEC 23008-2.
* **HLS**: High-level syntax.
* **HM**: HEVC Test Model – the draft reference software and its (non-normative) encoder algorithms used for HEVC experiments.
* **HRD**: Hypothetical reference decoder.
* **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 (esp. 8 bits per sample) source video is encoded using higher bit-depth signal processing, ordinarily including higher bit-depth reference picture storage (esp. 12 bits per sample).
* **IBF**: Intra boundary filtering.
* **ILP**: Inter-layer prediction (in scalable coding).
* **IPCM**: Intra pulse-code modulation (as in AVC and HEVC).
* **JM**: Joint model – the primary software codebase and associated (non-normative) encoding algorithms 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.
* **Last Call**: The stage of the ITU-T "alternative approval process" that follows Consent, during which a proposed text is available on the ITU web site for consideration as a candidate for final approval.
* **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.
* **LM**: Linear model.
* **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.
* **MANE**: Media-aware network element.
* **MC**: Motion compensation.
* **MCTS**: Motion-constrained tile set.
* **MOS**: Mean opinion score – a measurement of subjective video quality as reported by human test subjects.
* **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 JCT-VC).
* **MV**: Motion vector; alternatively, multiview.
* **MV-HEVC**: A set of extensions of HEVC using layered coding to enable the coding of video with multiple views or depth maps.
* **NAL**: Network abstraction layer (as in AVC and HEVC, contrast with VCL).
* **NCL**: Non-constant luminance, a type of colour difference representation.
* **Nits**: Candelas per square metre (cd/m2).
* **NB**: National body (usually used in reference to NBs of the WG 11 parent body).
* **NSQT**: Non-square quadtree.
* **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., light input to a camera) to output light (e.g., light emitted by a display).
* **PCP**: Parallelization of context processing.
* **PDAM**: Proposed draft amendment – a draft text of an amendment to an international standard for the first formal ballot stage of the ISO/IEC approval process – corresponding to a CD for complete texts.
* **PDTR**: Proposed draft technical report – the draft of a TR that is sent for a ballot in the ISO/IEC approval process.
* **POC**: Picture order count.
* **PoR**: Plan of record.
* **PPS**: Picture parameter set (as in AVC and HEVC).
* **PQ**: Perceptual quantization – the name given to an HDR EOTF curve specified in SMPTE ST 2084 and Rec. ITU-R BT.2100.
* **QM**: Quantization matrix (as in AVC and HEVC).
* **QP**: Quantization parameter (as in AVC and HEVC, sometimes confused with quantization step size).
* **QT**: Quadtree.
* **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.
* **RExt**: Format range extensions – a set of extensions of HEVC addressing high bit rate operation, high bit depths, and alternative chroma formats such as monochrome, 4:2:2, 4:4:4, high bit depths, and high throughput.
* **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.
* **SCC**: Screen content coding.
* **SCE**: Scalability core experiment (for SHVC).
* **SCCE**: Screen content core experiment (for SCC).
* **SCM**: Screen coding model (for SCC).
* **SD**: Slice data; alternatively, standard-definition.
* **SDR**: Standard dynamic range – referring to video content having a brightness range that would produce a maximum brightness of approximately 100 nits on a reference display under reference viewing conditions.
* **SEI**: Supplemental enhancement information (as in AVC and HEVC).
* **SH**: Slice header.
* **SHM**: Scalable HM (for SHVC).
* **SHVC**: Scalable high efficiency video coding – a set of extensions of HEVC that uses layered coding to enable the coding of supplemental pictures, quality enhancement layers, spatial resolution enhancement layers, and colour gamut enhancement layers.
* **SIMD**: Single instruction, multiple data.
* **SPS**: Sequence parameter set (as in AVC and HEVC).
* **Supplement**: In ITU-T terminology, a document that assists its readers by providing non-normative information and suggestions (sometimes considered a TR in ISO/IEC terminology).
* **SVC**: Scalable video coding, especially when referring to the associated extensions of AVC.
* **TBA/TBD/TBP**: To be announced/determined/presented.
* **TE**: Tool Experiment – a coordinated experiment conducted toward HEVC design at a more preliminary stage of work than those of CEs, e.g., as between the 1st and 2nd or 2nd and 3rd JCT-VC meetings, or a coordinated experiment conducted toward SHVC design between the 11th and 12th JCT-VC meetings.
* **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.
* **TR**: Technical report – e.g., a collection of non-normative suggestion guidance on appropriate technical practices (sometimes considered a “supplement” in ITU-T terminology).
* **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 JCT-VC).
* **VCL**: Video coding layer (as in AVC and HEVC, contrast with NAL).
* **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.
* **WCG**: Wide colour gamut – referring to video content having a colour gamut that includes colours substantially outside of the range of values that is representable using Rec. ITU-R BT.709.
* **WD**: Working draft – a term for a draft standard, especially one prior to its first ballot in the ISO/IEC approval process, although the term is sometimes used loosely to refer to a draft standard at any actual stage of parent-level approval processes.
* **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**:
  + **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.
  + **LCU**: (formerly LCTU) largest coding unit (name formerly used for CTU before finalization of HEVC version 1).
  + **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[[1]](#footnote-2) in HEVC.
  + **PU**: Prediction unit (containing both luma and chroma), the level of the prediction control syntax1 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).

## Liaison activity

The JCT-VC did not directly send or receive formal liaison communications at this meeting. However, there was an exchange of status and project information between the parent bodies.

Additionally, ITU-T SG16 received an incoming liaison letter [SG16-TD 443/Gen](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG16-200622-TD-GEN-0443), from SMPTE on the first edition “Usage of video signal type code points” technical report (for which JCT-VC had recently completed a revised second edition). For further notes about the information provided in this letter, see the section below discussing JCTVC-AL0002. It was understood by JCT-VC that the VCEG parent body would respond with thanks to the information provided by SMPTE.

## Opening remarks and status of work items

Opening remarks included:

* Meeting logistics, review of policies and communication practices, attendance recording, and registration and badge pick-up reminders
* It was noted that number of contributions to this meeting has continued to be low relative to a few years ago.

Primary topic areas were noted as follows: (additional detail on the status for reference software and conformance would also be desirable)

* HEVC text status:
  + The the 6th ed. for ITU had been Consented in 2019-03, approved in 2019-06, and published on 2019-09-23; and the 7th ed. had been approved in 2019-11 and published 2020-01-10.
  + The 3rd ed. for ISO/IEC had been published in 2017-10, and the 4th edition for ISO/IEC had an FDIS and a DoC issued at the meeting of 2019-01 and had a DIS approved for registration as FDIS on 2019-02-18.
  + DAM1 to the 4th edition had been issued in ISO/IEC at the 2019-01 meeting, containing the annotated regions and fisheye video SEI messages (which were also not yet in the ITU 5th and 6th editions). The DAM ballot started 2019-07-10, and closed 2019-10-02, and an FDAM text was issued at the 2019-10 meeting.
  + Software for some of the newer SEI messages became available as of the previous meeting of 2019-10 (fisheye and annotated regions).

Issuing a new edition of software and conformance testing may also be possible.

* AVC status:
  + In ISO/IEC, FDAM 1 for adding SEI messages was issued in Macao (October 2018), but was then integrated into the 9th edition by an updated text issued in Marrakech (January 2019). The FDIS ballot had not yet been issued. The overall status was:
    - ISO/IEC 14496-10:2014 (Edition 8), published 2014-09
    - ISO/IEC 14496-10:2014/Amd 1:2015 (Multi-resolution frame compatible stereoscopic video with depth maps, additional supplemental enhancement information and video usability information), published 2015-11
    - ISO/IEC 14496-10:2014/FDAMD 2 (Additional Levels and Supplemental Enhancement Information); stage 50.98, deleted in preparation for Edition 9
    - ISO/IEC 14496-10:2014/Amd 3:2016 (Additional supplemental enhancement information); published 2016-12, published 2016-12
    - ISO/IEC DIS 14496-10:201x (Edition 9); stage 40.99 (DIS approved for registration as FDIS) since 2018-01-31
  + In ITU-T, a new edition was Consented in 2019-03: (06/19, Edition 13) Approved 2019-06-13, and published 2019-09-06.
* Policies of ITU-T and ISO/IEC and possible consequences for JCT-VC were noted
  + Standards editing guidelines and publication practices
  + Rules for standards under ballot in ISO/IEC
* HEVC screen content coding (SCC) status
  + Software (bug fixes and code cleanup remain needed for the SCM to become a completely adequate replacement for the HM); issuing a new edition would be appropriate if this work converges.
  + Conformance – an FDAM was issued in March (skipping FDAM). The new (2nd) edition of the basis text had been published in 2018-08. The new (3rd) edition in ITU-T had been consented at the Ljubljana meeting, Last Call closed 2018-10-13, and pre-publication occurred on 2018-11-27. No particular need for updates/corrections was identified.
  + Reference software – In the last approved version, there were errors in profile/level/constraint syntax for SCC in the SCM. At some point, we should approve a new version. However, we may wish to defer the next version until there is more to put in it.
* HDR/WCG video coding work
  + SEI/VUI has been specified in recent revised editions
  + Two TRs on this subject have been published in ITU-T and ISO/IEC:
    - Conversion and coding practices for HDR/WCG Y′CbCr 4:2:0 video with PQ transfer characteristics
      * ITU-T H.Sup15 (01/17) published 2017-04-12
      * ISO/IEC TR 23008-14:2018 published 2018-08
    - Signalling, backward compatibility and display adaptation for HDR/WCG video coding
      * ITU-T H.Sup18 (10/17) published 2018-01-18
      * ISO/IEC TR 23008-15:2018 published 2018-08
  + Reference software remains to be developed – software relating to HDR was currently in the HM separate from the SCM, plus there is a separate HDRTools library
* A new edition of the TR on signalling combinations in practical use was under preparation for publication. The original edition was H.Sup.19 in ITU-T approved 2019-03 and published 2019-04-30 and ISO/IEC 23091-4 (originally published 2019-08) in ISO/IEC. The second edition text had been issued at the meeting of 2019-10 and in ITU-T was published 2019-11-14 and in ISO/IEC was pending publication.
* Improvement of test model texts and software manuals was encouraged. An update for HM description had been produced at the previous meeting.
* It was noted that software support for the SEI messages is desirable. Together with HDRTools and 360Lib, we have software for experimentation with some SEI messages. The following items were noted to be desirable additionally.
  + Fisheye projection – the recently provided software had not seemed well tested yet.
  + Region-wise packing might be improved to illustrate the use of padding for a cubemap (some degree of support for the SEI message is available in the software)
  + Annotated regions software has been available but might benefit from further testing
* For video CICP, the publication status was noted as follows. Some recent errata reports are relevant to this.
  + Rec. ITU-T H.273 (02/16, Edition 1) Approved 2016-12-22, published 2017-04-27
  + ISO/IEC 23091-2:2019 (previously part of ISO/IEC 23001-8), published 2019-07
* Experimental uses of the HM, SCM, SHM, and HTM reference software remain of interest

Key deliverables initially planned from this meeting:

* Updated draft for shutter interval SEI message (possible PDAM for ISO/IEC)
* Updated Errata for AVC; possibly HEVC, and Video CICP
* New HM, SHM, and SCM document versions? HM17 with SCM integrated? This was not expected. (Code cleanup remains needed for the SCM to become a completely adequate replacement for the HM.)

A single meeting track was followed for the meeting discussions.

## Scheduling of discussions

Scheduling: Generally, meeting time was scheduled during 0900–2000 hours, with coffee and lunch breaks as convenient. The meeting had been announced to start with AHG reports and then proceed with review of contributions. 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:

* Fri. 10 Jan., 1st meeting session
  + 0900–0930 Opening remarks, status review
  + 0930–1000 AHG report reviews
  + 1010 JCTVC-AL0020 Deployment status
  + 1020 JCTVC-AL0021 Shutter interval SEI message modifications
  + 1030 JCTVC-AL0022 Film grain synthesis
* Wed. 15 Jan., 2nd meeting session
  + 1230 Status review
  + 1245 JCTVC-AL0023 Shutter interval SEI message modifications
  + 1300 Future planning, AHG establishment, output documents review
  + 1400 Closing of the meeting

## Contribution topic overview

The approximate subject categories and quantity of contributions per category for the meeting were summarized and categorized as follows. Some sessions were chaired by both co-chairmen, and others by only one. Chairing of discussions is noted for particular topics.

* AHG reports (7) (section 2)
* Project development status and errata reports (6) (section 3)
* Non-normative encoding practices and software development (2) (section 4)
* SEI messages (4) (section 5)
* Technical information contributions (1) (section 6)
* Outputs & planning: AHG plans, Conformance, Reference software, Verification testing, CTC (sections 7, 8, and 9)

NOTE – The number of contributions in each category, as shown in parenthesis above, may not be 100% precise.

## Topics discussed in final wrap-up at the end of the meeting

Notes on potential remainders near the end of the meeting:

* Output preparations (see section 9 for the full list)
* Plans
  + AHGs
  + CEs – None.
  + OLSs to be produced by the parent bodies (and status and project planning information exchanged between each other)
  + Reflectors (jct-vc) & sites (phenix and wftp3) to be used in future work
  + Meeting dates (next meeting to start Saturday, 18 April 2020)
  + Document contribution deadline (next meeting deadline Friday 10 April 2020)

There were no requests to present any "TBP" contributions in the closing plenary.

# AHG reports (5)

These reports were discussed Friday 10 Jan. 0930–1000 (chaired by GJS and JRO), except as otherwise noted.

[JCTVC-AL0001](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10993) JCT-VC AHG report: Project management (AHG1) [G. J. Sullivan, J.-R. Ohm]

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

In the interim period since the 36th JCT-VC meeting, work towards finalizing the following (5) documents had been performed:

* For HEVC SEI message development:
  + Draft 3 of annotated regions and fisheye video information SEI messages (JCTVC-AK1012)
  + Draft 1 of a shutter interval SEI message (JCTVC-AK1005)
* For HEVC, AVC, and Video CICP text specification maintenance, a description of current errata report items (JCTVC-AK1004)
* For non-normative guidance on HEVC encoding practices, Update 12 of the HEVC Model (HM) 16 encoding algorithm description (JCTVC-AK1002)
* For video code points coordination, Draft 6 toward version 2 of the technical report on usage of video signal type code points (JCTVC-AK1003).

The work of the JCT-VC overall had proceeded well in the interim period, although with very few input documents submitted to the current meeting (the lowest number ever at a JCT-VC meeting). Some discussion had been carried out on the group email reflector (which had approx. 1294 subscribers as of Jan. 09, 2020), and all output documents from the preceding meeting had been produced.

The output documents from the preceding meeting had been made available at the "Phenix" site (<http://phenix.it-sudparis.eu/jct/>) or the ITU-based JCT-VC site (<http://wftp3.itu.int/av-arch/jctvc-site/2019_10_AK_Geneva/>), particularly including the following:

* The meeting report (JCTVC-AK1000), posted 2020-01-09
* Draft 3 of annotated regions and fisheye video information SEI messages for HEVC (JCTVC-AK1012), posted 2020-01-07
* Draft 1 of a shutter interval SEI message for HEVC (JCTVC-AK1005), posted 2020-01-04
* For HEVC, AVC, and Video CICP text specification maintenance, a description of current errata report items (JCTVC-AK1004), posted 2019-12-21
* For non-normative guidance on HEVC encoding practices, Update 12 of the HEVC Model (HM) 16 encoding algorithm description (JCTVC-AK1002), posted 2019-12-17
* For video code points coordination, Draft 6 toward version 2 of the technical report on usage of video signal type code points (JCTVC-AK1003), posted 2019-10-21.

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

Software maintenance generally was progressing according to plans. Further action remains necessary for full integration including SCM tools as main branch.

Since the approval of software copyright header language at the March 2011 parent-body meetings, that topic seems to be resolved.

Released versions of the software are available on the SVN server at the following URL:  
https://hevc.hhi.fraunhofer.de/svn/svn\_HEVCSoftware/tags/*version\_number*,  
where *version\_number* corresponds to one of the versions described below – e.g., HM-16.20.

Intermediate code submissions can be found on a variety of branches available at:  
https://hevc.hhi.fraunhofer.de/svn/svn\_HEVCSoftware/branches/*branch\_name*,  
where *branch\_name* corresponds to a branch (eg., HM-16.20-dev).

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

The ftp site at ITU-T is used to exchange draft conformance testing bitstreams. The ftp site for downloading bitstreams is <http://wftp3.itu.int/av-arch/jctvc-site/bitstream_exchange/>.

A spreadsheet to summarize the status of bitstream exchange, conformance bitstream generation is available in the same directory. It includes the list of bitstreams, codec features and settings, and status of verification.

4 input contributions to the current meeting (not counting the AHG reports) had been registered for consideration at the meeting. These included three on SEI message development and one information document about deployment of the HEVC standard by industry.

A preliminary basis for the document subject allocation and meeting notes for the 36th meeting had been circulated to the participants by being announced in email, and was publicly available on the ITU-hosted ftp site (<http://wftp3.itu.int/av-arch/jctvc-site/2020_01_AL_Brussels/>).

[JCTVC-AL0002](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10992) JCT-VC AHG report: HEVC test model editing and errata reporting (AHG2) [B. Bross, C. Rosewarne, J.-R. Ohm, K. Sharman, G. J. Sullivan, A. M. Tourapis, Y.-K. Wang]

This document reports the work of the JCT-VC ad hoc group on (HEVC and AVC) test model editing and errata reporting (AHG2) between the 37th meeting in Geneva, CH (Oct. 2019) and the 38th meeting in Brussels, BE (Jan. 2020).

*JCTVC-AK1002 revised encoder description*

Update 12 of the Encoder Description (JCTVC-AK1002) was uploaded, incorporating the revised GOP structure for random access of JCTVC-AK0030.

Note that the released software version is described as HM16.22, in accordance with decisions made at the 37th JCT-VC meeting in Geneva. However, the latest version released at the time of the 38th JCT-VC meeting was HM16.21. The difference is the integration of proposal JCTVC-AJ0028 (merge request #11 in HM Git).

No input documents were noted as being of relevance to mandate 2 of the AHG.

*Text ticket review*

|  |  |  |
| --- | --- | --- |
| **Ticket** | **One liner** | **Status** |
| 1375 | minor fix for the spec | Confirmed fixed in H.265 (11/19) |
| 1504 | Small typos in profile\_tier\_level syntax in tabular form (7.3.3) | Aspect 1: Extra ')' is still present in H.265 (11/19) Aspect 2: sub\_layer\_profile\_compatibility\_flag missing[ i ] issue confirmed fixed in H.265 (11/19). |
| 1500 | typo in equation (8-69),(8-70) (palette\_transpose\_flag not transposing) | Confirmed present in H.265 (11/19). |
| 1499 | Equation 8-47 in v5 spec was inadvertently changed from v4 spec ('k + 1' accidently became 'k - 1' in dcVal derivation) | Confirmed fixed in H.265 (11/19). |
| 1498 | Typos in Table 9-43 (for palette\_run\_suffix PalletMaxRun should be PalletMaxRunMinus1) | Confirmed present in H.265 (11/19). |
| 1494 | Erroneous loop conditions in Table D.2.43 ( \*ps\_rbsp\_data\_length comparison should be "<" instead of "<=" to avoid an off-by-one error) | Confirmed fixed in H.265 (11/19). |
| 1491 | Duplicate invocation of 9.3.4.3 arithmetic decoding process (invoked both in 9.3.4.1 and also in 9.3.4.2). | Confirmed present in H.265 (11/19) - confirm whether action is needed) |

P. Wu commented that an error had been corrected in the specification of an SEI message for HEVC but had not been corrected for AVC. Further detail on the issue was requested.

The recommendations of the HEVC test model editing and errata reporting AHG are for JCT-VC to:

* Encourage the use of the issue tracker to report issues with the text of both the HEVC specification and the encoder description.
* Confirm resolutions of open tickets (if any) in the issue tracker and close them.
* Confirm behaviour of 3DV ATM versus the corresponding text.
* Review the above-identified input documents.

There appeared to be no action needed for the text aspect of 3D AVC.

It was commented that further improvement of the HM text description is desirable.

* VPCC is in the text description, but the software work has not yet been completed. If the description of that can be improved, it could be in an update.
* Improve the quantization description.
* Improvement of other aspects if text improvements are provided.

On the Usage of video signal type codepoints TR (aka Supplement) – information about potential issues in the ITU version were collected during the meeting as follows:

* P3D65x1000n0005 vs P3D65x1000n005
* P3D65x4000n0005 vs P3D65x4000n005
* 060e2b34.0101010e.04200401.01040000 vs. 060e2b34.0101010e.04200401.01030000
* “urn:smpte:ul:
* No reference to SMPTE registry
* “specs"” (ending in quote mark)
* “and the combination is specified in ITU-R and/or SMPTE specifications”
* 7.2.3 note below table 5 add “(Rec. ITU-R BT.709)” to the sentence: "ATSC specifications list use of the transfer characteristics value of 1 for SDR NCG  (Rec. ITU-R BT.709) video"

Small English suggestion for 7.2.4:  
“It is important for tools to process video according to the colour volume it is operating in to make sure the conversion is consistent.”  
==>  
It is important for tools to process video according to the colour volume it is operating in, to ensure the conversion is consistent.

Slightly awkward sentence in the same note area in 7.2.4:  
"ARIB STD B32 lists use of the transfer characteristics value 1 for HD and 14 for UHD for SDR WCG video.”  
==>  
"ARIB STD B32 lists use of the transfer characteristics value 1 for HD (Rec. ITU-R BT.709) and 14 for UHD SDR WCG (Rec. ITU-R BT.2020) video.”

* To the last sentence in 7.2.4, add as

The indicated chroma sample location alignment is only applicable for 4:2:0 chroma sampling. ChromaLocType (the generic label used in this document for the HEVC and AVC bitstream syntax elements: chroma\_sample\_loc\_type\_top\_field and chroma\_sample\_loc\_type\_bottom\_field), listed in Tables 1 and 3 of this document, indicates the 4:2:0 chroma sample position alignment.   
==>  
The indicated chroma sample location alignment is only applicable for 4:2:0 chroma sampling. ChromaLocType (the generic label used in this document for the HEVC and AVC bitstream syntax elements: chroma\_sample\_loc\_type\_top\_field and chroma\_sample\_loc\_type\_bottom\_field), listed in Tables 1 and 3 of this document, indicates the 4:2:0 chroma sample position alignment.  The Rec. ITU-R program signal exchange series (BT.601, BT.709, BT.2020, BT.2100) consider 4:2:2 and 4:4:4 chroma samples to be co-sited with luma.

* Also insert parenthetic details in Annex A

The transfer characteristics indicator values of 1, 6, 14, and 15 are functionally the same. Blu-ray BD-ROM 3.1 (“4K”) and the DVB UHD specifications list use of the transfer characteristics value of 14 for SDR/WCG (Rec. ITU-R BT.2020) video. ATSC specifications list use of the transfer characteristics value of 1 for SDR video. ARIB STD B32 lists use of the transfer characteristics value 1 for HD and 14 for UHD for SDR WCG video.  
==>  
The transfer characteristics indicator values of 1, 6, 14, and 15 are functionally the same. Blu-ray BD-ROM 3.1 (“4K”) and the DVB UHD specifications list use of the transfer characteristics value of 14 for SDR/WCG (Rec. ITU-R BT.2020) video. ATSC specifications list use of the transfer characteristics value of 1 for SDR NCG (Rec. ITU-R BT.709) and SDR WCG (Rec. ITU-R BT.2020) video. ARIB STD B32 lists use of the transfer characteristics value 1 for HD (Rec. ITU-R BT.709) and 14 for UHD SDR WCG (Rec. ITU-R BT.2020) video.

* General: Review parentheticals
* General: Review/rephrase instances of “and that”.

For AVC:

* A report from P. Wu:

**num\_sample\_shift\_plus512[** i **]** indicates the recommended additional horizontal shift for a stereo-pair corresponding to the i-th reference baseline and the i-th reference display. If ( num\_sample\_shift\_plus512[ i ] − 512 ) is less than 0, it is recommended that the left view of the stereo-pair corresponding to the i-th reference baseline and the i-th reference display is shifted in the left direction by ( 512 − num\_sample\_shift\_plus512[ i ] ) samples with respect to the right view of the stereo-pair; if num\_sample\_shift\_plus512[ i ] is equal to 512, it is recommended that shifting is not applied; **if ( num\_sample\_shift\_plus512[ i ] − 512 ) is greater than 0**, it is recommended that the left view in the stereo-pair corresponding to the i-th reference baseline and the i-th reference display should be shifted in the right direction by **( 512 − num\_sample\_shift\_plus512[ i ] )** samples with respect to the right view of the stereo-pair. The value of num\_sample\_shift\_plus512[ i ] shall be in the range of 0 to 1023, inclusive.

[Ping Wu]:  if ( num\_sample\_shift\_plus512[ i ] − 512 ) , then ( 512 − num\_sample\_shift\_plus512[ i ] ) is a negative value. The correct one is: ( num\_sample\_shift\_plus512[ i ]−512 ) .

In the HEVC spec, it is correct (i.e., has been corrected).

In HEVC:

* In D.3.41.6.2 (Projection for one sample location), it says that there are inputs to the process that are “pictureWidth and pictureHeight, which are the width and height, respectively, of a monoscopic projected luma picture, in relative projected picture sample units” and “the centre point of a sample location (hPos, vPos) along the horizontal and vertical axes, respectively, in relative projected picture sample units, where hPos and vPos may have non-integer real values”. It does not seem clear what this means.
* The pictureWidth and pictureHeight variables are also modified internally in D.3.41.6.2, which seems potentially unwise.
* D.3.41.6.4 (Conversion of sample locations for rectangular region-wise packing) has inputs that are “offset values for the sampling position (offsetX, offsetY)”. D.3.41.6.5 says “offsetX is set equal to 0.5 and offsetY is set equal to 0.5.” Are those the only values that are ever used?
* The variable names offsetX and offsetYare also used in 8.5.3.2 for something different. It may be unwise to use the same variable names in Annex D.
* The first sentence of D.3.41.6.5 (Mapping of luma sample locations within a cropped decoded picture to sphere coordinates relative to the global coordinate axes) says “This clause specifies the semantics of luma sample locations within a cropped decoded picture to sphere coordinates relative to the global coordinate axes.” Here, “semantics” should probably be “mapping”.
* In the ITU-T version of HEVC and the w18881 MPEG document for FDAM1, in the semantics of ar\_object\_label\_update\_flag, “will not” is repeated.
* In the ITU-T version (2019-11), the level 5 heading format for D.3.41.7.3 through 6 is messed up.
* D.3.41.7.7 is only for fisheye; fisheye is somewhat handled separately; is this clear enough?

[JCTVC-AL0003](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10994) JCT-VC AHG report: Software development and software technical evaluation (AHG3) [K. Sühring, B. Li, K. Sharman, V. Seregin, G. Tech, A. Tourapis]

This report summarizes the activities of the AhG on HEVC HM, SCM, SHM, HTM and HDRTools software development and software technical evaluation that have taken place between the 37th and 38th JCT-VC meetings.

The current software model versions were:

* [HM-16.21](https://vcgit.hhi.fraunhofer.de/jct-vc/HM/-/tags/HM-16.21) (Oct. 2019)
  + (svn [HM 16.20](https://hevc.hhi.fraunhofer.de/trac/hevc/browser/tags/HM-16.20) (Sep. 2018) )
* [HM-16.20+SCM-8.8](https://vcgit.hhi.fraunhofer.de/jct-vc/HM/-/tags/HM-16.20+SCM-8.8) (svn [HM 16.20 + SCM 8.8](https://hevc.hhi.fraunhofer.de/trac/hevc/browser/tags/HM-16.20%2BSCM-8.8)) (Mar. 2018)
* [SHM 12.4](https://hevc.hhi.fraunhofer.de/trac/shvc/browser/SHVCSoftware/tags/SHM-12.4) (Jan. 2018)
* [HTM 16.3](https://hevc.hhi.fraunhofer.de/trac/3d-hevc/browser/3DVCSoftware/tags/HTM-16.3) (Jul. 2018)
* [JM 19.0](JM%2019.0)
* [3DV ATM 15.0](https://vcgit.hhi.fraunhofer.de/jct-vc/3dv-atm/-/tags/3DV-ATM_v15.0)
* [HDRTools 0.19.1](https://gitlab.com/standards/HDRTools/-/tags/v0.19.1) (Sep. 2019)

There had not been any further releases of the HM reference software other than HM16.21, which was released during the previous meeting.

Remaining for future revisions:

* The adopted changes in JCTVC-Y0038 that include changes in the closed-GOP settings, which require coordination with JVET for JEM development.
* JCTVC-AG0026 (Random Access encoding with HM for video-based point cloud coding): Software was provided and reviewed in several rounds. There were concerns from the software coordinators regarding structure and interaction with interlace coding, which had not been resolved yet.
* JCTVC-AJ0028 (Encoder-only Supplemental Motion Vector Estimation for Point cloud Coding content) – to review MR on HM. No corresponding text was provided for AHG2 for this. The software release target for this was thus deferred to HM 16.22. It was agreed that we should make sure this doesn't get checked into the software without adequate documentation; it was reported that the document that had been provided about this has insufficient detail.
* JCTVC-AK0030 (Change to random-access encoder configuration).

The coordinators highlighted that JVET introduced a “Low Delay B” configuration change, and that it is encouraged that a similar (but conforming) change should be investigated for HM.

In addition, a merge request had been made for the shutter interval SEI message, as specified in JCTVC-AK0026 (“It was agreed to output a first draft text for this.”). This merge request also includes the addition of encoder support for film grain characteristics, content light level and ambient viewing environment SEI messages.

The following SEI messages did not have any support:

* Motion-constrained tile sets extraction info nesting (159)
* SEI manifest (JCTVC-AG1005) (200)
* SEI prefix indication (JCTVC-AG1005) (201)

The following SEI messages currently did not have control mechanisms to configure the encoder to form them (although there is code to put the messages in the bit-stream):

* Pan scan rectangle (payloadType == 2)
* Filler data payload (3)
* User data registered by ITU T T35 (4)
* User data unregistered (5)
* Scene information (9)
* Picture snapshot (15)
* Progressive refinement segments (16, 17)
* Film grain characteristics (19)
* Post filter hint (22)
* Deinterlace field identification (143)
* Content light level information (144)
* Dependent RAP indication (145)
* Coded region completion (146)
* Ambient viewing environment (148)

The following are persistent bug reports where study is encouraged (there were no recent updates in this list):

* High level picture types: IRAP, RASL, RADL, STSA:

Tickets #1096, #1101, #1333, #1334, #1346.

* Rate-control and QP selection – numerous problems with multiple slices:

Tickets #1314, #1338, #1339.

* Field-coding:

Tickets #1145, #1153.

* Decoder picture buffer:

Tickets #1277, #1286, #1287, #1304.

* NoOutputOfPriorPicture processing:

Tickets #1335, #1336, #1393.

* Additional decoder checks:

Tickets #1367, #1383.

There had not been any further developments to SCM during this meeting cycle.

There had not been any further developments to SHM’s SHVC during this meeting cycle.

There had not been any updates to the HTM of MV-HEVC and 3D-HEVC.

There had not been any updates of the HDRTools.

There had not been any updates to the JM, JSVM and JMVM software.

The AHG recommended to

* Continue to develop reference software based on HM 16.21, HM 16.20 + SCM 8.8, SHM 12.4, HTM 16.3 and HDRTools 0.19.1 and improve their quality.
* Test the reference software more extensively outside of common test conditions.
* Add more conformance checks to the decoder to more easily identify non-conforming bit-streams, especially for profile and level constraints.
* Encourage people who are implementing HEVC based products to report all (potential) bugs that they are finding in that process.
* Encourage people to submit bitstreams that trigger bugs in the HM. Such bitstreams may also be useful for the conformance specification.
* Encourage people to submit configuration files that trigger bugs in HDRTools.
* Continue to investigate the merging of branches.
* Keep common test conditions aligned with JVET.

In discussion, the following were noted:

* The change for the new GOP structure for RA (JCTVC-AK0030) was not yet in a released version.
* Help with the SCM cleanup would particularly be appreciated.
* A new merge request providing software for several SEI messages was noted and appreciated, and was pending review.
* The 3DV software needs updating to fix the mismatch issue.
* A git repository for JM software with cmake had reportedly been developed and was available on the same server as the JVET VTM software; checking that would be appreciated. This has involved various changes to correct compiler compatibility issues.

[JCTVC-AL0004](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10995) JCT-VC AHG report: Supplemental enhancement infomation (AHG4) [J. Boyce, C. Fogg, S. McCarthy, H.-M. Oh, G. J. Sullivan, Y.-K. Wang]

This document summarizes the activity of AHG4: Supplemental enhancement information between the 37th meeting in Geneva, CH (October 2019) and the 38th meeting in Brussels, BE (January 2020).

The main activity of the AHG was to prepare the following output documents:

* JCTVC-AK1005 “Shutter interval SEI message for HEVC (Draft 1)”
* JCTVC-AK1012 “Annotated regions and fisheye video information SEI messages for HEVC (Draft 3)”.

The JCTVC-AK1012 document was used as the basis for ITU-T consent of H.265 (V7).

There was no email reflector discussion, which is to take place on the main JCT-VC reflector.

There were two SEI related input contributions.

* One contribution is a proposed revision of an SEI message already present in a draft specification.
  + JCTVC-AL0021 Proposed modifications of the draft shutter interval information SEI message syntax [G. J. Sullivan (Microsoft)]
* One contribution proposes a new SEI message, on the condition that a corresponding version of the SEI message is adopted to VVC.
  + JCTVC-AL0022 Film Grain Synthesis Support in AVC and HEVC [A. M. Tourapis, K. Rapaka, D. Singer, K. Kolarov (Apple)]

Software for the Annotated regions SEI message in JCTVC-AK1012 had been integrated into HM 16.21.

Software for the fisheye projection format SEI message in JCTVC-AK1012 had been integrated into HM 16.21.

Software for conversions and metric calculations for the fisheye SEI format was included in the 10.0 release of the 360Lib software.

The AHG recommended to review the relevant input contributions.

[JCTVC-AL0005](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10988) JCTVC AHG report: Test sequence material (AHG5) [T. Suzuki, V. Baroncini, E. Francois, P. Topiwala, S. Wenger]

No activity was noted; the available test sequences were listed in the AHG report.

# Project development, status, and guidance (6)

## General (1)

[JCTVC-AL0020](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10987) Deployment status of the HEVC standard [G. J. Sullivan (Microsoft)]

(Review chaired by JRO, Fri 10 Jan 1010-1020)

This information contribution contains a survey of deployed products and services using the HEVC standard and the formal specifications in which it is supported, along with a brief introduction to the standard written for broad readership. Revision marking is included to show changes relative to JCTVC-AK0020-v2 of October 2019.

New deployments and developments noted since October 2019:

* CISCO released an updated report; the percentage of video traffic continues to go up
* 8K consumer TVs have begun to be released, all with HEVC support
* Croatia started broadcast based on HEVC
* LiveU says 50% of their service is HEVC
* ARM has new chip supporting 4K for surveillance
* The 8K Association has specified performance requirements for HEVC support with 60 fps HDR

It was commented that the new services Disney+, Apple TV+ and Peacock were likely using HEVC, and that there may be new cameras released from Panasonic. It was suggested that these could be included in a future update.

## Errata reports (0)

See the notes for the AHG report JCTVC-AL0002.

## Communication with parent bodies

No specific communication with the parent bodies was noted. See section 1.11 regarding liaison communication.

# Non-normative encoding and software contributions (0)

No contributions on non-normative encoding practices or software development were noted. See the AHG report JCTVC-AL0003 for further information.

# SEI message technical contributions (3)

[JCTVC-AL0021](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10986) Proposed modifications of the draft shutter interval information SEI message syntax [G. J. Sullivan (Microsoft)]

Review of this contribution was chaired by JRO, Fri 10 Jan 10:20-10:40.

This contribution discusses the draft shutter interval information SEI message as found in JCTVC-AK1005, which was adopted at the 37th JCT-VC meeting of October 2019. It asserts that the syntax has some undesirable characteristics, including the following:

* That it seems pointless and confusing to send sii\_num\_units\_in\_shutter\_interval when fixed\_shutter\_interval\_within\_clvs\_flag is equal to 0, since the syntax element has no apparent purpose or meaning in that case.
* That it seems pointless and confusing to send sii\_max\_sub\_layers\_minus1 when fixed\_shutter\_interval\_within\_clvs\_flag is equal to 1, since the syntax element has no apparent purpose in that case.
* That when the value of sps\_max\_sub\_layers\_minus1 in the SPS is equal to 0, it is strange to allow fixed\_shutter\_interval\_within\_clvs\_flag to be equal to 0, since this case becomes just an alternative way to express the same case as with fixed\_shutter\_interval\_within\_clvs\_flag to be equal to 1.
* That the syntax seems excessive in terms of bit usage, using 68 + n \* 32 bits for a CLVS with n temporal sub-layers.

Six potential variations of the syntax are proposed to address these issues.

It was agreed that these points are reasonable, and that the text could be improved accordingly. Offline discussion was then conducted with the original proponents of the SEI message, who later submitted JCTVC-AL0023. See the notes on that contribution.

[JCTVC-AL0022](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10991) Film Grain Synthesis Support in AVC and HEVC [A. M. Tourapis, K. Rapaka, D. Singer, K. Kolarov (Apple)] [late]

This contribution was discussed at 1030 on Friday 10 January.

Inspired by contribution JVET-Q0424, this contribution proposes that if the AV1 film grain synthesis model is to be adopted in VVC, such adoption should be done again in a form of a new film grain SEI message and should not, as suggested by JVET-Q0424, be a normative part of the decoding process. It is also suggested that the same SEI message is also introduced in the AVC and HEVC specifications since that may better fit existing deployed implementations.

It was commented that other models may also be of interest and that further study should be conducted.

It was discussed whether we would extend the previous SEI message.

Encoder and decoder software for the test model would be desired.

AV1 transcode was a suggested rationale for using the scheme as proposed.

As a general rule, we have been wanting to have software for actually demonstrating the functionality of proposed new SEI message features.

[JCTVC-AL0023](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10996) Additional proposed modifications of the draft shutter interval information SEI message syntax [S. McCarthy, F. Pu, T. Lu, P. Yin, W. Husak, T. Chen (Dolby)] [late]

This contribution was p. at.

This contribution discusses the draft shutter interval information SEI message as found in JCTVC-AK1005, which was adopted at the 37th JCT-VC meeting of October 2019; and proposed modifications to the draft as found in JCTVC-AL0021. JCTVC-AL0021 asserts that the syntax, as currently drafted, has undesirable characteristics, and proposes six variant syntaxes to address these issues. This contribution proposes two additional variants to address those syntax characteristics that the contributors agree are undesirable, and provides corresponding semantics.

In version 2 of this contribution, variation A is identical to variation #1 of JCTVC-AL0021. Version 2 also adds semantics to specify the presence and persistence of the shutter interval information SEI message in a CLVS.

Advantage of variant B would be that fewer bits might be necessary in most applications than variant A, as typically the sublayers would have rational factors of shutter interval duration relative to the base.

However, variant A is simpler in syntax and semantics, and the typical case would be having only 2 sublayers, such that the saving in bits would be low.

It is agreed that constraining the number of sublayers to be consistent with the number of layers in the current CLVS is appropriate.

It is also suggested that, as it is assumed that the video would be unwatchable if the SEI message appears (similar as with 360° projection maps, frame packing etc.), it is suggested that the semantics of general\_non\_packed\_constraint\_flag should be extended to this SEI message. Frame packing also has a mode of temporal interleaving which would be unwatchable in a similar way (however, only in one layer). It was concluded that this is not necessary, as it is not a big issue to display some flicker.

Software availability was asked for – only parsing software was available so far.

A reasonable post-decoder mechanism would be using the sharp pictures of layer 0 to improve the blurred pictures of layer 1. A minimum runnable implementation of such an approach was requested to be provided (it is noted that something like that exists in ATSC already).

This is a general policy that has been executed in JCT-VC in recent cases, similar software capability was requested for the fisheye and annotated regions SEI messages before progressing them.

Reference to the ATSC A/341 Annex D should be added.

Decision: Adopt JCTVC-AL0023, variant A.

The change was agreed to be included in draft 2 as an output of the current meeting. It was also agreed to progress the text to CDAM status in the ISO/IEC approval process. A request to start work on the new amendment was also agreed to be issued for ISO/IEC, and it was agreed to determine an editing period to progress to DAM at the next meeting (which would only happen upon availability of post processing software, and a demonstration).

# Technical information contributions (0)

No particular technical information contributions were noted.

# Project planning

## Joint meeting

No joint meetings with the parent bodies were held on JCT-VC matters at this meeting.

## Text drafting and software quality

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. Similarly, software coordinators have the discretion to evaluate contributed software for suitability in regard to proper code style, bugginess, etc., and to not integrate code that is determined inadequate in software quality.

## 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 CEs).

Suggestions for future meetings included the following generally supported principles:

* No review of normative contributions without draft specification text
* HM 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

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. Also, core experiment responsibility descriptions should name individuals, not just companies. AHG reports and CE descriptions/summaries are considered to be the contributions of individuals, not companies.

## General issues for CEs and TEs

Group coordinated experiments have been planned in previous work, although none were established at the current meeting. These may generally fall into one of two categories:

* "Core experiments" (CEs) are the experiments for which there is a draft design and associated test model software that have been established.
* "Tool experiments" (TEs) are the coordinated experiments on coding tools at a more preliminary stage of work than those of "core experiments".

A preliminary description of each experiment is to be approved at the meeting at which the experiment plan is established.

It is possible to define sub-experiments within particular CEs and TEs, for example designated as CEX.a, CEX.b, etc., for a CEX, where X is the basic CE number.

As a general rule, it has been agreed that each CE should be run under the same testing conditions using one software codebase, which should be based on the HM 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.

CE descriptions need to be fully precise – this is intended as a method of enabling full study and testing of a specific technology. Greater discipline in terms of what can be established as a CE may be an approach to helping with such issues. CEs should be more focused on testing just a few specific things, and the description should precisely define what is intended to be tested (available by the end of the meeting when the CE plan is approved).

It was noted that sometimes there is a problem of needing to look up other referenced documents, sometimes through multiple levels of linked references, to understand what technology is being discussed in a contribution – and that this often seems to happen with CE documents. It was emphasized that we need to have some reasonably understandable basic description, within a document, of what it is talking about.

Software study can be a useful and important element of adequate study; however, software availability is not a proper substitute for document clarity.

Software shared for CE purposes needs to be available with adequate time for study. Software of CEs should be available early, to enable close study by cross-checkers (not just provided shortly before the document upload deadline).

The general agreed common conditions for single-layer coding efficiency experiments are as described in the prior output document JCTVC-AF1100.

The general timeline agreed for CEs was expected to be as follows: 3 weeks to obtain the software to be used as the basis of experimental feature integration, 1 more week to finalize the description and participation, 2 more weeks to finalize the software.

When a CE is planned, a deadline of four weeks after the meeting would be established for organizations to express their interest in participating in a CE to the CE coordinators and for finalization of the CE descriptions by the CE coordinator with the assistance and consensus of the CE participants.

Any change in the scope of what technology will be tested in a CE, beyond what is recorded in the meeting notes, requires discussion on the general JCT-VC reflector.

As a general rule, all CEs are expected to include software available to all participants of the CE, with software to be provided within two (calendar) weeks after the release of the relevant software basis (e.g. the SCM). Exceptions must be justified, discussed on the general JCT-VC reflector, and recorded in the abstract of the summary report.

Final CE descriptions shall clearly describe specific tests to be performed, not describe vague activities. Activities of a less specific nature are delegated to Ad Hoc Groups rather than designated as CEs.

Experiment descriptions should be written in a way such that it is understood as a JCT-VC output document (written from an objective "third party perspective", not a company proponent perspective – e.g. 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 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 referenced documents that are also available in the JCT-VC document archive.

Those who proposed technology in the respective context (by this or the previous meeting) can propose a CE or CE sub-experiment. Harmonizations of multiple such proposals and minor refinements of proposed technology may also be considered. Other subjects would not be designated as CEs.

Any technology must have at least one cross-check partner to establish a CE – a single proponent is not enough. It is highly desirable to have more than just one proponent and one cross-checker.

It is strongly recommended to plan resources carefully and not waste time on CE work on technology that may have little or no apparent benefit – it is also within the responsibility of the CE coordinator to take care of this.

A summary report written by the coordinator (with the assistance of the participants) is expected to be provided to the subsequent meeting. The review of the status of the work on the CE at the meeting is expected to rely heavily on the summary report, so it is important for that report to be well-prepared, thorough, and objective.

A non-final CE plan document would be reviewed and given tentative approval during the meeting (with guidance expressed to suggest modifications to be made in a subsequent revision).

The CE description for each planned CE would be described in an associated output document numbered as, for example, JCTVC-XX11xx for CExx, where "xx" is the CE number (xx = 01, 02, etc.). Final CE plans would be recorded as revisions of these documents.

It must be understood that the JCT-VC is not obligated to consider the test methodology or outcome of a CE as being adequate. Good results from a CE do not impose an obligation on the group to accept the result (e.g., if the expert judgment of the group is that further data is needed or that the test methodology was flawed).

Some agreements relating to CE activities have been established as follows:

* Only qualified JCT-VC members can participate in a CE.
* Participation in a CE is possible without a commitment of submitting an input document to the next meeting.
* All software, results, documents produced in the CE should be announced and made available to all CE participants in a timely manner.
* If combinations of proposals are intended to be tested in a CE, the precise description shall be available with the final CE description; otherwise it cannot be claimed to be part of the CE.

## Alternative procedure for handling complicated feature adoptions

The following alternative procedure had been approved at a preceding meeting as a method to be applied for more complicated feature adoptions:

1. Run CE + provide software + text, then, if successful,
2. Adopt into HM, including refinements of software and text (both normative & non-normative); then, if successful,
3. Adopt into WD and common conditions.

Of course, we have the freedom (e.g. for simple things) to skip step 2.

## Common test conditions for HEVC Coding Experiments

No particular changes were noted w.r.t. the prior CTC for work within the current scope of JCT-VC. See the prior output documents JCTVC-AF1100 for HEVC test conditions, JCTVC-X1009 for SHVC test conditions, JCTVC-Z1015 for SCC test conditions, and JCTVC-Z1020 for HDR/WCG test conditions.

## Software development planning

Software coordinators were asked to work out the detailed schedule for software updates with the proponents of adopted changes as applicable.

Any adopted proposals where necessary software is not delivered by the scheduled date in a timely manner may be rejected.

At a previous meeting (Sapporo, July 2014), it was noted that it should be relatively easy to add MV-HEVC capability to the SHVC software, and it was strongly suggested that this should be done. This remains desirable. Further study was encouraged to determine the appropriate approach to future software maintenance, especially in regard to alignment of 3D video software with the SHM software.

# 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 JCT-VC reflector ([jct-vc@lists.rwth-aachen.de](mailto:jct-vc@lists.rwth-aachen.de)).

|  |  |  |
| --- | --- | --- |
| **Title and Email Reflector** | **Chairs** | **Mtg** |
| **JCT-VC project management (AHG1)**  ([jct-vc@lists.rwth-aachen.de](mailto:jct-vc@lists.rwth-aachen.de))   * Coordinate overall JCT-VC interim efforts. * Report on project status to JCT-VC reflector. * Provide a report to next meeting on project coordination status. | G. J. Sullivan, J.-R. Ohm (co‑chairs) | N |
| **Test model editing and errata reporting (AHG2)**  ([jct-vc@lists.rwth-aachen.de](mailto:jct-vc@lists.rwth-aachen.de))   * Produce and propose improvements to the JCTVC-AL1002 HEVC Test Model 16 (HM 16) Update 13 of Encoder Description * Collect reports of errata for the HEVC, AVC, CICP, the Usage TR specification and the published HDR-related technical reports. * Gather and address comments for refinement of these documents. * Coordinate with AHG3 on software development and software technical evaluation to address issues relating to mismatches between software and text. | B. Bross, C. Rosewarne (co‑chairs), J.‑R. Ohm, K. Sharman, G. J. Sullivan, A. Tourapis, Y.‑K. Wang (vice‑chairs) | N |
| **Software development and software technical evaluation (AHG3)**  ([jct-vc@lists.rwth-aachen.de](mailto:jct-vc@lists.rwth-aachen.de))   * Coordinate development of the HM, SCM, SHM, HTM, MFC, MFCD, JM, JSVM, JMVM, 3DV-ATM, and HDRTools software and their distribution. * Enable software support for recently standardized additional SEI messages. * Produce documentation of software usage for distribution with the software. * Prepare and deliver results, reporting templates, and anchor test results according to JCT-VC common conditions. * Suggest configuration files for additional testing of tools. * Investigate how to minimize the number of separate codebases maintained for group reference software. * Coordinate with AHG2 on HEVC and AVC test model editing and errata reporting to identify any mismatches between software and text. | K. Sühring (chair), B. Li, K. Sharman, V. Seregin, G. Tech, A. Tourapis (vice‑chairs) | N |
| **Supplemental enhancement information (AHG4)**  ([jct-vc@lists.rwth-aachen.de](mailto:jct-vc@lists.rwth-aachen.de))   * Produce and study the draft text JCTVC-AL1005 (shutter interval) for HEVC * Study the status of text and potential needs for SEI messages for AVC. * Consider proposals for additional SEI message data and associated syntax and semantics specification. * Develop usage scenario descriptions and showcase demonstrations. * Coordinate with AHG3 for software support of SEI messages. | J. Boyce (chair), C. Fogg, S. McCarthy, H.-M. Oh, G. J. Sullivan, Y.-K. Wang (vice‑chairs) | N |
| **Test sequence material (AHG5)**  ([jct-vc@lists.rwth-aachen.de](mailto:jct-vc@lists.rwth-aachen.de))   * Maintain the video sequence test material database for development of HEVC and its RExt, SHVC and SCC extensions. * Identify, collect, and make available a variety of video sequence test material, especially focusing on new needs for HDR/WCG test material and corresponding SDR test material. * Study coding performance and characteristics in relation to video test materials. * Identify and recommend appropriate test materials and corresponding test conditions for use in development of HEVC and its extensions. * Coordinate with the activities in AHG3 and AHG6 regarding HDR/WCG testing. | T. Suzuki, V. Baroncini (co‑chairs), E. François, P. Topiwala, S. Wenger (vice‑chairs) | N |

# Output documents

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.

[JCTVC-AL1000](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11007) Meeting Report of the 38th JCT-VC Meeting [G. J. Sullivan, J.-R. Ohm (chairs)] [2020-04-03] (near the next meeting)

Remains valid – not updated: [JCTVC-H1001](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=5095) HEVC software guidelines [K. Sühring, D. Flynn, F. Bossen (software coordinators)]

[JCTVC-AL1002](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11000) High Efficiency Video Coding (HEVC) Test Model 16 (HM 16) Encoder Description Update 13 [C. Rosewarne (primary editor), K. Sharman, R. Sjöberg, G. J. Sullivan (co-editors)] (WG 11 N 19122) [2020-04-03] (near next meeting)

This will include a description of the GOP16 structure. The description of the PCC motion search hint functionality of JCTVC-AJ0028 should also be improved. These are to be supported in the HM16.22 software release.

No output: JCTVC-AL1003

[JCTVC-AL1004](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11006) Errata report items for HEVC, AVC, Video CICP, and CP usage TR [G. J. Sullivan, Y. Syed, Y.-K. Wang] [2020-04-03] (near next meeting)

[JCTVC-AL1005](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10997) Shutter interval SEI message for HEVC (Draft 2) [S. McCarthy, G. J. Sullivan, Y.-K. Wang] (WG 11 CDAM N 19121) (2020-02-07)

A request to start work on the new amendment was also issued for WG 11 as WG 11 N 19120.

No output: JCTVC-AK1006

Remains valid – not updated: [JCTVC-V1007](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=10312) SHVC Test Model 11 (SHM 11) Introduction and Encoder Description [G. Barroux, J. Boyce, J. Chen, M. M. Hannuksela, Y. Ye (editors)] (WG 11 [N 15778](http://phenix.it-sudparis.eu/mpeg/doc_end_user/current_document.php?id=53941&id_meeting=165))

No output: JCTVC-AK1008

Remains valid – not updated: [JCTVC-X1009](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=10572) Common Test Conditions for SHVC [V. Seregin, Y. He (editors)]

Remains valid – not updated [JCTVC-O1010](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=8511) Guidelines for Conformance Testing Bitstream Preparation [T. Suzuki, W. Wan (editors)]

No output: JCTVC-AL1011

No output: JCTVC-AL1012

No output: JCTVC-AL1013

Remains valid – not updated [JCTVC-V1014](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=10316) Screen Content Coding Test Model 7 Encoder Description (SCM 7) [R. Joshi, J. Xu, R. Cohen, S. Liu, Y. Ye (editors)] (WG 11 [N 16049](http://phenix.it-sudparis.eu/mpeg/doc_end_user/current_document.php?id=54889&id_meeting=166))

Remains valid – not updated: [JCTVC-Z1015](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=10689) Common Test Conditions for Screen Content Coding [H. Yu, R. Cohen, K. Rapaka, J. Xu (editors)] [2017-02-17]

No output: JCTVC-AL1016 through JCTVC-AL1019

Remains valid – not updated: [JCTVC-Z1020](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=10692) Common Test Conditions for HDR/WCG Video Coding Experiments [E. François, J. Sole, J. Ström, P. Yin (editors)] [2017-02-17] (1 month)

Remains valid – not updated: – [JCTVC-AF1100](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=10693) Common Test Conditions for HM Video Coding Experiments [K. Sharman, K. Sühring (editors)] [2018-09-14]

(Revision only to be issued if needed for coordination; no such need was identified.)

# 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 (usually starting meetings on the Thursday or Friday of the first week and closing it on the Tuesday or Wednesday of the second week of the SG 16 meeting – a total of 5–6.5 meeting days), and
* Otherwise meeting under ISO/IEC JTC 1/SC 29/WG 11 auspices when it meets (starting meetings on the Saturday prior to such meetings and closing it on the last day of the WG 11 meeting – a total of 6.5 meeting days).

Some specific future meeting plans (to be confirmed) were established as follows:

* Sat. 18 – Fri. 24 April 2020, 39th meeting, under WG 11 auspices in Alpbach, AT (post-meeting note: the planned Alpbach meeting was later converted to a teleconference-based meeting in response to the COVID-19 pandemic)
* Thu. 25 June – Wed. 1 July 2020, 40th meeting, under ITU-T SG16 auspices in Geneva, CH
* Fri. 9 – Fri. 16 October 2020, 41st meeting, under WG 11 auspices in Rennes, FR
* Fri. 8 – Fri. 15 January 2021, 42nd meeting under WG 11 auspices in Capetown, ZA.

The agreed document deadline for the 39th JCT-VC meeting is Friday 10 April 2020. Plans for scheduling of agenda items within that meeting remained TBA.

Brussels University (ULB) was thanked for the excellent hosting and organization of the 38th meeting of the JCT-VC.

The JCT-VC meeting was closed at approximately 1400 hours on Wednesday, 15 January 2020.

# Annex A to JCT-VC report: List of documents

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| [JCTVC-AL0001](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10993) | m52743 | 2020-01-09 10:58:11 | 2020-01-09 23:34:08 | 2020-01-10 09:38:44 | JCT-VC AHG report: Project management (AHG1) | G. J. Sullivan,  J.-R. Ohm |
| [JCTVC-AL0002](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10992) | m52739 | 2020-01-09 09:59:44 | 2020-01-09 19:31:44 | 2020-01-09 19:31:44 | JCT-VC AHG report: HEVC test model editing and errata reporting (AHG2) | [B. Bross](mailto:benjamin.bross@hhi.fraunhofer.de),  [C. Rosewarne](mailto:chris.rosewarne@canon.com.au),  [J.-R. Ohm](mailto:ohm@ient.rwth-aachen.de),  [K. Sharman](mailto:karl.sharman@eu.sony.com),  [G. J. Sullivan](mailto:garysull@microsoft.com),  [A. M. Tourapis](mailto:alexismt@apple.com),  [Y.-K. Wang](mailto:yekui.wang@bytedance.com) |
| [JCTVC-AL0003](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10994) | m52744 | 2020-01-09 11:00:09 | 2020-01-10 09:11:10 | 2020-01-10 09:11:10 | JCT-VC AHG report: Software development and software technical evaluation (AHG3) | K. Sühring,  B. Li,  K. Sharman,  V. Seregin,  G. Tech,  A. Tourapis |
| [JCTVC-AL0004](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10995) | m52745 | 2020-01-09 11:02:16 | 2020-01-09 23:27:26 | 2020-01-09 23:27:26 | JCT-VC AHG report: Supplemental enhancement infomation (AHG4) | J. Boyce,  C. Fogg,  S. McCarthy,  H.-M. Oh,  G. J. Sullivan,  Y.-K. Wang |
| [JCTVC-AL0005](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10988) | m52568 | 2020-01-07 11:33:04 | 2020-01-07 22:21:15 | 2020-01-07 22:21:15 | JCTVC AHG report: Test sequence material (AHG5) | [T. Suzuki](mailto:teruhiko.s@sony.com),  [V. Baroncini](mailto:baroncini@gmx.com),  [E. Francois](mailto:Edouard.Francois@InterDigital.com),  [P. Topiwala](mailto:pankajtva@gmail.com),  [S. Wenger](mailto:stewe@stewe.org) |
| [JCTVC-AL0020](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10987) | m52213 | 2020-01-03 23:24:25 | 2020-01-03 23:27:12 | 2020-01-04 05:11:52 | Deployment status of the HEVC standard | [G. J. Sullivan (Microsoft)](mailto:garysull@microsoft.com) |
| [JCTVC-AL0021](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10986) | m52212 | 2020-01-03 23:10:06 | 2020-01-03 23:27:32 | 2020-01-03 23:27:32 | Proposed modifications of the draft shutter interval information SEI message syntax | [G. J. Sullivan (Microsoft)](mailto:garysull@microsoft.com) |
| [JCTVC-AL0022](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10991) | m52579 | 2020-01-07 15:47:03 | 2020-01-07 15:51:19 | 2020-01-07 15:51:19 | Film Grain Synthesis Support in AVC and HEVC | [A. M. Tourapis](mailto:atourapis@apple.com),  K. Rapaka,  D. Singer,  K. Kolarov |
| [JCTVC-AL0023](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10996) | m52763 | 2020-01-10 00:24:42 | 2020-01-10 01:32:51 | 2020-01-15 11:55:46 | Additional proposed modifications of the draft shutter interval information SEI message syntax | [S. McCarthy](mailto:sean.mccarthy@dolby.com),  [F. Pu](mailto:fangjun.pu@dolby.com),  [T. Lu](mailto:tlu@dolby.com),  [P. Yin](mailto:pyin@dolby.com),  [W. Husak](mailto:wjh@dolby.com),  [T. Chen](mailto:tchen@dolby.com), |
| [JCTVC-AL1002](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11000) | m53406 | 2020-04-07 14:58:15 | 2020-04-07 14:59:23 | 2020-04-07 14:59:23 | High Efficiency Video Coding (HEVC) Test Model 16 (HM 16) Improved Encoder Description Update 13 | C. Rosewarne,  K. Sharman,  R. Sjöberg,  G. Sullivan |
| [JCTVC-AL1005](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10997) | m52944 | 2020-02-15 01:16:47 | 2020-02-15 01:19:51 | 2020-02-15 01:19:51 | Shutter interval information SEI message for HEVC (Draft 2) | S. T. McCarthy,  G. J. Sullivan,  Y.-K. Wang |

# Annex B to JCT-VC report: List of meeting participants

The participants of the thirty-eighth meeting of the JCT-VC, according to a sign-in sheet circulated during the meeting sessions (approximately 30 people in total), were as follows:

1. Ichiro Ando (Nikon)
2. Jill Boyce (Intel)
3. Benjamin Bross (Fraunhofer HHI)
4. Takeshi Chujoh (Sharp)
5. Chad Fogg (MovieLabs)
6. Ryoji Hashimoto (Renesas)
7. Walt Husak (Dolby Labs)
8. Atsuro Ichigaya (NHK (Japan Broadcasting Corp.))
9. Tomohiro Ikai (Sharp)
10. Shunsuke Iwamura (NHK (Japan Broadcasting Corp.))
11. Kei Kawamura (KDDI)
12. Konstantinos Konstantinides (Dolby Labs)
13. Sean McCarthy (Dolby Labs)
14. Shimpei Nemoto (NHK (Japan Broadcasting Corp.))
15. Tung Nguyen (Fraunhofer HHI)
16. Andrey Norkin (Netflix)
17. Jens-Rainer Ohm (RWTH Aachen Univ.)
18. Krishnakanth Rapaka (Apple)
19. Justin Ridge (Nokia)
20. Christopher Rosewarne (Canon)
21. Karl Sharman (Sony Europe)
22. Masato Shima (Canon)
23. Rickard Sjöberg (Ericsson)
24. Robert Skupin (Fraunhofer HHI)
25. Karsten Sühring (Fraunhofer HHI)
26. Gary Sullivan (Microsoft)
27. Teruhiko Suzuki (Sony)
28. Yasser Syed (Comcast Cable)
29. Alexandros Tourapis (Apple)
30. Ping Wu (ZTE UK)

1. The definitions of PB and PU are tricky for a 64x64 intra luma CB when the prediction control information is sent at the 64x64 level but the prediction operation is performed on 32x32 blocks. The PB, PU, TB and TU definitions are also tricky in relation to chroma for the smallest block sizes with the 4:2:0 and 4:2:2 chroma formats. Double-checking of these definitions is encouraged. [↑](#footnote-ref-2)