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| **Joint Collaborative Team on Video Coding (JCT-VC)of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11**40th Meeting: by teleconference, 24 June – 1 July 2020 | Document: JCTVC-AN\_Notes\_d4 |

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| *Title:* | **Meeting report of the 40th meeting of the Joint Collaborative Team on Video Coding (JCT-VC), by teleconference, 24 June – 1 July 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 fortieth meeting during 24 June – 1 July 2020 as an online-only meeting. It had previously been planned to be held in Geneva, Switzerland, at the ITU premises. The conversion of the meeting to be conducted only online was necessitated due to issues associated with the COVID-19 pandemic. 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 1900 hours UTC on Wednesday 24 June 2020 with a two-hour meeting session. Additional meeting sessions were held at 1300 hours UTC on Sunday 28 June 2020, 1300 hours UTC on Tuesday 30 June, and 2120 hours UTC on Wednesday 1 July 2020. The meeting was closed at approximately 2335 hours on Wednesday 1 July 2020. Approximately 54 people attended the JCT-VC meeting, and 5 input documents and 5 AHG reports were discussed. The meeting took place in a coordinated fashion with a meeting of SG16 – one of the two parent bodies of the JCT-VC, under whose auspices this JCT-VC meeting was held. 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 39th JCT-VC meeting in producing the outputs of that meeting:

* Draft revisions for coding-independent code points for video signal type identification (JCTVC-AM1003)
* Errata report items for HEVC, AVC, Video CICP, and Codepoint Usage Technical Report (JCTVC-AM1004)

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 4 output documents from the meeting:

* HEVC test model 16 (HM 16) encoder description (Update 14) (JCTVC-AN1002)
* Errata report items for HEVC, AVC, Video CICP, and Codepoint Usage Technical Report (JCTVC-AN1004)
* Draft annotated regions and shutter interval information SEI messages for AVC (Draft 1) (JCTVC-AN1006)
* Draft revised report on usage of video signal type code points (Draft 1) (JCTVC-AN1008)

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 document distribution site <http://phenix.int-evry.fr/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 hosted at RWTH Aachen University. For subscription to this list, see
<https://lists.rwth-aachen.de/postorius/lists/jct-vc.lists.rwth-aachen.de/>.

With JCT-VC no longer as active, and with VVC v1 finished and some future work overlapping (e.g., for SEI messages and some errata maintenance), it was expected for SG 16 to request merging JCT-VC into JVET. This was generally supported in the discussion. JVET would have a scope to include all of the joint video coding work. JCT-VC AHGs established at this meeting may report into JVET, pending SC29 consideration.

Post-meeting note: The suggestion to merge JCT-VC into JVET for future work was confirmed in liaison communication. Thus, no further meetings of JCT-VC as a distinct organization are expected.

In commemoration of the 40th meeting, the participants of the JCT-VC were thanked for all their contributions to the HEVC work.

# 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 fortieth meeting during 24 June – 1 July 2020 as an online-only meeting.. The meeting took place in a collocated fashion with a meeting of SG16 – 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 1900 hours UTC on Wednesday 24 June 2020 with a two-hour meeting session. Additional meeting sessions were held at 1300 hours UTC on Sunday 28 June 2020, 1300 hours UTC on Tuesday 30 June, and 2120 hours UTC on Wednesday 1 July 2020. The meeting was closed at approximately 2335 hours on Wednesday 1 July 2020. Approximately 54 people attended the JCT-VC meeting, and 5 input documents and 5 AHG reports were discussed. The meeting took place in a coordinated fashion with a meeting of SG16 – one of the two parent bodies of the JCT-VC, under whose auspices this JCT-VC meeting was held. 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
* 39th "AM" meeting (by telco, 2020-04) 53 people, 8 input documents
* 40th "AN" meeting (by telco, 2020-06) 54 people, 5 input documents

Information regarding logistics arrangements for the meeting had been provided via the email reflector jct-vc@lists.rwth-aachen.de and at <http://wftp3.itu.int/av-arch/jctvc-site/2020_06_AN_Virtual/>.

## Primary goals

One primary goal of the meeting was to review the work that was performed in the interim period since the 39th JCT-VC meeting in producing:

* Draft revisions for coding-independent code points for video signal type identification (JCTVC-AM1003)
* Errata report items for HEVC, AVC, Video CICP, and Codepoint Usage Technical Report (JCTVC-AM1004)

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.int-evry.fr/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) use UTC since this was an electronic meeting.

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 Tuesday, 16 June 2020.

Non-administrative documents uploaded after 2359 hours in Paris/Geneva time Wednesday 17 June 2020 were to be considered "officially late". Two of the five contributions were registered after the “officially late” deadline (and therefore were also uploaded late), as follows:

* JCTVC-AN0020, an information contribution containing a survey of the deployment status of the HEVC standard, uploaded 45 minutes after the “officially late” deadline
* JCTVC-AN0024, a report of some HEVC and AVC errata items, uploaded 06-24, revised 06-28

Also, contribution JCTVC-AN0022, an information contribution, was revised on 06-24 after the initial version was uploaded on 06-16. 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.

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.

### Outputs of the preceding meeting

The output documents of the previous meeting, particularly including the meeting report (JCTVC-AM1000), the Draft revisions for coding-independent code points for video signal type identification (JCTVC-AM1003), and the Errata report items for HEVC, AVC, Video CICP, and Codepoint Usage Technical Report (JCTVC-AM1004), were approved.

The group was initially asked to review the prior meeting report for finalization. The meeting report was later approved after minor clerical refinements (as recorded in revision marks in the -v3 document).

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

## Attendance

The list of participants in the JCT-VC meeting can be found in Annex B of this report. It was generated from the electronic attendance record generated by the Zoom tool that was used for conducting the meeting.

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.

It was further announced that it is necessary to register for the meeting on the SG16 website. Access to the teleconference sessions of the JCT-VC meeting was controlled with a password. Due to the difficulty of determining how to send the password only to registered participants, the password was simply sent to the JCT-VC email reflector. No particular problems were observed that resulted in interference with the meeting due to the lack of strict access control.

The following rules had been established for the Zoom teleconference meeting:

* Use the “hand-raising” function to enter yourself in the queue to speak (unless otherwise instructed by the session chair). If you are dialed in by phone, request your queue position verbally.
* Stay muted unless you have something to say. (people were muted by default when they join and would need to unmute themselves to speak. The chair may mute anyone who is disrupting the proceedings (e.g. by forgetting they have a live microphone while chatting with their family or by causing bad noise or echo).
* Identify who you are and your affiliation when you begin speaking.
* Use your full name and company/organization affiliation in your joining information. We will use the participation list for attendance records.
* Turn on the chat window and watch for chair communication and side commentary there as well as by audio.
* Avoid overloading people’s internet connections, we do not plan to use video for the teleconferencing calls – only voice and screen sharing. Extensive use of screen sharing is encouraged.

## 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
* ISO Code of Conduct, ITU-R/ITU-T/ISO/IEC 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 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 errata reports and needs for maintenance and enhancements of technical reports (a.k.a. *supplements*) on HDR/WCG video coding and usage of video signal type code point identifiers
* Consideration of information contributions and non-normative guidance relevant to the HEVC standard
* Consideration of errata reports and needs for maintenance and enhancements of the AVC standard (esp. regarding errata reports and supplemental enhancement information)
* Consideration of errata reports and needs for maintenance and enhancements of the specification of coding-independent code points for video signal type identification
* 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

## ISO Code of Conduct reminder

Participants were reminded of the ISO Code of Conduct, found at

<https://www.iso.org/publication/PUB100397.html>.

This includes points relating to:

* Respecting others
* Behaving ethically
* Escalating and resolving disputes
* Working for the net benefit of the international community
* Upholding consensus and governance
* Agreeing to a clear purpose and scope
* Participating actively and managing effective representation

## 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 meeting was conducted using the Zoom teleconferencing software tool, using a link .

A schedule of meeting sessions, with agenda items and links for the Zoom teleconferencing tool, was linked on that website.

The documents for the meeting can be found at <http://phenix.int-evry.fr/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. 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 was 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. A joint discussion between VCEG and MPEG during the meeting included tentative plans to merge JCT-VC into JVET for future work (see section 8.1).

## Opening remarks and status of work items

Opening remarks included:

* Online meeting logistics, review of policies and communication practices, attendance recording, and registration 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:

* HEVC text status:
	+ 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 meeting of 2019-10 (fisheye and annotated regions).
	+ The 4th edition FDIS and FDAM were being consolidated by the ISO Central Secretariat as a single FDIS for ballot
	+ Work item 1 – for possible Consent (with errata): The DAM 2 ballot for the shutter interval SEI message was an output of the previous meeting; however, it was agreed not to forward the document for Consent at the current meeting

Issuing a new edition of software and conformance testing could 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 [update]
	+ In ITU-T, a new edition was Consented in 2019-03: (06/19, Edition 13) Approved 2019-06-13, and published 2019-09-06.
	+ Work item 4: It was initially planned to issue a request to start work on a new edition and issue a WD for SEI messages for annotated regions and shutter interval. Target Consent in 2021-04. This should include corrections, including a persistence flag. It was agreed to add this into the corrections (also make sure the semantics allows cancellation of individual objects to be repeated). The request was later deferred to be issued at the next meeting.
* Policies of ITU-T and ISO/IEC and possible consequences for JCT-VC were noted
	+ Standards editing guidelines and publication practices
	+ ISO Coded of Conduct
	+ Rules for standards under ballot in ISO/IEC
	+ IPR policy reminder
* 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 usage 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.
	+ A new edition is needed eventually, and should include correction SMPTE identifier, which was also agreed to be included in an output errata report.
	+ Work item 3: It was planned to issue a request to start work in MPEG
* 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
	+ Work item 2: An output of previous meeting was a CD in MPEG
* 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 (not issued; DAM for ISO/IEC was an output from the January meeting)
* Updated Errata for AVC; possibly HEVC, and Video CICP
	+ Possible draft amendments/revisions for AVC, HEVC, CICP
* Proposed amendment for CICP
* Possible draft amendment for film grain
* 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.)
* Possible new TR on BD measurement

A single meeting track was followed for the meeting discussions.

## Scheduling of discussions

The plans for the times of meeting sessions were established as follows, in UTC (2 hours behind the time in Geneva, Paris; 7 hours ahead of the time in Los Angeles, etc.). No session was planned to last longer than 2 hrs. The meeting sessions were selected from the following times:

* 1300-1500 1st “afternoon” session
* 1520-1720 2nd “afternoon” session
* 1900-2100 1st “evening” session
* 2120-2320 2nd “evening” session

Only few of these session slots were used. Particular scheduling notes are shown below (all times are in UTC):

* 1900 UTC Wed. 24 June, 1st meeting session
	+ 1900–2000 Opening remarks, status review
	+ 2045 JCTVC-AN0020 Deployment status
	+ 2110–2145 AHG report reviews for AHGs 1-4
	+ 2155 JCTVC-AN0024 Errata (to include mention of an incorrect SMPTE registration code in the usage TR)
* 1300 UTC Sun. 28 June, 2nd meeting session
	+ 1305 AHG5 report
	+ 1320 JCTVC-AN0023 Shutter interval info SEI message in AVC
* 1300 UTC Tue. 30 June, 3rd (joint) meeting session on future planning and organizational matters
* 2120 UTC Sed. 1 July, 4th meeting session
	+ 2335 Meeting closed

## Contribution topic overview

The 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 (5 such reports) (section 2)
* Project development status and errata reports (2 contributions) (section 3)
* CICP related (0 contributions) (section 4)
* SEI messages (3 contributions) (section 5)
* Non-normative encoding practices and software development (0 contributions) (section 6)
* Technical information contributions (0 contributions) (section 7)
* Outputs & planning: AHG plans, Conformance, Reference software, Verification testing, CTC (sections 8, 9, and 10)

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

Topics for finalization near the end of the meeting included:

* 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 (the next meeting was planned to start Thursday, 8 Oct. 2020)
	+ Document contribution deadline (next meeting deadline Wednesday 30 Sep. 2020)

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

# AHG reports (5)

These AHG reports were reviewed 2110-2145 on 24 June (chaired by GJS & JRO) except as otherwise noted.

[JCTVC-AN0001](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11022) JCT-VC AHG report: Project management (AHG1) [G. J. Sullivan, J.-R. Ohm]

This document reported 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 39th JCT-VC meeting, work towards finalizing the following 2) documents had been performed:

* For CICP, Draft revisions for coding-independent code points for video signal type identification (JCTVC-AM1003)
* Errata report items for HEVC, AVC, Video CICP, and Codepoint Usage Technical Report (JCTVC-AM1004)

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. Some discussion had been carried out on the group email reflector (which had approx. 1296 subscribers as of June 23, 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.int-evry.fr/jct/>) or the ITU-based JCT-VC site (<http://wftp3.itu.int/av-arch/jctvc-site/2020_04_AM_Alpbach/>), particularly including the following:

* The meeting report (JCTVC-AM1000), posted 2020-06-24
* Draft revisions for coding-independent code points for video signal type identification (JCTVC-AM1003), posted 2020-06-24
* Errata report items for HEVC, AVC, Video CICP, and Codepoint Usage Technical Report (JCTVC-AM1004), posted 2020-06-24

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.

5 input contributions to the current meeting (not counting the AHG reports) had been registered for consideration at the meeting. Three of these relate to SEI messages, one for errata reporting, and one is an information document on HEVC deployment.

A preliminary basis for the document subject allocation and meeting notes for the 38th 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_06_AN_Virtual/>).

In the discussion, the state of the work on the outputs was described.

* For the CICP output:
	+ There had been discussion at the previous meeting that matrix coefficients 5 and 6 should correspond to sYCC, not just 5. This was left open at the time. The drafted output identified only 5.
	+ Further work should be done to double-check the content and compare it to the content of AVC and HEVC and to check for newer editions of referenced specifications and identification of referenced specifications that should be marked historical.
* For the errata report correction JCTVC-AM1004, no meaningful update had been done; however -v2 and -v3 versions were later uploaded to finalize this.

[JCTVC-AN0002](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11023) JCT-VC AHG report: Test model editing and errata reporting (AHG2) [B. Bross, C. Rosewarne, J.-R. Ohm, K. Sharman, G. J. Sullivan, A. 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 39th meeting by teleconference (Apr. 2020) and the 40th meeting by teleconference.

-v2 adds 20 SCC tickets that were not visible in the default view of open HEVC text tickets

-v3 has tickets removed from the ticket table that had been determined to have been resolved in already issued versions of HEVC. Of the 20 SCC tickets, 18 were already resolved, leaving two open SCC tickets. Seven tickets relating to v1/RExt were open, leaving nine open tickets.

JCT-VC output document JCTVC-AM1004 was prepared and uploaded to the document register. See also the notes in the above section.

JCTVC-AN0024 was noted to contain some additional HEVC and AVC errata items

had was (if this was to be done, but it was not)

* JVET-S0124 (3.1.2, item 15 of JVET-S0237), reportedly may also need to be an errata item for HEVC:

(aspect a, adopted with modification) Add derivation of TemporalId, ph\_non\_ref\_pic\_flag, and parameter sets to the decoding process for generating unavailable reference pictures (in order to enable checking of some constraints for them).

As proposed “parameter set information” was vague, and specifying inference of ph\_pic\_parameter\_set\_id instead was suggested.

* JVET-S0156 aspect 3 (3.1.2, item 21 of JVET-S0237) noted to also affect HEVC:

In clause C.4 (Bitstream conformance), the 6th constraint, change "CpbRemovalTime[ n ] less than CpbRemovalTime[ currPic ]" to "DpbOutputTime[ n ] greater than DpbOutputTime[ currPic ]". This is asserted to be a bug, because all decoded pictures in the DPB are always decoded earlier than decoding of the current picture, and thus CpbRemovalTime[ n ] in the context is always less than CpbRemovalTime[ currPic ]. This is also asserted to be a bug in the latest HEVC spec.

* JVET-S0160 aspect 6 (3.1.2, item 23 of JVET-S0237) noted to also affect HEVC:

Remove the following constraint from the definition of the two still picture profiles: The referenced SPS shall have max\_dec\_pic\_buffering\_minus1[ sps\_max\_sublayers\_minus1 ] equal to 0.

* JVET-S0188 aspect 4 (3.1.2, item 33 of JVET-S0237) noted as possibly also affecting HEVC and AVC:

It was remarked that in the semantics of ph\_recovery\_poc\_cnt and possibly in a NOTE in 8.3.4.2, there is a lack of consideration of the case with recovery POC distance of 0.

* JVET-S0042 (3.1.4, item 1 of JVET-S0237), noted that this should also be considered as an errata report for HEVC semantics clarification:

Relax the semantics so that an extension\_flag in DCI, VPS, SPS, PPS, or APS equal to 1 specifies that specifies extension\_data\_flag syntax elements *may be* present. (Currently, it says these flags *are* present.)

* JVET-S0101 aspect 1 (3.1.8, item 5 of JVET-S0237):

Fix an asserted bug in Equation C.10 (also applicable to HEVC):

The asserted bug in both HEVC and VVC is that a delta (CpbDelayOffset) is incorrectly subtracted from the removal times after derivation of the removal times in the case that alternative timing is used, e.g. removal of RASL pictures.

* JVET-S0178 aspect 4 (3.1.8, item 33 of JVET-S0237) noted as recently added as corrigendum item to the HEVC specification, but does AVC also need consideration?:

Add the clarification (that was recently added to the HEVC specification as an corrigendum item) on the value ranges of tone\_map\_id, frame\_packing\_arrangement\_id, knee\_function\_id, and colour\_remap\_id, including potential collisions of the interpretation for values of these syntax elements?

Some tickets, esp. SCC tickets, were still under review.

After offline consideration, 2 SCC bug reports remained for further discussion. The bug reports were discussed in the closing plenary.

* Ticket #1507 Duplicate syntax element ctxInc assignments in Table 9-48. Confirmed present in H.265 (11/19) (new ticket, filed 2020-04-18).
* Ticket #1505 Relates to semantics of AUs appearing after an ‘end of sequence’ or ‘end of bitstream’ NAL unit. See previous meeting notes regarding JCTVC-AM0002.
* Ticket #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).
* Ticket #1500 typo in equation (8-69),(8-70) (palette\_transpose\_flag not transposing) Confirmed present in H.265 (11/19).
* Ticket #Ticket #1498 Typos in Table 9-43 (for palette\_run\_suffix PalletMaxRun should be PalletMaxRunMinus1) Confirmed present in H.265 (11/19).
* Ticket #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)
* Ticket #1456 Clarification on note related to repetition of SPS Confirmed present in H.265 (11/19). (complex – for inclusion in the errata report for further study)
* Ticket #1437 Typo in the spec in 8.4.4.3 Corrected prior to publication in v4, but current spec now indicated 2 inputs to 8.6.8.1 (ACT) called resSampleArrayCb/Cr, both described as the array of chroma components of the current block. (reports a tiny grammatical error – should remove “the”)
* Ticket #1427 Eqns (8-185) and (8-187) could be removed as editorial cleanup. The ticket is marked as enhancement and note the equation numbers are updated since the ticket was filed.
* Ticket #1372 (intra pred mode Y is not set to DC for palette and IBC mode – for inclusion in the errata report for further study)

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

* Encourage the use of the issue tracker to report issues with the text of the HEVC, AVC, and CICP specifications in addition to any associate encoder description documents.
* Review the above-identified input documents.
* Review the above-identified errata reports.
* Confirm resolutions of open tickets (if any) in the issue tracker and close them.

[JCTVC-AN0003](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11024) 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, AVC and HDRTools software development and software technical evaluation that have taken place between the 39th and 40th JCT-VC meetings.

There were no updates of software in the interim.

The software model versions at prior to the start of the meeting 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-16.21+SCM-8.8](https://vcgit.hhi.fraunhofer.de/jct-vc/HM/-/tags/HM-16.21%2BSCM-8.8) (Mar. 2020)
	+ (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](https://vcgit.hhi.fraunhofer.de/jct-vc/JM/-/tags/JM-19.0)
* [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)

*HM releases and adoptions outstanding*

HM16.22 was due for release during the 39th meeting, and it would reportedly include:

* JCTVC-AK0030 (Change to random-access encoder configuration).
* JCTVC-AK1005 (Shutter interval information SEI)
* Additional checks to warn if DPB limits would be exceeded by a configuration.
* Porting of JVET’s parcat software for concatenating simulations run in parallel.
* Removal of macros.
* Updates to the software reference manual for the new cmake build process.
* Addition of encoder controls for some SEIs (from author of Shutter interval SEI), namely ambient view environment SEI, content light level SEI, and film grain characteristics SEI,

The following actions had yet to be included:

* The adopted changes in JCTVC-Y0038 that include changes in the closed-GOP settings, which require coordination with JVET for JEM development. There has been no input on this since the original proposal, and therefore it is recommended that this action be dropped.
* 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. Last communication on this was Nov. 2018. It was recommended that this action be dropped.
* JCTVC-AJ0028 (Encoder-only Supplemental Motion Vector Estimation for Point cloud Coding content) – some minor changes remained, and it was hoped that the contributor addresses them in a timely manner.

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

In addition, it was noted that lambda optimization is to be done by JVET, and perhaps a similar study, including comparing the allocation of bits within GOP hierarchical layers, is needed for HM.

*SEI message support*

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)
* Post filter hint (22)
* Deinterlace field identification (143)
* Dependent RAP indication (145)
* Coded region completion (146)

*Persistent bug reports*

The following were persistent bug reports where study was 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.

*SCM related activities*

HM-16.20+SCM-8.8 was merged with HM-16.21 to form HM-16.21+SCM-8.8 and tagged. This merger included the latest cmake build environment.

*SHM related activities*

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

*HTM related activities*

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

*HDRTools related activities*

There had not been any updates of the HDRTools.

*JM, JSVM, JMVM related activities*

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 16.22, HM 16.21 + 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 bit-streams that trigger bugs in the HM. Such bit-streams 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.

[JCTVC-AN0004](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11025) JCT-VC AHG report: Supplemental enhancement information (AHG4) [J. Boyce, C. Fogg, S. McCarthy, H.-M. Oh, G. J. Sullivan, Y.-K. Wang]

This document summarized the activity of AHG4 on supplemental enhancement information between the 39th meeting held by teleconference and the 40th meeting held by teleconference.

There was no significant activity in AHG, because there was no need to generate a new output document version containing draft SEI message text. There was no email reflector discussion, which is to take place on the main JCT-VC reflector.

There were 3 SEI related input contributions. One contribution provided errata for an existing SEI message used in both HEVC and AVC. One contribution proposed adding an SEI message to AVC, based on the HEVC message but with adaptations for AVC support. One contribution provided software to support an existing AVC SEI message. The noted contributions were:

*Errata to existing HEVC and AVC SEI message*

[JCTVC-AN0021](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11018) Errata for FGC SEI message semantics [S. McCarthy, F. Pu, T. Lu, P. Yin, W. Husak, T. Chen (Dolby), P. de Lagrange, E. François (InterDigital)]

*AVC SEI proposal (1)*

[JCTVC-AN0023](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11020) Shutter interval info SEI message in AVC [S. McCarthy, F. Pu, T. Lu, P. Yin, W. Husak, T. Chen (Dolby)]

*Software to support existing AVC SEI message*

[JCTVC-AN0022](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11019) Illustration of the film grain characteristics SEI message in AVC [S. McCarthy, F. Pu, T. Lu, P. Yin, W. Husak, T. Chen (Dolby)]

The AHG recommended the following:

* Review input contributions
* Prepare new version of HEVC containing shutter interval SEI message and other errata for ITU-T Consent and ISO/IEC ballot.
* Consider timing for a new AVC version for SEI message updates

[JCTVC-AN0005](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11026) JCT-VC AHG Report: Test sequence material (AHG5) [T. Suzuki, V. Baroncini, E. François, P. Topiwala, S. Wenger]

This AHG Report was discussed Sunday at 1305 UTC (GJS & JRO)

The only update was on the investigation of other available test sequences.

ITU-R BT.2245-7 “HDTV and UHDTV including HDR-TV test materials for assessment of picture quality” was published in July 2019. It includes a characterization of the test sequences in the text in addition to making available the test sequences themselves. It provides the list of test materials of HDTV and UHDTV. The information of the contact person is also included. The availability of UHDTV including 4:4:4 12 bit was investigated (copyright is owned by ITE). It was reported that, unfortunately, those sequences may not be good to use for JCT-VC and JVET. The test sequences can be used for standardization purposes; however, those are not free (~$2000 for academic institutions and somewhat more for other institutions to obtain the entire test set).

It was reported to be necessary to study further for other sequences in BT.2245-7 and sequences of other organizations.

It was encouraged for those who may have access to those test sequences to perform some testing with them and report the results of their experiments.

It seemed likely that other good test sequences should also become available.

It was noted that there are efforts in JVET for test sequence identification, and that new test sequences had been offered for UHD HDR in JVET-S0218 for verification testing (4K HLG 10 bit 4:2:0). The contributor was also investigating the possibility of making available some versions with higher resolution and 4:4:4 chroma.

The lists of available test sequences was provided in the AHG report.

# Project development, status, and guidance (1)

## General (1)

[JCTVC-AN0020](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11021) Deployment status of the HEVC standard [G. J. Sullivan (Microsoft)]

This contribution was discussed at 2045 on 24 June (chaired by JRO).

This information contribution contained 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 was included to show changes relative to JCTVC-AM0020-v2 of April 2020.

Relative to the most recent similar contribution, this document reported that the Ultra HD Forum publishes a UHD service tracker at <https://ultrahdforum.org/uhd-service-tracker/>, listing a large number of HEVC deployed services.

The overwhelming majority of these were reported to be using HEVC.

## Errata reports (1)

See also the notes for the AHG report JCTVC-AN0002.

[JCTVC-AN0024](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11027) Some HEVC and AVC errata items [Y.-K. Wang (Bytedance)] [late]

This contribution was discussed at 2155 on 24 June (chaired by GJS & JRO).

These were requested to be studied in side activity and potentially included in outputs.

This contribution reports some errata items for HEVC and AVC.

For HEVC, for both the ITU-T and the ISO texts:

1. The semantics of the deblocking disable flag in the PPS should be updated to better reflect the behaviour.
2. Corresponding to the following changes to VVC, an errata report for AVC and HEVC, to change the MinCr limit to be derived from the CPB size limit or add a note for cases where the CPB size imposes a tighter limit than the MinCr does:

MaxCPB = 80 000 for level 6, 120 000 for level 6.1, 180 000 for level 6.2, and change MinCrScaleFactor for the 4:4:4 profile to 0.75, and change MinCrBase to 8 for level 6.2.

1. The following two bullet items on non-scalable-nested BP/PT/DUI SEI messages should be changed as shown below:

– For a non-scalable-nested SEI message, when payloadType is equal to 0 (buffering period) or 130 (decoding unit information), the non-scalable-nested SEI message applies to the operation point that has OpTid equal to the greatest value of nuh\_temporal\_id\_plus1 among all VCL NAL units in the bitstream, ~~and that~~ has OpLayerIdList containing all values of nuh\_layer\_id in all VCL units in the bitstream, and has only the base layer as the output layer.

– For a non-scalable-nested SEI message, when payloadType is equal to 1 (picture timing), the frame field information carried in the syntax elements pic\_struct, source\_scan\_type and duplicate\_flag, when present, in the non-scalable-nested picture timing SEI message applies to the base layer only, while the picture timing information carried in other syntax elements, when present, in the non-scalable-nested picture timing SEI message applies to the operation point that has OpTid equal to the greatest value of nuh\_temporal\_id\_plus1 among all VCL NAL units in the bitstream, ~~and that~~ has OpLayerIdList containing all values of nuh\_layer\_id in all VCL units in the bitstream, and has only the base layer as the output layer.

1. In the semantics of the decoded picture hash SEI message, the specification that the colour component arrays use two’s complement representation was an error and needs to be corrected. Unsigned integers are used for the colour component arrays.
2. Add derivation of TemporalId and reference pic\_parameter\_set\_id to the decoding process for generating unavailable reference pictures (in order to enable checking of some constraints for them).
3. In clause C.4 (Bitstream conformance), change the constraint on i.e., the number of all pictures n in the DPB for referencing or output after invocation of the process for removal of pictures from the DPB, change "CpbRemovalTime[ n ] less than CpbRemovalTime[ n ]" to "DpbOutputTime[ n ] greater than CpbRemovalTime[ currPic ]". This is asserted to be a bug, because all decoded pictures in the DPB are always decoded earlier than decoding of the current picture, and thus CpbRemovalTime[ n ] in the context is always less than CpbRemovalTime[ currPic ].
4. Remove the following constraint from the definition of the still picture profiles: The active SPS shall have max\_dec\_pic\_buffering\_minus1[ sps\_max\_sublayers\_minus1 ] equal to 0.
5. Relax the semantics so that an extension\_flag in VPS, SPS, or PPS equal to 1 specifies that specifies extension\_data\_flag syntax elements may be present. (Currently, it says these flags are present.)
6. Fix an asserted bug in Equation C.10 as follows, coming from JVET-S0101:

if( !concatenationFlag ) {
 baseTime = AuNominalRemovalTime[ firstPicInPrevBuffPeriod ]
 tmpCpbRemovalDelay = AuCpbRemovalDelayVal
 tmpCpbDelayOffset = CpbDelayOffset
} else {
 baseTime1 = AuNominalRemovalTime[ prevNonDiscardablePic ]
 tmpCpbRemovalDelay1 = ( auCpbRemovalDelayDeltaMinus1 + 1 )
 baseTime2 = AuNominalRemovalTime[ n − 1 ]
 tmpCpbRemovalDelay2 = (C.X)
 Ceil( ( InitCpbRemovalDelay[ Htid ][ ScIdx ] ÷ 90000 +
 AuFinalArrivalTime[ n − 1 ] − AuNominalRemovalTime[ n − 1 ] ) ÷ ClockTick )
 if( baseTime1 + ClockTick \* tmpCpbRemovalDelay1 <
 baseTime2 + ClockTick \* tmpCpbRemovalDelay2 ) {
 baseTime = baseTime2
 tmpCpbRemovalDelay = tmpCpbRemovalDelay2
 } else {
 baseTime = baseTime1
 tmpCpbRemovalDelay = tmpCpbRemovalDelay1
 }
 tmpCpbDelayOffset = 0
}
AuNominalRemovalTime[ n ] = baseTime + ( ClockTick \* tmpCpbRemovalDelay − tmpCpbDelayOffset

1. In the semantics of elemental\_duration\_in\_tc\_minus1[ i ], the syntax element fixed\_pic\_rate\_general\_flag[ i ] of both the first and second CVS to determine whether the fixed output rate applies also across CVSs. However, it is asserted that the value of fixed\_pic\_rate\_general\_flag[ i ] of the first CVS should not be taken into account for determining whether the fixed output rate applies across the two CVSs. Therefore, the first two instances of fixed\_pic\_rate\_general\_flag highlighted in green below should be fixed\_pic\_rate\_within\_cvs\_flag instead:

**elemental\_duration\_in\_tc\_minus1**[ i ] plus 1 (when present) specifies, when Htid is equal to i, the temporal distance, in clock ticks, between the elemental units that specify the HRD output times of consecutive pictures in output order as specified below. The value of elemental\_duration\_in\_tc\_minus1[ i ] shall be in the range of 0 to 2047, inclusive.

When Htid is equal to i and fixed\_pic\_rate\_general\_flag[ i ] is equal to 1 for a CVS containing picture n, and picture n is a picture that is output and is not the last picture in the bitstream (in output order) that is output, the value of the variable DpbOutputElementalInterval[ n ] is specified by:

* DpbOutputElementalInterval[ n ] = DpbOutputInterval[ n ]  elementalOutputPeriods (113)

where DpbOutputInterval[ n ] is specified in Equation C.16 and elementalOutputPeriods is specified as follows:

– If a PT SEI message is present for picture n, elementalOutputPeriods is equal to the value of pt\_display\_elemental\_periods\_minus1 + 1.

– Otherwise, elementalOutputPeriods is equal to 1.

When Htid is equal to i and fixed\_pic\_rate\_general\_flag[ i ] is equal to 1 for a CVS containing picture n, and picture n is a picture that is output and is not the last picture in the bitstream (in output order) that is output, the value computed for DpbOutputElementalInterval[ n ] shall be equal to ClockTick \* ( elemental\_duration\_in\_tc\_minus1[ i ] + 1 ), wherein ClockTick is as specified in Equation C.X (using the value of ClockTick for the CVS containing picture n) when one of the following conditions is true for the following picture in output order nextPicInOutputOrder that is specified for use in Equation C.X:

– picture nextPicInOutputOrder is in the same CVS as picture n.

– picture nextPicInOutputOrder is in a different CVS and fixed\_pic\_rate\_general\_flag[ i ] is equal to 1 in the CVS containing picture nextPicInOutputOrder, the value of ClockTick is the same for both CVSs, and the value of elemental\_duration\_in\_tc\_minus1[ i ] is the same for both CVSs.

When Htid is equal to i and fixed\_pic\_rate\_within\_cvs\_flag[ i ] is equal to 1 for a CVS containing picture n, and picture n is a picture that is output and is not the last picture in the CVS (in output order) that is output, the value computed for DpbOutputElementalInterval[ n ] shall be equal to ClockTick \* ( elemental\_duration\_in\_tc\_minus1[ i ] + 1 ), wherein ClockTick is as specified in Equation C.X (using the value of ClockTick for the CVS containing picture n) when the following picture in output order nextPicInOutputOrder that is specified for use in Equation C.X is in the same CVS as picture n.

1. In clause 8.1.1, add the derivation of the variables DuHrdPreferredFlag and DecodingUnitHrdFlag, similarly as in HEVC.
2. Add "The variable DuHrdPreferredFlag is either specified by external means, or when not specified by external means, set equal to 0." to clause 8.1.2.

For item 7, this seemed to be a prior intentional design choice that cannot be dropped. The other aspects were confirmed for inclusion in an errata output document JCTVC-AN1004.

For HEVC and AVC, the following item was reported:

1. Fix the description of the recovery point picture to consider the case with a recovery POC distance of 0.

This was confirmed for inclusion in the output document JCTVC-AN1004.

## Communication with parent bodies

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

# CICP technical contributions (0)

No contributions specifically on the CICP specification were noted.

# SEI message technical contributions (3)

[JCTVC-AN0021](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11018) Errata for FGC SEI message semantics [S. McCarthy, F. Pu, T. Lu, P. Yin, W. Husak, T. Chen (Dolby), P. de Lagrange, E. François (InterDigital)]

This contribution proposed corrections for the semantics of the film grain characteristics SEI message to support bit depths greater than 8 bits.

Film grain characteristics syntax limits values for intensity\_interval\_lower\_bound[ c ][ i ] and intensity\_interval\_lower\_bound[ c ][ i ] to the range 0 to 255, inclusive.

It was reported that intensity\_interval\_lower\_bound[ c ][ i ] and intensity\_interval\_lower\_bound[ c ][ i ] define luma sample value intervals. Luma samples having a value within each interval are modified by the film grain generation process according to interval-specific parameters. Luma samples having a value that does not fall into any of the defined intervals are not modified by the film grain generation process. Thus, for a 10-bit picture, for example, the luma samples having a value greater than 255 are not modified by the film grain generation process.

(It was said that the FGC SEI example software described in JCTVC-AM0023, JCTVC-AN0022, and JVET-R0359 for AVC, HEVC, and VVC, respectively, are reportedly consistent with the semantics proposed below.)

The proposal does not change syntax, but adapts the parameters to apply to non-8-bit video.

It was remarked that the proposal to change semantics for non-8-bit video seemed backward compatible, as prior systems that pay attention to the SEI message would probably just ignore the message if they have not made this adjustment for themselves.

The proposal was to modify the film grain characteristics SEI message semantics (In HEVC D.3.13 and AVC D.2.19) as follows (modifications are highlighted in yellow):

Depending on the value of film\_grain\_model\_id, the selection of the sets of model values is specified as follows:

– If film\_grain\_model\_id is equal to 0, the average value of each block b of 8x8 samples in Idecoded, divided by ( 1  <<  ( filmGrainBitDepth[ c ] − 8 ) ), referred to as bavg, is used to select the sets of model values with index s[ j ] that apply to all the samples in the block:

* for( i = 0, j = 0; i  <=  num\_intensity\_intervals\_minus1[ c ]; i++ )
 if( bavg  >=  intensity\_interval\_lower\_bound[ c ][ i ]
 &&  bavg  <=  intensity\_interval\_upper\_bound[ c ][ i ] ) {
 s[ j ] = i (D-8)
 j++
 }

– Otherwise (film\_grain\_model\_id is equal to 1), the sets of model values used to generate the film grain are selected for each sample value in Idecoded, divided by ( 1  <<  ( filmGrainBitDepth[ c ] − 8 ) ), referred to as Iinterval, as follows:

* for( i = 0, j = 0; i  <=  num\_intensity\_intervals\_minus1[ c ]; i++ )
 if( Iinterval[ x, y, c ]  >=  intensity\_interval\_lower\_bound[ c ][ i ]  &&
 Iinterval[ x, y, c ]  <=  intensity\_interval\_upper\_bound[ c ][ i ] ) { (D-9)
 s[ j ] = i
 j++
 }

It was commented that the “divided by” should perhaps be replaced with (x + (1 << (n-8-1)) >> (n-8) for n>8.

It was remarked that for JVET it might be better for the interval table to have the same bit depth as the sample values, as there is no backward compatibility issue there.

As a JVET action item, it was noted that the same issue existed in draft Rec. ITU-T H.274 | ISO/IEC 23002-7.

Decision: It was agreed to include this in errata recording for planned action for HEVC and AVC, and that this correction should be made (if determined feasible by its editors) in finalization of draft Rec. ITU-T H.274 | ISO/IEC 23002-7.

In the closing plenary it was suggested since the syntax of the VSEI message cannot depend on the bit depth of the decoded video, the same fix needs to be applied as an editorial bug fix for VSEI as for the other relevant standards.

bit\_depth\_luma\_minus8 (and for chroma) was also noted to be a (purely editorial) issue for VSEI.

Also, it was commented that only the first flag can be 1 for monochrome video.

Post-meeting note: The editors of the VSEI standard conducted further study after the meeting and incorporated their understanding of the intent into the text to be submitted for approval by the partent bodies.

[JCTVC-AN0022](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11019) Illustration of the film grain characteristics SEI message in AVC [S. McCarthy, F. Pu, T. Lu, P. Yin, W. Husak, T. Chen (Dolby)]

This contribution describes a software implementation that illustrates the use of the film grain characteristics SEI message in AVC. Specifically, the software illustrates the example of film grain synthesis specified in SMPTE RDD 5 and signalling of film grain characteristics syntax values using the SEI message. (The software described in this contribution for AVC is the same as the software for HEVC previously described in JCTVC-AM0023 except that it has been adapted for the JM codebase.)

The previous contribution was for the HM context; this contribution provides similar software for the JM.

The software was uploaded with the contribution.

Study of this software by the software coordinator for potential inclusion in a future version the JM was encouraged.

[JCTVC-AN0023](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11020) Shutter interval info SEI message in AVC [S. McCarthy, F. Pu, T. Lu, P. Yin, W. Husak, T. Chen (Dolby)]

This contribution was discussed at 1320 on 28 June (GJS & JRO).

This contribution proposes that the shutter interval information SEI message be adopted in the next version of AVC. The shutter interval information SEI message was previously adopted in an HEVC draft. It was asserted that the SEI message in AVC would facilitate signalling shutter interval information in applications such as frame rate conversion, motion analysis, transcoding between AVC and HEVC, and others.

A suggested use case is to enable an improved display of temporal subsets of the video content, if special functionality is available in the decoder side. This use is not particularly backward compatible, since the full frame rate video would look strange when decoded by a system that does not do special processing to compensate for the special pre-processing that was applied prior to encoding. It was commented that this use does not seem really backward compatible, as the older systems would decode and display undesirable pictures. Some sort of semi-closed system environment would be needed for such a use case. This is the use case envisioned in ATSC 3.0 Annex D.

There was a discussion of the modifications proposed for the context of AVC.

It was asked how the temporal sublayer concept works in the AVC context as proposed. It was noted that there are is support for temporal sublayers in an SEI message for regular AVC and more support in the SVC extensions.

The proposal does not really introduce a sublayer concept for the SEI message. It uses a different scheme that is independent of the prior approaches. It sends a list of shutter intervals at the SPS level and has each picture indicate which of these shutter intervals applies to the picture.

The proposed text editorially refers to sublayers, but this seems potentially misleading, as it does not actually use that concept and does not express or depend on sublayer referencing constraints. However, temporal referencing constraints seem necessary for the envisioned use of the extraction and display of temporal subsets.

A note referring to ATSC 3.0 had been deleted, as it applies only to HEVC.

The persistence of the SEI message is at the CVS level, with an abbreviated SEI message also sent on each picture to refer to an indexed list of shutter intervals sent at the CVS level. It was commented that the list could be put into the VUI, since it applies at the CVS level. The proponent said it is different in spirit than most of the VUI aspects, as it is not necessary for interpretation of the video (e.g. colour information) for display.

The proponent indicated that the information could be used by such applications as machine analysis of video content, using an understanding of the amount of motion blur in the video content.

There was discussion of potentially putting this or something like it into draft Rec. ITU-T H.274 | ISO/IEC 23002-7 and referencing that.

An academic paper was referenced in the contribution for a different use case in frame rate conversion.

Non-proponents did not express interest in the proposal, and no action was taken on it.

# Non-normative encoding and software contributions (0)

See the AHG report JCTVC-AN0003 and JCTVC-AN0022 for information regarding non-normative encoding and software work. The output document JCTVC-AN1002 was also agreed to contain some additional information on non-normative encoding for low-delay usage.

# Technical information contributions (0)

See section 6.

# Project planning

In the interest of allowing Q6/16 to focus on VVC, it was agreed to defer Consent of an HEVC revision to the next meeting.

## Joint meeting with JVET, VCEG (Q6/16) and MPEG Requirements Tuesday 30 June 1300-1500

A joint meeting session was held with the parent bodies was held to discuss matters relating to the video coding collaborations of ITU-T SG16 and MPEG.

With JCT-VC no longer as active, and with VVC v1 finished and some future work overlapping (e.g., for SEI messages and some errata maintenance), it was expected for SG 16 to request merging JCT-VC into JVET. This was generally supported in the discussion. JVET would have a scope to include all of the joint video coding work. JCT-VC AHGs established at this meeting may report into JVET, pending SC29 consideration. Some website functionality support would be desirable to distinguish documents.

See the JVET report for additional information regarding the content of this discussion.

## 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).

|  |  |  |
| --- | --- | --- |
| **Title and Email Reflector** | **Chairs** | **Mtg** |
| **JCT-VC project management (AHG1)**(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)* 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 codepoint 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)* 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)* Study the status of text and potential needs for SEI messages for AVC and HEVC.
* 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, G. J. Sullivan, Y.-K. Wang (vice‑chairs) | N |
| **Test sequence material (AHG5)**(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.
* Collect information about test sequences that have been made available by other organizations.
* 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.

AVC draft annotated regions & shutter interval

Issue output targeted at inclusion in VSEI

Not yet MPEG request for new edition

m54737 contribution noted as relevant to annotated regions

Issue PDTR Codepoint usage TR v3 23094-4 (check number)

MPEG request

[JCTVC-AN1000](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11007) Meeting Report of the 40th JCT-VC Meeting [G. J. Sullivan, J.-R. Ohm (chairs)] [2020-10-05] (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-AN1002](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 14 [C. Rosewarne (primary editor), K. Sharman, R. Sjöberg, G. J. Sullivan (co-editors)] (WG 11 N 19473) [2020-10-05] (near next meeting)

This is update will describe the modified LDB GOP structure. (New RA GOP structure is already in Update 13.)

[Old notes from prior 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.]

HM16.22 had still not been released, and the PCC motion search had not yet been included in the work.

Is JCTVC-AJ0028 in the document? Yes, it was described in the document output from the previous meeting.

[In the closing plenary it was mentioned that there is a modified Low-delay B referencing structure used in JVET, described in JVET-P0345. If that fits in the HEVC buffering capacity and we have adequate software/configuration files for it, we would want this in our CTC and test model document. The proponents of that contribution had provided test results in the HEVC context (with about 4.7% gain in luma and somewhat more in chroma). From a look at the contribution, it appeared that the only software impact is on the configuration files. However, it may violate the HEVC buffering capacity. Further study on this was encouraged.]

There is no effect on the CTC document – only in the config files.

The latest tagged version of the HM (16.21) has a capacity-violating RA config (only a 0.2% impact on PSNR) and a not-as-good LDB referencing structure. HM 16.22 will have those features and its release was imminent.

The expected PCC motion search hint changes had not been followed up, and will not be included in HM 16.22.

Remains valid – not updated: JCTVC-AM1003 Draft revised coding-independent code points for video signal type identification [G. Sullivan, T. Suzuki, A. Tourapis] [2020-05-22]

Under ballot, not modified.

Corresponding MPEG document N19208 with request N19207.

[JCTVC-AN1004](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] [2020-10-05] (near next meeting)

This should include persistence flag discussion for the annotated regions SEI message.

It should also include correction of a SMPTE code identifier.

Remains valid – not updated: [JCTVC-AL1005](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10997) Shutter interval information SEI message for HEVC (Draft 2) [S. McCarthy, G. J. Sullivan, Y.-K. Wang] (WG 11 CDAM N 19121 🡪 DAM N 19198) (2020-02-07)

A DAM ballot was issued for WG 11 as WG 11 N 19198 (without changing the text).

In ISO/IEC the amendment will be renamed and renumbered.

JCTVC-AN1006 Annotated regions and shutter interval information SEI messages for AVC (Draft 1) [J. Boyce, S. McCarthy, Y.-K. Wang] [2020-10-05] (near next meeting)

This should include corrections including a persistence flag. It was agreed to target eventual inclusion in VSEI.

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))

JCTVC-AN1008 Usage of video signal type code points (Draft 1 for version 3) [W. Husak, G. J. Sullivan, Y. Syed, A. Tourapis (editors)] [2020-08-07]

(This includes only editorial improvements and errata corrections)

A PDTR ballot was issued for this in MPEG as N19481.

A request to start work on this was issued in MPEG as N19480.

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:

* Thu. 8 – Fri. 9 and Mon. 12 – Fri. 16 October 2020, 41st meeting under WG 11 auspices by teleconference
* Sat. 9 – Fri. 15 January 2021, 42nd meeting under WG 11 auspices in Capetown, ZA.
* Thu. 22 Apr. – Wed. 28 Apr. 2021, 43rd meeting under ITU-T SG16 auspices in Geneva, CH
* Sat. 10 – Fri. 16 July 2021, 23rd meeting under WG 11 auspices in Prague, CZ.

The agreed document deadline for the 41st JCT-VC meeting is Wednesday 30 September 2020. Plans for scheduling of agenda items within that meeting, if held, remained TBA.

With JCT-VC no longer as active, and with VVC v1 finished and some future work overlapping (e.g., for SEI messages and some errata maintenance), it was expected for SG 16 to request merging JCT-VC into JVET. This was generally supported in the discussion. JVET would have a scope to include all of the joint video coding work. JCT-VC AHGs established at this meeting may report into JVET, pending SC29 consideration.

Post-meeting note: The suggestion to merge JCT-VC into JVET for future work was confirmed in liaison communication. Thus, no further meetings of JCT-VC as a distinct organization are expected.

In commemoration of the 40th meeting, the participants of the JCT-VC were thanked for all their contributions to the HEVC work.

The JCT-VC meeting was closed at approximately 2335 hours UTC on Wednesday, 1 July 2020.

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| [JCT-VC number](http://phenix.it-sudparis.eu/jct/doc_end_user/current_meeting.php?id_meeting=183&type_order=&sql_type=document_number) | MPEG number | [Created](http://phenix.it-sudparis.eu/jct/doc_end_user/current_meeting.php?id_meeting=183&type_order=&sql_type=document_date_time) | First Upload | [Last upload](http://phenix.it-sudparis.eu/jct/doc_end_user/current_meeting.php?id_meeting=183&type_order=&sql_type=upload_document_date_time) | [Title](http://phenix.it-sudparis.eu/jct/doc_end_user/current_meeting.php?id_meeting=183&type_order=&sql_type=title) | [Source](http://phenix.it-sudparis.eu/jct/doc_end_user/current_meeting.php?id_meeting=183&type_order=&sql_type=authors) |
| [JCTVC-AN0001](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11022) | m54718 | 2020-06-23 22:01:36 | 2020-06-23 22:55:38 | 2020-06-24 22:43:14 | JCT-VC AHG report: Project management (AHG1) | G. J. SullivanJ.-R. Ohm |
| [JCTVC-AN0002](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11023) | m54719 | 2020-06-23 22:03:15 | 2020-06-24 18:31:37 | 2020-07-02 01:41:48 | JCT-VC AHG report: Test model editing and errata reporting (AHG2) | B. BrossC. RosewarneJ.-R. OhmK. SharmanG. J. SullivanA. TourapisY.-K. Wang |
| [JCTVC-AN0003](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11024) | m54720 | 2020-06-23 22:04:47 | 2020-06-24 18:41:39 | 2020-06-24 18:41:39 | JCT-VC AHG report: Software development and software technical evaluation (AHG3) | K. SühringB. LiK. SharmanV. SereginG. TechA. Tourapis |
| [JCTVC-AN0004](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11025) | m54721 | 2020-06-23 22:06:21 | 2020-06-24 19:03:39 | 2020-06-24 19:03:39 | JCT-VC AHG report: Supplemental enhancement information (AHG4) | J. BoyceC. FoggS. McCarthyH.-M. OhG. J. SullivanY.-K. Wang |
| [JCTVC-AN0005](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11026) | m54722 | 2020-06-23 22:08:47 | 2020-06-25 23:34:54 | 2020-06-25 23:34:54 | JCT-VC AHG report: Test sequence material (AHG5) | T. SuzukiV. BaronciniE. FrançoisP. TopiwalaS. Wenger |
| [JCTVC-AN0020](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11021) | m54538 | 2020-06-18 00:43:06 | 2020-06-18 00:44:40 | 2020-06-18 00:44:40 | Deployment status of the HEVC standard | G. J. Sullivan (Microsoft) |
| [JCTVC-AN0021](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11018) | m54303 | 2020-06-16 21:50:59 | 2020-06-16 21:59:51 | 2020-06-16 21:59:51 | Errata for FGC SEI message semantics | S. McCarthyF. PuT. LuP. YinW. HusakT. Chen (Dolby)P. de LagrangeE. Francois (InterDigital) |
| [JCTVC-AN0022](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11019) | m54304 | 2020-06-16 21:56:36 | 2020-06-16 22:00:14 | 2020-06-24 23:08:26 | Illustration of the film grain characteristics SEI message in AVC | S. McCarthyF. PuT. LuP. YinW. HusakT. Chen (Dolby) |
| [JCTVC-AN0023](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11020) | m54305 | 2020-06-16 22:03:08 | 2020-06-16 22:04:40 | 2020-06-16 22:04:40 | Shutter interval info SEI message in AVC | S. McCarthyF. PuT. LuP. YinW. HusakT. Chen (Dolby) |
| [JCTVC-AN0024](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11027) | m54736 | 2020-06-24 18:31:52 | 2020-06-24 18:51:15 | 2020-06-28 16:44:47 | Some HEVC and AVC errata items | Y.-K. Wang (Bytedance) |
| [JCTVC-AN1000](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11028) | m54833 | 2020-07-07 19:46:10 | (this document) | (this document) | Meeting Report of the 40th JCT-VC Meeting (teleconference, 24 June – 1 July 2020) | G. J. SullivanJ.-R. Ohm |
| [JCTVC-AN1002](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11029) | m54834 | 2020-07-07 19:47:29 | 2020-10-06 01:29:53 | 2020-10-06 01:29:53 | High Efficiency Video Coding (HEVC) Test Model 16 (HM 16) Encoder Description Update 14 | C. RosewarneK. SharmanR. SjöbergG. J. Sullivan |
| [JCTVC-AN1004](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11030) | m54835 | 2020-07-07 19:48:38 | 2020-10-06 17:22:11 | 2020-10-06 17:22:11 | Errata report items for HEVC, AVC, Video CICP, and CP usage TR | G. J. SullivanY. SyedY.-K. Wang |
| [JCTVC-AN1006](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11031) | m54836 | 2020-07-07 19:51:04 | 2020-09-11 18:02:49 | 2020-09-11 18:02:49 | Annotated regions and shutter interval information SEI messages for AVC (Draft 1) | J. BoyceS. McCarthyY.-K. Wang |
| [JCTVC-AN1008](http://phenix.it-sudparis.eu/jct/doc_end_user/current_document.php?id=11032) | m54837 | 2020-07-07 19:51:55 |  |  | Usage of video signal type code points (Draft 1 for version 3) | W. HusakG. J. SullivanY. SyedA. Tourapis |

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

The participants of the thirty-ninth meeting of the JCT-VC, according to a sign-in sheet circulated during the meeting sessions (approximately 54 people in total), were as follows:

1. Kenneth Andersson (Ericsson)
2. Ichiro Ando (Nikon)
3. Gun Bang (ETRI)
4. Jill Boyce (Intel)
5. Benjamin Bross (HHI)
6. Jie Chen (Alibaba)
7. Lulin Chen (MediaTek)
8. Yi-Jen Chiu (Intel)
9. Byeongdoo Choi (Tencent)
10. Tzu-Der (Peter) Chuang (MediaTek)
11. Takeshi Chujoh (Sharp)
12. Philippe de Lagrange (Interdigital)
13. Alberto Duenas (Facebook)
14. Chad Fogg (MovieLabs)
15. Miska Hannuksela (Nokia)
16. Tomonori Hashimoto (Sharp)
17. Hendry (LG)
18. Walt Husak (Dolby)
19. Atsuro Ichigaya (NHK)
20. Tomohiro Ikai (Sharp)
21. Shunsuke Iwamura (NHK)
22. Hong-Jheng Jhu (Kwai)
23. Kei Kawamura (KDDI)
24. Kenji Kondo (Sony)
25. Konstantinos Konstantinides (Dolby)
26. Brian Lee (Dolby)
27. Guichun Li (Tencent)
28. Ru-Ling Liao (Alibaba)
29. Ching-Chieh Lin (ITRI)
30. Lukasz Litwic (Ericsson)
31. Ajay Luthra (Picsel Labs)
32. Sean McCarthy (Dolby)
33. Koohyar Minoo (IRNB)
34. Shimpei Nemoto (NHK)
35. Tung Nguyen (HHI)
36. Jens-Rainer Ohm (RWTH)
37. Yinji Piao (Samsung)
38. Justin Ridge (Nokia)
39. Chris Rosewarne (Canon)
40. Karl Sharman (Sony)
41. Masato Shima (Canon)
42. Robert Skupin (HHI)
43. Jacob Ström (Ericsson)
44. Karsten Suehring (HHI)
45. Gary Sullivan (Microsoft)
46. Teruhiko Suzuki (Sony)
47. Yasser Syed (Comcast)
48. Alexandros Tourapis (Apple)
49. Ye-Kui Wang (Bytedance)
50. Stephan Wenger (Tencent)
51. Ping Wu (ZTE)
52. Yan Ye (Alibaba)
53. Peng Yin (Dolby)
54. Xiaozhen Zheng (DJI)

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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)