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| **Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11**  39th Meeting: by teleconference, 18–24 April 2020 | Document: JCTVC-AM\_Notes\_d0 |

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| *Title:* | **Meeting report of the 39th meeting of the Joint Collaborative Team on Video Coding (JCT-VC), by teleconference, 18–24 April 2020** | | |
| *Status:* | Report document from chairs of JCT-VC | | |
| *Purpose:* | Report | | |
| *Author(s) or Contact(s):* | **Gary Sullivan** Microsoft Corp. 1 Microsoft Way Redmond, WA 98052 USA  **Jens-Rainer Ohm** Institute of Communication Engineering RWTH Aachen University Melatener Straße 23 D-52074 Aachen | Tel: Email:  Tel: Email: | +1 425 703 5308 [garysull@microsoft.com](mailto:garysull@microsoft.com)  +49 241 80 27671 [ohm@ient.rwth-aachen.de](mailto:ohm@ient.rwth-aachen.de) |
| *Source:* | Chairs | | |

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**Summary**

The Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T WP3/16 and ISO/IEC JTC 1/‌SC 29/‌WG 11 held its thirty-ninth meeting during 18–24 April 2020 as an online-only meeting. It had previously been planned to be held in Alpbach, Austria, at Congress Centrum Alpbach. The conversion of the meeting to be conducted only online was necessitated due to issues associated with the recently declared 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 0500 hours UTC on Saturday 18 January 2020 with a half-day of meeting sessions. Additional meeting sessions was held at 0715 on Monday 20 April 2020, and 1515 on Wednesday 22 April 2020. The meeting was closed at approximately XXXX hours on XXday XX April 2020. Approximately XX people attended the JCT-VC meeting, and 6 input documents and 5 AHG reports were discussed. The meeting took place in a collocated fashion with a meeting of WG11 – one of the two parent bodies of the JCT-VC. The subject matter of the JCT-VC meeting activities consisted of work on the video coding standardization project known as High Efficiency Video Coding (HEVC) and its extensions, and the development of associated conformance test sets, reference software, verification testing, and non-normative guidance information. Further work was performed on the specification of coding-independent code points related to video data. Maintenance and minor enhancement work on the Advanced Video Coding (AVC) standard, if necessary, were also conducted.

One primary goal of the meeting was to review the work that was performed in the interim period since the 38th JCT-VC meeting in producing the outputs of that meeting:

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

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 X output documents from the meeting (update):

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

For the organization and planning of its future work, the JCT-VC established X "ad hoc groups" (AHGs) to progress the work on particular subject areas. The next four JCT-VC meetings were planned for Thu. 25 June – Wed. 1 July 2020 under ITU-T SG16 auspices in Geneva, CH (note this may again be converted to a teleconference-based meeting in response to the COVID-19 pandemic), during Fri. 9 – Fri. 16 October 2020 under WG 11 auspices in Rennes, FR, during Fri. 8 – Fri. 15 January 2021 under WG 11 auspices in Capetown, ZA, and during Thu. 22 – Wed. 28 April 2021 under ITU-T SG16 auspices in Geneva, CH.

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](mailto:jct-vc@lists.rwth-aachen.de) hosted at RWTH Aachen University. For subscription to this list, see  
<https://lists.rwth-aachen.de/postorius/lists/jct-vc.lists.rwth-aachen.de/>.

# Administrative topics

## Organization

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

The Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T WP3/16 and ISO/IEC JTC 1/‌SC 29/‌WG 11 held its thirty-ninth meeting during 18–24 April 2020 as an online-only meeting.. The meeting took place in a collocated fashion with a meeting of WG11 – one of the two parent bodies of the JCT-VC. The JCT-VC meeting was held under the chairmanship of Dr Gary Sullivan (Microsoft/USA) and Dr Jens-Rainer Ohm (RWTH Aachen/Germany).

## Meeting logistics

The JCT-VC meeting began at approximately 0500 hours UTC on Saturday 18 January 2020 with a half-day of meeting sessions. Additional meeting sessions was held at 0715 on Monday 20 April 2020, and 1515 on Wednesday 22 April 2020. The meeting was closed at approximately XXXX hours on XXday XX April 2020. Approximately XX people attended the JCT-VC meeting, and 6 input documents and 5 AHG reports were discussed. The meeting took place in a collocated fashion with a meeting of WG11 – one of the two parent bodies of the JCT-VC. The subject matter of the JCT-VC meeting activities consisted of work on the video coding standardization project known as High Efficiency Video Coding (HEVC) and its extensions, and the development of associated conformance test sets, reference software, verification testing, and non-normative guidance information. Further work was performed on the specification of coding-independent code points related to video data. Maintenance and minor enhancement work on the Advanced Video Coding (AVC) standard were also conducted.

Some statistics are provided below for historical reference purposes:

* 1st "A" meeting (Dresden, 2010-04): 188 people, 40 input documents
* 2nd "B" meeting (Geneva, 2010-07): 221 people, 120 input documents
* 3rd "C" meeting (Guangzhou, 2010-10): 244 people, 300 input documents
* 4th "D" meeting (Daegu, 2011-01): 248 people, 400 input documents
* 5th "E" meeting (Geneva, 2011-03): 226 people, 500 input documents
* 6th "F" meeting (Turin, 2011-07): 254 people, 700 input documents
* 7th "G" meeting (Geneva, 2011-11) 284 people, 1000 input documents
* 8th "H" meeting (San Jose, 2012-02) 255 people, 700 input documents
* 9th "I" meeting (Geneva, 2012-04/05) 241 people, 550 input documents
* 10th "J" meeting (Stockholm, 2012-07) 214 people, 550 input documents
* 11th "K" meeting (Shanghai, 2012-10) 235 people, 350 input documents
* 12th "L" meeting (Geneva, 2013-01) 262 people, 450 input documents
* 13th "M" meeting (Incheon, 2013-04) 183 people, 450 input documents
* 14th "N" meeting (Vienna, 2013-07/08) 162 people, 350 input documents
* 15th "O" meeting (Geneva, 2013-10/11) 195 people, 350 input documents
* 16th "P" meeting (San José, 2014-01) 152 people, 300 input documents
* 17th "Q" meeting (Valencia, 2014-03/04) 126 people, 250 input documents
* 18th "R" meeting (Sapporo, 2014-06/07) 150 people, 350 input documents
* 19th "S" meeting (Strasbourg, 2014-10) 125 people, 300 input documents
* 20th "T" meeting (Geneva, 2015-02) 120 people, 200 input documents
* 21st "U" meeting (Warsaw, 2015-06) 91 people, 150 input documents
* 22nd "V" meeting (Geneva, 2015-10) 155 people, 75 input documents
* 23rd "W" meeting (San Diego, 2016-02) 159 people, 125 input documents
* 24th "X" meeting (Geneva, 2016-05/06) 162 people, 60 input documents
* 25th "Y" meeting (Chengdu, 2016-10) 93 people, 40 input documents
* 26th "Z" meeting (Geneva, 2017-01) 95 people, 30 input documents
* 27th "AA" meeting (Hobart, 2017-03/04) 76 people, 25 input documents
* 28th "AB" meeting (Turin, 2017-07) 71 people, 25 input documents
* 29th "AC" meeting (Macao, 2017-10) 107 people, 21 input documents
* 30th "AD" meeting (Gwangju, 2018-01) 85 people, 4 input documents
* 31st "AE" meeting (San Diego, 2018-04) 37 people, 11 input documents
* 32nd "AF" meeting (Ljubljana, 2018-07) 38 people, 8 input documents
* 33rd "AG" meeting (Macao, 2018-10) 32 people, 9 input documents
* 34th "AH" meeting (Marrakech, 2019-01) 34 people, 7 input documents
* 35th "AI" meeting (Geneva, 2019-03) 29 people, 4 input documents
* 36th "AJ" meeting (Gothenburg, 2019-07) 63 people, 11 input documents
* 37th "AK" meeting (Geneva, 2019-10) 40 people, 12 input documents
* 38th "AL" meeting (Brussels, 2020-01) 30 people, 4 input documents
* 39th "AM" meeting (by telco, 2020-04) XX people, 6 input documents

Information regarding logistics arrangements for the meeting had been provided via the email reflector [jct-vc@lists.rwth-aachen.de](mailto:jct-vc@lists.rwth-aachen.de) and at <http://wftp3.itu.int/av-arch/jctvc-site/2020_04_AM_Alpbach/>.

## Primary goals

One primary goal of the meeting was to review the work that was performed in the interim period since the 38th JCT-VC meeting in producing:

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

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) follow the local time at the meeting facility.

Highlighting of recorded decisions in this report is done using the keyword “Decision”, e.g., as follows:

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

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

### Late and incomplete document considerations

The formal deadline for registering and uploading non-administrative contributions had been announced as Friday, 10 April 2020.

Non-administrative documents uploaded after 2359 hours in Paris/Geneva time Saturday 11 April 2020 were to be considered "officially late". No contributions to this meeting were registered and/or submitted late. Therefore, the following considerations are not relevant at this meeting, and only kept for future use.

In some cases, contributions were revised after the initial version was uploaded. The contribution document archive website retains publicly-accessible prior versions in such cases. The timing of late document submissions for contributions is recorded in the list of documents in Annex A of this report and is also generally noted in the section discussing each contribution in this report.

As a general policy, missing documents were not to be presented, and late documents (and substantial revisions) could only be presented when sufficient time for studying was given after the upload. Again, an exception is applied for AHG reports, CE summaries, and other such reports which can only be produced after the availability of other input documents. There were no objections raised by the group regarding presentation of late contributions for this meeting.

It is noted that documents that are substantially revised after the initial upload are also a problem, as this becomes confusing, interferes with study, and puts an extra burden on synchronization of the discussion. This is especially a problem in cases where the initial upload is clearly incomplete, and in cases where it is difficult to figure out what parts were changed in a revision. For document contributions, revision marking is very helpful to indicate what has been changed. Also, the "comments" field on the web site can be used to indicate what is different in a revision (although this field has seldom been used and is often not checked by our participants).

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

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

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

### Outputs of the preceding meeting

The output documents of the previous meeting, particularly including the meeting report JCTVC-AL1000, the Update 13 of the HEVC Model (HM) 16 encoding algorithm description JCTVC-AL1002, the description of current errata report items in AVC, HEVC and Video CICP (JCTVC-AL1004), and the Shutter interval SEI message for HEVC (Draft 2) (JCTVC-AL1005), were approved.

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

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

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

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

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

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

## Attendance

The list of participants in the JCT-VC meeting can be found in Annex B of this report. It was generated by

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 WG11 host’s website. Access to the teleconference sessions of the main JVET meeting was controlled with a password that is distributed to the registered participants; this should help overloading the teleconferencing tool.

The following rules were initially set up for the Zoom teleconference meeting:

o 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.

o 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).

o Identify who you are and your affiliation when you begin speaking.

o Use your full name and company/organization affiliation in your joining information. We will use the participation list for attendance records.

o Turn on the chat window and watch for chair communication and side commentary there as well as by audio.

o 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
* 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

## IPR policy reminder

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

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

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

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

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

* <http://www.itu.int/ITU-T/ipr/index.html> (common patent policy for ITU-T, ITU-R, ISO, and IEC, and guidelines and forms for formal reporting to the parent bodies)
* <http://wftp3.itu.int/av-arch/jctvc-site> (JCT-VC contribution templates)
* <http://www.itu.int/ITU-T/studygroups/com16/jct-vc/index.html> (JCT-VC general information and founding charter)
* <http://www.itu.int/ITU-T/dbase/patent/index.html> (ITU-T IPR database)
* <http://www.itscj.ipsj.or.jp/sc29/29w7proc.htm> (JTC 1/‌SC 29 Procedures)

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

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

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

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

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

The chairs invited participants to make any necessary verbal reports of previously-unreported IPR in draft standards under preparation, and opened the floor for such reports: No such verbal reports were made.

## Software copyright disclaimer header reminder

It was noted that, as had been agreed at the 5th meeting of the JCT-VC and approved by both parent bodies at their collocated meetings at that time, the HEVC reference software copyright license header language is the BSD license with a preceding sentence declaring that other contributor or third party rights, such as patent rights, may exist that are not granted by the license, as recorded in N10791 of the 89th meeting of ISO/IEC JTC 1/‌SC 29/‌WG 11. Both ITU and ISO/IEC will be identified in the <OWNER> and <ORGANIZATION> tags in the header. This software is used in the process of designing the HEVC standard and its extensions, and for evaluating proposals for technology to be included in the design. After finalization of the draft, the software will be published by ITU-T and ISO/IEC as an example implementation of the HEVC standard and for use as the basis of products to promote adoption of the technology.

The same applies for the HDRTools and 360Lib codebases.

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

The JM and other AVC codebases are handled similarly.

## Communication practices

The documents for the meeting can be found at <http://phenix.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](mailto:jct-vc@lists.rwth-aachen.de). Only members of the reflector can send email to the list. However, membership of the reflector is not limited to qualified JCT-VC participants.

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

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

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

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

## Terminology

Some terminology used in this report is explained below:

* **3D-HEVC**: A set of extensions of HEVC that includes the combined coding of depth and texture information for 3D video coding.
* **ACT**: Adaptive colour transform.
* **Additional Review**: The stage of the ITU-T "alternative approval process" that follows a Last Call if substantial comments are received in the Last Call, during which a proposed revised text is available on the ITU web site for consideration as a candidate for final approval.
* **AHG**: Ad hoc group.
* **AI**: All-intra.
* **AIF**: Adaptive interpolation filtering.
* **ALF**: Adaptive loop filter.
* **AMP**: Asymmetric motion partitioning – a motion prediction partitioning for which the sub-regions of a region are not equal in size (in HEVC, being N/2x2N and 3N/2x2N or 2NxN/2 and 2Nx3N/2 with 2N equal to 16 or 32 for the luma component).
* **AMVP**: Adaptive motion vector prediction.
* **APS**: Active parameter sets.
* **ARC**: Adaptive resolution conversion (synonymous with DRC, and a form of RPR).
* **AU**: Access unit.
* **AUD**: Access unit delimiter.
* **AVC**: Advanced video coding – the video coding standard formally published as ITU-T Recommendation H.264 and ISO/IEC 14496-10.
* **BA**: Block adaptive.
* **BC**: May refer either to block copy (see CPR or IBC) or backward compatibility. In the case of backward compatibility, this often refers to what is more formally called forward compatibility.
* **BD**: Bjøntegaard-delta – a method for measuring percentage bit rate savings at equal PSNR or decibels of PSNR benefit at equal bit rate (e.g., as described in document VCEG-M33 of April 2001).
* **BL**: Base layer.
* **BoG**: Break-out group.
* **BR**: Bit rate.
* **BV**: Block vector (MV used for intra BC prediction, not a term used in the standard).
* **CABAC**: Context-adaptive binary arithmetic coding.
* **CBF**: Coded block flag(s).
* **CC**: May refer to context-coded, common (test) conditions, or cross-component.
* **CCP**: Cross-component prediction.
* **CD**: Committee draft – a draft text of an international standard for the first formal ballot stage of the approval process in ISO/IEC – corresponding to a PDAM for amendment texts.
* **CE**: Core experiment – a coordinated experiment for which there is a draft design and associated test model software that have been established, e.g., as in experiments conducted after the 3rd or subsequent JCT-VC meeting and approved to be considered a CE by the group (see also SCE and SCCE, and TE).
* **CGS**: Colour gamut scalability (historically, also coarse-grained scalability).
* **CL-RAS**: Cross-layer random-access skip.
* **CPR**: Current-picture referencing, also known as IBC – a technique by which sample values are predicted from other samples in the same picture by means of a displacement vector sometimes called a block vector, in a manner basically the same as motion-compensated prediction.
* **Consent**: A step taken in the ITU-T to formally move forward a text as a candidate for final approval (the primary stage of the ITU-T "alternative approval process").
* **CTC**: Common test conditions – a set of agreed conditions for coding experiments.
* **CVS**: Coded video sequence.
* **DAM**: Draft amendment – a draft text of an amendment to an international standard for the second formal ballot stage of the approval process in ISO/IEC – corresponding to a DIS for complete texts.
* **DCT**: Discrete cosine transform (sometimes used loosely to refer to other transforms with conceptually similar characteristics).
* **DCTIF**: DCT-derived interpolation filter.
* **DIS**: Draft international standard – the second formal ballot stage of the approval process in ISO/IEC – corresponding to a DAM for amendment texts.
* **DF**: Deblocking filter.
* **DRC**: Dynamic resolution conversion (synonymous with ARC, and a form of RPR).
* **DT**: Decoding time.
* **ECS**: Entropy coding synchronization (typically synonymous with WPP).
* **EOTF**: Electro-optical transfer function – a function that converts a representation value to a quantity of output light (e.g., light emitted by a display.
* **EPB**: Emulation prevention byte (as in the emulation\_prevention\_byte syntax element of AVC or HEVC).
* **EL**: Enhancement layer.
* **ET**: Encoding time.
* **ETM**: Experimental test model (design and software used for prior HDR/WCG coding experiments in MPEG).
* **FDAM**: Final draft amendment – a draft text of an amendment to an international standard for the third formal ballot stage of the approval process in ISO/IEC – corresponding to an FDIS for complete texts.
* **FDIS**: Final draft international standard – a draft text of an international standard for the third formal ballot stage of the approval process in ISO/IEC – corresponding to an FDAM for amendment texts.
* **HDR**: High dynamic range – referring to video content having a brightness range that includes values greater than approximately 100 nits (often implicitly including WCG as well, since HDR video is typically also WCG video).
* **HDR10**: A term that refers to the single-layer coding of HDR/WCG video content using the HEVC Main 10 profile with a Y′CbCr 4:2:0 10 bit per sample colour representation with ITU-R BT.2020 colour primaries and the PQ transfer characteristics EOTF.
* **HEVC**: High Efficiency Video Coding – the video coding standard developed and extended by the JCT-VC, formalized in ITU-T as Rec. ITU-T H.265 and in ISO/IEC as ISO/IEC 23008-2.
* **HLS**: High-level syntax.
* **HM**: HEVC Test Model – the draft reference software and its (non-normative) encoder algorithms used for HEVC experiments.
* **HRD**: Hypothetical reference decoder.
* **IBC** (also **Intra BC**): Intra block copy, also known as CPR – a technique by which sample values are predicted from other samples in the same picture by means of a displacement vector called a block vector, in a manner conceptually similar to motion-compensated prediction.
* **IBDI**: Internal bit-depth increase – a technique by which lower bit-depth (esp. 8 bits per sample) source video is encoded using higher bit-depth signal processing, ordinarily including higher bit-depth reference picture storage (esp. 12 bits per sample).
* **IBF**: Intra boundary filtering.
* **ILP**: Inter-layer prediction (in scalable coding).
* **IPCM**: Intra pulse-code modulation (as in AVC and HEVC).
* **JM**: Joint model – the primary software codebase and associated (non-normative) encoding algorithms that has been developed for the AVC standard.
* **JSVM**: Joint scalable video model – another software codebase that has been developed for the AVC standard, which includes support for scalable video coding extensions.
* **Last Call**: The stage of the ITU-T "alternative approval process" that follows Consent, during which a proposed text is available on the ITU web site for consideration as a candidate for final approval.
* **LB** or **LDB**: Low-delay B – the variant of the LD conditions that uses B pictures.
* **LD**: Low delay – one of two sets of coding conditions designed to enable interactive real-time communication, with less emphasis on ease of random access (contrast with RA). Typically refers to LB, although also applies to LP.
* **LM**: Linear model.
* **LP** or **LDP**: Low-delay P – the variant of the LD conditions that uses P frames.
* **LUT**: Look-up table.
* **LTRP**: Long-term reference pictures.
* **MANE**: Media-aware network element.
* **MC**: Motion compensation.
* **MCTS**: Motion-constrained tile set.
* **MOS**: Mean opinion score – a measurement of subjective video quality as reported by human test subjects.
* **MPEG**: Moving picture experts group (WG 11, the parent body working group in ISO/IEC JTC 1/‌SC 29, one of the two parent bodies of the JCT-VC).
* **MV**: Motion vector; alternatively, multiview.
* **MV-HEVC**: A set of extensions of HEVC using layered coding to enable the coding of video with multiple views or depth maps.
* **NAL**: Network abstraction layer (as in AVC and HEVC, contrast with VCL).
* **NCL**: Non-constant luminance, a type of colour difference representation.
* **Nits**: Candelas per square metre (cd/m2).
* **NB**: National body (usually used in reference to NBs of the WG 11 parent body).
* **NSQT**: Non-square quadtree.
* **NUH**: NAL unit header.
* **NUT**: NAL unit type (as in AVC and HEVC).
* **OBMC**: Overlapped block motion compensation (e.g., as in H.263 Annex F).
* **OETF**: Opto-electronic transfer function – a function that converts to input light (e.g., light input to a camera) to a representation value.
* **OLS**: Output layer set.
* **OOTF**: Optical-to-optical transfer function – a function that converts input light (e.g., light input to a camera) to output light (e.g., light emitted by a display).
* **PCP**: Parallelization of context processing.
* **PDAM**: Proposed draft amendment – a draft text of an amendment to an international standard for the first formal ballot stage of the ISO/IEC approval process – corresponding to a CD for complete texts.
* **PDTR**: Proposed draft technical report – the draft of a TR that is sent for a ballot in the ISO/IEC approval process.
* **POC**: Picture order count.
* **PoR**: Plan of record.
* **PPS**: Picture parameter set (as in AVC and HEVC).
* **PQ**: Perceptual quantization – the name given to an HDR EOTF curve specified in SMPTE ST 2084 and Rec. ITU-R BT.2100.
* **QM**: Quantization matrix (as in AVC and HEVC).
* **QP**: Quantization parameter (as in AVC and HEVC, sometimes confused with quantization step size).
* **QT**: Quadtree.
* **RA**: Random access – a set of coding conditions designed to enable relatively-frequent random access points in the coded video data, with less emphasis on minimization of delay (contrast with LD).
* **RADL**: Random-access decodable leading.
* **RASL**: Random-access skipped leading.
* **R-D**: Rate-distortion.
* **RDO**: Rate-distortion optimization.
* **RDOQ**: Rate-distortion optimized quantization.
* **RExt**: Format range extensions – a set of extensions of HEVC addressing high bit rate operation, high bit depths, and alternative chroma formats such as monochrome, 4:2:2, 4:4:4, high bit depths, and high throughput.
* **RPR**: Reference picture resampling (e.g., as in H.263 Annex P), a special case of which is also known as ARC or DRC.
* **RPS**: Reference picture set.
* **RQT**: Residual quadtree.
* **RRU**: Reduced-resolution update (e.g. as in H.263 Annex Q).
* **RVM**: Rate variation measure.
* **SAO**: Sample-adaptive offset.
* **SCC**: Screen content coding.
* **SCE**: Scalability core experiment (for SHVC).
* **SCCE**: Screen content core experiment (for SCC).
* **SCM**: Screen coding model (for SCC).
* **SD**: Slice data; alternatively, standard-definition.
* **SDR**: Standard dynamic range – referring to video content having a brightness range that would produce a maximum brightness of approximately 100 nits on a reference display under reference viewing conditions.
* **SEI**: Supplemental enhancement information (as in AVC and HEVC).
* **SH**: Slice header.
* **SHM**: Scalable HM (for SHVC).
* **SHVC**: Scalable high efficiency video coding – a set of extensions of HEVC that uses layered coding to enable the coding of supplemental pictures, quality enhancement layers, spatial resolution enhancement layers, and colour gamut enhancement layers.
* **SIMD**: Single instruction, multiple data.
* **SPS**: Sequence parameter set (as in AVC and HEVC).
* **Supplement**: In ITU-T terminology, a document that assists its readers by providing non-normative information and suggestions (sometimes considered a TR in ISO/IEC terminology).
* **SVC**: Scalable video coding, especially when referring to the associated extensions of AVC.
* **TBA/TBD/TBP**: To be announced/determined/presented.
* **TE**: Tool Experiment – a coordinated experiment conducted toward HEVC design at a more preliminary stage of work than those of CEs, e.g., as between the 1st and 2nd or 2nd and 3rd JCT-VC meetings, or a coordinated experiment conducted toward SHVC design between the 11th and 12th JCT-VC meetings.
* **TGM**: Text and graphics with motion – a category of content that primarily contains rendered text and graphics with motion, mixed with a relatively small amount of camera-captured content.
* **TR**: Technical report – e.g., a collection of non-normative suggestion guidance on appropriate technical practices (sometimes considered a “supplement” in ITU-T terminology).
* **VCEG**: Visual coding experts group (ITU-T Q.6/16, the relevant rapporteur group in ITU-T WP3/16, which is one of the two parent bodies of the JCT-VC).
* **VCL**: Video coding layer (as in AVC and HEVC, contrast with NAL).
* **VPS**: Video parameter set – a parameter set that describes the overall characteristics of a coded video sequence – conceptually sitting above the SPS in the syntax hierarchy.
* **WCG**: Wide colour gamut – referring to video content having a colour gamut that includes colours substantially outside of the range of values that is representable using Rec. ITU-R BT.709.
* **WD**: Working draft – a term for a draft standard, especially one prior to its first ballot in the ISO/IEC approval process, although the term is sometimes used loosely to refer to a draft standard at any actual stage of parent-level approval processes.
* **WG**: Working group, a group of technical experts (usually used to refer to WG 11, a.k.a. MPEG).
* **WPP**: Wavefront parallel processing (usually synonymous with ECS).
* **Block and unit names**:
  + **CTB**: Coding tree block (luma or chroma) – unless the format is monochrome, there are three CTBs per CTU.
  + **CTU**: Coding tree unit (containing both luma and chroma, synonymous with LCU), with a size of 16x16, 32x32, or 64x64 for the luma component.
  + **CB**: Coding block (luma or chroma), a luma or chroma block in a CU.
  + **CU**: Coding unit (containing both luma and chroma), the level at which the prediction mode, such as intra versus inter, is determined in HEVC, with a size of 2Nx2N for 2N equal to 8, 16, 32, or 64 for luma.
  + **LCU**: (formerly LCTU) largest coding unit (name formerly used for CTU before finalization of HEVC version 1).
  + **PB**: Prediction block (luma or chroma), a luma or chroma block of a PU, the level at which the prediction information is conveyed or the level at which the prediction process is performed[[1]](#footnote-2) in HEVC.
  + **PU**: Prediction unit (containing both luma and chroma), the level of the prediction control syntax1 within a CU, with eight shape possibilities in HEVC:
    - **2Nx2N**: Having the full width and height of the CU.
    - **2NxN (or Nx2N)**: Having two areas that each have the full width and half the height of the CU (or having two areas that each have half the width and the full height of the CU).
    - **NxN**: Having four areas that each have half the width and half the height of the CU, with N equal to 4, 8, 16, or 32 for intra-predicted luma and N equal to 8, 16, or 32 for inter-predicted luma – a case only used when 2N×2N is the minimum CU size.
    - **N/2x2N** paired with **3N/2x2N** or **2NxN/2** paired with **2Nx3N/2**: Having two areas that are different in size – cases referred to as AMP, with 2N equal to 16 or 32 for the luma component.
  + **TB**: Transform block (luma or chroma), a luma or chroma block of a TU, with a size of 4x4, 8x8, 16x16, or 32x32.
  + **TU**: Transform unit (containing both luma and chroma), the level of the residual transform (or transform skip or palette coding) segmentation within a CU (which, when using inter prediction in HEVC, may sometimes span across multiple PU regions).

## Liaison activity

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

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

## Opening remarks and status of work items (only minor update so far)

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 (approximately the same as last meeting)

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

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

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

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

Key deliverables initially planned from this meeting:

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

A single meeting track was followed for the meeting discussions.

## Scheduling of discussions

The plans for the times of meeting sessions were established as follows, in UTC (2 hours behind the time in Geneva, Paris (and Alpbach); 7 hours ahead of the time in Los Angeles, etc.). No session should last longer than 2 hrs.

* 0500-0700 1st “morning” session [break after 2 hours]
* 0715-0915 2nd “morning” session
* [“lunch” break – nearly 4 hours]
* 1300-1500 1st “afternoon” session [break after 2 hours]
* 1515-1715 2nd “afternoon” session

Only few of these session slots were used. Some particular scheduling notes are shown below, although not necessarily 100% accurate or complete (all times are in UTC):

* Sat. 18 Apr., 1st meeting session
  + 0500–05XX Opening remarks, status review
  + XXXX–XXXX AHG report reviews
  + XXXX JCTVC-AM0020 Deployment status
  + …
* Mon. 20 Apr., 2nd meeting session
  + 0715 Status review
  + …
* Wed. 22 Apr., 3rd meeting session
  + 1515 …
  + XXXX closing

## Contribution topic overview

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

* AHG reports (5) (section 2)
* Project development status and errata reports (2) (section 3)
* CICP related (1) (section 4)
* SEI messages (3) (section 5)
* Non-normative encoding practices and software development (0) (section 6)
* Technical information contributions (0) (section 7)
* Outputs & planning: AHG plans, Conformance, Reference software, Verification testing, CTC (sections 8, 9, and 10)

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

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

Notes on potential remainders near the end of the meeting:

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

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

# AHG reports (5)

These reports were discussed Saturday 18 Apr. 0500–XXXX (chaired by GJS and JRO), except as otherwise noted.

[JCTVC-AM0001](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11008) JCT-VC AHG report: Project management (AHG1) [G. J. Sullivan, J.-R. Ohm]

[JCTVC-AM0002](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11009) 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]

[JCTVC-AM0003](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11010) JCT-VC AHG report: Software development and software technical evaluation (AHG3) [K. Sühring, B. Li, K. Sharman, V. Seregin, G. Tech, A. Tourapis]

[JCTVC-AM0004](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11011) JCT-VC AHG report: Supplemental enhancement infomation (AHG4) [J. Boyce, C. Fogg, S. McCarthy, H.-M. Oh, G. J. Sullivan, Y.-K. Wang]

[JCTVC-AM0005](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11005) JCT-VC AHG report: Test sequence material (AHG5) [T. Suzuki, V. Baroncini, E. François, P. Topiwala, S. Wenger]

# Project development, status, and guidance (6)

## General (1)

[JCTVC-AM0020](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10998) Deployment status of the HEVC standard [G. J. Sullivan (Microsoft)]

## Errata reports (1)

[JCTVC-AM0021](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=10999) On Errata items for HEVC, AVC, and Video CICP [T. Suzuki (Sony)]

See also the notes for the AHG report JCTVC-AM0002.

## Communication with parent bodies

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

# CICP technical contributions

[JCTVC-AM0022](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11001) Addition of the Chroma Sample Location as a code point in the CICP (23091-2) specification [C. Fogg (Movielabs), A. M. Tourapis, D. Singer (Apple)]

# SEI message technical contributions (3)

[JCTVC-AM0023](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11002) Illustration of the film grain characteristics SEI message in HEVC [S. McCarthy, F. Pu, T. Lu, P. Yin, W. Husak, T. Chen]

[JCTVC-AM0024](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11003) Illustration of the shutter interval info SEI message in HEVC Draft [S. McCarthy, F. Pu, T. Lu, P. Yin, W. Husak, T. Chen]

[JCTVC-AM0025](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=11004) Cross-check of JCTVC-AM0024 shutter interval SEI message software [[C. Fogg (MovieLabs)](mailto:chadfogg@gmail.com)]

# Non-normative encoding and software contributions (0)

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

# Technical information contributions (0)

No particular technical information contributions were noted.

# Project planning

## Joint meeting

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

## Text drafting and software quality

The following agreement has been established: the editorial team has the discretion to not integrate recorded adoptions for which the available text is grossly inadequate (and cannot be fixed with a reasonable degree of effort), if such a situation hypothetically arises. In such an event, the text would record the intent expressed by the committee without including a full integration of the available inadequate text. Similarly, software coordinators have the discretion to evaluate contributed software for suitability in regard to proper code style, bugginess, etc., and to not integrate code that is determined inadequate in software quality.

## Plans for improved efficiency and contribution consideration

The group considered it important to have the full design of proposals documented to enable proper study.

Adoptions need to be based on properly drafted working draft text (on normative elements) and HM encoder algorithm descriptions – relative to the existing drafts. Proposal contributions should also provide a software implementation (or at least such software should be made available for study and testing by other participants at the meeting, and software must be made available to cross-checkers in CEs).

Suggestions for future meetings included the following generally supported principles:

* No review of normative contributions without draft specification text
* HM text is strongly encouraged for non-normative contributions
* Early upload deadline to enable substantial study prior to the meeting
* Using a clock timer to ensure efficient proposal presentations (5 min) and discussions

As general guidance, it was suggested to avoid usage of company names in document titles, software modules, etc., and not to describe a technology by using a company name. Also, core experiment responsibility descriptions should name individuals, not just companies. AHG reports and CE descriptions/summaries are considered to be the contributions of individuals, not companies.

## General issues for CEs and TEs

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

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

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

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

As a general rule, it has been agreed that each CE should be run under the same testing conditions using one software codebase, which should be based on the HM software codebase. An experiment is not to be established as a CE unless there is access given to the participants in (any part of) the CE to the software used to perform the experiments.

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

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

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

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

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

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

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

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

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

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

Experiment descriptions should be written in a way such that it is understood as a JCT-VC output document (written from an objective "third party perspective", not a company proponent perspective – e.g. referring to methods as "improved", "optimized" etc.). The experiment descriptions should generally not express opinions or suggest conclusions – rather, they should just describe what technology will be tested, how it will be tested, who will participate, etc. Responsibilities for contributions to CE work should identify individuals in addition to company names.

CE descriptions should not contain excessively verbose descriptions of a technology (at least not unless the technology is not adequately documented elsewhere). Instead, the CE descriptions should refer to the relevant proposal contributions for any necessary further detail. However, the complete detail of what technology will be tested must be available – either in the CE description itself or in referenced documents that are also available in the JCT-VC document archive.

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

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

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

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

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

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

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

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

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

## Alternative procedure for handling complicated feature adoptions

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

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

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

## Common test conditions for HEVC Coding Experiments

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

## Software development planning

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

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

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

# Establishment of ad hoc groups

The ad hoc groups established to progress work on particular subject areas until the next meeting are described in the table below. The discussion list for all of these ad hoc groups was agreed to be the main JCT-VC reflector ([jct-vc@lists.rwth-aachen.de](mailto:jct-vc@lists.rwth-aachen.de)).

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

# Output documents

The following documents were agreed to be produced or endorsed as outputs of the meeting. Names recorded below indicate the editors responsible for the document production.

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

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

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

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

No output: JCTVC-AL1003

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

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

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

No output: JCTVC-AK1006

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

No output: JCTVC-AK1008

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

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

No output: JCTVC-AL1011

No output: JCTVC-AL1012

No output: JCTVC-AL1013

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

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

No output: JCTVC-AL1016 through JCTVC-AL1019

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

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

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

# Future meeting plans, expressions of thanks, and closing of the meeting

Future meeting plans were established according to the following guidelines:

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

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

* Thu. 25 June – Wed. 1 July 2020, 40th meeting under ITU-T SG16 auspices in Geneva, CH (note: this might be converted to a teleconference-based meeting in response to the COVID-19 pandemic)
* Fri. 9 – Fri. 16 October 2020, 41st meeting under WG 11 auspices in Rennes, FR
* Fri. 8 – Fri. 15 January 2021, 42nd meeting under WG 11 auspices in Capetown, ZA.
* Thu. 22 Apr. – Wed. 28 Apr. 2021, 43rd meeting under ITU-T SG16 auspices in Geneva, CH (note: this might be converted to a teleconference-based meeting in response to the COVID-19 pandemic)

The agreed document deadline for the 40th JCT-VC meeting is XXday XX June 2020. Plans for scheduling of agenda items within that meeting remained TBA.

XXXX was thanked for the excellent hosting and organization of the 39th meeting of the JCT-VC.

The JCT-VC meeting was closed at approximately XXXX hours UTC on XXday, XX April 2020.

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

# 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 XX people in total), were as follows:

1. …

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)