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| **Joint Video Experts Team (JVET)****of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29**24th Meeting, by teleconference, 6–15 October 2021 | Document: JVET-X\_Notes\_d0 |

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| *Title:* | **Meeting Report of the 24th Meeting of the Joint Video Experts Team (JVET),by teleconference, 6–15 October 2021** |
| *Status:* | Report document from the chair of JVET |
| *Purpose:* | Report |
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| *Source:* | Chair 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-fourth meeting during 6–15 October 2021 as an online-only meeting. It had previously been planned to be in Antalya, TR, 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 fifth meeting as WG 5. The JVET meeting was held under the chairmanship of 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 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 6 October 2021. Meeting sessions were held on all days except the weekend days of Saturday and Sunday 9 and 10 October 2021, until the meeting was closed at approximately XXXX hours UTC on Friday 15 October 2021. Approximately 1 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 coordination with a meeting of various SC29 Working Groups – where WG 5 is representing the Joint Video Coding Team(s) and their activities from the perspective of the SC 29 parent body, under whose auspices this JVET meeting was held. 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, reference software and conformance testing packages. As a primary goal, the JVET meeting reviewed the work that was performed in the interim period since the twenty-third JVET meeting in producing the following documents:

* JVET-W1000 Meeting report
* JVET-W1004 Errata report items for VVC, HEVC, AVC, Video CICP, and CP usage TR
* JVET-W2002 Algorithm description for Versatile Video Coding and Test Model 14 (VTM 14)
* JVET-W2005 VVC operation range extensions (Draft 4)
* JVET-W2006 Additional SEI messages for VSEI (Draft 4)
* JVET-W2016 Common Test Conditions and evaluation procedures for neural network-based video coding technology
* JVET-W2017 Common Test Conditions and evaluation procedures for enhanced compression tool testing
* JVET-W2019 White paper on VVC
* JVET-W2020 VVC verification test report for HDR video content
* JVET-W2022 Core Experiment on film grain synthesis
* JVET-W2023 Exploration Experiment on neural network-based video coding (EE1)
* JVET-W2024 Exploration Experiment on enhanced compression beyond VVC capability (EE2)
* JVET-W2025 Algorithm description of Enhanced Compression Model 2 (ECM 2)
* JVET-W2026 Conformance testing for VVC operation range extensions (Draft 1)

Further important goals were reviewing the results of the CE on Film Grain Synthesis, 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 to plan next steps for investigation of candidate technology towards further standard development.

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

* JVET-W1004 Errata report items for VVC, HEVC, AVC, Video CICP, and CP usage TR
* JVET-W2002 Algorithm description for Versatile Video Coding and Test Model 14 (VTM 14)
* JVET-W2005 VVC operation range extensions (Draft 4)
* JVET-W2006 Additional SEI messages for VSEI (Draft 4)
* JVET-W2016 Common Test Conditions and evaluation procedures for neural network-based video coding technology
* JVET-W2017 Common Test Conditions and evaluation procedures for enhanced compression tool testing
* JVET-W2019 White paper on VVC
* JVET-W2020 VVC verification test report for HDR video content
* JVET-W2022 Core Experiment on film grain synthesis
* JVET-W2023 Exploration Experiment on neural network-based video coding (EE1)
* JVET-W2024 Exploration Experiment on enhanced compression beyond VVC capability (EE2)
* JVET-W2025 Algorithm description of Enhanced Compression Model 2 (ECM 2)
* JVET-W2026 Conformance testing for VVC operation range extensions (Draft 1)

For the organization and planning of its future work, the JVET established XX “ad hoc groups” (AHGs) to progress the work on particular subject areas. At this meeting, X Core Experiment (CE) and X Exploration Experiments (EE) were defined. The next eight JVET meetings were planned for Tue. 11 – Fri. 14 January and Mon. 17 – Wed. 19 January 2022 as a virtual meeting under ITU-T SG16 auspices; during Fri. 22 – Fri. 29 April 2022 under ISO/IEC JTC 1/‌SC 29 auspices in Alpbach, AT; 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.; during July 2023 under ITU-T SG16 auspices in Geneva, CH; and during October 2023 under ISO/IEC JTC 1/‌SC 29 auspices, location t.b.d.

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 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-fourth meeting during 6–15 October 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 fifth meeting as WG 5. The JVET meeting was held under the chairmanship of 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 and at <http://wftp3.itu.int/av-arch/jvet-site/2022_10_X_Virtual/>.

## Primary goals

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

* JVET-W1000 Meeting report
* JVET-W1004 Errata report items for VVC, HEVC, AVC, Video CICP, and CP usage TR
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Further important goals were reviewing the results of the CE on Film Grain Synthesis, 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 UTC timezone.

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 chair. 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 Thursday, 30 September 2021. Any documents uploaded after 2359 hours Paris/Geneva time on Thursday 30 September 2021 were considered “officially late”. The usual grace period of 12 hours (to accommodate those living in different time zones of the world) was not applied, as the deadline was already one day later than originally intended, due to a wrong expression of date in the previous meeting report. 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-X0146 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-X0XXX (a proposal on …), uploaded 10-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-X0XXX (a document on …), uploaded 10-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-X0042, JVET-X0057, JVET-X0062, … .

“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 may have been 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-W1000, the Errata report items for VVC, VSEI, HEVC, AVC, Video CICP, and CP usage TR JVET-W1004, the Algorithm description for Versatile Video Coding and Test Model 14 (VTM 14) JVET-W2002, the Operation range extensions for VVC (Draft 4) JVET-W2005, the Additional SEI messages for VSEI (Draft 4) JVET-W2006, the Common Test Conditions and evaluation procedures for neural network-based video coding technology JVET-W2016, the Common Test Conditions and evaluation procedures for enhanced compression tool testing JVET-W2017, the White paper on VVC JVET-W2019, the VVC verification test report for HDR video content JVET-W2020, the Description of the CE on Film Grain Synthesis JVET-W2022, the Description of the EE on Neural Network-based Video Coding JVET-W2023, the Description of the EE on Enhanced Compression beyond VVC capability JVET-W2024, the Algorithm description of Enhanced Compression Model 2 (ECM 2) JVET-W2025, and the Conformance testing for VVC operation range extensions (Draft 1) JVET-W2026, had been completed and were approved. The software implementations of VTM (version 14.0), ECM (version 2.0), and HDRTools (version 0.22) were also approved.

Only minor editorial issues were found in the meeting report JVET-W1000 – no need to produce an update was identified (see section 2.12 for details).

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 for meeting access had been sent to registered participants via these channels. Links to the Zoom sessions (without the necessary password) were available in the posted meeting logistics information and the calendar of meeting sessions in the JVET web site.

The following rules were established for the Zoom teleconference meeting:

* Use the “hand-raising” function to enter yourself in the queue to speak (unless otherwise instructed by the session chair). If you are dialed in by phone, request your queue position verbally.
* Stay muted unless you have something to say. People are muted by default when they join and 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 and country 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
* 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 film grain synthesis
* 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 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
* [“midday” break – nearly 4 hours]
* 1300–1500 1st “afternoon” session [break after 2 hours]
* 1520–1720 2nd “afternoon” 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 fairly either in one meeting or another. For the current meeting, the same session times were used as in the 21st JVET meeting (which had been the fourth meeting conducted as an online meeting)

* 1. ***ISO and IEC Code of Conduct reminders***

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>

These include 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)

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 and ECM software implementation packages use 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. 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 1340 (as of 5 October 2021). All future discussions (including those on HEVC, VVC, CICP, etc.) shall be conducted on the JVET reflector rather than the JCT-VC reflector, while the old reflectors (including JVT, JCT-VC, and JCT-3V) are 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)
* **ARMC**: Adaptive re-ordering of merge candidates
* **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
* **DIMD**: Decoder intra mode derivation
* **DMVR**: Decoder 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)
* **ECM**: Enhanced compression model – a software codebase for future video coding exploration
* **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 – a software codebase previously used for 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.
* **TIMD**: Template-based intra mode derivation
* **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 6 October at 0500 UTC were as follows.

* Timing and organization of online meetings, calendar
* Standards approval and publication status
	+ Working practices using objective metrics report
		- HSTP-VID-WPOM V1: 2020-07-03, published 2020-11
		- ISO/IEC TR 23002-8 (Ed. 1) published 2021-05-20
	+ AVC
		- H.264v14 Consented at 22nd meeting (with annotated regions, shutter interval, and miscellaneous corrections), Last Call closed during the 23rd meeting, published XXX
		- ISO/IEC 14496-10:2020 (Ed. 9) FDIS closed 2020-11-27, published 2020-12-15 – corresponding aspects are partly in the in-progress CDAM (see below)
	+ HEVC
		- H.265 V7 approved 2019-11-29, published 2020-01-10
		- ISO/IEC 23008-2:2020 (Ed. 4) FDIS closed 2020-07-16, published 2020-08-27
		- H.265 V8 Consented at the 22nd meeting (Shutter interval information SEI message and miscellaneous corrections), Last Call closed during the 23rd meeting, published XXX
		- ISO/IEC 23008-2:2020 FDAM 1 ballot closed 2021-06-03 (Shutter interval information SEI message) published 2021-07-12
	+ Usage of code points report
		- H.Sup19 V3 approved 2021-04-30, published 2021-06-04
		- ISO/IEC TR 23091-4 (Ed. 3) 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)
		- ISO/IEC 23091-2 had been forwarded from DIS directly for publication in 2021-04
		- H.273v2 (with 4:2:0 sampling alignment and corrections for range of values for sample aspect ratio, ICTCP equations for HLG, and transfer characteristics function for sYCC of IEC 61966-2-1) Last Call closed during the 23rd meeting, published XXX
	+ The following freely available standards are published here in ISO/IEC:
	<https://standards.iso.org/ittf/PubliclyAvailableStandards/index.html>
		- ISO/IEC 14496-10:2020 (Ed. 9)
		- 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 23090-15 ballot closed 2021-09-29, FDIS from current meetng
		- [m57147](https://dms.mpeg.expert/doc_end_user/current_document.php?id=79339&id_meeting=187) Summary of voting on ISO/IEC DIS 23090-15
	+ VVC reference SW – under DIS 23090-16 ballot closed 2021-09-30, FDIS from current meeting
		- [m57147](https://dms.mpeg.expert/doc_end_user/current_document.php?id=79339&id_meeting=187) Summary of voting on ISO/IEC DIS 23090-16
	+ AVC additional SEI – integrated into DIS of new edition at 23rd meeting, ballot closes XX-XX, FDIS in January
	+ VSEI extensions – integrated into DIS of new edition at 23rd meeting, ballot closes XX-XX, FDIS in January
	+ VVC operation range extensions – integrated into DIS of new edition at 23rd meeting, ballot closes XX-XX, FDIS in January
	+ 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. A freely available URL on ITU part should be provided for the following parts:
		- ISO/IEC 14496-10:2020/Amd 1 – AVC to be done when finishing new edition
		- ISO/IEC 23008-2:2020/Amd 1 – HEVC done last meeting
		- ISO/IEC DIS 23091-2, 2nd edition – CICP done last meeting
		- ISO/IEC 23002-7:2021/Amd 1 – VSEI to be done when finishing new edition
		- ISO/IEC 23090-3:2021/Amd 1 – VVC to be done when finishing new edition
* The meeting logistics, agenda, working practices, policies, and document allocation were reviewed.
	+ The meeting was 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 JVET-W1000 were reviewed. The following small copy-paste issues in the meeting report were noted and were not considered sufficient to warrant issuing a revision:
	+ In section 2.6, it was stated that meeting hours of the 23rd meeting were identical to those of the 19th meeting, but actually they were matching with those of the 20th meeting
	+ In the report JVET-W0005 of AHG5 (conformance), it was stated that FDIS 23090-15 would be an output from the 23rd meeting, but actually the DIS was still under ballot by that time.
	+ In section 11 and Annex C 6.3.1, the document deadline for the current meeting was defined as “Wednesday 30 September”, but actually 2021-09-30 was a Thursday, Even though the intention might have been to have Wednesday 29 as the deadline, a deadline of Thursday 30 was later defined in the meeting announcement.
	+ In Annex C 4, recommendations related to VVC are under wrong headers for HEVC (already noted in JVET-W1000).
* There was somewhat less of a problem of late non-cross-check documents and no “placeholders” (see section 2.4.2).
* There were quite a few documents where authors’ given names were not abbreviated, and company affiliation was missing in the authors’ list. Reminder to stick to our conventions.
* The primary goals of the meeting were
	+ Errata
	+ Conformance and software for version2 of VVC & VSEI
	+ Extensions of VVC (High bit rate / high bit depth)
	+ Additional SEI messages for VSEI
	+ Core Experiment on Film Grain Synthesis
	+ Explorations
		- Neural network-based video coding
		- Enhanced compression beyond VVC
* Funding of verification testing activities: recommendation of thanks, recommendation calling for funding wrt upcoming tests.
* Liaison communication
* Number of documents similar to last meeting
* Scheduling was discussed, and it was agreed to avoid conducting “track” sessions in parallel (some BoG parallelism might occur)
* 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
* [“midday” break – nearly 4 hours]
* 1300–1500 1st “afternoon” session [break after 2 hours]
* 1520–1720+1 2nd “afternoon” 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. 06 Oct., 1st day
	+ Session 1:
		- 0500–05XX Opening remarks, review of practices, agenda, IPR reminder
		- 05XX–0700 Reports of AHGs 1–X
	+ Session 2:
		- 0720–0XXX Reports of AHGs X–12
		- 0XXX-0920 Review of CE
	+ Session 3:
		- 1300–1500 Review of CE/EE
	+ Session 4:
		- 1520–1720 Review of EE
* Thu. 7 Oct., 2nd day
	+ Session 5:
		- 0500–0700 Review of CE/EE and related
	+ Session 6:
		- 0720–0920 …
		- …
* Mon. 11 Oct., 4th day
	+ 0500–0700 MPEG information sharing session
* Wed. 13 Oct., 6th day
	+ 0500–0630 MPEG information sharing session
* Fri. 15 Oct., 8th day
	+ Plenary:
		- 0500–0700 Revisits, Approval of output docs, AHG plans, recommendations
	+ Plenary:
		- 0720–0920 Revisits, Approval of output docs, AHG plans, recommendations
	+ 2100–2300 MPEG information sharing session
	+ XXXX–XXXX WG 5 Closing plenary: Approval of recommendations

## 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 and advertisement of standards (2)
	+ Text development and errata reporting (6)
	+ Test conditions (1)
	+ Verification testing (0)
	+ Test Material (0)
	+ Quality assessment (1)
	+ Conformance test development (1)
	+ Software development (0)
	+ Implementation studies (2)
	+ Complexity analysis (0)
	+ Encoding algorithm optimization (4)
	+ Profile/tier/level specification (6)
	+ Proposed modification of system interface (0)
* Low-level tool technology proposals (section 5) with subtopics (number counts excluding BoG and summary reports)
	+ AHG8: High bit depth and high bit rate coding (5) (section 5.1)
	+ AHG11 and EE1: Neural network-based technology (29) (section 5.2)
	+ AHG12 and EE2: Enhanced compression beyond VVC capability (52) (section 5.3)
* High-level syntax (HLS) proposals (section 6) with subtopics
	+ AHG9: SEI message studies and proposals (4) (section 6.1)
	+ CE on film grain synthesis (2) (section 6.2)
	+ Non-SEI HLS aspects (0) (section 6.3)
* Joint meetings, plenary discussions, BoG reports (X), 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 6 Oct. 2021 during XXXX–XXXX and XXXX–XXXX UTC (chaired by JRO).

[JVET-X0001](https://jvet-experts.org/doc_end_user/current_document.php?id=11146) JVET AHG report: Project management (AHG1) [J.-R. Ohm, G. J. Sullivan]

[JVET-X0002](https://jvet-experts.org/doc_end_user/current_document.php?id=11147) JVET AHG report: Draft text and test model algorithm description editing (AHG2) [B. Bross, J. Chen, C. Rosewarne, F. Bossen, J. Boyce, A. Browne, S. Kim, S. Liu, J.-R. Ohm, G. J. Sullivan, A. Tourapis, Y.-K. Wang, Y. Ye]

[JVET-X0003](https://jvet-experts.org/doc_end_user/current_document.php?id=11148) JVET AHG report: Test model software development (AHG3) [F. Bossen, X. Li, K. Sühring, Y. He, K. Sharman, V. Seregin, A. Tourapis]

[JVET-X0004](https://jvet-experts.org/doc_end_user/current_document.php?id=11149) 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-X0005](https://jvet-experts.org/doc_end_user/current_document.php?id=11150) JVET AHG report: Conformance testing (AHG5) [J. Boyce, W. Wan, E. Alshina, F. Bossen, I. Moccagatta, K. Kawamura, D. Rusanovskyy, K. Sühring, X. Xu, T. Zhou]

[JVET-X0006](https://jvet-experts.org/doc_end_user/current_document.php?id=11151) JVET AHG report: ECM software development (AHG6) [V. Seregin, J. Chen, F. Le Léannec, K. Zhang]

[JVET-X0007](https://jvet-experts.org/doc_end_user/current_document.php?id=11152) JVET AHG report: Coding of HDR/WCG material (AHG7) [A. Segall, E. François, W. Husak, S. Iwamura, D. Rusanovskyy]

[JVET-X0008](https://jvet-experts.org/doc_end_user/current_document.php?id=11153) 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-X0009](https://jvet-experts.org/doc_end_user/current_document.php?id=11154) 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-X0010](https://jvet-experts.org/doc_end_user/current_document.php?id=11155) JVET AHG report: Encoding algorithm optimization (AHG10) [P. de Lagrange, R. Sjöberg, A. Tourapis]

[JVET-X0011](https://jvet-experts.org/doc_end_user/current_document.php?id=11156) 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-X0012](https://jvet-experts.org/doc_end_user/current_document.php?id=11157) JVET AHG report: Enhanced compression beyond VVC capability (AHG12) [M. Karczewicz, Y. Ye, L. Zhang, B. Bross, X. Li, K. Naser, H. Yang]Formularende

# Project development (22)

## Deployment and advertisement of standards (0)

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

[JVET-X0020](https://jvet-experts.org/doc_end_user/current_document.php?id=11158) Deployment status of the HEVC standard [G. J. Sullivan] [late]

[JVET-X0021](https://www.jvet-experts.org/doc_end_user/current_document.php?id=11159) Deployment status of the VVC standard [G. J. Sullivan] [miss] [late]

## Text development and errata reporting (6)

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

[JVET-X0050](https://jvet-experts.org/doc_end_user/current_document.php?id=11043) AHG2: On editing notes for the 2nd edition draft text of VVC [Y.-K. Wang (Bytedance), M. Zhou (Broadcom)]

[JVET-X0093](https://jvet-experts.org/doc_end_user/current_document.php?id=11086) AHG2/AHG8: Comments on VVC operation range extensions [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-X0059](https://jvet-experts.org/doc_end_user/current_document.php?id=11052) AHG2/AHG9: Comments on the 2nd edition draft text for VSEI [Y.-K. Wang (Bytedance)]

[JVET-X0096](https://jvet-experts.org/doc_end_user/current_document.php?id=11089) AHG2/AHG9: On Multiview View Position (MVP) SEI message [B. Choi, A. Hinds, X. Zhang, S. Wenger, S. Liu (Tencent)]

Items 2 and 3 of this document belong to this category.

[JVET-X0076](https://jvet-experts.org/doc_end_user/current_document.php?id=11069) AHG8: GCI flags for VVC operation range extension profiles [T. Ikai, T. Chujoh, T. Aono (Sharp)] [late]

[JVET-X0095](https://jvet-experts.org/doc_end_user/current_document.php?id=11088) AHG8: General Constraints Information (GCI) flags for operation range extensions [B. Choi, S. Wenger, S. Liu (Tencent)]

## Test conditions (1)

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

[JVET-X0138](https://jvet-experts.org/doc_end_user/current_document.php?id=11131) Proposal for a new Low Latency & Controlled Complexity (LLCC) common test conditions [G. Martin-Cocher, T. Poirier, S. Puri (InterDigital)]

## Verification testing (0)

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

## Test material (0)

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

## Quality assessment (1)

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

See the AHG4 report discussion in section 3 and the verification testing discussions in section 4.4.

[JVET-X0051](https://jvet-experts.org/doc_end_user/current_document.php?id=11044) AG5-Related: Full Reference Video Quality Analysis [P. Topiwala (FastVDO)]

## Conformance test development (1)

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

See the AHG5 report discussion in section 3, and BoG report JVET-W0188.

[JVET-X0161](https://jvet-experts.org/doc_end_user/current_document.php?id=11168) AHG5: Editors update on VVC conformance testing [J. Boyce, E. Alshina, F. Bossen, K. Kawamura, I. Moccagatta, W. Wan] [late] [miss]

## Software development (0)

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

## Implementation studies (2)

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

[JVET-X0044](https://jvet-experts.org/doc_end_user/current_document.php?id=11037) Update on open, optimized VVC implementations VVenC and VVdeC [A. Wieckowski, J. Brandenburg, C. Bartnik, V. George, J. Güther, G. Hege, C. Helmrich, A. Henkel, T. Hinz, C. Lehmann, C. Stoffers, I. Zupancic, B. Bross, H. Schwarz, D. Marpe, T. Schierl (HHI)] [miss] [late]

[JVET-X0104](https://jvet-experts.org/doc_end_user/current_document.php?id=11097) Update on the progress of the optimized VVC encoder implementation, Ali266 [X. Dong, S. Fang, Z. Huang, J. Liu, S. Xu, R. Yang, L. Yu, J. Chen, R.-L. Liao, Y. Ye (Alibaba)]

## Complexity analysis (0)

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

## AHG10: Encoding algorithm optimization (4)

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

[JVET-X0061](https://jvet-experts.org/doc_end_user/current_document.php?id=11054) AHG10: Fast skip of TT split partitioning on top of VTM-14.0 and ECM reference software [L.-F. Chen, X. Li, S. Liu (Tencent)]

[JVET-X0167](https://jvet-experts.org/doc_end_user/current_document.php?id=11175) Cross-check of JVET-X0061: AHG10: Fast skip of TT split partitioning on top of VTM-14.0 and ECM reference software [A.Henkel (HHI)] [late] [miss]

[JVET-X0063](https://jvet-experts.org/doc_end_user/current_document.php?id=11056) AHG10: Deblocking filter setting for VTM [H. Zhang, X. Li, S. Liu (Tencent)]

[JVET-X0116](https://jvet-experts.org/doc_end_user/current_document.php?id=11109) AHG10: Suggestion to enable GOP-based temporal filtering for low-delay configurations in CTC for HM and VTM [K. Andersson, J. Enhorn, P. Wennersten (Ericsson)]

[JVET-X0143](https://jvet-experts.org/doc_end_user/current_document.php?id=11136) AHG10: VTM Encoder Changes for ALF Usage in Viewport-adaptive Streaming [A. Zare, A. Aminlou, A. Hallapuro, M. M. Hannuksela (Nokia)]

## Profile/tier/level specification (6)

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

[JVET-X0073](https://jvet-experts.org/doc_end_user/current_document.php?id=11066) AHG2: On specifying the range extensions profiles [Y.-K. Wang (Bytedance)]

[JVET-X0106](https://jvet-experts.org/doc_end_user/current_document.php?id=11099) On constraints for intra profiles in VVC [T. Tsukuba, S. Keating (Sony)]

[JVET-X0075](https://jvet-experts.org/doc_end_user/current_document.php?id=11068) AHG8: Level refinement for VVC operation range extension profiles [T. Ikai, T. Chujoh, T. Aono (Sharp)] [late]

[JVET-X0079](https://jvet-experts.org/doc_end_user/current_document.php?id=11072) Proposals on maximum bit rate for HEVC and VVC [T. Tsukuba, M. Ikeda, T. Suzuki (Sony)]

[JVET-X0108](https://jvet-experts.org/doc_end_user/current_document.php?id=11101) Coded Picture Buffer sizes and MinCr for high bit-depth profiles [S. Keating, A. Browne, K. Sharman (Sony)]

[JVET-X0109](https://jvet-experts.org/doc_end_user/current_document.php?id=11102) On maximum bit-rates for high bit-depth profiles [S. Keating, A. Browne, K. Sharman (Sony)]

## Proposed modification of system interface (0)

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

# Low-level tool technology proposals (84)

## AHG8: High bit rate and high bit depth coding for VVC (5)

### General (0)

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

### Entropy Coding for High Bit Depth and High Bit Rate Coding (5)

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

[JVET-X0127](https://jvet-experts.org/doc_end_user/current_document.php?id=11120) AHG8: Modification of History Based Rice Parameter Derivation [Y. Yu, H. Yu, Z. Xie, F. Wang, L. Xu, D. Wang (OPPO)]

[JVET-X0157](https://jvet-experts.org/doc_end_user/current_document.php?id=11164) Cross-check report of JVET-X0127: AHG8: Modification of History Based Rice Parameter Derivation [D. Rusanovskyy (Qualcomm)] [late] [miss]

[JVET-X0128](https://jvet-experts.org/doc_end_user/current_document.php?id=11121) AHG8: On History-Based Rice Parameter Derivations for Wavefront Parallel Processing [Y. Yu, H. Yu, Z. Xie, F. Wang, L. Xu, D. Wang (OPPO)]

[JVET-X0158](https://jvet-experts.org/doc_end_user/current_document.php?id=11165) Cross-check report of JVET-X0128: AHG8: On History-Based Rice Parameter Derivations for Wavefront Parallel Processing [D. Rusanovskyy (Qualcomm)] [late] [miss]

[JVET-X0129](https://jvet-experts.org/doc_end_user/current_document.php?id=11122) AHG8: Independent Rice Parameter Derivation for high bit depth and high bit rate extensions [Y. Yu, H. Yu, Z. Xie, F. Wang, L. Xu, D. Wang (OPPO)]

[JVET-X0159](https://jvet-experts.org/doc_end_user/current_document.php?id=11166) Cross-check report of JVET-X0129: AHG8: Independent Rice Parameter Derivation for high bit depth and high bit rate extensions [D. Rusanovskyy (Qualcomm)] [late] [miss]

[JVET-X0136](https://jvet-experts.org/doc_end_user/current_document.php?id=11129) AHG8: On significance, GT1, and GT2 flag coding for high bit depths [A. Browne, S. Keating, K. Sharman (Sony)]

[JVET-X0137](https://jvet-experts.org/doc_end_user/current_document.php?id=11130) AHG8 and AHG10: On derivation of sh\_reverse\_last\_sig\_coeff\_flag and sh\_ts\_residual\_coding\_rice\_idx\_minus1 [A. Browne, S. Keating, K. Sharman (Sony)]

### Adaptation of other tools for high bit rate and high bit depth (0)

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

## AHG11: Neural network-based video coding (29)

### General (0)

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

### EE1 contributions: Neural network-based video coding (12)

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

[JVET-X0023](https://jvet-experts.org/doc_end_user/current_document.php?id=11173) EE1: Summary of Exploration Experiments on Neural Network-based Video Coding [E. Alshina, S. Liu, W. Chen, F. Galpin, Y. Li, Z. Ma, H. Wang]

[JVET-X0052](https://jvet-experts.org/doc_end_user/current_document.php?id=11045) EE1-1.3: neural network based in-loop filter [L. Wang, W. Jiang, X. Xu, S. Liu (Tencent)]

[JVET-X0053](https://jvet-experts.org/doc_end_user/current_document.php?id=11046) EE1-1.5: neural network based in-loop filter using depthwise separable convolution and regular convolution [L. Wang, S. Lin, X. Xu, S. Liu, Xiang Li (Tencent)]

[JVET-X0064](https://jvet-experts.org/doc_end_user/current_document.php?id=11057) EE1-2.2: CNN-based Super Resolution for Video Coding Using Decoded Information [C. Lin, Y. Li, K. Zhang, L. Zhang (Bytedance)]

[JVET-X0065](https://jvet-experts.org/doc_end_user/current_document.php?id=11058) EE1-1.2: Test on Deep In-Loop Filter with Adaptive Model Selection and External Attention [Y. Li, K. Zhang, L. Zhang (Bytedance)]

[JVET-X0066](https://jvet-experts.org/doc_end_user/current_document.php?id=11059) EE1-1.6: Combined Test of EE1-1.2 and EE1-1.4 [Y. Li, K. Zhang, L. Zhang (Bytedance), H. Wang, J. Chen, K. Reuzé, A.M. Kotra, M. Karczewicz (Qualcomm)]

[JVET-X0074](https://jvet-experts.org/doc_end_user/current_document.php?id=11067) EE1-2.4: 1.5x/2.0x Upsample method for NN-Based Super-Resolution Post-Filters [K. Takada, Y. Yasugi, T. Chujoh, T. Ikai (Sharp)]

[JVET-X0107](https://jvet-experts.org/doc_end_user/current_document.php?id=11100) EE1-2.3: Neural Network-based Super Resolution [A. M. Kotra, K. Reuzé, J. Chen, H. Wang, M. Karczewicz, J. Li (Qualcomm)]

[JVET-X0110](https://jvet-experts.org/doc_end_user/current_document.php?id=11103) EE1-1.1: Content-adaptive neural network post-processing filter [M. Santamaria, J. Lainema, F. Cricri, R. G. Youvalari, H. Zhang, A. Zare, H. R. Tavakoli, M. Hannuksela (Nokia)]

[JVET-X0117](https://jvet-experts.org/doc_end_user/current_document.php?id=11110) EE1-2.1: Super Resolution with existing VVC functionality [E. Alshina, J. Sauer (Huawei)]

[JVET-X0118](https://jvet-experts.org/doc_end_user/current_document.php?id=11111) EE1-3.1: BD-rate gains vs complexity of NN-based intra prediction [T. Dumas, F. Galpin, P. Bordes, F. Le Léannec (InterDigital)]

[JVET-X0123](https://jvet-experts.org/doc_end_user/current_document.php?id=11116) Crosscheck of JVET-X0118 (EE1-3.1: BD-rate gains vs complexity of NN-based intra prediction) [J. Sauer (Huawei)]

[JVET-X0140](https://jvet-experts.org/doc_end_user/current_document.php?id=11133) EE1-1.4: Tests on Neural Network-based In-Loop Filter with constrained computational complexity [H. Wang, J. Chen, K. Reuzé, A. M. Kotra, M. Karczewicz (Qualcomm)]

### EE1 related contributions: Neural network-based video coding (11)

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

[JVET-X0041](https://jvet-experts.org/doc_end_user/current_document.php?id=11034) AHG11: CNN-based In-Loop Filter with Knowledge Distillation [H.-K. Kang, D.-W. Kim, S.-W. Jung (Korea Univ.), H. Kwon, S. Jeong (ETRI)]

[JVET-X0054](https://jvet-experts.org/doc_end_user/current_document.php?id=11047) AHG11: neural network based in-loop filter with adaptive model selection [L. Wang, X. Xu, S. Liu (Tencent)]

[JVET-X0055](https://jvet-experts.org/doc_end_user/current_document.php?id=11048) AHG11: neural network based in-loop filter with constrained storage and low complexity [L. Wang, X. Xu, S. Liu (Tencent)]

[JVET-X0080](https://jvet-experts.org/doc_end_user/current_document.php?id=11073) EE1-related: CNN-based Super Resolution for Video Coding Using Decoded Information with Simplified Models [C. Lin, Y. Li, K. Zhang, L. Zhang (Bytedance)]

[JVET-X0081](https://jvet-experts.org/doc_end_user/current_document.php?id=11074) EE1-related: CNN-based Super Resolution for Video Coding Using Separate Networks for Chroma Components [C. Lin, Y. Li, K. Zhang, L. Zhang (Bytedance)]

[JVET-X0082](https://jvet-experts.org/doc_end_user/current_document.php?id=11075) EE1-related: Training Using Knowledge Distillation for Deep In-Loop Filters [Y. Li, K. Zhang, L. Zhang (Bytedance)]

[JVET-X0084](https://jvet-experts.org/doc_end_user/current_document.php?id=11077) EE1-related: Improved RDO Considering Deep In-Loop Filter [J. Li, Y. Li, K. Zhang, L. Zhang (Bytedance)]

[JVET-X0094](https://jvet-experts.org/doc_end_user/current_document.php?id=11087) AHG11: A Deep In-Loop Filter with Frame Level Flag [X. Zhang, C. Fang, S. Peng, D. Jiang, J. Lin (Dahua)]

[JVET-X0097](https://jvet-experts.org/doc_end_user/current_document.php?id=11090) AHG11: A CNN-based Super Resolution Method [S. Peng, C. Fang, X. Zhang, D. Jiang, J. Lin (Dahua)]

[JVET-X0111](https://jvet-experts.org/doc_end_user/current_document.php?id=11104) AHG11: MPEG NNR compressed bias update for the CNN based post-filter of EE1-1.1 [M. Santamaria, J. Lainema, F. Cricri, R. G. Youvalari, H. Zhang, A. Zare, G. Rangu, H. R. Tavakoli, H. Afrabandpey, M. Hannuksela (Nokia)]

[JVET-X0113](https://jvet-experts.org/doc_end_user/current_document.php?id=11106) AHG11: CNN-based Low Complexity Super Resolution [E. Yeo, J. Kang (Ewha W. University), D. Kim, K. Kim, J.-H. Son, J. S. Kwak (WILUS Inc.)]

### Other (6)

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

[JVET-X0043](https://jvet-experts.org/doc_end_user/current_document.php?id=11036) [AHG11 & AHG6] DOVC: Deep Omnidirectional Video Compression [Q. Qin, C. Jung (Xidian Univ.), Z. Dan, M. Li (OPPO)]

[JVET-X0060](https://jvet-experts.org/doc_end_user/current_document.php?id=11053) AHG11: NN-based Reference Frame Interpolation for VVC Hierarchical Coding Structure [Z. Liu, X. Xu, S. Liu (Tencent), Y. Guo, Z. Chen (Wuhan Univ.)]

[JVET-X0102](https://jvet-experts.org/doc_end_user/current_document.php?id=11095) AHG11: Deep neural network for inter bi-prediction [Y.-J. Choi, Y.-W. Lee, B.-G. Kim (SWU), J. Kim, S. Y. Jeong (ETRI)]

[JVET-X0125](https://jvet-experts.org/doc_end_user/current_document.php?id=11118) AHG11: Autoencoder-based intra prediction with auxiliary feature [L. Xu, Y. Yu, H. Yu, K. Sato, Z. Dai, Z. Xie, D. Wang (OPPO)]

[JVET-X0126](https://jvet-experts.org/doc_end_user/current_document.php?id=11119) AHG11: Neural Network-based Adaptive Model Selection for CNN In-Loop Filtering [Z. Dai, Y. Yu, H. Yu, K. Sato, L. Xu, Z. Xie, D. Wang (OPPO)]

[JVET-X0130](https://jvet-experts.org/doc_end_user/current_document.php?id=11123) AHG11: Cross-component prediction based on a neural network model [Y. Y. Lee, T. M. Bae, D. Ruiz Coll, K. Goswami, A. Filippov, V. Rufitskiy (Ofinno)] [late]

### NN related HLS signalling (0)

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

## AHG12: Enhanced compression beyond VVC capability (52)

### General (0)

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

### EE2 contributions: Enhanced compression beyond VVC capability (13)

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

[JVET-X0045](https://jvet-experts.org/doc_end_user/current_document.php?id=11038) EE2-4.2, EE2-4.3: On CCALF filter [M. G. Sarwer, R.-L. Liao, J. Chen, Y. Ye, X. Li (Alibaba)]

[JVET-X0046](https://jvet-experts.org/doc_end_user/current_document.php?id=11039) EE2-4.6: Joint ALF and CCALF tests [M. G. Sarwer, R.-L. Liao, J. Chen, Y. Ye, X. Li (Alibaba), N. Hu, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-X0047](https://jvet-experts.org/doc_end_user/current_document.php?id=11040) EE2-4.7: Joint test on CCALF and chroma-bilateral filter [M. G. Sarwer, R.-L. Liao, J. Chen, Y. Ye, X. Li (Alibaba), W. Yin, K. Zhang, L. Zhang (Bytedance)]

[JVET-X0049](https://jvet-experts.org/doc_end_user/current_document.php?id=11042) EE2: Adaptive decoder side motion vector refinement (test 3.4) [H. Huang, Z. Zhang, V. Seregin, W.-J. Chien, C.-C. Chen, M. Karczewicz (Qualcomm)]

[JVET-X0067](https://jvet-experts.org/doc_end_user/current_document.php?id=11060) EE2-4.1: Bilateral Inloop Filter on Chroma [W. Yin, K. Zhang, L. Zhang (Bytedance)]

[JVET-X0068](https://jvet-experts.org/doc_end_user/current_document.php?id=11061) EE2-1.1~EE2-1.4: Tests on unsymmetric partitioning methods [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-X0069](https://jvet-experts.org/doc_end_user/current_document.php?id=11062) EE2-4.9: A combining test of EE2-4.1 and EE2-4.4/4.5 [W. Yin, K. Zhang, L. Zhang (Bytedance), N. Hu, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-X0070](https://jvet-experts.org/doc_end_user/current_document.php?id=11063) EE2: Alternative classifiers for ALF (tests 4.4 and 4.5) [N. Hu, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-X0071](https://jvet-experts.org/doc_end_user/current_document.php?id=11064) EE2-4.8: Joint tests of chroma BIF, ALF and CCALF [N. Hu, V. Seregin, M. Karczewicz (Qualcomm), M. G. Mohammed, R.-L. Liao, J. Chen, Y. Ye, X. Li (Alibaba), W. Yin, K. Zhang, L. Zhang (Bytedance)]

[JVET-X0077](https://jvet-experts.org/doc_end_user/current_document.php?id=11070) EE2-3.2: GPM with inter and intra prediction (JVET-W0110) [Y. Kidani, H. Kato, K. Kawamura (KDDI)]

[JVET-X0083](https://jvet-experts.org/doc_end_user/current_document.php?id=11076) EE2: Bilateral and template matching AMVP-merge mode (test 3.3) [Z. Zhang, H. Huang, C.-C. Chen, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-X0098](https://jvet-experts.org/doc_end_user/current_document.php?id=11091) EE2-3.1: Combination of CIIP and DIMD/TIMD [X. Li, R.-L. Liao, J. Chen, Y. Ye (Alibaba)]

[JVET-X0144](https://jvet-experts.org/doc_end_user/current_document.php?id=11137) EE2: Encoder partitioning optimization for ECM and crosscheck of EE2-1.1 [M. Coban, V. Seregin, M. Karczewicz (Qualcomm)]

### EE2 related contributions (15)

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

[JVET-X0056](https://jvet-experts.org/doc_end_user/current_document.php?id=11049) EE2-Related: Complexity reduction for decoder side motion derivation [H. Huang, V. Seregin, Z. Zhang, C.-C. Chen, M. Karczewicz (Qualcomm)]

[JVET-X0072](https://jvet-experts.org/doc_end_user/current_document.php?id=11065) EE2-related: PDPC-skip scheme for angular intra modes [J. Zhang, C. Zhou, Z. Lv (vivo)]

[JVET-X0078](https://jvet-experts.org/doc_end_user/current_document.php?id=11071) EE2-related: Modified GPM with inter and intra prediction [Y. Kidani, H. Kato, K. Kawamura (KDDI)]

[JVET-X0086](https://jvet-experts.org/doc_end_user/current_document.php?id=11079) EE2-related: Adaptive Filter Shape Selection for ALF [W. Yin, K. Zhang, L. Zhang (Bytedance), N. Hu, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-X0100](https://jvet-experts.org/doc_end_user/current_document.php?id=11093) EE2-related: On propagating intra prediction mode for IBC [L.-F. Chen, X. Li, L. Li, S. Liu (Tencent)]

[JVET-X0114](https://jvet-experts.org/doc_end_user/current_document.php?id=11107) EE2-related: Fix on issues of TIMD mode [C. Zhou, Z. Lv, J. Zhang (vivo)]

[JVET-X0155](https://jvet-experts.org/doc_end_user/current_document.php?id=11162) EE2-related: Crosscheck of JVET-X0114 (Fix on issues of TIMD mode) [K. Cao (Qualcomm)] [late] [miss]

[JVET-X0162](https://jvet-experts.org/doc_end_user/current_document.php?id=11169) Crosscheck of JVET-X0114 (EE2-related: Fix on issues of TIMD mode) [X. Li (Alibaba)] [late] [miss]

[JVET-X0115](https://jvet-experts.org/doc_end_user/current_document.php?id=11108) EE2-related: Optimization on the second mode derivation of DIMD blending mode [C. Zhou, Z. Lv, J. Zhang (vivo)]

[JVET-X0163](https://jvet-experts.org/doc_end_user/current_document.php?id=11170) Crosscheck of JVET-X0115 (EE2-related: Optimization on the second mode derivation of DIMD blending mode) [X. Li (Alibaba)] [late] [miss]

[JVET-X0121](https://jvet-experts.org/doc_end_user/current_document.php?id=11114) EE2-related: bug fixes for enabling RPR in ECM [P. Bordes, F. Galpin, F. Le Léannec, E. François (InterDigital)]

[JVET-X0132](https://jvet-experts.org/doc_end_user/current_document.php?id=11125) EE2-Related: On MVD sign prediction [Y. Zhang, B. Ray, H. Huang, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-X0133](https://jvet-experts.org/doc_end_user/current_document.php?id=11126) EE2-related: MV candidate type-based ARMC [Y.-J. Chang, H. Huang, V. Seregin, C.-C. Chen, M. Karczewicz (Qualcomm)]

[JVET-X0134](https://jvet-experts.org/doc_end_user/current_document.php?id=11127) EE2-related: On the number of TM merge candidates [Y.-J. Chang, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-X0170](https://jvet-experts.org/doc_end_user/current_document.php?id=11178) Crosscheck of JVET-X0134 (Non-EE2: On the number of TM merge candidates) [R.-L. Liao (Alibaba)] [late] [miss]

[JVET-X0141](https://jvet-experts.org/doc_end_user/current_document.php?id=11134) EE2-3.1-related: CIIP with template matching [Z. Deng, K. Zhang, L. Zhang (Bytedance), X. Li, R.-L. Liao, J. Chen, Y. Ye (Alibaba)]

[JVET-X0145](https://jvet-experts.org/doc_end_user/current_document.php?id=11138) EE2-related: Template matching CIIP on top of EE2-3.1 [Y.-J. Chang, V. Seregin, M. Karczewicz (Qualcomm)] [late]

[JVET-X0147](https://jvet-experts.org/doc_end_user/current_document.php?id=11140) EE2-related: intra mode derivation based on TIMD for GPM inter/intra [H. Jang, S. Kim, J. Lim (LGE), Y. Kidani, H. Kato, K. Kawamura (KDDI)] [late]

[JVET-X0166](https://jvet-experts.org/doc_end_user/current_document.php?id=11174) EE2-related: Combination of JVET-X0078 (Test 7/8), JVET-X0147 (Proposal-2), and GPM direct motion storage [Y. Kidani, H. Kato, K. Kawamura (KDDI), H. Jang, S. Kim, J. Lim (LGE), Z. Deng, K. Zhang, L. Zhang (Bytedance)] [late] [miss]

### ECM modifications beyond EE2 (24)

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

[JVET-X0058](https://jvet-experts.org/doc_end_user/current_document.php?id=11051) AHG12: Bilateral matching SMVD mode [D. Kim, H. Kwon, J. Kim, W. Lim, S. Y. Jeong (ETRI)]

[JVET-X0085](https://jvet-experts.org/doc_end_user/current_document.php?id=11078) Non-EE2: Template Matching-based Reordering for Extended MMVD Design [M. Salehifar, Y. He, K. Zhang, N. Zhang, L. Zhang (Bytedance)]

[JVET-X0087](https://jvet-experts.org/doc_end_user/current_document.php?id=11080) Non-EE2: Template Matching Based Merge Candidate List Construction (TM-MCLC) [L. Zhao, K. Zhang, N. Zhang, L. Zhang (Bytedance)]

[JVET-X0088](https://jvet-experts.org/doc_end_user/current_document.php?id=11081) Non-EE2: History-based Affine Model Inheritance [K. Zhang, L. Zhang, Z. Deng, N. Zhang, Y. Wang (Bytedance)]

[JVET-X0089](https://jvet-experts.org/doc_end_user/current_document.php?id=11082) Non-EE2: Modifications of IBC Merge/AMVP List Construction [N. Zhang, K. Zhang, L. Zhang, J. Xu (Bytedance)]

[JVET-X0090](https://jvet-experts.org/doc_end_user/current_document.php?id=11083) Non-EE2: On combination of CIIP, OBMC and LMCS [R.-L. Liao, X. Li, J. Chen, Y. Ye (Alibaba)]

[JVET-X0091](https://jvet-experts.org/doc_end_user/current_document.php?id=11084) Non-EE2: On TMVP improvement [R.-L. Liao, J. Chen, Y. Ye, X. Li (Alibaba)]

[JVET-X0099](https://jvet-experts.org/doc_end_user/current_document.php?id=11092) Non-EE2: Extension of TIMD to intra chroma coding [Y. Wang, K. Zhang, L. Zhang, H. Liu (Bytedance)]

[JVET-X0105](https://jvet-experts.org/doc_end_user/current_document.php?id=11098) AHG12: Edge Classifier for Cross-component Sample Adaptive Offset (CCSAO) [A. M. Kotra, N. Hu, V. Seregin, M. Karczewicz (Qualcomm)] [late]

[JVET-X0119](https://jvet-experts.org/doc_end_user/current_document.php?id=11112) Non-EE2: On pairwise merge candidate [G. Laroche, P. Onno, R. Bellessort (Canon)]

[JVET-X0153](https://jvet-experts.org/doc_end_user/current_document.php?id=11160) Crosscheck of JVET-X0119 (Non-EE2: On pairwise merge candidate) [N. Zhang (Bytedance)] [late] [miss]

[JVET-X0120](https://jvet-experts.org/doc_end_user/current_document.php?id=11113) AHG12: On sign prediction [M. G. Sarwer, Y. Yan, J. Chen, R.-L. Liao (Alibaba)]

[JVET-X0122](https://jvet-experts.org/doc_end_user/current_document.php?id=11115) Non-EE2: Unification of negative modes processing in TIMD [A. Filippov, V. Rufitskiy, K. Goswami, D. Ruiz Coll, Y. Y. Lee, T. M. Bae, E. Dinan (Ofinno)]

[JVET-X0165](https://jvet-experts.org/doc_end_user/current_document.php?id=11172) Crosscheck of JVET-X0122 (Non-EE2: Unification of negative modes processing in TIMD) [K. Kondo (Sony)] [late] [miss]

[JVET-X0124](https://jvet-experts.org/doc_end_user/current_document.php?id=11117) AHG12: On signalling of intra template matching [Z. Xie, Y. Yu, H. Yu, L. Xu, F. Wang, D. Wang (OPPO)]

[JVET-X0164](https://jvet-experts.org/doc_end_user/current_document.php?id=11171) Crosscheck of JVET-X0124 (AHG12: On signalling of intra template matching) [X. Li (Alibaba)] [late] [miss]

[JVET-X0131](https://jvet-experts.org/doc_end_user/current_document.php?id=11124) Non-EE2: Low-Complexity Improvements of Intra Coding for Screen Content [D. Ruiz Coll, T. M. Bae, A. Filippov, V. Rufitskiy, Y. Y. Lee, K. Goswami (Ofinno)] [late]

[JVET-X0135](https://jvet-experts.org/doc_end_user/current_document.php?id=11128) Non-EE2: Adaptive intra MTS [B. Ray, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-X0139](https://jvet-experts.org/doc_end_user/current_document.php?id=11132) AHG12: removing a discontinuity in the discrete angle comparison in DIMD [T. Dumas, P. Bordes, F. Galpin, F. Le Léannec (InterDigital)]

[JVET-X0142](https://jvet-experts.org/doc_end_user/current_document.php?id=11135) Non-EE2: Extended MRL candidate list [K. Cao, Y.-J. Chang, B. Ray, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-X0146](https://jvet-experts.org/doc_end_user/current_document.php?id=11139) Non-EE2: Decoder side motion derivation using sample's spatial correlation [H. Huang, V. Seregin, C.-C. Chen, M. Karczewicz (Qualcomm)]

[JVET-X0148](https://jvet-experts.org/doc_end_user/current_document.php?id=11141) AHG12: On the PDPC handling in DIMD and TIMD [H.-J. Jhu, X. Xiu, Y.-W. Chen, W. Chen, C.-W. Kuo, N. Yan, X. Wang (Kwai)] [late]

[JVET-X0160](https://jvet-experts.org/doc_end_user/current_document.php?id=11167) AHG12: Crosscheck of JVET-X0148 (On the PDPC handling in DIMD and TIMD) [K. Cao (Qualcomm)] [late] [miss]

[JVET-X0149](https://jvet-experts.org/doc_end_user/current_document.php?id=11142) AHG12: Removal of floating operations in DIMD and TIMD [X. Xiu, J.-H. Jhu, W. Chen, C.-W. Kuo, N. Yan, Y.-W. Chen, X. Wang (Kwai)] [late]

[JVET-X0150](https://jvet-experts.org/doc_end_user/current_document.php?id=11143) AHG12: Enhanced sign prediction [X. Xiu, Y.-W. Chen, N. Yan, C.-W. Kuo, H.-J. Jhu, W. Chen, X. Wang (Kwai)] [late]

[JVET-X0151](https://jvet-experts.org/doc_end_user/current_document.php?id=11144) AHG12: Non-adjacent spatial neighbors for affine merge mode [W. Chen, X. Xiu, Y.-W. Chen, H.-J. Jhu, C.-W. Kup, N. Yan, X. Wang (Kwai)] [late]

[JVET-X0152](https://jvet-experts.org/doc_end_user/current_document.php?id=11145) AHG12: CCSAO classification with edge information [C.-W. Kuo, X. Xiu, Y.-W. Chen, H.-J. Jhu, W. Chen, N. Yan, X. Wang (Kwai)] [late]

[JVET-X0168](https://jvet-experts.org/doc_end_user/current_document.php?id=11176) Crosscheck of JVET-X0152: AHG12: CCSAO classification with edge information [J. Chen, X. Li (Alibaba)] [late] [miss]

[JVET-X0156](https://jvet-experts.org/doc_end_user/current_document.php?id=11163) Non-EE2: Fix for histogram of gradients derivation in DIMD mode [K. Cao, V. Seregin, M. Karczewicz (Qualcomm)] [late]

# High-level syntax (HLS) proposals (6)

## AHG9: SEI message studies and proposals (4)

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

[JVET-X0092](https://jvet-experts.org/doc_end_user/current_document.php?id=11085) AHG9: Down-sample phase indication (SEI message) [J. Samuelsson, A. Tourapis, D. Podborski, K. Rapaka, D. Singer (Apple)]

[JVET-X0096](https://jvet-experts.org/doc_end_user/current_document.php?id=11089) AHG2/AHG9: On Multiview View Position (MVP) SEI message [B. Choi, A. Hinds, X. Zhang, S. Wenger, S. Liu (Tencent)]

Item 1 of this document belongs to this category.

[JVET-X0101](https://jvet-experts.org/doc_end_user/current_document.php?id=11094) AHG9: On the CREI SEI message [R. Skupin, C. Bartnik, A. Wieckowski, K. Sühring, Y. Sanchez, B. Bross, T. Schierl (HHI)] [late]

[JVET-X0112](https://jvet-experts.org/doc_end_user/current_document.php?id=11105) AHG9: On post-filter SEI [M. M. Hannuksela, E. B. Aksu, F. Cricri, H. R. Tavakoli, M. Santamaria (Nokia)]

## CE on Film Grain Synthesis (2)

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

[JVET-X0048](https://jvet-experts.org/doc_end_user/current_document.php?id=11041) CE: Film Grain Synthesis (test CE2.1 and CE2.2) [F. Pu, S. McCarthy, W. Husak, P. Yin, T. Lu, A. Arora, T. Chen (Dolby), V. G R, J. Shingala, K. Patankar, S. Kadaramandalgi, Ajayshyam (Ittiam)]

[JVET-X0169](https://jvet-experts.org/doc_end_user/current_document.php?id=11177) Crosscheck of JVET-X0048 (CE: Film Grain Synthesis (test CE2.1 and CE2.2)) [R.-L. Liao (Alibaba)] [late] [miss]

[JVET-X0103](https://jvet-experts.org/doc_end_user/current_document.php?id=11096) [CE] Evaluation of VVC DCT-2 transform for Film Grain Synthesis (test CE1.1) [M. Radosavljevic, E. François (InterDigital)]

[JVET-X0154](https://jvet-experts.org/doc_end_user/current_document.php?id=11161) Crosscheck of JVET-X0103 ([CE] Evaluation of VVC DCT-2 transform for Film Grain Synthesis (test CE1.1)) [F. Pu (Dolby)] [late] [miss]

## Non-SEI HLS aspects (0)

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

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

## JVET plenaries

Some of the discussions and actions at plenary sessions are noted in this section (especially those of Monday 12 July 0750–0920 and Wednesday 14 July 0820-0935).

Monday 12 July 0750–0920:

* BoG reporting
* Scheduling / further BoG sessions?
* Conformance V2 planning (BoG D. Rusanovskyy)
* Planning of output documents: Standard parts & DoCRs, CE & EE descriptions, verification test plan/report
	+ Prepare integrated version texts of VVC V2 and VSEI V2, issue resolutions to ballot DIS of 2nd edition rather than DAM texts.
	+ Add Gary Sullivan as editor, nominate editors for new edition (an action item for a meeting recommendation)
* Whether to hold a hybrid meeting in October 2021: An informal poll gave 5% who would consider travelling to participate physically, 90% who would participate remotely, and 5% who would not want to participate.

Wed. 14 Jul. 0820-0935:

* Report from NN BoG:
	+ Further work on summary analysis (Excel sheet attached to report)
	+ Updates on future contributions’ reporting requirements
	+ EE1 planning (JVET-W2023): proposals identified for next round
	+ More emphasis on cross-checking, training should be cross-checked as well
	+ No need to meet again; offline activities on preparing EE and CTC documents
	+ Recommendations of BoG (as per v3 of JVET-W0182, further editing cleanups in v4) were approved
	+ Plan liaison statement to JPEG on NN activities (E. Alshina and A. Segall were asked to prepare text for that)
* Report from BoG on VVC V2 conformance (JVET-W0188) discussed at 0850
	+ Identified 65 desired bitstreams
	+ Plan to issue draft 1 of VVC V2 conformance
	+ Clarification and agreements: 9 new profiles, new tools not enabled for Main 12, Main 12 Still Picture, Main 12 Intra
	+ Add chairs to AHG5
	+ Make a request for ISO amendment? (this did not seem necessary/appropriate yet)
* EE2 (JVET-W2024):
	+ It was agreed to also investigate the previous 1.5a in the next round, together with 1.5b
	+ EE document to be prepared offline (by previous coordinators)
* CE on high bit depth to be discontinued
* New CE on film grain: Investigate the method from JVET-W0095 versus the RDD-5, in terms of complexity and quality; also investigate the impact of the block sizes, and whether larger block sizes than 8x8 would be necessary (JVET-W2022); it is commented that it would be desirable having a precise description of the algorithms, as useful for a TR later.

## 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 11 Oct. 0500–0730, Wednesday 13 Oct. 0500–0630, and Friday 15 Oct. 2100–2300. The status of the work in the MPEG WGs was reviewed at these information sharing sessions.

## Joint meeting with Q6/16 (VCEG) and SC 29/WG 2 MPEG Requirements 0730–0845 Tuesday 13 July

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

* VVC V2 Profiles (Tuesday 0730-0845 UTC with JVET and MPEG Requirements on VVC v2 profiles)
	+ [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]
		- Monochrome profiles proposed
		- All-intra video profiles proposed (with loop filter support required)
		- 10, 12, and 16 b profiles proposed
		- Monochrome, 4:2:2, 4:4:4
		- Inter-predictive profiles proposed (unlike in HEVC)
		- Main 12 Still Picture, Main 12 4:4:4 Still Picture proposed (not in HEVC)
		- ~16 profiles were proposed in the contribution
		- Discussion:
			* Tiers and levels roughly per HEVC (OK for now – JVET-W0183?)
			* Do we need 4:2:2 profiles? (maybe not)
			* Do we need monochrome profiles? (maybe not)
			* Loop filter support requirement? (OK)
			* Palette mode and new coding tools proposed to be supported except in 10/12 b 4:2:0 & 10/12 b Mono profiles (OK)
				+ (Some tools are already conditioned on b > 10)
* Film grain (optional mandatory, additional profile(s), or as an alternative VVC-based example)
	+ JVET-W0095, proposed 8x8 blocks to be used for HD, 16x16 for 4K, and 32x32 for 8K
	+ The possible publication of a technical report on the subject was discussed
	+ Reference software can be provided
	+ The SMPTE relationship was discussed, as SMPTE had previously published the RDD 5 scheme.
	+ Discussion in VSEI vs VVC was discussed, as the proposed scheme uses VVC-based transforms.
	+ The scheme was described as not necessarily for pre-filtering removal with post-process restoration of grain, but rather as a potential method for subjective improvement of low bit rate coded video
	+ The current proposal is for inclusion in VSEI as an alternative example

## Joint meeting with MPEG WG3 0630–0700 Wednesday 14 July on Systems metadata

Topics of discussion:

* Proposal m57457 is to use a single code for any system metadata rather than multiple SEI messages as proposed in JVET-W0169. The MPEG Systems WG did not have a strong opinion on that.
* Should the specification of such an SEI message go in VSEI or in a video coding standard directly? Tentatively directly in the video coding standard.
* What should it reference? Should it reference multiple systems standards (initially two)? The tentative answer is yes.
* Should it be extensible? Yes.
* Timeline? VDI work might go to CD at this meeting, with green metadata following shortly after.
* It was agreed we are not planning to put such SEI message(s) into the VVC v2 DAM text; it should follow a bit later.

Conclusions:

* Codepoints for Green Metadata and VDI: Better to define separate ones in VVC, and refer the corresponding systems specs directly
* SC 29/WG 3 would have the primary responsibility on what is going inside such an SEI message
* JVET should start a VVC amendment in October or January to align with the progression in WG3 (expecting this could be final at DAM stage)

## Joint meeting of SC 29/AG 5 with WGs 4 (MPEG Video), 5 (JVET) and 7 (MPEG 3D Graphics Coding) 0720–0820 Wednesday 14 July

There was a presentation of JVET-W0185 (MPEG m57393) on remote testing coordination of proposals by J. Jung. See the summary of that document in section 4.4.

* Further work was expected to study and refine various aspects.
* It was commented that further information on the setup of testing sites and the level of training for test subjects should be further detailed.
* It was commented that information on suitable players for being used in the testing purposes would be very valuable. Initiatives from experts are solicited to contribute to the development of a suitable open source player to enable stable playout capabilities for these. It was commented that HDRtools provides means to pack raw video files and associated metadata into mp4 files which enlarges the number of players to handle this data.
* It was suggested to clarify the status of verifications tests in the standardization process in the guidelines document.
* The relationship with ITU subjective assessment Recommendations was discussed; nearly all aspects are well aligned – perhaps the forced-choice A-B comparison is less well established (5-grade comparison vs. 4-grade comparison)
* The scheme is currently not intended for formal subjective assessment, but rather for informal testing.
* It was asked how well verified it is that a remote viewing test can match the results of a lab test; this is a major question for study, e.g., in VQEG. However, since testing in labs is currently not feasible, such studies are not immediately planned.
* Also, expert viewing tests would not necessarily always match naïve subject viewing in any case.

There was also a presentation by M. Wien of draft verification test guidelines that had been submitted to MPEG as m57463.

* This document defines guidelines for MPEG verification tests to serve as a reference for ongoing and future verification test activities. It describes verification testing of standards which define visual media output. In order to assert the suitability of the standard for visual assessment by users, formal subjective evaluation of the visual media signal reconstructed or synthesized from the compressed bitstream is needed.
* MPEG verification tests has been since the beginning a fundamental step in the path to the release of a new standard. Nevertheless, the new organization of SC29 in Working Groups and Advisory Groups induces the need for a procedure defining the necessary communication and the exchange of test results between the relevant WGs and AG5. The document is supposed to reflect the common understanding of previous verification test activities in MPEG, and the transition of the best practice into the new organizational structure of MPEG.
* The description currently relies on the assumption of video sequences to be compressed and reconstructed. For visual media which is rendered (e.g. in case of 3D-video, or 3DoF, 3DoF+, and 6DoF), additional steps may be required and should be added in a revision of this document.
* There was discussion of types of encoder optimization, depending on what is intended to be tested and demonstrated.
	+ Having similar types of optimization vs independent optimization of each encoder separately
	+ Similarity of configurations - e.g., intra period and GOP structures – in some cases a different GOP structure is intended to be part of what is being tested, and in other cases it is not
* It was suggested that encoder implementations used in the verification test should include optimized rate allocation algorithm, potentially also rate control. It was commented that the level of optimization of encoder implementations of a new specification typically is lower than for a longer available, well-studied anchor scheme. At the same time, the test model implementations typically follow comparable encoder decision strategies, e.g. including fixed QP settings and rate-distortion based tool decisions. Further, these test model implementations and applicable configurations are typically well understood by the group such that a fair comparison is achievable. Nonetheless, additional implementations may be considered, such as the example of VVenC in the context of the VVC verification tests.
* It was further recommended to add a note to the reporting section on highlighting specific features or differences between the new scheme and the anchor in order to make readers of the public document aware of such aspects.
* A list was included of what prior verification tests have been conducted in recent years.

## BoGs (X)

The following break-out groups were established at this meeting to conduct discussion and develop recommendations on specific topics.

## Liaison communications

The JVET did not directly receive any liaison statements at its current meeting, although a liaison communication relevant to JVET work was conveyed at the parent level from ITU-T SG 16 to ISO/IEC JTC 1/SC 29 for review at the SC 29 meeting planned to be held during the week following the JVET meeting. One outgoing liaison letter was prepared by JVET, which was to ISO/IEC JTC 1/SC 29/WG 1 (JPEG) to inform them of the status of the JVET exploration experiment work on neural network based video coding, which has some relevance to recent JPEG work on its new JPEG AI image coding project. The outgoing liaison statement was issued as WG 5 output document N 78.

# Project planning

## Software timeline

ECM2 software (including all adoptions) was planned to be available 2 weeks after the meeting. F. Le Léannec and J. Chen were named as additional coordinators (in addition to V. Seregin and K. Zhang).

VTM14 software was planned to be available on 2021-08-09.

## Core experiment and exploration experiment planning

A CE on film grain synthesis was established, as recorded in output document JVET-W2022.

An EE on neural network-based video coding was established, as recorded in output document JVET-W2023.

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-W2024.

Initial versions of these documents were presented and approved in the plenary on Friday 16 July.

## 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).

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)* 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)* Produce and finalize draft text outputs of the meeting (JVET-W2005 and JVET-W2006).
* 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-W1004 errata output collection.
* Produce and finalize JVET-W2002 VVC Test Model 14 (VTM 14) 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, A. Browne, 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)* Coordinate development of test models (VTM, HM, SCM, SHM, HTM, MFC, MFCD, JM, JSVM, JMVM, 3DV-ATM, 360Lib, 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.
* Prepare drafts of merged CTC documents for HM and VTM, as applicable.
 | F. Bossen, X. Li, K. Sühring (co-chairs), Y. He, K. Sharman, V. Seregin, A. Tourapis (vice‑chairs) | N |
| **Test material and visual assessment (AHG4)**(jvet@lists.rwth-aachen.de)* Produce the verification test report JVET-W2020, and consider plans for additional 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) | N |
| **Conformance testing (AHG5)**(jvet@lists.rwth-aachen.de)* Study the JVET-U2008 draft conformance testing specification and investigate the need for extensions.
* Study the JVET-W2026 draft conformance testing for operation rage extensions and investigate the need for improvements.
* 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, D. Rusanovskyy, K. Sühring, X. Xu, T. Zhou (vice-chairs) | N |
| **ECM software development (AHG6)**(jvet@lists.rwth-aachen.de)* Coordinate development of the ECM software and associated configuration files.
* Produce documentation of software usage for distribution with the software.
* Prepare and deliver ECM-2.0 software version and the reference configuration encodings according to JVET-W2017 common test conditions.
* Investigate encoder speedup and other encoder software optimization.
* Coordinate with ECM algorithm description editors to identify any mismatches between software and text, make further updates and cleanups to the software as appropriate.
 | V. Seregin (chair), J. Chen, F. Le Léannec, K. Zhang (vice-chairs) | N |
| **Coding of HDR/WCG material (AHG7)**(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.
* Study the luma/chroma bit allocation in the HDR CTC, especially for HLG content.
* Contribute to activities in merging HDR related CTC documents, in ccordination with AHG3.
* 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)* 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.
* Study the JVET-U2018 testing conditions for high bit depth, high bit rate, and high frame rate coding, and suggest improvements as applicable.
* Contribute to the development of conformance testing for operation range extensions in coordination with AHG5.
* 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 and latency 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) | N |
| **SEI message studies (AHG9)**(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)* 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.
* Study optimized encoding for reference picture resampling and scalability modes in VTM.
* 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.
 | P. de Lagrange, R. Sjöberg and A. Tourapis (co-chairs) | N |
| **Neural network-based video coding (AHG11)**(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-W2023.
* 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.
* Study and collect information related to near-term and longer-term architectures for neural network-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-W2016 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) | N |
| **Enhanced compression beyond VVC capability (AHG12)**(jvet@lists.rwth-aachen.de)* Solicit and study non-neural-network video coding tools with enhanced compression capabilities beyond VVC.
* Discuss and propose refinements to the ECM2 algorithm description JVET-W2025.
* Study the performance and complexity tradeoff of these video coding tools.
* Coordinate with AHG6 on ECM software development.
* Refine test conditions in JVET-W2017, generate anchors, identify new test sequences to be added, especially high resolution ones in 8K, in coordination with AHG4.
* Analyse the results of exploration experiments described in JVET-W2024 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) | N |

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-W1000](https://jvet-experts.org/doc_end_user/current_document.php?id=11024) Meeting Report of the 23rd JVET Meeting [G. J. Sullivan, J.-R. Ohm] [WG 5 N 64] (2021-08-13)

Initial versions of the meeting notes (d0 … d8) 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)]

Remains valid – not updated: [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)]

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]

[JVET-W1004](https://jvet-experts.org/doc_end_user/current_document.php?id=11025) Errata report items for VVC, HEVC, AVC, Video CICP, and CP usage TR [C. Rosewarne, G. J. Sullivan, Y. Syed, Y.-K. Wang] (2021-09-30, near next meeting)

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]

This content was included in a new edition issued as a DIS of a new edition [WG 5 N 66](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/5/Text%20of%20ISO-IEC%20DIS%2014496-10%3A202X%20Advanced%20Video%20Coding%20(10th%20edition)) (due 2021-07-30). Twin text was already consented in ITU-T from the last meeting

Editors of the DIS will be J. Boyce, S. McCarthy, G. Sullivan, and Y.-K. Wang.

A DoCR ([WG 5 N 65](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/5/Disposition%20of%20comments%20on%20ISO-IEC%2014496-10%3A2020%20CDAM%201%20Additional%20SEI%20messages)) of the NB comments received in [m57147](https://dms.mpeg.expert/doc_end_user/current_document.php?id=79339&id_meeting=187) from the ISO/IEC JTC 1/SC 29 CDAM ballot was reviewed Thursday 15 July in session 22.

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: [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)

Remains valid – not updated: [JVET-T2001](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10540) Versatile Video Coding Draft 10 [B. Bross, J. Chen, S. Liu, Y.-K. Wang]

[JVET-W2002](https://jvet-experts.org/doc_end_user/current_document.php?id=11026) Algorithm description for Versatile Video Coding and Test Model 14 (VTM 14) [A. Browne, J. Chen, Y. Ye, S. Kim] [WG 5 N 71] (2021-09-30, near next meeting)

Changes to encoding algorithms, include the tools for 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]

[JVET-W2005](https://jvet-experts.org/doc_end_user/current_document.php?id=11027) VVC operation range extensions (Draft 4) [F. Bossen, B. Bross, T. Ikai, D. Rusanovskyy, G. J. Sullivan, Y.-K. Wang] (2021-07-30)

Was integrated into a DIS of a new edition issued as [WG 5 N 70](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/5/Text%20of%20ISO-IEC%20DIS%2023090-3%3A202X%20Versatile%20Video%20Coding%20(2nd%20edition)) (due 2021-07-30)

Editors are F. Bossen, B. Bross, T. Ikai, D. Rusanovskyy, G. Sullivan, Y.-K. Wang.

A DoCR ([WG 5 N 69](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/5/Disposition%20of%20comments%20on%20ISO-IEC%2023090-3%3A2021%20CDAM%201%20Operation%20range%20extensions)) of the NB comments received in [m57149](https://dms.mpeg.expert/doc_end_user/current_document.php?id=79341&id_meeting=187) from the ISO/IEC JTC 1/SC 29 CDAM ballot was reviewed Thursday 15 July in session 22.

[JVET-W2006](https://jvet-experts.org/doc_end_user/current_document.php?id=11028) Additional SEI messages for VSEI (Draft 4) [J. Boyce, G. J. Sullivan, Y.-K. Wang] (2021-07-30)

Was integrated into a DIS of a new edition issued as [WG 5 N 68](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/5/Text%20of%20ISO-IEC%20DIS%2023002-7%3A202X%20Versatile%20supplemental%20enhancement%20information%20messages%20for%20coded%20video%20bitstreams%20(2nd%20edition)) (due 2021-07-30)

Editors are J. Boyce, G. Sullivan, Y.-K. Wang.

A DoCR ([WG 5 N 67](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/5/Disposition%20of%20comments%20on%20ISO-IEC%2023002-7%3A2021%20CDAM%201%20Additional%20SEI%20messages)) of the NB comments received in [m57148](https://dms.mpeg.expert/doc_end_user/current_document.php?id=79340&id_meeting=187) from the ISO/IEC JTC 1/SC 29 CDAM ballot was reviewed Thursday 15 July in session 22.

Remains valid – not updated: [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]

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] (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] (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]

Remains valid – not updated: [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]

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-W2016](https://jvet-experts.org/doc_end_user/current_document.php?id=11029) Common Test Conditions and evaluation procedures for neural network-based video coding technology [S. Liu, A. Segall, E. Alshina, R.-L. Liao] (2021-07-30)

Updates to template, and clarifications

[JVET-W2017](https://jvet-experts.org/doc_end_user/current_document.php?id=11030) Common Test Conditions and evaluation procedures for enhanced compression tool testing [M. Karczewicz and Y. Ye] (2021-07-30)

This is to include clarifications and editorial refinements.

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]

[JVET-W2019](https://jvet-experts.org/doc_end_user/current_document.php?id=11031) White paper on Versatile Video Coding [B. Bross and G. Sullivan] [SC 29 AG 3 N 35] (2021-09-14)

[JVET-W2020](https://jvet-experts.org/doc_end_user/current_document.php?id=11032) VVC verification test report for high dynamic range video content [V. Baroncini, M. Wien] [WG 5 N 72] (2021-08-31)

It was pointed out that it might be useful to release an integrated report of SDR, HDR, and 360° test results in the future.

No output: JVET-W2021

Number retained for future purposes of planning possible additional verification testing.

[JVET-W2022](https://jvet-experts.org/doc_end_user/current_document.php?id=11021) Core Experiment on Film Grain Synthesis [S. McCarthy, M. Radosavljević, J. Shingala] [WG 5 N 74] (2021-07-30)

An initial draft was reviewed and approved. It is suggested to determine the runtime of the proposals relative to each other rather than taking VTM runtime as reference. VTM 13 is used, as there would be no difference in performance compared to VTM 14.

[JVET-W2023](https://jvet-experts.org/doc_end_user/current_document.php?id=11022) 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 75] (2021-07-30)

An initial draft of this document was reviewed and approved.

Three categories of experiments were planned: Enhancement filters (loop and post), super resolution, and intra prediction.

It was suggested to use negative values for bit rate saving in the diagrams.

[JVET-W2024](https://jvet-experts.org/doc_end_user/current_document.php?id=11020) 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 76] (2021-08-06)

An initial draft was reviewed and approved. It was suggested to also test UQT standalone additionally to its combination with ABT.

[JVET-W2025](https://jvet-experts.org/doc_end_user/current_document.php?id=11033) Algorithm description of Enhanced Compression Model 2 (ECM 2) [M. Coban, F. Le Léannec, J. Ström] [WG 5 N 73] (2021-08-31)

See notes under JVET-W0102.

[JVET-W2026](https://jvet-experts.org/doc_end_user/current_document.php?id=11023) Conformance testing for VVC operation range extensions (draft 1) [D. Rusanovskyy, J.-H. Jhu, I. Moccagatta, M. Sarwer, Y. Yu] (2021-08-31)

An initial version of this document was reviewed and approved.

# 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:

* Wed. 6 – Fri. 15 October 2021, 24th meeting under ISO/IEC JTC 1/‌SC 29 auspices as a virtual meeting
* During January 2022, 25th meeting under ITU-T SG16 auspices, location t.b.d.
* Fri. 22 – Fri. 29 April 2022, 26th meeting under ISO/IEC JTC 1/‌SC 29 auspices in Alpbach, AT
* 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 July 2023, 31st meeting under ITU-T SG16 auspices in Geneva, CH.

The agreed document deadline for the 24th JVET meeting was planned to be Wednesday 30 Sept. 2021. [Ed. (GJS): Mismatch: Either Wednesday 29 Sept. or Thursday 30 Sept.]

Giacomo Baroncini and Vittorio Baroncini were thanked for conducting, and Mathias Wien was thanked for coordinating the VVC verification test for HDR video. It is greatly appreciated that this testing was successfully completed ahead of time relative to the original plans, and despite requiring extraordinary efforts due the complications caused by the pandemic situation.

InterDigital was thanked for providing financial support for the VVC verification tests.

Mathias Wien was thanked for planning, organizing and conducting the remote expert viewing related to the exploration experiment on neural network-based video compression. It is emphasized that this effort was extremely helpful to better understand the benefits of this new technology in terms of subjective quality improvement.

The 23rd JVET meeting was closed at approximately 0028 hours UTC on Saturday 17 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 the participation records from the Zoom teleconferencing tool used for the meting sessions (approximately 1 people in total, not including those who attended only the joint sessions with other groups), were as follows:

1. XX YY (ZZZ)

# Annex C to JVET report:Recommendations of the 4th meeting ofISO/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**](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/4/Recommendations%20of%20the%204th%20WG%205%20meeting)