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| **Joint Video Experts Team (JVET)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29**  23rd Meeting, by teleconference, 7–16 July 2021 | Document: JVET-W\_Notes\_d0 |

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| *Title:* | **Meeting Report of the 23rd Meeting of the Joint Video Experts Team (JVET), by teleconference, 7–16 July 2021** | | |
| *Status:* | Report document from the chairs of JVET | | |
| *Purpose:* | Report | | |
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| *Source:* | Chairs of JVET | | |

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# Summary

The Joint Video Experts Team (JVET) of ITU-T WP3/16 and ISO/IEC JTC 1/‌SC 29 held its twenty-third meeting during 7–16 July 2021 as an online-only meeting. It had previously been planned to be in Prague, CZ, but this plan was changed due to the difficulties resulting from the COVID-19 pandemic. For ISO/IEC purposes, JVET is alternatively designated ISO/IEC JTC 1/‌SC 29/‌WG 5, and this was the fourth meeting as WG 5. The JVET meeting was held under the chairmanship of Dr Gary Sullivan (Microsoft/USA) and Dr Jens-Rainer Ohm (RWTH Aachen/Germany). For rapid access to particular topics in this report, a subject categorization is found (with hyperlinks) in section 2.14 of this document. It is further noted that the unabbreviated name of JVET was formerly known as “Joint Video *Exploration* Team”, but the parent bodies modified it when entering the phase of formal development of Versatile Video Coding (VVC) in April 2018. Furthermore, starting from the twentieth meeting, work items which had originally been conducted by the Joint Collaborative Team on Video Coding (JCT-VC) were continued in JVET as a single joint team, and explorations towards possible future need of standardization in the area of video coding are also conducted by JVET, as negotiated by the parent bodies.

The JVET meeting began at approximately 0500 hours UTC on Wednesday 7 July 2021. Meeting sessions were held on all days except the weekend days of Saturday and Sunday 10 and 11 July 2021, until the meeting was closed at approximately XXXX hours UTC on Friday 16 July 2021. Approximately XXX people attended the JVET meeting, and approximately XXX input documents (not counting crosschecks), 12 AHG reports, 3 CE/EE summary reports, and X BoG reports were discussed. The meeting took place in a collocated fashion with a meeting of various SC29 Working Groups – where WG 5 is representing the Joint Video Coding Team(s) and their activities from the SC 29 parent body. The subject matter of the JVET meeting activities consisted of work on further development and maintenance of the twin-text video coding technology standards *Advanced Video Coding* (AVC), *High Efficiency Video Coding* (HEVC), *Versatile Video Coding* (VVC)*, Coding-independent Code Points (Video)* (CICP), and *Versatile Supplemental Enhancement Information Messages for Coded Video Bitstreams* (VSEI), as well as related technical reports, software and conformance packages. As a primary goal, the JVET meeting reviewed the work that was performed in the interim period since the twenty-second JVET meeting in producing the following documents:

* JVET-V1000 Meeting report
* JVET-V1002 High Efficiency Video Coding (HEVC) Test Model 16 (HM 16) Encoder Description Update 15
* JVET-V1004 Errata report items for VVC, HEVC, AVC, Video CICP, and CP usage TR
* JVET-V2002 Algorithm description for Versatile Video Coding and Test Model 13 (VTM 13)
* JVET-V2005 New level and additional SEI messages for VVC (Draft 3)
* JVET-V2006 Additional SEI messages for VSEI (Draft 3)
* JVET-V2011 JVET common test conditions and evaluation procedures for HDR/WCG video
* JVET-V2016 Common Test Conditions and evaluation procedures for neural network-based video coding technology
* JVET-V2017 Common Test Conditions and evaluation procedures for enhanced compression tool testing
* JVET-V2020 VVC verification test report for HD SDR and 360° video content
* JVET-V2021 VVC verification test plan (Draft 6)
* JVET-V2022 CE on Entropy Coding for High Bit Depth and High Bit Rate Coding
* JVET-V2023 Exploration Experiment on Neural Network-based Video Coding (EE1)
* JVET-V2024 Exploration Experiment on Enhanced Compression beyond VVC capability (EE2)

Further important goals were reviewing the results of the CE on Entropy Coding for High Bit Depth and High Bit Rate Coding, of the EE on Neural Network-based Video Coding, of the EE on Enhanced Compression beyond VVC capability, of other technical input on novel aspects of video coding technology, and plan next steps for investigation of candidate technology towards further standard development.

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

* JVET-V1002 High Efficiency Video Coding (HEVC) Test Model 16 (HM 16) Encoder Description Update 15
* JVET-V1004 Errata report items for VVC, HEVC, AVC, Video CICP, and CP usage TR
* JVET-V2002 Algorithm description for Versatile Video Coding and Test Model 13 (VTM 13)
* JVET-V2005 New level and additional SEI messages for VVC (Draft 3)
* JVET-V2006 Additional SEI messages for VSEI (Draft 3)
* JVET-V2011 JVET common test conditions and evaluation procedures for HDR/WCG video
* JVET-V2016 Common Test Conditions and evaluation procedures for neural network-based video coding technology
* JVET-V2017 Common Test Conditions and evaluation procedures for enhanced compression tool testing
* JVET-V2020 VVC verification test report for HD SDR and 360° video content
* JVET-V2021 VVC verification test plan (Draft 6)
* JVET-V2022 CE on Entropy Coding for High Bit Depth and High Bit Rate Coding
* JVET-V2023 Exploration Experiment on Neural Network-based Video Coding (EE1)
* JVET-V2024 Exploration Experiment on Enhanced Compression beyond VVC capability (EE2)

For the organization and planning of its future work, the JVET established 12 “ad hoc groups” (AHGs) to progress the work on particular subject areas. At this meeting, 1 Core Experiment (CE) and 2 Exploration Experiments (EE) were defined. The next eight JVET meetings were planned for Fri. 8 – Fri. 15 October 2021 as a mixed-mode meeting under ISO/IEC JTC 1/‌SC 29 auspices in Antalya, TR, during January 2022 under ITU-T SG16 auspices in Geneva, CH, during Fri. 22 – Fri. 29 April 2022 under ISO/IEC JTC 1/‌SC 29 auspices, location t.b.d., during Fri. 15 – Fri. 22 July 2022 under ISO/IEC JTC 1/‌SC 29 auspices in Cologne, DE, during October 2022 under ITU-T SG16 auspices in Geneva, CH, during January 2023 under ISO/IEC JTC 1/‌SC 29 auspices, location t.b.d., during April 2023 under ISO/IEC JTC 1/‌SC 29 auspices, location t.b.d., and during June/July 2023 under ITU-T SG16 auspices in Geneva, CH

The document distribution site <https://jvet-experts.org/> was used for distribution of all documents. It was noted that the previous site <http://phenix.int-evry.fr/jvet/> is still accessible, but was converted to read-only.

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

# Administrative topics

## Organization

The ITU-T/ISO/IEC Joint Video Experts Team (JVET) is a group of video coding experts from the ITU-T Study Group 16 Visual Coding Experts Group (VCEG) and the ISO/IEC JTC 1/‌SC 29/‌WG 5. The parent bodies of the JVET are ITU-T WP3/16 and ISO/IEC JTC 1/‌SC 29.

The Joint Video Experts Team (JVET) of ITU-T WP3/16 and ISO/IEC JTC 1/‌SC 29 held its twenty-second meeting during 7–16 July 2021 as an online-only meeting, using Zoom teleconferencing tools. For ISO/IEC purposes, JVET is alternatively designated ISO/IEC JTC 1/‌SC 29/‌WG 5, and this was the fourth meeting as WG 5. The JVET meeting was held under the chairmanship of Dr Gary Sullivan (Microsoft/USA) and Dr Jens-Rainer Ohm (RWTH Aachen/Germany).

It is further noted that the unabbreviated name of JVET was formerly known as “Joint Video *Exploration* Team”, but the parent bodies modified it when entering the phase of formal development of the *Versatile Video Coding* (VVC) and *Versatile Supplemental Enhancement Information Messages for Coded Video Bitstreams* (VSEI) standards. Furthermore, starting from the twentieth meeting, work items which had originally been conducted by the Joint Collaborative Team on Video Coding (JCT-VC) were continued to be conducted in JVET as a single joint team, as negotiated by the parent bodies. This particularly consists of work on:

* *High Efficiency Video Coding* (HEVC) and its extensions, the development of associated conformance test sets, reference software, verification testing, and non-normative guidance information,
* Specification of *Coding-independent Code Points (Video)* (CICP), and associated technical report(s),
* Maintenance and minor enhancement work on the *Advanced Video Coding* (AVC) standard, associated conformance test sets and reference software.

Furthermore, explorations towards possible future need of standardization in the area of video coding are also conducted by JVET. Currently, the following topics are under investigation:

* Exploration on Neural Network-based Video Coding
* Exploration on Enhanced Compression beyond VVC capability

This report contains three important annexes, as follows:

* Annex A contains a list of the documents of the JVET meeting
* Annex B contains a list of the meeting participants, as recorded by the teleconferencing tool used for the meeting
* Annex C contains the meeting recommendations of ISO/IEC JTC 1/‌SC 29/‌WG 5 for purposes of results reporting to ISO/IEC.

## Meeting logistics

Information regarding logistics arrangements for the meeting had been provided via the email reflector [jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de) and at <http://wftp3.itu.int/av-arch/jvet-site/2022_07_W_Virtual/>.

## Primary goals

As a primary goal, the JVET meeting reviewed the work that was performed in the interim period since the twenty-second JVET meeting in producing the following documents:

* JVET-V1000 Meeting report
* JVET-V1002 High Efficiency Video Coding (HEVC) Test Model 16 (HM 16) Encoder Description Update 15
* JVET-V1004 Errata report items for VVC, HEVC, AVC, Video CICP, and CP usage TR
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* JVET-V2020 VVC verification test report for HD SDR and 360° video content
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Further important goals were reviewing the results of the CE on Entropy Coding for High Bit Depth and High Bit Rate Coding, of the EE on Neural Network-based Video Coding, of the EE on Enhanced Compression beyond VVC capability, of other technical input on novel aspects of video coding technology, and plan next steps for investigation of candidate technology towards further standard development.

## Documents and document handling considerations

### General

The document distribution site <https://jvet-experts.org/> was used for distribution of all documents. It was noted that the previous site <http://phenix.int-evry.fr/jvet/> is still accessible, but was converted to read-only.

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

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

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

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

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

### Late and incomplete document considerations

The formal deadline for registering and uploading non-administrative contributions had been announced as Wednesday, 30 June 2021. Any documents uploaded after 1159 hours Paris/Geneva time on Thursday 1 July 2021 were considered “officially late”, giving a grace period of 12 hours to accommodate those living in different time zones of the world. The deadline does not apply to AHG reports, and other such reports which can only be produced after the availability of other input documents.

All contribution documents with registration numbers higher than JVET-W0132 were registered after the “officially late” deadline (and therefore were also uploaded late). However, some documents in the “late” range might include break-out activity reports that were generated during the meetings, and are therefore better considered as report documents rather than as late contributions.

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

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

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

* JVET-W0XXX (a proposal on …), uploaded 07-XX.
* …

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

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

* JVET-W0XXX (a document on …), uploaded 07-XX.
* …

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

The following contribution registrations were noted that were later cancelled, withdrawn, never provided, were cross-checks of a withdrawn contribution, or were registered in error: JVET-W0XXX.

“Placeholder” contribution documents that were basically empty of content, or lacking any results showing benefit for the proposed technology, and obviously uploaded with an intent to provide a more complete submission as a revision, had been agreed to be considered unacceptable and to be rejected in the document management system until a more complete version was available (which would then typically be counted as a late contribution). At the current meeting, this situation did not apply.

Contributions that had significant problems with uploaded versions were not observed.

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

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

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

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

### Outputs of the preceding meeting

All output documents of the previous meeting, particularly the meeting report JVET-V1000, the High Efficiency Video Coding (HEVC) Test Model 16 (HM 16) Encoder Description Update 15 JVET-V1002, the Errata report items for VVC, VSEI, HEVC, AVC, Video CICP, and CP usage TR JVET-V1004, the Algorithm description for Versatile Video Coding and Test Model 13 (VTM 13) JVET-V2002, the New level and additional SEI messages for VVC (Draft 3) JVET-V2005, the Additional SEI messages for VSEI (Draft 3) JVET-V2006, the JVET common test conditions and evaluation procedures for HDR/WCG video JVET-V2011, the Common Test Conditions and evaluation procedures for neural network-based video coding technology JVET-V2016, the Common Test Conditions and evaluation procedures for enhanced compression tool testing JVET-V2017, the VVC verification test report for HD SDR and 360° video content JVET-V2020, the VVC verification test plan (Draft 6) JVET-V2021, the Description of the CE on Entropy Coding for High Bit Depth and High Bit Rate Coding JVET-V2022, the Description of the EE on Neural Network-based Video Coding JVET-V2023, and the Description of the EE on Enhanced Compression beyond VVC capability JVET-V2024 had been completed and were approved. The software implementations of VTM (versions 13.0 and 13.1), HM 16.XX, and HDRTools (versions 0.2X and 0.2X) were also approved.

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

## Attendance

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

The meeting was open to those qualified to participate either in ITU-T WP3/16 or ISO/IEC JTC 1/‌SC 29/‌WG 5 (including experts who had been personally invited as permitted by ITU-T or ISO/IEC policies).

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

It was further announced that it is necessary to register for the meeting through the ISO Meetings website for ISO/IEC experts or through the Q6/16 rapporteur for ITU-T experts. The password had been sent to registered participants via these channels. Links to the Zoom sessions (without password) were available in the posted meeting logistics information and the calendar of meeting sessions in the JVET web site. No particular problems were observed that resulted in interference with the meeting, nor was anybody identified who would have attended sessions without being authorized.

The following rules were initially set up 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, as the participation list of Zoom would also be used to compile 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 by not using video for the teleconferencing calls – only voice and screen sharing. Extensive use of screen sharing is encouraged.

## Agenda

The agenda for the meeting, for the further development and maintenance of the twin-text video coding technology standards *Advanced Video Coding* (AVC), *High Efficiency Video Coding* (HEVC), *Versatile Video Coding* (VVC)*, Coding-independent Code Points (Video)* (CICP), and *Versatile Supplemental Enhancement Information Messages for Coded Video Bitstreams* (VSEI), as well as related technical reports, software and conformance packages, was as follows:

* Opening remarks and review of meeting logistics and communication practices
* Code of conduct policy reminder
* IPR policy reminder and declarations
* Contribution document allocation
* Review of results of the previous meeting
* Reports of ad hoc group (AHG) activities
* Report of core experiment on entropy coding for high bit depth and high bit rate coding
* Report of exploration experiments on neural-network-based video coding
* Report of exploration experiments on enhanced compression beyond VVC capability
* Consideration of contributions on high-level syntax
* Consideration of contributions and communications on project guidance
* Consideration of video coding technology contributions
* Consideration of contributions on conformance and reference software development
* Consideration of contributions on coding-independent code points for video signal type identification
* Consideration of contributions on errata relating to standards in the domain of JVET
* Consideration of contributions on technical reports relating to standards and exploration study activities in the domain of JVET
* Consideration of contributions providing non-normative guidance relating to standards and exploration study activities in the domain of JVET
* Consideration of information contributions
* Coordination of visual quality testing
* Coordination activities with other organizations
* 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, other planning issues
* Other business as appropriate for consideration

Other business as appropriate for considerationThe 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 should last longer than 2 hrs.

* 0500–0700 1st “morning” session [break after 2 hours]
* 0720–0920 2nd “morning” session
* [“overday” break – nearly 12 hours]
* 2100–2300 1st “night” session [break after 2 hours]
* 2320–0120+1 2nd “night” session

It was also pointed out that the session times had been changed from meeting to meeting, such that different time zones of the world might be treated approximately equally fair either in one meeting or another. For the current meeting, the same session times were used as in the 19th JVET meeting (which used to be the second meeting conducted as online meeting)

* 1. ***ISO Code of Conduct reminder***

Participants were reminded of the ISO and IEC Codes of Conduct, found at

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

<https://www.iecapc.jp/F/IEC_Code_of_Conduct.pdf>

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 JVET and were referred to the parent body websites for further information. The IPR policy was summarized for the participants.

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

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

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

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

* <http://www.itu.int/ITU-T/ipr/index.html> (common patent policy for ITU-T, ITU-R, ISO, and IEC, and guidelines and forms for formal reporting to the parent bodies)
* <http://ftp3.itu.int/av-arch/jvet-site> (JVET contribution templates)
* <http://www.itu.int/ITU-T/dbase/patent/index.html> (ITU-T IPR database)

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

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

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

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

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

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

## Software copyright disclaimer header reminder

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

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

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

Software packages that had been developed in prior work of the JCT-VC have similar considerations and are maintained according to the past practice in that work.

## Communication practices

The documents for the meeting can be found at <https://jvet-experts.org/>. It was noted that the previous site <http://phenix.int-evry.fr/jvet/> is still accessible, but was converted to read-only. It was reminded to send a notice to the chairs in cases of changes to document titles, authors etc.

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

It was emphasized that reflector subscriptions and email sent to the reflector must use real names when subscribing and sending messages and subscribers must respond to inquiries regarding the nature of their interest in the work. The current number of subscribers on the JVET email list was 1300. Furthermore, the JCT-VC email list currently had XXXX subscribers (as of 6 July 2021). Future discussions should be conducted on the JVET reflector rather than the JCT-VC reflector (or JVT reflector), while the old reflectors should be retained for archiving purposes.

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

## Terminology

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

## Opening remarks

Remarks during the opening session of the meeting Wednesday 07 April at 0500 UTC (chaired by GJS and JRO) were as follows.

* Timing and organization of online meetings, calendar
* Standards approval and publication status (update)
  + Working practices using objective metrics report
    - HSTP-VID-WPOM V1: 2020-07-03, published 2020-11
    - ISO/IEC TR 23002-8 (Ed. 1) pending publication as of this meeting; later published 2021-05-20
  + HEVC
    - H.265 V7 approved 2019-11-29, published 2020-01-10
    - ISO/IEC 23008-2:2020 (Ed. 4) published 2020-08-27
    - H.265 V8 to be Consented at the current meeting (Shutter interval information SEI message)
    - ISO/IEC 23008-2:2020 FDAM 1 ballot started 2021-04-07 (Shutter interval information SEI message)
  + Usage of code points report
    - H.Sup19 V3 to be Approved at the current meeting
    - ISO/IEC TR 23091-4 (Ed. 3) pending publication as of this meeting; later published 2021-05-23
  + VVC
    - H.266 V1 approved 2020-08-29, published 2020-11-10
    - ISO/IEC 23090-3:2021 (Ed. 1) published 2021-02-16
  + VSEI
    - H.274 V1 approved 2020-08-29, published 2020-11-10
    - ISO/IEC 23002-7:2021 (Ed. 1) published 2021-01-28
  + CICP v2 (incudes errata items)
    - Was FDIS in ISO/IEC and ITU-T Consent last meeting
  + The following freely available standards are published here in ISO/IEC:  
    <https://standards.iso.org/ittf/PubliclyAvailableStandards/index.html>
    - ISO/IEC 23002-7:2021 (Ed. 1) VSEI
    - ISO/IEC 23008-2:2020 (Ed. 4) HEVC
    - ISO/IEC 23090-3:2021 (Ed. 1) VVC
    - ISO/IEC 23091-2:2019 (Ed. 1) Video CICP
* Draft standards progression status
  + VVC conformance – under DIS ballot, FDIS in October
  + VVC reference SW – under DIS ballot, FDIS in October
  + AVC additional SEI – DAM this meeting, new draft
  + VSEI extensions – DAM this meeting, new draft
  + VVC operation range extensions – DAM this meeting, new draft
  + The request for free availability in ISO/IEC has to be made for each edition, amendment and corrigendum, and these will also need a request form to be filled out and be approved in the Recommendations. Freely available URL on ITU part should be provided for the following parts:
    - ISO/IEC 23008-2:2020/Amd 1 – done last meeting
    - ISO/IEC DIS 23091-2, 2nd edition – done last meeting
    - ISO/IEC 23002-7:2021/Amd 1 – to be done when finishing
    - ISO/IEC 23090-3:2021/Amd 1 – to be done when finishing
* The meeting logistics, agenda, working practices, policies, and document allocation were reviewed.
  + The meeting is conducted using Zoom
  + Having text and software available is crucial (and not just arriving at the end of the meeting).
  + There were no objections voiced in the opening plenary to the consideration of late contributions.
* The results of the previous meeting and the meeting report were reviewed.
* There was somewhat less of a problem of late non-cross-check documents and no “placeholders” (see section 2.4.2).
* The primary goals of the meeting were
  + Errata
  + Conformance and software for VVC & VSEI
  + Verification test planning
  + Extensions of VVC
    - High bit rate / high bit depth
  + Additional SEI messages for VSEI
  + Explorations
    - Neural network-based video coding
    - Enhanced compression beyond VVC
* Funding of verification testing activities: Thank resolution, resolution calling for funding wrt upcoming tests.
* Liaisons?
* Number of documents similar to last meeting, but if possible not conduct sessions in parallel
* Scheduling was discussed
* Principles of standards development were discussed.

## 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 should last longer than 2 hrs.

* 0500–0700 1st “morning” session [break after 2 hours]
* 0720–0920 2nd “morning” session
* [“overday” break – nearly 12 hours]
* 2100–2300 1st “night” session [break after 2 hours]
* 2320–0120+1 2nd “night” session

Sessions were announced via the calendar in the JVET document site at least 22 hrs. in advance. Particular scheduling notes are shown below, although not necessarily 100% accurate or complete:

* Wed. 07 July, 1st day
  + Session 1:
    - 0500–05XX Opening remarks, review of practices, agenda, IPR reminder
    - 05XX–0700 Reports of AHGs 1–X
  + Session 2:
    - 0720–0920 Reports of AHGs X–XX
  + Session 3:
    - 2100–2300 Review of CE and related
  + Session 4:
    - 2320–0120 Review of XXXX
* Thu. 8 April, 2nd day
  + Session 5:
    - 0500–0700 Review of XXXX
  + …

## Contribution topic overview

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

* AHG reports (section 3)
* Project development (section 4)
  + Deployment of standards (1)
  + Text development and errata reporting (0)
  + Test conditions (0)
  + Verification testing (3)
  + Test Material (0)
  + Quality assessment (0)
  + Conformance test development (0)
  + Software development (1)
  + Implementation studies (1)
  + Complexity analysis (0)
  + Encoder optimization (4)
  + Profile/tier/level specification (1)
  + Proposed modification of system interface (1)
* Low-level tool technology proposals (section 5) with subtopics
  + AHG8: High bit depth and high bit rate coding (20) (section 5.1)
  + AHG11: Neural network-based technology (15) (section 5.2)
  + AHG12: Enhanced compression beyond VVC capability (30) (section 5.3)
* High-level syntax (HLS) proposals (section 6) with subtopics
  + AHG9: SEI message studies and proposals (11) (section 6.1)
  + Non-SEI HLS aspects (4) (section 6.2)
* Joint meetings, plenary discussions, BoG reports (0), summary of actions (section 7)
* Project planning (section 8)
* Establishment of AHGs (section 9)
* Output documents (section 10)
* Future meeting plans and concluding remarks (section 11)

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

# AHG reports (12)

These reports were discussed Wednesday 7 July 2021 during 05XX–XXXX UTC (chaired by GJS & JRO).

[JVET-W0001](https://jvet-experts.org/doc_end_user/current_document.php?id=10948) JVET AHG report: Project management (AHG1) [J.-R. Ohm, G. J. Sullivan]

[JVET-W0002](https://jvet-experts.org/doc_end_user/current_document.php?id=10949) JVET AHG report: Draft text and test model algorithm description editing (AHG2) [B. Bross, J. Chen, C. Rosewarne, F. Bossen, J. Boyce, S. Kim, S. Liu, J.-R. Ohm, G. J. Sullivan, A. Tourapis, Y.-K. Wang, Y. Ye]

[JVET-W0003](https://jvet-experts.org/doc_end_user/current_document.php?id=10950) JVET AHG report: Test model software development (AHG3) [F. Bossen, X. Li, K. Sühring, K. Sharman, V. Seregin, A. Tourapis]

[JVET-W0004](https://jvet-experts.org/doc_end_user/current_document.php?id=10951) JVET AHG report: Test material and visual assessment (AHG4) [V. Baroncini, T. Suzuki, M. Wien, E. François, S. Liu, A. Norkin, A. Segall, P. Topiwala, S. Wenger, Y. Ye]

[JVET-W0005](https://jvet-experts.org/doc_end_user/current_document.php?id=10952) JVET AHG report: Conformance testing (AHG5) [J. Boyce, W. Wan, E. Alshina, F. Bossen, I. Moccagatta, K. Kawamura, K. Sühring, X. Xu]

[JVET-W0006](https://jvet-experts.org/doc_end_user/current_document.php?id=10953) JVET AHG report: 360° video coding, software and test conditions (AHG6) [J. Boyce, Y. He, K. Choi, Y. Ye]

[JVET-W0007](https://jvet-experts.org/doc_end_user/current_document.php?id=10954) JVET AHG report: Coding of HDR/WCG material (AHG7) [A. Segall, E. François, W. Husak, S. Iwamura, D. Rusanovskyy]

[JVET-W0008](https://jvet-experts.org/doc_end_user/current_document.php?id=10955) JVET AHG report: High bit depth, high bit rate, and high frame rate coding (AHG8) [A. Browne, T. Ikai, D. Rusanovskyy, M. Sarwer, X. Xiu, Y. Yu]

[JVET-W0009](https://jvet-experts.org/doc_end_user/current_document.php?id=10956) JVET AHG report: SEI message studies (AHG9) [J. Boyce, S. McCarthy, C. Fogg, P. de Lagrange, A. Luthra, G. J. Sullivan, A. Tourapis, Y.-K. Wang, S. Wenger]

[JVET-W0010](https://jvet-experts.org/doc_end_user/current_document.php?id=10957) JVET AHG report: Encoding algorithm optimization (AHG10) [A. Duenas, R. Sjöberg, A. Tourapis]

[JVET-W0011](https://jvet-experts.org/doc_end_user/current_document.php?id=10958) JVET AHG report: Neural network-based video coding (AHG11) [E. Alshina, S. Liu, A. Segall, J. Chen, F. Galpin, J. Pfaff, S. S. Wang, Z. Wang, M. Wien, P. Wu, J. Xu]

[JVET-W0012](https://jvet-experts.org/doc_end_user/current_document.php?id=10959) JVET AHG report: Enhanced compression beyond VVC capability (AHG12) [M. Karczewicz, Y. Ye, L. Zhang, B. Bross, X. Li, K. Naser, H. Yang]

# Project development (11)

## Deployment of standards (1)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0021](https://jvet-experts.org/doc_end_user/current_document.php?id=10884) Deployment status of the VVC standard [G. J. Sullivan]

## Text development and errata reporting (0)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

## Test conditions (0)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

## Verification testing (3)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0041](https://jvet-experts.org/doc_end_user/current_document.php?id=10856) AHG4: Status Report on HDR Video Verification Test Preparation [[A. Segall](mailto:asegall@sharplabs.com), M. Wien, V. Baroncini, K. Andersson]

[JVET-W0042](https://jvet-experts.org/doc_end_user/current_document.php?id=10857) AHG4: Agenda and report of the AHG meeting on the HDR video verification test preparation on 2021-06-10 [A. Segall, M. Wien, V. Baroncini]

[JVET-W0145](https://jvet-experts.org/doc_end_user/current_document.php?id=10974) Report on dry-run results for VVC compression performance verification testing in the HDR PQ and HLG categories [M. Wien, A. Segall, V. Baroncini, G. Baroncini]

## Test material (0)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

## Quality assessment (0)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

## Conformance test development (0)

See the AHG5 report in section 3.

## Software development (1)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0134](https://jvet-experts.org/doc_end_user/current_document.php?id=10963) AHG3: Uniform logs output [F. Galpin (InterDigital)] [late]

## Implementation studies (1)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0127](https://jvet-experts.org/doc_end_user/current_document.php?id=10944) Ali266: an optimized VVC software encoder implementation [S. Fang, J. Guo, Z. Huang, J. Liu, S. Xu, L. Yu, J. Chen, R.-L. Liao, Y. Ye (Alibaba)] [miss] [late]

## Complexity analysis (0)

No contributions in this area were noted.

## AHG10: Encoding algorithm optimization (4)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0043](https://jvet-experts.org/doc_end_user/current_document.php?id=10858) AHG10: Alignment of smooth QP control with adaptive QP in VTM [K. Andersson, J. Enhorn, J. Ström (Ericsson)]

[JVET-W0061](https://jvet-experts.org/doc_end_user/current_document.php?id=10876) AHG10: Encoder MV selections and DMVR [R. Yu, K. Andersson, J. Ström (Ericsson)]

[JVET-W0082](https://jvet-experts.org/doc_end_user/current_document.php?id=10898) AHG10: GOP-based RPR encoder control [K. Andersson, J. Ström, R. Yu (Ericsson)]

[JVET-W0129](https://jvet-experts.org/doc_end_user/current_document.php?id=10946) AHG10: Using original samples for ALF optimization [N. Hu, D. Rusanovskyy, V. Seregin, M. Karczewicz (Qualcomm)]

## Profile/tier/level specification (1)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0136](https://jvet-experts.org/doc_end_user/current_document.php?id=10965) Suggested initial profile text for VVC operation range extension [T. Ikai (Sharp)] [late] [miss]

## Proposed modification of system interface (0)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

# Low-level tool technology proposals (65)

## AHG8: High bit rate and high bit depth coding for VVC (20)

### General (0)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

### CE contributions: Entropy Coding for High Bit Depth and High Bit Rate Coding (4)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0022](https://jvet-experts.org/doc_end_user/current_document.php?id=10943) CE: Summary Report on Entropy Coding for High Bit Depth and High Bit Rate Coding [D. Rusanovskyy, K. Naser, M. G. Sarwer, F. Wang]

[JVET-W0044](https://jvet-experts.org/doc_end_user/current_document.php?id=10859) CE3.1: CABAC-bypass alignment for high bit-depth coding [M. G. Sarwer, J. Chen, Y. Ye, R. -L. Liao (Alibaba)]

[JVET-W0047](https://jvet-experts.org/doc_end_user/current_document.php?id=10862) Crosscheck of JVET-W0044: CE3.1: CABAC-bypass alignment for high bit-depth coding [A. Browne (Sony)] [miss] [late]

[JVET-W0045](https://jvet-experts.org/doc_end_user/current_document.php?id=10860) CE-3.2: a high throughput mode for high bit depth and high bit rate extensions [F. Wang, Z. Xie, Y. Yu, H. Yu, D. Wang (OPPO), M. Sarwer, J. Chen, Y. Ye, R. Liao (Alibaba)]

[JVET-W0058](https://jvet-experts.org/doc_end_user/current_document.php?id=10873) Crosscheck of CE-3.2: a high throughput mode for high bit depth and high bit rate extensions [K. Naser (InterDigital)] [miss] [late]

[JVET-W0046](https://jvet-experts.org/doc_end_user/current_document.php?id=10861) CE-1.1: coding of last significant coefficient position for high bit depth and high bit rate extensions [F. Wang, L. Xu, Z. Xie, Y. Yu, H. Yu, D. Wang (OPPO)]

[JVET-W0048](https://jvet-experts.org/doc_end_user/current_document.php?id=10863) Cross-check on JVET-W0046: Coding of last significant coefficient position for high bit depth and high bit rate extensions (CE1.1) [D. Rusanovskyy (Qualcomm)] [miss] [late]

[JVET-W0050](https://jvet-experts.org/doc_end_user/current_document.php?id=10865) [CE2.1][CE2.2] Content Adaptive Transform Precision [K. Naser, F. Galpin, T. Poirier, F. Le Leannec (InterDigital)]

[JVET-W0056](https://jvet-experts.org/doc_end_user/current_document.php?id=10871) Crosscheck of JVET-W0050: [CE2.1][CE2.2] Content Adaptive Transform Precision [A. Browne (Sony)] [miss] [late]

[JVET-W0094](https://jvet-experts.org/doc_end_user/current_document.php?id=10910) Cross-check on JVET-W0050: [CE2.1][CE2.2] Content Adaptive Transform Precision (CE2.2) [D. Rusanovskyy (Qualcomm)] [miss] [late]

### CE related contributions: Entropy Coding for High Bit Depth and High Bit Rate Coding (7)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0051](https://jvet-experts.org/doc_end_user/current_document.php?id=10866) CE-related: Additional bypass coding for high throughput CABAC [M. G. Sarwer, J. Chen, Y. Ye, R. -L. Liao (Alibaba)]

[JVET-W0052](https://jvet-experts.org/doc_end_user/current_document.php?id=10867) CE-related: CABAC skip mode [K. Abe, T. Toma, V. Drugeon (Panasonic)]

[JVET-W0139](https://jvet-experts.org/doc_end_user/current_document.php?id=10968) Crosscheck of JVET-W0052: CE-related: CABAC skip mode [T. Zhou, T. Ikai (Sharp)] [late] [miss]

[JVET-W0092](https://jvet-experts.org/doc_end_user/current_document.php?id=10908) CE-related: On constraining inverse transform precision for high bit depth and high bitrate video coding [L. Kerofsky, D. Rusanovskyy, M. Karczewicz (Qualcomm)]

[JVET-W0114](https://jvet-experts.org/doc_end_user/current_document.php?id=10930) CE-related: High throughput mode for high bit-depth coding – harmonization of CE-3.2 and CE-1.1 [T. Tsukuba, M. Ikeda, T. Suzuki (Sony)]

[JVET-W0138](https://jvet-experts.org/doc_end_user/current_document.php?id=10967) Crosscheck of JVET-W0114 (CE-related: High throughput mode for high bit-depth coding – harmonization of CE-3.2 and CE-1.1) [F. Wang (OPPO)] [late] [miss]

[JVET-W0116](https://jvet-experts.org/doc_end_user/current_document.php?id=10932) CE-3 related: a different alignment position for high throughput mode [F. Wang, Z. Xie, Y. Yu, H. Yu, D. Wang (OPPO)]

[JVET-W0117](https://jvet-experts.org/doc_end_user/current_document.php?id=10933) CE-3 related: a slice level high throughput mode [F. Wang, Z. Xie, Y. Yu, H. Yu, D. Wang (OPPO)]

[JVET-W0118](https://jvet-experts.org/doc_end_user/current_document.php?id=10934) CE-3 related: High throughput 4:4:4 16 intra profile for VVC [F. Wang, Z. Xie, Y. Yu, H. Yu, D. Wang (OPPO)]

[JVET-W0135](https://jvet-experts.org/doc_end_user/current_document.php?id=10964) Cross-check on JVET-W0118: CE related: High throughput 4:4:4 16 intra profile for VVC [T. Tsukuba (Sony)] [late] [miss]

### Adaptation of other tools for high bit rate and high bit depth (9)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0055](https://jvet-experts.org/doc_end_user/current_document.php?id=10870) AHG8: Signaling TSRC rice parameter in slice header extension [T. Tsukuba, M. Ikeda, T. Suzuki (Sony)]

[JVET-W0060](https://jvet-experts.org/doc_end_user/current_document.php?id=10875) AHG8: A constraint of max CTU size and tile on WPP for high bit rate coding [K. Kondo, M. Ikeda (Sony)]

[JVET-W0140](https://jvet-experts.org/doc_end_user/current_document.php?id=10969) Crosscheck of JVET-W0060: AHG8: A constraint of max CTU size and tile on WPP for high bit rate coding [T. Zhou, T. Ikai (Sharp)] [late] [miss]

[JVET-W0064](https://jvet-experts.org/doc_end_user/current_document.php?id=10879) AHG8: Constraints on transforms and high precision operation [T. Ikai, T. Zhou, T. Hashimoto (Sharp)]

[JVET-W0141](https://jvet-experts.org/doc_end_user/current_document.php?id=10970) Crosscheck of JVET-W0064 (AHG8: Constraints on transforms and high precision operation) [K. Kondo (Sony)] [late]

[JVET-W0070](https://jvet-experts.org/doc_end_user/current_document.php?id=10886) [AHG8] SPS Cleanup for VVC operation range extension [K. Naser, F. Galpin, T. Poirier, F. Le Leannec (InterDigital)]

[JVET-W0091](https://jvet-experts.org/doc_end_user/current_document.php?id=10907) AHG8: On constraining of bit depth of ALF classifier and CCLM derivation for coding of high bit-depth video data [D. Rusanovskyy, M. Karczewicz (Qualcomm)]

[JVET-W0093](https://jvet-experts.org/doc_end_user/current_document.php?id=10909) AHG8: On significance, GT1, and GT2 flag coding for high bit depths [A. Browne, S. Keating, K. Sharman (Sony)]

[JVET-W0109](https://jvet-experts.org/doc_end_user/current_document.php?id=10925) AHG8: Removal of a prevention mechanism of extended precision for low bit-depth [T. Tsukuba, M. Ikeda, T. Suzuki (Sony)]

[JVET-W0115](https://jvet-experts.org/doc_end_user/current_document.php?id=10931) AHG8: A study on Bin-to-Bit ratio of VTM-13.0 for high bit depth coding [T. Tsukuba, M. Ikeda, T. Suzuki (Sony)]

[JVET-W0121](https://jvet-experts.org/doc_end_user/current_document.php?id=10937) AHG8: On signalling of sps\_ts\_residual\_coding\_rice\_present\_in\_sh\_flag [H.-J. Jhu, X. Xiu, Y.-W. Chen, W. Chen, C.-W. Kuo, X. Wang (Kwai)]

## AHG11: Neural network-based video coding (15)

### General (0)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

### EE1 contributions: Neural network-based video coding (5)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0023](https://jvet-experts.org/doc_end_user/current_document.php?id=10976) EE1: Summary of Exploration Experiments on Neural Network-based Video Coding [E. Alshina, S. Lui, W. Chen, F. Galpin, Y. Li, Z. Ma, H. Wang]

[JVET-W0062](https://jvet-experts.org/doc_end_user/current_document.php?id=10877) EE1: SSIM based CNN model for in-loop filtering [T. Ouyang, Y. Guo, Z. Chen (Wuhan Univ.), X. Xu, S. Liu (Tencent)]

[JVET-W0063](https://jvet-experts.org/doc_end_user/current_document.php?id=10878) EE1.2.2: NN-based super resolution (JVET-V0073) [T. Chujoh, Y. Yasugi, T. Ikai (Sharp)]

[JVET-W0105](https://jvet-experts.org/doc_end_user/current_document.php?id=10921) EE1-2.3: Neural Network-based Super Resolution [A. M. Kotra, K. Reuzé, J. Chen, H. Wang, M. Karczewicz, J. Li (Qualcomm)]

[JVET-W0125](https://jvet-experts.org/doc_end_user/current_document.php?id=10941) EE1: Tests on Decomposition, Compression and Synthesis (DCS)-based Technology (JVET-V0149) [Ming Lu, Zhan Ma (NJU), Zhenyu Dai, Dong Wang (OPPO)] [miss] [late]

[JVET-W0130](https://jvet-experts.org/doc_end_user/current_document.php?id=10947) EE1-1.4: Test on Neural Network-based In-Loop Filter with Large Activation Layer [H. Wang, J. Chen, K. Reuzé, A.M. Kotra, M. Karczewicz (Qualcomm)]

### EE1 related contributions: Neural network-based video coding (6)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0131](https://jvet-experts.org/doc_end_user/current_document.php?id=10960) EE1-related: Neural Network-based in-loop filter with constrained computational complexity [H. Wang, J. Chen, K. Reuze, A.M. Kotra, M. Karczewicz (Qualcomm)]

[JVET-W0059](https://jvet-experts.org/doc_end_user/current_document.php?id=10874) AHG11: A Deep In-Loop Filter Method [X. Zhang, C. Fang, D. Jiang, J. Lin (Dahua)]

[JVET-W0099](https://jvet-experts.org/doc_end_user/current_document.php?id=10915) AHG11: CNN-based Super Resolution for Video Coding Using Decoded Information [C. Lin, L. Zhang, K. Zhang, Y. Li (Bytedance)]

[JVET-W0100](https://jvet-experts.org/doc_end_user/current_document.php?id=10916) AHG11: Deep In-Loop Filter with Adaptive Model Selection and External Attention [Y. Li, K. Zhang, L. Zhang (Bytedance)]

[JVET-W0101](https://jvet-experts.org/doc_end_user/current_document.php?id=10917) AHG11 & AHG12: Deep In-Loop Filter with Adaptive Model Selection and External Attention for Enhanced Compression Beyond VVC Capability [Y. Li, K. Zhang, L. Zhang (Bytedance)]

[JVET-W0132](https://jvet-experts.org/doc_end_user/current_document.php?id=10961) AHG11: 1.5x/2.0x Upsample method for NN-Based Super-Resolution Post-Filters [Y. Yasugi, T. Chujoh, T. Ikai (Sharp)]

### Other (4)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0057](https://jvet-experts.org/doc_end_user/current_document.php?id=10872) AHG11: Content-adaptive neural network post-processing filter [M. Santamaria, Y.-H. Lam, J. Lainema, F. Cricri, R. Ghaznavi-Youvalari, H. Zhang, A. Zare, H. R. Tavakoli, M. Hannuksela (Nokia)]

[JVET-W0081](https://jvet-experts.org/doc_end_user/current_document.php?id=10897) AHG11: BD-rate gains vs complexity of NN-based intra prediction [T. Dumas, F. Galpin, P. Bordes, F. Le Léannec (InterDigital)]

[JVET-W0111](https://jvet-experts.org/doc_end_user/current_document.php?id=10927) AHG11: neural network based cross-component prediction model [L. Wang, S. Lin, R. Chang, X. Xu, S. Liu (Tencent)]

[JVET-W0113](https://jvet-experts.org/doc_end_user/current_document.php?id=10929) AHG11: neural network based in-loop filter [L. Wang, W. Jiang, X. Xu, S. Liu (Tencent)]

### NN related HLS signalling (0)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

## AHG12: Enhanced compression beyond VVC capability (30)

### General (2)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0049](https://jvet-experts.org/doc_end_user/current_document.php?id=10864) AHG12: on the status of the ECM software [Y. Ye (Alibaba), M. Karczewicz (Qualcomm), Y.-W. Huang (MediaTek), P. Yin (Dolby), D. Wang (OPPO), X. Wang (Kwai), J. Ström (Ericsson), F. Le Leannec (InterDigital), L. Zhang (Bytedance), S.-H. Kim (LGE), M. Hannuksela (Nokia), P. Wu (ZTE)]

[JVET-W0102](https://jvet-experts.org/doc_end_user/current_document.php?id=10918) Preliminary draft of algorithm description for Enhanced Compression Model 1 Software (ECM 1) [M. Coban (Qualcomm), F. Le Léannec (InterDigital), J. Ström (Ericsson), Y. Ye (Alibaba)]

### EE2 contributions: Enhanced compression beyond VVC capability (12)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0053](https://jvet-experts.org/doc_end_user/current_document.php?id=10868) EE2-2.1: Results for template-based intra mode derivation using MPMs [Y. Wang, L. Zhang, K. Zhang, Z. Deng, N. Zhang (Bytedance)]

[JVET-W0054](https://jvet-experts.org/doc_end_user/current_document.php?id=10869) EE2 Test 2.2: DIMD with multiple blending modes [J. Zhao, S. Paluri, S. Kim (LGE)]

[JVET-W0065](https://jvet-experts.org/doc_end_user/current_document.php?id=10880) EE2: Results of Test 3.4 and Test 3.5 [R.-L. Liao, Y. Ye, J. Chen, X. Li (Alibaba), Y.-J. Chang, H. Huang, V. Seregin, C.-C. Chen, M. Karczewicz (Qualcomm)]

[JVET-W0066](https://jvet-experts.org/doc_end_user/current_document.php?id=10881) EE2-5.1: Cross-component Sample Adaptive Offset [C.-W. Kuo, X. Xiu, Y.-W. Chen, H.-J. Jhu, W. Chen, X. Wang (Kwai)]

[JVET-W0146](https://jvet-experts.org/doc_end_user/current_document.php?id=10975) Crosscheck of JVET-W0066 (EE 2-5.1: Cross-Component Sample Adaptive Offset) [A. M. Kotra (Qualcomm)] [late] [miss]

[JVET-W0084](https://jvet-experts.org/doc_end_user/current_document.php?id=10900) EE2-1.1 and EE2-1.2: Asymmetric Binary Tree partitioning [F. Le Léannec, K. Naser, T. Dumas, A. Robert, F. Galpin, E. François (InterDigital)]

[JVET-W0086](https://jvet-experts.org/doc_end_user/current_document.php?id=10902) EE2-1.3/EE2-1.4: Unsymmetric partitioning methods in video coding [K. Zhang, L. Zhang, Z. Deng, N. Zhang, Y. Wang (Bytedance)]

[JVET-W0137](https://jvet-experts.org/doc_end_user/current_document.php?id=10966) Cross-check of JVET-W0086 "EE2-1.3/EE2-1.4: Unsymmetric partitioning methods in video coding" [F. Le Léannec (InterDigital)] [late] [miss]

[JVET-W0087](https://jvet-experts.org/doc_end_user/current_document.php?id=10903) EE2-1.5: A combining test of EE2-1.2 and EE2-1.4b [K. Zhang, L. Zhang, Z. Deng, N. Zhang, Y. Wang (Bytedance), F. Le Léannec, K. Naser, T. Dumas, A. Robert, F. Galpin, E. François (InterDigital)]

[JVET-W0088](https://jvet-experts.org/doc_end_user/current_document.php?id=10904) EE2-3.3: GPM with MMVD (JVET-V0103 and JVET-V0125) [Z. Deng, K. Zhang, L. Zhang, N. Zhang, Y. Wang (Bytedance), X. Xiu, C.-W. Kuo, X. Wang (Kwai)]

[JVET-W0089](https://jvet-experts.org/doc_end_user/current_document.php?id=10905) EE2: Combined test of EE2-3.3 and EE2-3.5 [Z. Deng, K. Zhang, L. Zhang, N. Zhang, Y. Wang (Bytedance), X. Xiu, C.-W. Kuo, X. Wang (Kwai), Y.-J Chang, H. Huang, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-W0143](https://jvet-experts.org/doc_end_user/current_document.php?id=10972) Crosscheck of JVET-W0089 (EE2: Combined test of EE2-3.3 and EE2-3.5) [R.-L. Liao (Alibaba)] [late] [miss]

[JVET-W0090](https://jvet-experts.org/doc_end_user/current_document.php?id=10906) EE2-3.1/EE2-3.2: Adaptive Reordering of Merge Candidates with Template/Bilateral Matching [N. Zhang, K. Zhang, L. Zhang, H. Liu, Z. Deng, Y. Wang (Bytedance)]

[JVET-W0144](https://jvet-experts.org/doc_end_user/current_document.php?id=10973) Crosscheck of JVET-W0090 (EE2-3.1/EE2-3.2: Adaptive Reordering of Merge Candidates with Template/Bilateral Matching) [R.-L. Liao (Alibaba)] [late] [miss]

[JVET-W0103](https://jvet-experts.org/doc_end_user/current_document.php?id=10919) EE2: Enhanced intra MTS and LFNST (tests 4.1, 4.2, and 4.4) [B. Ray, M. Coban, V. Seregin, H. Egilmez, M. Karczewicz (Qualcomm)]

[JVET-W0119](https://jvet-experts.org/doc_end_user/current_document.php?id=10935) EE2: LFNST extension with large kernel (tests 4.5, 4.6, 4.7, and 4.8) [M. Koo, J. Zhao, J. Lim, S. Kim (LGE)]

[JVET-W0120](https://jvet-experts.org/doc_end_user/current_document.php?id=10936) Crosscheck of JVET-W0119 (EE2: LFNST extension with large kernel (tests 4.5, 4.6, 4.7, and 4.8)) [M. Coban (Qualcomm)] [miss] [late]

### EE2 related contributions: Enhanced compression beyond VVC capability (11)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0067](https://jvet-experts.org/doc_end_user/current_document.php?id=10882) EE2-related: Implicit derivation of DIMD blend modes [X. Li, R.-L. Liao, J. Chen, Y. Ye (Alibaba)]

[JVET-W0068](https://jvet-experts.org/doc_end_user/current_document.php?id=10883) EE2-related: A combination of CIIP and DIMD/TIMD [X. Li, R.-L. Liao, J. Chen, Y. Ye (Alibaba)]

[JVET-W0097](https://jvet-experts.org/doc_end_user/current_document.php?id=10913) EE2-related: Combination of EE2-3.3, EE2-3.4 and EE2-3.5 [X. Xiu, C.-W. Kuo, X. Wang (Kwai), R.-L. Liao, Y. Ye, X. Li, J. Chen (Alibaba), Z. Deng, K. Zhang, L. Zhang, N. Zhang, Y. Wang (Bytedance), Y.-J. Chang, H. Huang, V. Seregin, C.-C. Chen, M. Karczewicz (Qualcomm)]

[JVET-W0098](https://jvet-experts.org/doc_end_user/current_document.php?id=10914) Non-EE2: Bilateral Inloop Filter on Chroma [W. Yin, K. Zhang, L. Zhang (Bytedance)]

[JVET-W0106](https://jvet-experts.org/doc_end_user/current_document.php?id=10922) EE2-related: Bilateral matching AMVP-merge mode [Z. Zhang, H. Huang, C.-C. Chen, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-W0107](https://jvet-experts.org/doc_end_user/current_document.php?id=10923) EE2-related: Adaptive decoder side motion vector refinement [H. Huang, Z. Zhang, V. Seregin, W.-J. Chien, C.-C. Chen, M. Karczewicz (Qualcomm)]

[JVET-W0108](https://jvet-experts.org/doc_end_user/current_document.php?id=10924) EE2-related: Low complexity sign prediction [C. Auyeung, X. Li, S. Liu (Tencent)]

[JVET-W0122](https://jvet-experts.org/doc_end_user/current_document.php?id=10938) EE2-related: On spatial MV propagation and neighboring template block access for template matching and multi-pass DMVR [C.-C. Chen, C.-T. Hsieh, H. Huang, V. Seregin, W.-J. Chien, Y.-J. Chang, Z. Zhang, Y. Zhang, M. Karczewicz (Qualcomm)]

[JVET-W0123](https://jvet-experts.org/doc_end_user/current_document.php?id=10939) EE2-related: Fusion for template-based intra mode derivation [K. Cao, N. Hu, V. Seregin, M. Karczewicz (Qualcomm), Y. Wang, K. Zhang, L. Zhang (Bytedance)]

[JVET-W0142](https://jvet-experts.org/doc_end_user/current_document.php?id=10971) Crosscheck of JVET-W0123 (EE2-related: Fusion for template-based intra mode derivation) [X. Li (Alibaba)] [late] [miss]

[JVET-W0124](https://jvet-experts.org/doc_end_user/current_document.php?id=10940) EE2-related: Templated based intra most probable modes sorting [K. Cao, N. Hu, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-W0126](https://jvet-experts.org/doc_end_user/current_document.php?id=10942) EE2 Related – DIMD with implicitly derived multiple blending modes [J. Zhao, S. Paluri, S. Kim (LGE)] [miss] [late]

### Technology elements beyond EE2 (5)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0069](https://jvet-experts.org/doc_end_user/current_document.php?id=10885) [AHG12] On Intra TMP Boundary Conditions [K. Naser, T. Poirier, F. Le Léannec, G. Martin-Cocher (InterDigital)]

[JVET-W0079](https://jvet-experts.org/doc_end_user/current_document.php?id=10895) AHG12: CTB level filter shape selection of CCALF [M. G. Sarwer, R. -L. Liao, J. Chen, Y. Ye, X. Li (Alibaba)]

[JVET-W0110](https://jvet-experts.org/doc_end_user/current_document.php?id=10926) AHG12: GPM with inter and intra prediction [Y. Kidani, H. Kato, K. Kawamura (KDDI)]

[JVET-W0112](https://jvet-experts.org/doc_end_user/current_document.php?id=10928) AHG12: Diagonal MMVD with ARMC [Y. Kidani, K. Kawamura (KDDI)]

[JVET-W0128](https://jvet-experts.org/doc_end_user/current_document.php?id=10945) AHG12: Alternative classifiers for ALF [N. Hu, V. Seregin, M. Karczewicz (Qualcomm)]

# High-level syntax (HLS) proposals (15)

## AHG9: SEI message studies and proposals (11)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0071](https://jvet-experts.org/doc_end_user/current_document.php?id=10887) AHG9: Green Metadata SEI message for VVC [C. Herglotz, M. Kränzler, A. Kaup (FAU), E. François, M. Radosavljevic, E. Reinhard (InterDigital), X. Ducloux (Harmonic), D. Menard (INSA)]

[JVET-W0072](https://jvet-experts.org/doc_end_user/current_document.php?id=10888) AHG9: Enhancement of film grain parameter estimation for different intensity intervals [M. Radosavljević, E. François (InterDigital), W. Hamidouche, T. Amestoy, G. Gautier (INSA)] [miss] [late]

[JVET-W0076](https://jvet-experts.org/doc_end_user/current_document.php?id=10892) AHG9: Independently coded region output SEI message [B. Choi, S. Wenger, X. Li, S. Liu (Tencent)]

[JVET-W0077](https://jvet-experts.org/doc_end_user/current_document.php?id=10893) AHG9: Comments on multiview-related SEI messages in VSEI [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-W0078](https://jvet-experts.org/doc_end_user/current_document.php?id=10894) AHG9: Multiview view position SEI message [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-W0080](https://jvet-experts.org/doc_end_user/current_document.php?id=10896) AHG9: some errata and clarification items for Additional SEI messages for VSEI [E. François, M. Radosavljevic (InterDigital)]

[JVET-W0083](https://jvet-experts.org/doc_end_user/current_document.php?id=10899) AHG9: Bug fixes for some SEI messages in the VSEI amendment [Y.-K. Wang, Y. Wang, L. Zhang (Bytedance)]

[JVET-W0085](https://jvet-experts.org/doc_end_user/current_document.php?id=10901) AHG9: Picture quality metrics SEI message [Y. He, M. Coban, D. Rusanovskyy, M. Karczewicz (Qualcomm)]

[JVET-W0095](https://jvet-experts.org/doc_end_user/current_document.php?id=10911) AHG 9: Bit-accurate grain blending process for film grain characteristics SEI message [S. McCarthy, P. Yin, W. Husak, F. Pu, T. Lu, T. Chen (Dolby), E. François, M. Radosavljević (InterDigital), V. G R, K. Patankar, S. Kadaramandalgi, Ajayshyam (Ittiam)]

[JVET-W0096](https://jvet-experts.org/doc_end_user/current_document.php?id=10912) AHG9: Demonstration of AVC FGC SEI in real-time bit-accurate grain blending process on smartphone [V. G R, J. Shingala, S. Kadaramandalgi, Ajayshyam (Ittiam), S. McCarthy, P. Yin, W. Husak, F. Pu, T. Lu, T. Chen (Dolby)]

[JVET-W0104](https://jvet-experts.org/doc_end_user/current_document.php?id=10920) AHG9: Resampling SEI message [T. Poirier, G. Martin-Cocher, F. Le Léannec, K. Naser (InterDigital)]

## Non-SEI HLS aspects (4)

Contributions in this area were discussed in session X at XXXX–XXXX UTC on XXday X July 2021 (chaired by XXX).

[JVET-W0133](https://jvet-experts.org/doc_end_user/current_document.php?id=10962) Constrained RASL encoding for bitstream switching [R. Skupin, C. Bartnik, A. Wieckowski, K. Sühring, Y. Sanchez, B. Bross (HHI)] [late]

[JVET-W0073](https://jvet-experts.org/doc_end_user/current_document.php?id=10889) ALF parameters for RPR [P. Bordes, F. Galpin, F. Le Léannec (InterDigital)]

[JVET-W0074](https://jvet-experts.org/doc_end_user/current_document.php?id=10890) HLS for ALF parameters for RPR [P. Bordes, F. Galpin, K. Naser, F. Le Léannec (InterDigital)]

[JVET-W0075](https://jvet-experts.org/doc_end_user/current_document.php?id=10891) Subpicture-wise reference picture resampling and scalability for Game/E-sport contents streaming [B. Choi, S. Wenger, X. Li, S. Liu (Tencent)]

# Plenary meetings, joint meetings, BoG reports, and liaison communications

## JVET plenaries (update)

Some of the discussions and actions at plenary sessions are noted in this section (especially those of XXday X July XX00–XX00):

* Planning of output documents: Standard parts & DoCs, CE & EE descriptions, verification test plan & report?
  + Summary of voting for ISO/IEC 23091-2: m56377 – GJS was to prepare a candidate DoCR
  + Liaison output to JPEG about progress in NN video coding – Gary Sullivan and Elena Alshina were asked to coordinate preparation of text to be sent out via SG 16.
  + White paper on VVC – it was concluded that it is necessary to delay this to the next meeting, and encouraged to work until then on preparing something. It was mentioned that various IEEE papers have been worked on, including a special issue in TCSVT. These will be referenced in the white paper, anyway. The JVET chairs were given the action item to send links about such information to the JVET email reflector. This was followed up after the meeting with a message to the reflector on 24 May, pointing to tutorial information and other resources newly available on the JVET page of the ITU-T website (<https://www.itu.int/en/ITU-T/studygroups/2017-2020/16/Pages/video/jvet.aspx>). It was also mentioned that the MC-IF ([www.mc-if.org](http://www.mc-if.org)) and HHI web pages also maintain lists of references (<https://jvet.hhi.fraunhofer.de/>).
* Whether to hold a hybrid meeting in October 2021 An informal poll gave 22% who would consider travelling to participate physically, 50% who would not, and 28% who were undecided.

## Information sharing meetings

In addition to the joint meetings listed below, information sharing sessions with other WGs of the MPEG community were held on Monday 12 July 0500–0700 and Wednesday 14 July 0500–0700, and Friday 16 July XX00–XX00. The status of the work in the MPEG WGs was reviewed at these information sharing sessions.

## Joint meeting with Q6/16 (VCEG), WG2 MPEG Requirements and WG3 MPEG Systems XX00–XX00 XXday XX July

The following topics were discussed in this joint session. See also the notes recorded on these topics in other sections of this document.

* …

## Joint meeting with AG5 MPEG Visual Quality Assessment XX00–XX00 XXday XX July

Topics of discussion:

* …

## BoGs (0)

No break-out groups were established at this meeting; thus all notes of the meeting discussions were recorded directly in drafts of this document rather than in break-out group reports.

## Liaison communications (update)

The JVET did not directly receive or send any liaison statements at its current meeting. However, there was some related liaison communication between ITU-T SG 16, the AGs and WGs of ISO/IEC JTC 1/‌SC 29, and ITU-T Study Group 12 that were coordinated with JVET.

This included exchange of general status information about JVET work and management arrangements for video coding collaboration between the parent bodies of WP 3/16 and SC 29. SC 29 had sent a liaison statement to SG16 [[TD535/Gen](http://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG16-210419-TD-GEN-0535) / [SC29 N 19023](file:///C:\GarySull2\OneDrive%20-%20Microsoft\2021-04-telecons\2021-04-SG16-telecon\Gen\ISO\IEC%20JTC1\SC29-N19023)], and SG 16 prepared a reply.

ITU-T SG12 had sent a liaison statement [m56363](https://dms.mpeg.expert/doc_end_user/current_document.php?id=78266&id_meeting=186) to ISO/IEC JTC 1/‌SC 29/‌AG 5 (in reply to SC 29 N 19285, MDS 19755 from October 2020). SG12 expressed their strong interest in exchanging information and collaborating on aspects of video quality assessment. SG12 also welcomed the information received about the status of the verification tests of Versatile Video Coding (ITU-T H.266 and ISO/IEC 23090-3 VVC) conducted with SG16 in the Joint Video Experts Team (JVET). In light of possible future extensions of existing video quality models and the development of new assessment methods, SG12 expressed their particular interest in further exchanges about this and similar assessment campaigns. SC 29/AG 5 (Visual Quality Testing) prepared a reply liaison statement to ITU-T SG12 and ITU-R WP6C as document AG 05 N 23 that included a description of recent verification testing of VVC and further plans for such testing.

SC 29/‌WG 1 had recently sent several liaison statements to ITU-T SG16 [[TD537/Gen](http://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG16-210419-TD-GEN-0537) / [SC 29/WG 1 N 89052 (SC 29 N 19202)](https://www.itu.int/ifa/t/2017/ls/isoiecjtc1sc29wg1/sp16-iso_iecjtc1_sc29_wg1-iLS-00022.zip), [TD581/Gen](http://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG16-210419-TD-GEN-0581) / [SC 29/WG 1 N 90081 (SC 29 N 19574)](http://handle.itu.int/11.1002/ls/sp16-iso_iecjtc1_sc29_wg1-iLS-00025.pdf), and [TD600/Gen](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-SG16-210419-TD-GEN-0600) / [SC 29/WG 1 N 91067](https://www.itu.int/ifa/t/2017/ls/isoiecjtc1sc29wg1/sp16-iso_iecjtc1_sc29_wg1-iLS-00026.docx)] that included discussion of neural network image coding, and Gary Sullivan and Elena Alshina of JVET were given the action item to prepare status information about the neural network video coding exploration in JVET to be included in a liaison letter reply from ITU-T SG16 to SC 29/WG 1.

ITU-T SG13 had sent a liaison statement [m56366](https://dms.mpeg.expert/doc_end_user/current_document.php?id=78269&id_meeting=186) to SC 29 with an invitation to review an Artificial Intelligence Standardization Roadmap and provide missing or updated information. SC 29/AG 3 (Liaison and Communications) prepared a reply as document AG 3 N 28 that included a mention of the JVET exploration experiment work on neural network based video coding.

# Project planning

## Software timeline (update)

VTM13.0 including the adoptions from JVET-V0047, JVET-V0054, JVET-V0056, JVET-V0106: 2021-05-21 (needed for CE).

HM16.24 including the adoption from JVET-V0056: 2021-05-21.

VTM13.1 as appropriate date t.b.d. with remaining adoptions of encoder optimization, SEI messages.

## Core experiment and exploration experiment planning

A CE on entropy coding for high bit depths and high bit rates was established, as recorded in output document JVET-U2022.

An EE on neural network-based video coding was established, as recorded in output document JVET-U2023.

An EE on enhanced compression technology beyond VVC capability using techniques other than neural-network technology was also established, as recorded in output document JVET-U2024.

Initial versions of these documents were presented and approved in the plenary on Friday 15 January.

## Drafting of specification text, encoder algorithm descriptions, and software

The following agreement has been established: the editorial team has the discretion to not integrate recorded adoptions for which the available text is grossly inadequate (and cannot be fixed with a reasonable degree of effort), if such a situation hypothetically arises. In such an event, the text would record the intent expressed by the committee without including a full integration of the available inadequate text.

## Plans for improved efficiency and contribution consideration

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

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

Suggestions for future meetings included the following generally-supported principles:

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

The document upload deadline for the next meeting was planned to be Tuesday 13 April 2021.

As general guidance, it was suggested to avoid usage of company names in document titles, software modules etc., and not to describe a technology by using a company name.

## General issues for experiments

It was emphasized that those rules which had been set up or refined during the 12th JVET meeting should be observed. In particular, for some CEs of some previous meetings, results were available late, and some changes in the experimental setup had not been sufficiently discussed on the JVET reflector.

Group coordinated experiments have been planned as follows:

* “Core experiments” (CEs) are the coordinated experiments on coding tools which are deemed to be interesting but require more investigation and could potentially become part of a draft standard by the next meeting or in the near future.
* “Exploration experiments” (EEs) are also coordinated experiments. These are conducted on technology which is not foreseen to become part of a draft standard in near future. Investigating methodology for assessment of such technology can also be an important part of an EE. (Further general rules for EEs, as far as deviating from the CE rules below, should be discussed in a future meeting. For the current meeting, procedures as described in the EE description document are deemed to be sufficient)
* A CE is a test of a specific fully described technology in a specific agreed way. It is not a forum for thinking of new ideas (like an AHG). The CE coordinators are responsible for making sure that the CE description is complete and correct and has adequate detail. Reflector discussions about CE description clarity and other aspects of CE plans are encouraged.
* A description of each experiment is to be approved at the meeting at which the experiment plan is established. This should include the issues that were raised by other experts when the tool was presented, e.g., interference with other tools, contribution of different elements that are part of a package, etc. The experiment description document should provide the names of individual people, not just company names.
* Software for tools investigated in a CE will be provided in one or more separate branches of the software repository. Each CE will have a “fork” of the software, and within the CE there may be multiple branches established by the CE coordinator. The software coordinator will help coordinate the creation of these forks and branches and their naming. All JVET members will have read access to the CE software branches (using shared read-only credentials as described below).
* During the experiment, revisions of the experiment plans can be made, but not substantial changes to the proposed technology.
* The CE description must match the CE testing that is done. The CE description needs to be revised if there has been some change of plans.
* The CE summary report must describe any changes that were made in the process of finalizing the CE.
* By the next meeting it is expected that at least one independent cross-checker will report a detailed analysis of each proposed feature that has been tested and confirm that the implementation is correct. Commentary on the potential benefits and disadvantages of the proposed technology in cross-checking reports is highly encouraged. Having multiple cross-checking reports is also highly encouraged (especially if the cross-checking involves more than confirmation of correct test results). The reports of cross-checking activities may (and generally should) be integrated into the CE report rather than submitted as separate documents.

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

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

The general agreed common conditions for single-layer coding efficiency experiments for SDR video are described in the prior output document JVET-T2010.

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

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

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

The CE development workflow is described at:

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

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

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

Some agreements relating to CE activities were established as follows:

* Only qualified JVET members can participate in a CE.
* Participation in a CE is possible without a commitment of submitting an input document to the next meeting. Participation is requested by contacting the CE coordinator.
* All software, results, and documents produced in the CE should be announced and made available to JVET in a timely manner.
* A JVET CE reflector will be established and announced on the main JVET reflector. Discussion of logistics arrangements, exchange of data, minor refinement of the test plans, and preparation of documents shall be conducted on the JVET CE reflector, with subject lines prefixed by “[CEx: ]”, where “x” is the number of the CE. All substantial communications about a CE other than such details shall take place on main JVET reflector. In the case that large amounts of data are to be distributed, it is recommended to send a link to the data rather than the data itself, or upload the data as an input contribution to the next meeting.

General timeline for CEs

T1= 3 weeks after the JVET meeting: To revise the CE description and refine questions to be answered. Questions should be discussed and agreed on JVET reflector. Any changes of planned tests after this time need to be announced and discussed on the JVET reflector. Initially assigned description numbers shall not be changed later. If a test is skipped, it is to be marked as “withdrawn”.

T2 = Test model software release + 2 weeks: Integration of all tools into a separate CE branch of the VTM is completed and announced to JVET reflector.

* Initial study by cross-checkers can begin.
* Proponents may continue to modify the software in this branch until T3.
* 3rd parties are encouraged to study and make contributions to the next meeting with proposed changes

T3: 3 weeks before the next JVET meeting or T2 + 1 week, whichever is later: Any changes to the CE test branches of the software must be frozen, so the cross-checkers can know exactly what they are cross-checking. A software version tag should be created at this time. The name of the cross-checkers and list of specific tests for each tool under study in the CE plan description shall be documented in an updated CE description by this time.

T4: Regular document deadline minus 1 week: CE contribution documents including specification text and complete test results shall be uploaded to the JVET document repository (particularly for proposals targeting to be promoted to the draft standard at the next meeting).

The CE summary reports shall be available by the regular contribution deadline. This shall include documentation about crosscheck of software, matching of CE description and confirmation of the appropriateness of the text change, as well as sufficient crosscheck results to create evidence about correctness (crosscheckers must send this information to the CE coordinator at least 3 days ahead of the document deadline). Furthermore, any deviations from the timelines above shall be documented. The numbers used in the summary report shall not be changed relative to the description document.

CE reports may contain additional information about tests of straightforward combinations of the identified technologies. Such supplemental testing needs to be clearly identified in the report if it was not part of the CE plan.

New branches may be created which combine two or more tools included in the CE document or the VTM (as applicable).

It is not necessary to formally name cross-checkers in the initial version of the CE description document. To adopt a proposed feature at the next meeting, we would like see comprehensive cross-checking done, with analysis that the description matches the software, and recommendation of value of the tool given tradeoffs.

The establishment of a CE does not indicate that a proposed technology is mature for adoption or that the testing conducted in the CE is fully adequate for assessing the merits of the technology, and a favourable outcome of CE does not indicate a need for adoption of the technology into a standard.

Availability of spec text is important to have a detailed understanding of the technology and also to judge what its impact on the complexity of the spec will be. There must also be sufficient time to study it in detail. CE contributions without sufficiently mature draft spec text in the CE input document should not be considered for adoption.

Lists of participants in CE documents should be pruned to include only the active participants. Read access to software will be available to all members.

# Establishment of ad hoc groups

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

Review of AHG plans was conducted in session 25 on Wednesday 28 April 2021.

|  |  |  |
| --- | --- | --- |
| **Title and Email Reflector** | **Chairs** | **Mtg** |
| **Project Management (AHG1)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Coordinate overall JVET interim efforts. * Supervise AHG studies. * Report on project status to JVET reflector. * Provide a report to the next meeting on project coordination status. | J.-R. Ohm, G. J. Sullivan (co-chairs) | N |
| **Draft text and test model algorithm description editing (AHG2)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Produce and finalize draft text outputs of the meeting (JVET-V2005 and JVET-V2006). * Collect reports of errata for the VVC, VSEI, HEVC, AVC, CICP, the codepoint usage TR specification and the published HDR-related technical reports and produce the JVET-V1004 errata output collection. * Produce and finalize JVET-V1002 HEVC Test Model 16 (HM 16) Update 15 and JVET-V2002 VVC Test Model 13 (VTM 13) Algorithm and Encoder Descriptions. * Coordinate with the test model software development AhG to address issues relating to mismatches between software and text. * Collect and consider errata reports on the texts | B. Bross, J. Chen, C. Rosewarne (co-chairs), F. Bossen, J. Boyce, S. Kim, S. Liu, J.‑R. Ohm, G. J. Sullivan, A. Tourapis, Y.-K. Wang, Y. Ye (vice-chairs) | N |
| **Test model software development (AHG3)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Coordinate development of test models (VTM, HM, SCM, SHM, HTM, MFC, MFCD, JM, JSVM, JMVM, 3DV-ATM, and HDRTools) software and associated configuration files. * Produce documentation of software usage for distribution with the software. * Enable software support for recently standardized additional SEI messages. * Discuss and make recommendations on the software development process. * Propose improvements to the guideline document for developments of the test model software. * Perform comparative tests of test model behaviour using common test 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 AHG on Draft text and test model algorithm description editing (AHG2) to identify any mismatches between software and text, and make further updates and cleanups to the software as appropriate. * Coordinate with AHG6 for integration with 360lib software. * Investigate on the possibility of merging CTC documents for HM and VTM. | F. Bossen, X. Li, K. Sühring (co-chairs), K. Sharman, V. Seregin, A. Tourapis (vice‑chairs) | N |
| **Test material and visual assessment (AHG4)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Produce the verification test report JVET-V2020 and the draft test plan JVET-V2021, and develop proposed improvements for verification testing of VVC capability. * Maintain the video sequence test material database for testing the VVC and HEVC standards and potential future extensions, as well as exploration activities. * Study coding performance and characteristics in relation to video test materials, including new test materials. * Identify and recommend appropriate test materials for testing the VVC standard and potential future extensions, as well as exploration activities. * Identify missing types of video material, solicit contributions, collect, and make available a variety of video sequence test material. * Maintain and update the directory structure for the test sequence repository as necessary. * Collect information about test sequences that have been made available by other organizations. * Prepare and conduct remote expert viewing for purposes of subjective quality evaluation. * Prepare availability of viewing equipment and facilities arrangements for future meetings. | V. Baroncini, T. Suzuki, M. Wien (co-chairs), E. François, S. Liu, A. Norkin, A. Segall, P. Topiwala, S. Wenger, Y. Ye (vice-chairs) | Tel.  2 weeks notice |
| **Conformance testing (AHG5)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the JVET-U2008 draft conformance testing specification and investigate the need for extensions. * Study the requirements of VVC, HEVC, and AVC conformance testing to ensure interoperability. * Maintain and update the conformance bitstream database. * Study additional testing methodologies to fulfil the needs for VVC conformance testing. | J. Boyce and W. Wan (co-chairs), E. Alshina, F. Bossen, I. Moccagatta, K. Kawamura, K. Sühring, X. Xu (vice-chairs) | N |
| **360° video coding, software and test conditions (AHG6)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the effect on compression and subjective quality of different projections formats, resolutions, and packing layouts. * Solicit additional test sequences, and evaluate suitability of test sequences on head-mounted displays and normal 2D displays. * Study the effect of viewport resolution, field of view, and viewport speed/direction on visual comfort. * Prepare and deliver a 360Lib software version enabling the usage of PCMP with HM, and provide common test condition configuration files. * Generate CTC anchors and PERP results for the VTM according to JVET-U2012. * Coordinate with AHG4 in preparation for verification testing for 360° video content. * Produce documentation of 360° software usage for distribution with the software. * Prepare a cleaned-up version of JVET-T2004, reducing it to the elements which are relevant to enable 360° video applications based on AVC, HEVC and VVC, and related SEI messages. | J. Boyce and Y. He (co-chairs), K. Choi, Y. Ye (vice-chairs) | N |
| **Coding of HDR/WCG material (AHG7)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study and evaluate available HDR/WCG test content. * Study objective metrics for quality assessment of HDR/WCG material, including investigation of the correlation between subjective and objective results. * Compare the performance of the VTM and HM for HDR/WCG content. * Generate CTC anchors for the VTM according to JVET-V2011. * Study the luma/chroma bit allocation in the HDR CTC, especially for HLG content. * Coordinate with AHG4 in preparation for verification testing for HDR video content. * Study additional aspects of coding HDR/WCG content. | A. Segall (chair), E. François, W. Husak, S. Iwamura, D. Rusanovskyy (vice-chairs) | N |
| **High bit depth, high bit rate, and high frame rate coding (AHG8)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the benefits and characteristics of VVC coding tools for high bit depth, high bit rate, and high frame rate coding. * Study lossless coding characteristics of VVC. * Identify technologies for future extension of VVC to support such application usage. * Discuss and refine the JVET-U2018 testing conditions for high bit depth, high bit rate, and high frame rate coding. * Finalize, conduct and coordinate the work on the core experiment JVET-V2022. * Identify suitable test material for testing of high bit depth, high bit rate, and high frame rate coding in coordination with AHG4 and AHG7. * Study VVC entropy decoding throughput in the cases of high bit depth, high bit rate, and high frame rate coding. | A. Browne and T. Ikai (co-chairs), D. Rusanovskyy, M. Sarwer, X. Xiu, Y. Yu (vice-chairs) | Tel.  2 weeks notice |
| **SEI message studies (AHG9)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the SEI messages in VSEI, VVC, HEVC and AVC. * Collect software and showcase information for SEI messages, including encoder and decoder implementations and bitstreams for demonstration and testing. * Identify potential needs for additional SEI messages. * Investigate the possible need of mandatory post processing in the context of SEI messages * Study SEI messages defined in HEVC and AVC for potential use in the VVC context. * Coordinate with AHG3 for software support of SEI messages. | J. Boyce, S. McCarthy (co-chairs), C. Fogg, P. de Lagrange, A. Luthra, G. J. Sullivan, A. Tourapis, Y.-K. Wang, S. Wenger (vice-chairs) | N |
| **Encoding algorithm optimization (AHG10)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the impact of using techniques such as tool adaptation and configuration, and perceptually optimized adaptive quantization for encoder optimization. * Study the impact of non-normative techniques of pre processing for the benefit of encoder optimization. * Study encoding techniques of optimization for objective quality metrics and their relationship to subjective quality. * Consider neural network-based encoding optimization technologies for video coding standards. * Investigate other methods of improving objective and/or subjective quality, including adaptive coding structures and multi-pass encoding. * Study methods of rate control and rate-distortion optimization and their impact on performance, subjective and objective quality. * Study the potential of defining software configuration settings optimized for subjective quality, and coordinate such efforts with AHG3. | A. Duenas, R. Sjöberg and A. Tourapis (co-chairs) | N |
| **Neural network-based video coding (AHG11)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Evaluate and quantify performance improvement potential of NN-based video coding technologies compared to existing video coding standards such as VVC, including both individual coding tools and novel architectures. * Finalize, conduct and discuss the EE on neural network-based video coding JVET-V2023. * Solicit input contributions on NN-based video coding technologies. * Refine the test conditions for NN-based video coding, and develop supporting software as needed. * Investigate technical aspects specific to NN-based video coding, such as encoding and decoding complexity of neural networks, design network representation, operation, tensor, on-the-fly network adaption (e.g. updating during encoding) etc; * Study the impact of training (including the impact of loss function) on the performance of candidate technology, and identify suitable materials for training. * Analyse complexity characteristics, perform complexity analysis, and develop complexity reductions of candidate technology. * Refine testing methods for assessment of the effectiveness and complexity of considered technology. * Study the impact of parameter quantization and fixed-point computations in NN-based video coding. * Review the outcome of the expert viewing conducted at the meeting, refine the methodology, and prepare viewing for the next meeting. * Generate and distribute anchor encodings and develop improvements of the JVET-V2016 common test conditions for NNVC technology. * Coordinate with other relevant groups, including SC29/AG5 on visual quality assessment. | E. Alshina, S. Liu, A. Segall, (co‑chairs), J. Chen, F. Galpin, J. Pfaff, S. S. Wang, Z. Wang, M. Wien, P. Wu, J. Xu (vice‑chairs) | Tel.  2 weeks notice |
| **Enhanced compression beyond VVC capability (AHG12)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Solicit and study non-neural-network video coding tools with enhanced compression capabilities beyond VVC. * Study the performance and complexity tradeoff of these video coding tools. * Define a common software platform for developing and evaluating video coding tools with promising compression performance. * Refine test conditions in JVET-V2017, generate anchors, identify new test sequences to be added, especially high resolution ones in 8K, in coordination with AHG4. * Investigate methods to reduce simulation time. * Analyse the results of exploration experiments described in JVET-V2024 in coordination with the EE coordinators. * Coordinate with AHG11 to study the interaction with neural network-based coding tools. | M. Karczewicz, Y. Ye and L. Zhang (co-chairs), B. Bross, X. Li, K. Naser, H. Yang (vice chairs) | Tel.  2 weeks notice |

It was confirmed that the rules which can be found in document ISO/IEC JTC 1/‌SC 29/‌AG 2 N010 “Ad hoc group rules for MPEG AGs and WGs” (available at <https://www.mpegstandards.org/adhoc/>), are consistent with the operation mode of JVET AHGs. It is however pointed out that JVET does not allow separate AHG reflectors, such that any JVET member is implicitly a member of any AHG. This shall be mentioned in the related WG Recommendations. The list above was also issued as a separate WG 5 document (ISO/IEC JTC 1/‌SC 29/‌WG 5 [N 45](https://sd.iso.org/documents/ui/#!/browse/iso/iso-iec-jtc-1/iso-iec-jtc-1-sc-29/iso-iec-jtc-1-sc-29-wg-5/library/2/List%20of%20AHGs%20established%20at%20the%202nd%20WG%205%20meeting)) in order to make it easy to reference.

# 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. Where applicable, dates of planned finalization and corresponding parent-body document numbers are also noted.

It was reminded that in cases where the JVET document is also made available as a WG 5 output document, a separate version under the WG 5 document header should be generated. This version should be sent to GJS and JRO for upload.

The list of JVET ad hoc groups was also issued as a WG 5 output document [WG 5 N 45](https://sd.iso.org/documents/ui/#!/browse/iso/iso-iec-jtc-1/iso-iec-jtc-1-sc-29/iso-iec-jtc-1-sc-29-wg-5/library/2/List%20of%20AHGs%20established%20at%20the%202nd%20WG%205%20meeting), as noted in section 9.

[JVET-V1000](https://jvet-experts.org/doc_end_user/current_document.php?id=10845) Meeting Report of the 22nd JVET Meeting [G. J. Sullivan, J.-R. Ohm] [WG 5 N 49] (2021-05-26)

Initial versions of the meeting notes (d0 … d6) were made available on a daily basis during the 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)]

[JVET-V1002](https://jvet-experts.org/doc_end_user/current_document.php?id=10846) High Efficiency Video Coding (HEVC) Test Model 16 (HM 16) Encoder Description Update 15 [C. Rosewarne (primary editor), K. Sharman, R. Sjöberg, G. J. Sullivan (co-editors)] [WG 5 N 60] (2021-06-23)

Remains valid – not updated: [JVET-T1003](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10535) Revised coding-independent code points for video signal type identification (Draft 2) [G. J. Sullivan, T. Suzuki, A. Tourapis] [WG 5 DIS N 12)]

Resolution in WG5 to proceed to publication. Only editorial suggestions by ISO secretariat which are dealt with in publication proceed. No Disposition of comments was necessary.

To be Consented in ITU-T SG 16.

[JVET-V1004](https://jvet-experts.org/doc_end_user/current_document.php?id=10847) Errata report items for VVC, HEVC, AVC, Video CICP, and CP usage TR [C. Rosewarne, G. J. Sullivan, Y. Syed, Y.-K. Wang] (2021-06-23, near next meeting)

Remains valid – not updated: [JVET-T1005](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10537) Shutter interval information SEI message for HEVC (Draft 3) [S. McCarthy, G. J. Sullivan, Y.-K. Wang] [WG 5 FDAM N 8]

To be Consented by ITU-T SG 16.

Remains valid – not updated: [JVET-T1006](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10538) Annotated regions and shutter interval information SEI messages for AVC (Draft 2) [J. Boyce, S. McCarthy, Y.-K. Wang] [WG 5 CDAM N 50]

To be Consented by ITU-T SG 16.

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] [WG 11 N 15778]

Remains valid – not updated: [JVET-T1008](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10539) Usage of video signal type code points (Draft 2 for version 3) [W. Husak, G. J. Sullivan, Y. Syed, A. Tourapis] [WG 5 TR N 14]

To be Approved by ITU-T SG 16 in April 2021.

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]

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]

No output: JVET-T1011 through JVET-T1013

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] [WG 11 N 16049]

Remains valid for HM – 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]

No output: JVET-T1016 through JVET-T1019

Remains valid for HM – 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]

Remains valid for HM – not updated: [JVET-U1100](https://jvet-experts.org/doc_end_user/current_document.php?id=10675) Common Test Conditions for HM Video Coding Experiments [K. Sühring, K. Sharman] (2021-02-01)

Reserved for future use (new edition): [JVET-T2001](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10540) Versatile Video Coding Editorial Refinements on Draft 10 [B. Bross, J. Chen, S. Liu, Y.-K. Wang] (2020-10-30)

[JVET-V2002](https://jvet-experts.org/doc_end_user/current_document.php?id=10848) Algorithm description for Versatile Video Coding and Test Model 13 (VTM 13) [J. Chen, Y. Ye, S. Kim] [WG 5 N 56] (2021-06-30, near next meeting)

Further editorial improvements, inclusion of encoder changes e.g. MCTF, and elements from operation range extensions.

Remains valid – not updated: [JVET-N1003](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=6638) Guidelines for VVC reference software development [K. Sühring]

Remains valid – not updated: [JVET-T2004](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10542) Algorithm descriptions of projection format conversion and video quality metrics in 360Lib (Version 12) [Y. Ye, J. Boyce]

It was noted that this includes some “stale” formats are no longer subject of active investigation and had been moved to the last part. It was agreed to consider whether they should be removed when a new version is produced in the future. In the future, this could be converted into a technical report. This was added as a mandate to AHG6.

[JVET-V2005](https://jvet-experts.org/doc_end_user/current_document.php?id=10849) VVC operation range extensions (Draft 3) [F. Bossen, B. Bross, T. Ikai, D. Rusanovskyy, Y.-K. Wang] [WG 5 CDAM N 52] (2021-05-07)

See adoption notes elsewhere in the meeting report.

[JVET-V2006](https://jvet-experts.org/doc_end_user/current_document.php?id=10850) Additional SEI messages for VSEI (Draft 3) [J. Boyce, Y.-K. Wang] [WG 5 CDAM N 51] (2021-05-07)

For newly adopted SEI messages at the current meeting, see notes elsewhere in the meeting report.

Reserved for future use (new edition): [JVET-S2007](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9679) Versatile supplemental enhancement information messages for coded video bitstreams (Draft 5) [J. Boyce, V. Drugeon, G. J. Sullivan, Y.-K. Wang] [WG 11 N 19472]

Remains valid – not updated: [JVET-U2008](https://jvet-experts.org/doc_end_user/current_document.php?id=10679) Conformance testing for versatile video coding (Draft 6) [J. Boyce, E. Alshina, F. Bossen, K. Kawamura, I. Moccagatta, W. Wan] [WG 5 DIS N 37] (2021-03-31)

Remains valid – not updated: [JVET-U2009](https://jvet-experts.org/doc_end_user/current_document.php?id=10680) Reference software for versatile video coding (Draft 2) [F. Bossen, K. Sühring, X. Li] [WG 5 DIS N 39] (2021-03-31)

Remains valid – not updated: [JVET-T2010](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10545) VTM common test conditions and software reference configurations for SDR video [F. Bossen, J. Boyce, X. Li, V. Seregin, K. Sühring]

[JVET-V2011](https://jvet-experts.org/doc_end_user/current_document.php?id=10851) VTM common test conditions and evaluation procedures for HDR/WCG video [A. Segall, E. François, W. Husak, S. Iwamura, D. Rusanovskyy] (2021-05-14)

This was agreed to include the change suggested in JVET-V0107.

Remains valid – not updated: [JVET-U2012](https://jvet-experts.org/doc_end_user/current_document.php?id=10681) JVET common test conditions and evaluation procedures for 360° video [Y. He, J. Boyce, K. Choi, J.-L. Lin] (2021-03-31)

Remains valid – not updated: [JVET-T2013](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10546) VTM common test conditions and software reference configurations for non-4:2:0 colour formats [Y.-H. Chao, Y.-C. Sun, J. Xu, X. Xu]

Remains valid – not updated: [JVET-Q2014](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9683) JVET common test conditions and software reference configurations for lossless, near lossless, and mixed lossy/lossless coding [T.-C. Ma, A. Nalci, T. Nguyen]

Remains valid – not updated: [JVET-Q2015](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9684) JVET functionality confirmation test conditions for reference picture resampling [J. Luo, V. Seregin]

[JVET-V2016](https://jvet-experts.org/doc_end_user/current_document.php?id=10852) Common Test Conditions and evaluation procedures for neural network-based video coding technology [S. Liu, A. Segall, E. Alshina, R.-L. Liao] (2021-05-21)

Updates to template, change in anchor for EE1.

[JVET-V2017](https://jvet-experts.org/doc_end_user/current_document.php?id=10853) Common Test Conditions and evaluation procedures for enhanced compression tool testing [M. Karczewicz and Y. Ye] (2021-05-14)

Changes to LD configuration and screen content coding are needed for EE2.

Remains valid – not updated: [JVET-U2018](https://jvet-experts.org/doc_end_user/current_document.php?id=10683) Common test conditions for high bit depth and high bit rate video coding [A. Browne, T. Ikai, D. Rusanovskyy, M. Sarwer, X. Xiu] (2021-01-29)

Updates of anchor via config file are used in the context of the CE document.

[JVET-V2020](https://jvet-experts.org/doc_end_user/current_document.php?id=10854) VVC verification test report for HD SDR and 360° video content [V. Baroncini, M. Wien] [WG 5 N 54] (2021-06-11)

[JVET-V2021](https://jvet-experts.org/doc_end_user/current_document.php?id=10855) VVC verification test plan (Draft 6 [M. Wien, V. Baroncini, A. Segall, Y. Ye] [WG 5 N 55] (2021-06-11)

Changes: Remove SDR HD & 360, finalization of sequences and settings for HDR, timeline for dry run and testing for HDR.

[JVET-V2022](https://jvet-experts.org/doc_end_user/current_document.php?id=10843) Core Experiment on Entropy Coding for High Bit Depth and High Bit Rate Coding [K. Naser, D. Rusanovskyy, M. G. Sarwer, F. Wang] [WG 5 N 53] (2021-05-14)

An initial draft was reviewed and approved. One expert expressed the opinion that it might be desirable to test more options in CE3.x, e.g. for bypass alignment. This is to be further discussed in the CE definition finalization period.

[JVET-V2023](https://jvet-experts.org/doc_end_user/current_document.php?id=10844) Exploration Experiment on Neural Network-based Video Coding (EE1) [E. Alshina, S. Liu, W. Chen, F. Galpin, Y. Li, Z. Ma, H. Wang] [WG 5 N 57] (2021-05-14)

An initial draft was reviewed and approved. The technology elements investigated are the same as in the last round. Extended sequences for subjective testing, two different RPR configurations (every frame downsampled, or every second frame). Update of reporting template. A telco for further discussion of viewing preparation was planned.

It was suggested to add an additional RPR method which selectively decides using downsampled coding.

[JVET-V2024](https://jvet-experts.org/doc_end_user/current_document.php?id=10842) Exploration Experiment on Enhanced Compression beyond VVC capability (EE2) [ V. Seregin, J. Chen, S. Esenlik, F. Le Léannec, L. Li, J. Ström, M. Winken, X. Xiu, K. Zhang] [WG 5 N 58] (2021-05-21)

An initial draft was reviewed and approved. Agreed to shorten sequences for LB and LP to 5 seconds (all classes). It was suggested to call the software ECM (enhanced compression model). V. Seregin and K. Zhang to coordinate the software.

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

Future meeting plans were established according to the following guidelines:

* Meeting under ITU-T SG 16 auspices when it meets (ordinarily starting meetings on the Wednesday of the first week and closing it on the Wednesday of the second week of the SG 16 meeting – a total of 8 meeting days), and
* Otherwise meeting under ISO/IEC JTC 1/‌SC 29 auspices when its MPEG WGs meet (ordinarily starting meetings on the Friday prior to the main week of such meetings and closing it on the same day as other MPEG WGs – a total of 8 meeting days).

In cases where an exceptionally high workload is expected for a meeting, an earlier starting date may be defined. In case of online meetings, no sessions should be held on weekend days. This may imply an earlier starting date as well.

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

* Fri. 8 – Fri. 15 October 2021, 24th meeting under ISO/IEC JTC 1/‌SC 29 auspices as a mixed-mode meeting in Antalya, TR.
* During January 2022, 25th meeting under ITU-T SG16 auspices in Geneva, CH.
* Fri. 22 – Fri. 29 April 2022, 26th meeting under ISO/IEC JTC 1/‌SC 29 auspices, location t.b.d.
* Fri. 15 – Fri. 22 July 2022, 27th meeting under ISO/IEC JTC 1/‌SC 29 auspices in Cologne, DE.
* During October 2022, 28th meeting under ITU-T SG16 auspices in Geneva, CH.
* During January 2023, 29th meeting under ISO/IEC JTC 1/‌SC 29 auspices, location t.b.d.
* During April 2023, 30th meeting under ISO/IEC JTC 1/‌SC 29 auspices, location t.b.d.
* During XXXX 2023, 31st meeting under ITU-T SG16 auspices in Geneva, CH.

The agreed document deadline for the 24th JVET meeting was planned to be XXday X Oct. 2021.

Giacomo Baroncini and Vittorio Baroncini were thanked for conducting, and Mathias Wien was thanked for coordinating the VVC verification test in the categories of HD SDR and 360° video. It is greatly appreciated that this testing was successfully completed despite requiring extraordinary efforts due the complications caused by the pandemic situation.

Bytedance and Tencent were thanked for providing financial support for the VVC verification tests.

Mathias Wien was thanked for organizing and conducting expert viewing sessions related to the exploration experiment on neural network-based video compression.

The 23rd JVET meeting was closed at approximately XXXX hours UTC on Friday 16 July 2021.

# Annex A to JVET report: List of documents

# Annex B to JVET report: List of meeting participants

The participants of the twenty-third meeting of the JVET, according to an attendance sheet circulated during the meeting sessions (approximately XXX people in total), were as follows:

1. …

# Annex C to JVET report: Recommendations of the 4th meeting of ISO/IEC JTC 1/SC 29/WG 5 MPEG Joint Video Coding Team(s) with ITU-T SG 16

**ISO/IEC JTC 1/SC 29/WG 5 N XX**