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| **Joint Video Experts Team (JVET)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29**  35th Meeting: Sapporo, JP, 12–19 July 2024 | Document: JVET-AI\_notes\_d1 |

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| *Title:* | **Meeting Report of the 35th Meeting of the Joint Video Experts Team (JVET), Sapporo, 12–19 July 2024** | | |
| *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 thirty-fifth meeting during 12–19 July 2024 at ACU Sapporo (for the first two days), and at the Sapporo Convention Center (for the remaining days), in Sapporo, Japan. The meeting was held as a hybrid meeting, where remote participation was provided on best-effort basis for experts who were unable to travel.

For ISO/IEC purposes, JVET is alternatively designated ISO/IEC JTC 1/‌SC 29/‌WG 5, and this was the sixteenth 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 2.16 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 0910 JST on Friday 12 July 2024. Meeting sessions were held on all days including the weekend days of Saturday and Sunday 13 and 14 July 2024, until the meeting was closed at approximately XXXX hours JST on Friday 19 July 2024. Approximately XXX people attended the JVET meeting (XXX in person and XXX remotely), and approximately XXX input documents (not counting crosschecks, reports, and summary documents), 16 AHG reports, 2 EE summary reports, X BoG reports, and X incoming liaison document(s) were discussed. The meeting took place in a collocated fashion with meetings of various SC29 Working Groups and Advisory 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. Further important goals were reviewing the results of the Exploration Experiment (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.

As a primary goal, the JVET meeting reviewed the work that had been performed in the interim period since the thirty-fourth JVET meeting in producing the following documents:

a) JVET documents

* [JVET-AH1003](https://jvet-experts.org/doc_end_user/current_document.php?id=12567) Coding-independent code points for video signal type identification (Draft 3), also used as basis for ISO/IEC FDIS 23091-2:202X (Ed. 3), issued as WG 5 N 288
* [JVET-AH1004](https://jvet-experts.org/doc_end_user/current_document.php?id=12567) Errata report items for VVC, VSEI, HEVC, AVC, and Video CICP
* [JVET-AH1005](https://jvet-experts.org/doc_end_user/current_document.php?id=12567) Technology under consideration for future editions of CICP, also issued as WG 5 N 289
* [JVET-AH1006](https://jvet-experts.org/doc_end_user/current_document.php?id=12567) HEVC with extensions and corrections (draft 3), also used as basis for ISO/IEC FDIS 23008-2:202x (Ed. 6), issued as WG 5 N 281
* [JVET-AH1008](https://jvet-experts.org/doc_end_user/current_document.php?id=12567) Conformance testing for HEVC multiview extended and monochrome profiles
* [JVET-AH1016](https://jvet-experts.org/doc_end_user/current_document.php?id=12567) AVC with extensions and corrections (draft 3), also used as basis for ISO/IEC FDIS 14496-10:202x (Ed. 11), issued as WG 5 N 276
* [JVET-AH2002](https://jvet-experts.org/doc_end_user/current_document.php?id=12563) Algorithm description for Versatile Video Coding and Test Model 22 (VTM 22), also issued as WG 5 N 284
* [JVET-AH2005](https://jvet-experts.org/doc_end_user/current_document.php?id=12563) Additions and corrections for VVC version 4 (Draft 8), also issued as WG 5 CDAM N 283
* [JVET-AH2006](https://jvet-experts.org/doc_end_user/current_document.php?id=12563) Additional SEI messages for VSEI version 4 (Draft 2), also issued as WG 5 CDAM N 278
* [JVET-AH2009](https://jvet-experts.org/doc_end_user/current_document.php?id=12563) Reference software for versatile video coding 2nd edition (Draft 1), also issued as WG 5 CD N 286
* [JVET-AH2019](https://jvet-experts.org/doc_end_user/current_document.php?id=12563) Description of algorithms and software in neural network-based video coding (NNVC) version 7, also issued as WG 5 N 292
* [JVET-AH2021](https://jvet-experts.org/doc_end_user/current_document.php?id=12563) Verification test plan for VVC multilayer coding (update 3)
* JVET-AH2022 Draft plan for subjective quality testing of the FGC SEI message (update 2)
* [JVET-AH2023](https://jvet-experts.org/doc_end_user/current_document.php?id=12560) Exploration experiment on neural network-based video coding (EE1), also issued as WG 5 N 291
* [JVET-AH2024](https://jvet-experts.org/doc_end_user/current_document.php?id=12562) Exploration experiment on enhanced compression beyond VVC capability (EE2), also issued as WG 5 N 293
* [JVET-AH2025](https://jvet-experts.org/doc_end_user/current_document.php?id=12580) Algorithm description of Enhanced Compression Model 12 (ECM 12), also issued as WG 5 N 294
* [JVET-AH2027](https://jvet-experts.org/doc_end_user/current_document.php?id=12582) Draft CTC for gaming applications
* [JVET-AH2029](https://jvet-experts.org/doc_end_user/current_document.php?id=12580) Visual quality comparison of ECM/VTM encoding, also issued as AG 5 N 118
* [JVET-AH2030](https://jvet-experts.org/doc_end_user/current_document.php?id=12584) Optimization of encoders and receiving systems for machine analysis of coded video content (draft 5), also issued as WG 5 CDTR N 290
* [JVET-AH2031](https://jvet-experts.org/doc_end_user/current_document.php?id=12584) Common test conditions for optimization of encoders and receiving systems for machine analysis of coded video content
* [JVET-AH2032](https://jvet-experts.org/doc_end_user/current_document.php?id=12584) Technologies under consideration for future extensions of VSEI (version 4), also issued as WG 5 N 279

b) documents produced as WG 5 or SG16 documents only, without a corresponding JVET output document or direct repetition of their content in this meeting report:

* WG 5 N 275 Disposition of comments received on ISO/IEC DIS 14496-10:202x
* WG 5 N 277 Request for ISO/IEC 23002-7:2023/Amd.1
* WG 5 N 280 Disposition of comments received on ISO/IEC 23008-2:2023 (5th ed.) DAM 1
* WG 5 N 282 Request for ISO/IEC 23090-3:2023/Amd.1
* WG 5 N 285 Request for ISO/IEC 23090-16:202x
* WG 5 N 287 Disposition of comments received on ISO/IEC DIS 23091-3:202X
* WG 5 N 295, included in SG16-TD237/WP3, Liaison statement to ISO/IEC JTC 1/SC 29/WG 1 (JPEG) on JPEG AI and explorations on video coding
* WG 5 N 296, included in SG16-TD237/WP3, Liaison statement to 3GPP SA 4 on feasibility study on film grain synthesis
* WG 5 N 297, included in SG16-TD237/WP3, Liaison statement to ITU-R WP 6B on use cases of VVC multilayer profiles for broadcasting applications
* WG 5 N 298, included in SG16-TD237/WP3, Liaison statement to ARIB, ATSC, DVB, SBTVD, and SCTE on film grain synthesis investigations
* WG 5 N 299 List of AHGs established at the 15th WG 5 meeting

c) draft revised ITU-T Recommendations forwarded by JVET and Q6/16 for ITU-T Consent:

* [TD276/Plen](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T22-SG16-240415-TD-PLEN-0276) ITU-T H.264 (V15) "*Advanced video coding for generic audiovisual services*" (Rev.)
* [TD278/Plen](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T22-SG16-240415-TD-PLEN-0278) ITU-T H.266.2 (V2) "*Reference software for ITU-T H.266 versatile video coding*" (Rev.)
* [TD279/Plen](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T22-SG16-240415-TD-PLEN-0279) ITU-T H.265 (V10) "*High efficiency video coding*" (Rev.)
* [TD283/Plen](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T22-SG16-240415-TD-PLEN-0283) ITU-T H.273 (V4) "*Coding-independent code points for video signal type identification*" (Rev.)

As main results, the JVET produced XX output documents from the current meeting (update):

* [JVET-AH1003](https://jvet-experts.org/doc_end_user/current_document.php?id=12567) Coding-independent code points for video signal type identification (Draft 3), also used as basis for ISO/IEC FDIS 23091-2:202X (Ed. 3), issued as WG 5 N 288
* [JVET-AH1004](https://jvet-experts.org/doc_end_user/current_document.php?id=12567) Errata report items for VVC, VSEI, HEVC, AVC, and Video CICP
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* [JVET-AH2002](https://jvet-experts.org/doc_end_user/current_document.php?id=12563) Algorithm description for Versatile Video Coding and Test Model 22 (VTM 22), also issued as WG 5 N 284
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* [JVET-AH2024](https://jvet-experts.org/doc_end_user/current_document.php?id=12562) Exploration experiment on enhanced compression beyond VVC capability (EE2), also issued as WG 5 N 293
* [JVET-AH2025](https://jvet-experts.org/doc_end_user/current_document.php?id=12580) Algorithm description of Enhanced Compression Model 12 (ECM 12), also issued as WG 5 N 294
* [JVET-AH2027](https://jvet-experts.org/doc_end_user/current_document.php?id=12582) Draft CTC for gaming applications
* [JVET-AH2029](https://jvet-experts.org/doc_end_user/current_document.php?id=12580) Visual quality comparison of ECM/VTM encoding, also issued as AG 5 N 118
* [JVET-AH2030](https://jvet-experts.org/doc_end_user/current_document.php?id=12584) Optimization of encoders and receiving systems for machine analysis of coded video content (draft 5), also issued as WG 5 CDTR N 290
* [JVET-AH2031](https://jvet-experts.org/doc_end_user/current_document.php?id=12584) Common test conditions for optimization of encoders and receiving systems for machine analysis of coded video content
* [JVET-AH2032](https://jvet-experts.org/doc_end_user/current_document.php?id=12584) Technologies under consideration for future extensions of VSEI (version 4), also issued as WG 5 N 279

The following documents were produced as WG 5 only, without a corresponding JVET output document or direct repetition of their content in this meeting report:

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* WG 5 N 277 Request for ISO/IEC 23002-7:2023/Amd.1
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* WG 5 N 282 Request for ISO/IEC 23090-3:2023/Amd.1
* WG 5 N 285 Request for ISO/IEC 23090-16:202x
* WG 5 N 287 Disposition of comments received on ISO/IEC DIS 23091-3:202X
* WG 5 N 295 Liaison statement to ISO/IEC JTC 1/SC 29/WG 1 (JPEG) on JPEG AI and explorations on video coding
* WG 5 N 296 Liaison statement to 3GPP SA 4 on feasibility study on film grain synthesis
* WG 5 N 297 Liaison statement to ITU-R WP 6B on use cases of VVC multilayer profiles for broadcasting applications
* WG 5 N 298 Liaison statement to ARIB, ATSC, DVB, SBTVD, and SCTE on film grain synthesis investigations
* WG 5 N 299 List of AHGs established at the 15th WG 5 meeting

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 Exploration Experiments (EE) were defined. The next eight JVET meetings were planned for 1 – 8 November 2024 under ISO/IEC JTC 1/‌SC 29 auspices, in Antalya, TR; during 13 – 22 January 2025 under ITU-T SG16 auspices in Geneva, CH; during 26 March – 4 April 2025 under ISO/IEC JTC 1/‌SC 29 auspices, to be conducted as teleconference meeting; during 26 June – 4 July 2025 under ISO/IEC JTC 1/‌SC 29 auspices in Daejeon, – KR; during 2 – 10 October 2025 under ITU-T SG 16 auspices in Geneva, CH; during 14 – 23 January 2026 under ISO/IEC JTC 1/‌SC 29 auspices, to be conducted as teleconference meeting; and during April 2026 under ISO/IEC JTC 1/‌SC 29 auspices, date and location t.b.d.; and during July 2026 under ISO/IEC JTC 1/‌SC 29 auspices, date and 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 sites <http://phenix.int-evry.fr/jvet/>, <http://phenix.int-evry.fr/jct/>, and <http://phenix.int-evry.fr/jct3v/> are still accessible, but were converted to read-only.

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

# Administrative topics

## Organization

The ITU-T/ISO/IEC Joint Video Experts Team (JVET) is a group of video coding experts from the ITU-T Study Group 16 Visual Coding Experts Group (VCEG) and 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 thirty-fifth meeting during 12–19 July 2024 at ACU Sapporo (for the first two days), and at the Sapporo Convention Center (for the remaining days), in Sapporo, Japan. The meeting was held as a hybrid meeting, where remote participation was provided on best-effort basis for experts who were unable to travel.

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, as well as associated conformance test sets, reference software, verification testing, and non-normative guidance information. 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 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
* Annex C contains the meeting recommendations of ISO/IEC JTC 1/‌SC 29/‌WG 5 for purposes of results reporting to ISO/IEC.

## Meeting logistics

Information regarding logistics arrangements for the meeting had been provided via the email reflector [jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de) and at <http://wftp3.itu.int/av-arch/jvet-site/2024_07_AI_Sapporo/>.

## Primary goals

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

a) JVET documents

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Further important goals were reviewing the results 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 planning 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/> was still accessible, but had been converted to read-only.

Document 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 follow the CEST timezone (local time in Geneva), except as otherwise noted.

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 on text 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.
* Other parenthetical comments may be used for describing the impact or motivation of a decision. Some decisions are recorded with the word “agreed” rather than “Decision:”, especially for work items under study, non-normative, editorial and planning matters.

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 Friday, 5 July 2024. Any documents uploaded after 1159 hours Paris/Geneva time on Saturday 6 July 2024 were considered “officially late”, with a grace period of 12 hours (to accommodate those living in different time zones of the world). The deadline does not apply to AHG reports and other such reports which can only be produced after the availability of other input documents.

All contribution documents with registration numbers higher than JVET-AI0226 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 meeting, or documents which were requested to be produced for the purpose of improving specification text, 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 has been 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 has been 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-AI0XXX (a proposal on …), uploaded 07-XX,
* … .

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

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

* JVET-AI0XXX (a document suggesting …), uploaded 07-XX,
* … .

All cross-verification reports at this meeting (except for JVET-AI0215) 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-AI0049, JVET-AI0055, JVET-AI0075, JVET-AI0091, JVET-AI0123, JVET-AI0222, JVET-AI0231, JVET-AI0239, JVET-AI0252, JVET-AI0276, JVET-AI0315, … .

The following cross-verification reports were still missing by the end of the meeting, but were uploaded later: JVET-AI0XXX, …; this sentence is kept for future use. The following reports had not become available yet three weeks after the end of the meeting: JVET-AI0XXX, … . These were marked as withdrawn by the JVET chair, assuming the registration had become obsolete.

“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 be counted as a late contribution if the update was after the document deadline). At the current meeting, this situation did apply to document JVET-AI0091, which was later withdrawn and replaced by JVET-AI0230 which still was empty of results and is flagged as late in the list above, based on the time of the first reasonable document upload.

Contributions that had significant problems with uploaded versions were not observed at this meeting. Some problems were observed with wrong filenames or wrong headers. E.g., several were using country code “JT” instead of “JP”.

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.

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.

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.). Any such 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 may have also 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-AH1000, the Coding-independent code points for video signal type identification (Draft 3) JVET-AH1003, the Errata report items for VVC, VSEI, HEVC, AVC, and Video CICP JVET-AH1004, the Technology under consideration for future editions of CICP JVET-AH1005, the HEVC with extensions and corrections (draft 3) JVET-AH1006, the Conformance testing for HEVC multiview extended and monochrome profiles JVET-AH1008, the AVC with extensions and corrections (draft 3) JVET-AH1016, the Algorithm description for Versatile Video Coding and Test Model 22 JVET-AH2002, the Additions and corrections for VVC version 4 (Draft 8) JVET-AH2005, the Additional SEI messages for VSEI version 4 (Draft 2) JVET-AH2006, the Reference software for versatile video coding 2nd edition (Draft 1) JVET-AH2009, the Description of algorithms and software in neural network-based video coding (NNVC) version 7 JVET-AH2019, the Verification test plan for VVC multilayer coding (update 3) JVET-AH2021, the Draft plan for subjective quality testing of the FGC SEI message (update 2) JVET-AH2022, the Description of the EE on Neural Network-based Video Coding JVET-AH2023, the Description of the EE on Enhanced Compression beyond VVC capability JVET-AH2024, the Algorithm description of Enhanced Compression Model 13 (ECM 13) JVET-AH2025, the Draft CTC for gaming applications JVET-AH2027, the Visual quality comparison of ECM/VTM encoding JVET-AH2029, the Optimization of encoders and receiving systems for machine analysis of coded video content (draft 5) [JVET-AH2030](https://jvet-experts.org/doc_end_user/current_document.php?id=12584), the Common test conditions for optimization of encoders and receiving systems for machine analysis of coded video content [JVET-AH2031](https://jvet-experts.org/doc_end_user/current_document.php?id=12584), and the Technologies under consideration for future extensions of VSEI (version 4) JVET-AH2032, had been completed and were approved. In a few cases, the corresponding WG 5 N-numbered documents had not yet been uploaded, and this was requested to be done as soon as possible. The software implementations of VTM version 23.3, ECM version 13.0, and NNVC version 9.0 and 9.1were also approved.

Only minor editorial issues were found in the meeting report JVET-AH1000; no need to produce an update was identified (see section 2.14 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 in Annexes B1 and B2 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 those participating remotely via 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. The online queue will be interleaved with the room queue, though it may not always be guaranteed that the sequence perfectly follows the sequence by which hand raising occurred.
* 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. The same applies for speakers in the room to let online participants know who is speaking.
* Use your full name and company/organization and country affiliation in your joining information, since the participation list of Zoom would also be used to compile the online part of attendance records.
* Turn on the chat window and watch for chair communication and side commentary there as well as by audio.
* Generally, do not use video for the teleconferencing calls in order to avoid overloading internet connections; enable only voice and screen sharing.
* Extensive use of screen sharing is encouraged, to enable participants to view the presented material and the meeting notes. At times, multiple sources of screen sharing may be enabled, so it may be necessary for participants to understand that this is happening and to understand how to select which shared screen they want to see.

## 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
* Roll call of participants
* Adoption of the agenda
* Code of conduct policy reminder
* IPR policy reminder and declarations
* Contribution document allocation
* Review of results of the previous meeting
* Review of target dates
* Reports of ad hoc group (AHG) activities
* 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 film grain synthesis technology
* Consideration of contributions on optimization of encoders and receiving systems for machine analysis of coded video content
* 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
* Consideration of future work items
* Coordination of visual quality testing
* Liaisons, coordination activities with other organizations
* Review of project editor and liaison assignments
* 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, future meeting planning, other planning issues
* Other business as appropriate for consideration
* Closing

The agenda was approved as suggested.

The times of meeting sessions followed the needs of the face-to-face meeting, with highest priority given to the aim of achieving the goals of the meeting. Typical meeting hours were expected to be 0830-1900 CEST with coffee breaks and lunch breaks as appropriate, however some early morning or late-night sessions were anticipated to be necessary. Sessions were announced in the online JVET calendar in advance as far as possible, but it was anticipated that some activities (such as breakout sessions) could be held at short notice.

## 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/PUB100011.html>.

<https://www.iec.ch/basecamp/iec-code-conduct-technical-work>

These include points relating to:

* Behave ethically
* Promote and enable all voices to be heard
* Engage constructively in ISO and IEC activities
* Respect others (in meetings, when writing, on social media)
* Declare actual and potential conflicts of interest and manage them appropriately
* Protect confidential information
* Protect ISO and IEC assets
* Avoid and prevent any form of bribery or corruption
* Uphold the consensus process
* When disputes arise, escalate, resolve and uphold agreed resolution• Avoid and prevent any form of bribery or corruption

## 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 of June/July 2009. Both ITU and ISO/IEC will be identified in the <OWNER> and <ORGANIZATION> tags in the header. This software header is also used in the process of designing the VTM and ECM software, and for evaluating proposals for technology to be potentially included in these designs. 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. The SADL and NNVC packages for neural network-based video coding use the same licensing terms.

Software packages that had been developed in prior work of the JVT, the JCT-VC and the JCT-3V 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/>. The site contains links for creating a user account for document uploading and for contacting an administrator – e.g., to update the email address associated with an account, and experts were reminded to keep this information up to date. It was noted that the previous websites <http://phenix.int-evry.fr/jvet/>, <http://phenix.int-evry.fr/jct/>, and <http://phenix.int-evry.fr/jct3v/> are still accessible, but had been converted to read-only. It was reminded to send a notice to the chairs in cases of changes to document titles, authors, etc.

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

It was emphasized that reflector subscriptions and email sent to the reflector must use real names when subscribing and sending messages and subscribers must respond to inquiries regarding the nature of their interest in the work. The current number of subscribers on the JVET email list was 1261 (as of 10 July 2024). All discussions (including those on AVC, HEVC, VVC, CICP, etc.) shall be conducted on the JVET reflector rather than any of the old reflectors (including JVT, JCT-VC, and JCT-3V) which 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).

It is further emphasized that the document JVET-AD1012 gives valuable hints about communication practices as well as other IT resources used in JVET, such as software, conformance, and test materials.

## 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
* **ATM**: AVC-based multiview and 3D test model
* **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
* **CCCM**: Cross-component convolutional model
* **CCP**: Cross-component prediction
* **CCSAO**:Cross-component SAO
* **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
* **CIPF**: CABAC initialization from the previous frame
* **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)
* **EIP**: Extrapolation based intra prediction
* **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
* **GLM**: Gradient linear model
* **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 conforms to the HEVC standard design (possibly with under-development extensions) – now also used especially in reference to the (non-normative) encoder algorithms (see WD and TM)
* **HMVP**: History based motion vector prediction
* **HOP**: High-complexity operating point for neural network-based filter.
* **HRD**: Hypothetical reference decoder
* **HTM**: HEVC-based multiview and 3D test model (developed by JCT-3V)
* **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
* **JCT-3V**: Joint collaborative team on 3D video (for AVC and HEVC)
* **JCT-VC**: Joint collaborative team on video coding (for HEVC)
* **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
* **JVET**: Joint video experts team (initially for VVC, later expanded)
* **JVT**: Joint video team (for AVC)
* **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”)
* **LOP**: Low-complexity operating point for neural network-based filter.
* **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
* **NNVC**: Neural network-based video coding (experimental software package)
* **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).
* **ONNX**: Open Neural Network Exchange – a format used to convert code from common neural network software packages into SADL code.
* **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.
* **SADL**: Small adhoc deep learning library
* **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
* **TM**: Template matching.
* **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).
* **VCM**: Video coding for machines.
* **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.

## Standards, TRs, supplements and technical papers approval and publication status (update)

* MPEG-2 | H.262 (coding specification is common text)
  + ITU-T H.262 V3 was approved in 2012-02; Amd.1 was approved in 2013-03 and was not published separately; it was instead incorporated directly into the V3 text and published 2013-09
  + ISO/IEC 13818-2:2013 V3 FDIS ballot closed 2012-05-08; FDAM 1 ballot closed 2013-04-12 and was not published separately; it was instead incorporated directly into the V3 text and published 2013-10
  + Conformance testing (not joint with ITU-T)
    - ISO/IEC 13818-4:2004 V2 FDIS closed 2004-08-22, published 2004-12-12; it specifies conformance testing for Part 1 (Systems), Part 2 (Video), Part 3 (Audio), and Part 7 (AAC)
    - ISO/IEC 13818-4:2004/Amd 3:2009 Level for 1080@50p/60p conformance testing
    - Cor 1:2007, Cor 2:2009, Cor 3:2012, Cor 4:2011 may also have video relevance
  + Reference software (not joint with ITU-T)
    - ISO/IEC TR 13818-5:2005 V2 FDIS closed 2005-07-24, published 2005-10; it specifies reference software for Part 1 (Systems), Part 2 (Video), Part 3 (Audio), Part 7 (AAC) and Part 11 (IPMP)
* AVC (twin text)
  + ITU-T H.264 V14 was Consented at 22nd meeting on 2021-04-30 (with annotated regions, shutter interval, and miscellaneous corrections), approved 2021-08-22, published 2021-10-13
  + ISO/IEC 14496-10:2020 (Ed. 9) FDIS ballot closed 2020-11-27, published 2020-12-15
  + ISO/IEC 14496-10:2022 (Ed. 10), had been forwarded from DIS directly for publication 2022-01-21 (with annotated regions, shutter interval, and miscellaneous corrections) with an editing period, submitted to ITTF in 2022-05 after consultation with ISO staff on format of graphics files, upgraded to “DIS approved for registration” in ISO Project system 2022-07-04, published 2022-11-07
  + Preliminary draft text for YCgCo-Re and YCgCo-Ro issued at 26th meeting, second draft including SMPTE ST 2128 issued at 28th meeting 2022-10, third draft issued at 29th meeting 2023-01, fourth draft issued at 30th meeting 2023-04, formal project requested and CD of 11th edition issued at 31st meeting 2023-07, DIS issued at 32nd meeting 2023-10, DAM ballot closed 2024-04-15, ready to proceed at the current meeting with
    - H.264 V15 Consent
    - ISO/IEC 14496-10 (Ed. 11) FDIS
  + Conformance testing (twin text)
    - ITU-T H.264.1 V6 Approved 2016-02-13, published 2016-06-17
    - Various amendments of ISO/IEC 14496-4:2004, including:
      * ISO/IEC 14496-4:2004/AMD 6:2005 Advanced Video Coding conformance
      * ISO/IEC 14496-4:2004/AMD 9:2006 AVC fidelity range extensions conformance
      * ISO/IEC 14496-4:2004/AMD 30:2009 Conformance testing for new profiles for professional applications
      * ISO/IEC 14496-4:2004/AMD 31:2009 Conformance testing for SVC profiles
      * ISO/IEC 14496-4:2004/AMD 38:2010 Conformance testing for Multiview Video Coding
      * ISO/IEC 14496-4:2004/AMD 41:2014 Conformance testing of MVC plus depth extension of AVC
      * ISO/IEC 14496-4:2004/AMD 42:2014 Conformance testing of Multi-Resolution Frame Compatible Stereo Coding extension of AVC
      * ISO/IEC 14496-4:2004/AMD 43:2015 3D-AVC conformance testing
      * ISO/IEC 14496-4:2004/AMD 45:2016 Conformance Testing for the Multi-resolution Frame Compatible Stereo Coding with Depth Maps Extension of AVC
  + Reference software (twin text)
    - ITU-T H.264.2 V7 Approved 2016-02-13, published 2016-05-30
    - Various amendments of ISO/IEC 14496-5:2001 have been published, including:
      * ISO/IEC 14496-5:2001/AMD 6:2005 Advanced Video Coding (AVC) and High Efficiency Advanced Audio Coding (HE AAC) reference software
      * ISO/IEC 14496-5:2001/AMD 8:2006 AVC fidelity range extensions reference software
      * ISO/IEC 14496-5:2001/AMD 15:2010 Reference software for Multiview Video Coding
      * ISO/IEC 14496-5:2001/AMD 18:2008 Reference software for new profiles for professional applications
      * ISO/IEC 14496-5:2001/AMD 19:2009 Reference software for Scalable Video Coding
      * ISO/IEC 14496-5:2001/AMD 33:2015 Reference software for MVC plus depth extension of AVC
      * ISO/IEC 14496-5:2001/AMD 34:2014 Reference software of the multi-resolution frame compatible stereo coding of AVC
      * ISO/IEC 14496-5:2001/AMD 35:2015 3D-AVC Reference software
      * ISO/IEC 14496-5:2001/AMD 39:2016 Reference software for the Multi-resolution Frame Compatible Stereo Coding with Depth Maps of AVC
      * ISO/IEC 14496-5:2001/AMD 42:2017 Reference software for the alternative depth information SEI message extension of AVC
* HEVC (twin text)
  + ITU-T H.265 V7 approved 2019-11-29, published 2020-01-10
  + ISO/IEC 23008-2:2020 (Ed. 4) FDIS ballot closed 2020-07-16, published 2020-08-27
  + ITU-T H.265 V8 Consented at the 22nd meeting (shutter interval information SEI message and miscellaneous corrections), published 2020-10-13
  + ISO/IEC 23008-2:2020/AMD 1:2021 (shutter interval information SEI message) published 2021-07-12
  + ISO/IEC 23008-2:2023 (Ed. 5) began as CDAM 2 High-range levels output of 25th meeting of January 2022, CDAM ballot closed 2022-04-15, conversion to 5th edition with miscellaneous corrections planned at 26th meeting of 2022-04, text submitted for DIS ballot 2022-07-10, DIS ballot closed 2023-01-10, FDIS issued 29th meeting of 2023-01, FDIS ballot opened 2023-08-06, closed 2023-10-02, published 2023-10-30
  + ITU-T H.265 V9 Consented at 31st meeting 2023-07, approved 2023-09-13, and pre-published 2023-09, published 2023-11-24.
  + Preliminary draft HEVC text for YCgCo-Re and YCgCo-Ro issued at 26th meeting 2022-04, second draft including SMPTE ST 2128 issued at 28th meeting 2022-10, third draft at 29th meeting 2023-01, fourth draft at 30th meeting 2023-04, formal work item requested and CDAM1 issued 31st meeting 2023-07, DAM issued with new profiles and SEI messages at 32nd meeting 2023-10, DAM ballot closed 2024-04-08, ready to proceed at the current meeting with
    - H.265 V10 Consent
    - ISO/IEC 23008-2 (Ed. 6) FDIS
  + Conformance testing (twin text)
    - ITU-T H.265.1 V3 approved 2018-10-14, published 2019-01-15
    - ISO/IEC 23008-8:2018 (Ed. 2) Conformance specification for HEVC, published 2018-08-06
    - ISO/IEC 23008-8:2018/AMD 1:2019 Conformance testing for HEVC screen content coding (SCC) extensions and non-intra high throughput profiles, published 2019-10-15
  + Reference software (twin text)
    - ITU-T H.265.2 V4 approved 2016-12-22, published 2017-04-10
    - ISO/IEC 23008-5:2017 (Ed. 2) Reference software for high efficiency video coding, published 2017-03-01
    - ISO/IEC 23008-5:2017/AMD 1:2017 Reference software for screen content coding extensions, published 2017-11-09
* VVC (twin text)
  + ITU-T H.266 V1 approved 2020-08-29, published 2020-11-10
  + ISO/IEC 23090-3:2021 (Ed. 1) published 2021-02-16
  + ITU-T H.266 V2 with operation range extensions, Consented 2022-01-28, Last Call began 2022-04-01, Approved 2022-04-29, pre-published 2022-06-06, published 2022-07-12
  + ISO/IEC 23090-3:2022 (Ed. 2) with operation range extensions, approval at WG level to proceed to FDIS 2022-01-21, FDIS ballot opened 2022-06-29, closed 2022-08-24, published 2022-09-25
  + ISO/IEC 23090-3:202x (Ed. 3), initated as (Ed. 2) / Amd.1 New level and systems-related supplemental enhancement information, CDAM 1 issued from 26th meeting, ballot closed 2022-07-14, DAM 1 issued from 27th meeting, ballot closed 2023-01-03, FDIS issued at WG level 2023-07, FDIS ballot opened 2024-05-11, to close 2024-06-26
  + ITU-T H.266 V3 Consented 2023-07, approved 2023-09-29 and pre-published 2023-09, published 2023-11-29
  + Conformance testing (twin text)
    - ITU-T H.266.1 V1 Consented 2022-01-28, Last Call began 2022-04-01, Approved 2022-04-29, pre-published 2022-05-17, published 2022-07-12
    - ISO/IEC 23090-15:2022 V1 approval at WG level to proceed to FDIS 2022-10-15, upgraded to “DIS approved for registration” in ISO Projects system 2021-10-24, upgraded to “FDIS registered for formal approval” 2022-07-11, FDIS ballot closed 2022-11-04, published 2022-11-24
    - ISO/IEC 23090-15:2022/Amd.1 Operation range extensions – DAM 1 issued from 25th meeting 2022-01-21, upgraded to “CD approved for registration as DIS” status in ISO Projects system 2022-05-31, upgraded to “DIS registered” 2022-06-22, DAM ballot closed 2022-11-15, consolidated into FDIS 2nd edition issued as an output of the 29th meeting in January 2023, ballot opened 2024-04-08, to close 2024-06-03.
    - ITU-T H.266.1 V2 Consented 2023-07, approved 2023-09-13 and pre-published 2023-09, published 2023-10-19
  + Reference software (twin text)
    - ITU-T H.266.2 V1 Consented 2022-01-28, Last Call began 2022-04-01, Approved 2022-04-29, pre-published 2022-05-17, published 2022-07-12
    - ISO/IEC 23090-16:2022 V1 approval at WG level to proceed to FDIS 2022-01-21, upgraded to “DIS approved for registration” status in ISO Projects system 2022-04-21, upgraded to “FDIS registered for formal approval” 2022-04-22, FDIS ballot initiated 2022-07-24, FDIS ballot closed 2022-09-19, published 2022-10-23
* VSEI (twin text)
  + ITU-T H.274 V1 approved 2020-08-29, published 2020-11-10
  + ISO/IEC 23002-7:2021 (Ed. 1) published 2021-01-28
  + ITU-T H.274 V2 Consented 2022-01-28, Last Call began 2022-04-01, Approved 2022-05-22 (after 1 Last Call comment and Additional Review), pre-published 2022-06-17, published 2022-07-25
  + ISO/IEC 23002-7:2022 (Ed. 2) approval at WG level to proceed to FDIS 2022-01-21, upgraded to “DIS approved for registration” status in ISO Projects system 2022-05-05 and “FDIS registered for formal approval” 2022-05-08, FDIS ballot closed 2022-09-27, published 2022-10-30
  + ISO/IEC 23002-7:202x (Ed. 3) began as (2nd Ed.) Amd.1 Request for new edition and CD for additional SEI messages issued at 27th meeting, ballot closed 2022-10-10, DAM registered 2022-11-13, DAM ballot closed 2022-04-06, FDIS 3rd edition issued 2023-07 (pending FDIS ballot)
  + ITU-T H.274 V3 Consent 2023-07, approved 2023-09-29, pre-published 2023-10-11, published 2024-03-12.
* CICP (twin text)
  + ISO/IEC 23091-2:2021 (Ed. 2) had been forwarded from DIS directly for publication in 2021-04 and published 2021-10-18
  + ITU-T H.273 V2 (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) Consented on 2021-04-30, Last Call closed during the 23rd meeting with approval on 2021-07-14, published 2021-09-24
  + ISO/IEC 23091-2:202x (Ed. 3) Request for new edition and CD for new edition (including YCgCo-Re and YCoCg-Ro) issued at 27th meeting, ballot closed 2022-10-10, DIS registered 2022-11-13, DIS ballot closed 2023-04-06, preliminary draft text for including SMPTE ST 2128 issued at 28th meeting, incorporated into preliminary FDIS at 30th meeting 2023-04, FDIS waiting for publication of SMPTE ST 2128.
  + ITU-T H.273 V3 Consent 2023-07, approved 2023-09, publication waiting for publication of SMPTE ST 2128.
* Conversion and coding practices for HDR/WCG Y′CbCr 4:2:0 video with PQ transfer characteristics (twin text)
  + H.Sup15 V1, approved 2017-01-27, published 2017-04-12
  + ISO/IEC TR 23008-14:2018 published 2018-08
* Signalling, backward compatibility and display adaptation for HDR/WCG video coding (twin text)
  + H.Sup18 V1, approved 2017-10-27, published 2018-01-18
  + ISO/IEC TR 23008-15:2018 published 2018-08
* Usage of video signal type code points (twin text)
  + H.Sup19 V3 approved 2021-04-30, published 2021-06-04
  + ISO/IEC TR 23091-4 (Ed. 3) published 2021-05-23
* Working practices using objective metrics for evaluation of video coding efficiency experiments (twin text)
  + HSTP-VID-WPOM V1 approved 2020-07-03, published 2020-11
  + ISO/IEC TR 23002-8 (Ed. 1) published 2021-05-20
* Film grain synthesis technologies for video applications (twin text)
  + ISO/IEC TR 23002-9 Request for subdivision and WD 1 issued at 25th meeting 2022-01-21, WD 2 issued at 27th meeting, WD 3 issued at 28th meeting, CDTR issued at 29th meeting 2023-01, consultation period ended 2023-07-09, DTR text was issued from the 31st meeting in July 2023, put on hold by ISO staff editors, DTR ballot opened 2024-03-05, to close 2024-04-30, no action planned for current meeting
* Optimization of encoders and receiving systems for machine analysis of coded video content (twin text)
  + ISO/IEC 23888-3 Request for subdivision issued from 33rd JVET meeting 2024-01, ITU-T provisional name H.Sup-FGST
* The following freely available standards are published here in ISO/IEC:  
  <https://standards.iso.org/ittf/PubliclyAvailableStandards/index.html> as of the time of the current meeting:
  + ISO/IEC 13818-4:2004 Conformance for MPEG-2
  + ISO/IEC 13818-4:2004/Amd 3:2009 Level for 1080@50p/60p conformance testing
  + ISO/IEC TR 13818-5:2005 Software simulation for MPEG-2
  + Various amendments of ISO/IEC 14496-4:2004 Conformance for AVC
  + Various amendments of ISO/IEC 14496-5:2001 Reference software for AVC
  + ISO/IEC 14496-10:2022 (Ed. 10) AVC
  + ISO/IEC 23002-7:2022 (Ed. 2) – VSEI
  + ISO/IEC 23090-3:2022 (Ed. 2) VVC
  + ISO/IEC 23090-15:2022 (Ed. 1) Conformance for VVC
  + ISO/IEC 23090-16:2022 (Ed. 1) Reference software for VVC
  + ISO/IEC 23091-2:2021 (Ed. 2) Video CICP
* The following standards that have been intended by JVET to be publicly available were not available at <https://standards.iso.org/ittf/PubliclyAvailableStandards/index.html> as of the time of the current meeting. (These should be checked for previously issued requests for free availability.)
  + ISO/IEC 23008-2:2023 (Ed. 5) HEVC
  + ISO/IEC 23008-5:2017 (Ed. 2) Reference software for HEVC, published 2017-03-01
  + ISO/IEC 23008-5:2017/AMD 1:2017 Reference software for HEVC screen content coding extensions, published 2017-11-09
  + ISO/IEC 23008-8:2018 (Ed. 2) Conformance specification for HEVC, published 2018-08, published 2018-08-06
  + ISO/IEC 23008-8:2018/AMD 1:2019 Conformance testing for HEVC screen content coding (SCC) extensions and non-intra high throughput profiles, published 2019-10-15
* It appears necessary to check if all older software and conformance packages are publicly available – it might be that it was never requested, e.g. for those that were produced by JCT-3V. This topic was left TBD until the next meeting – perhaps it would be best to compile a list of all relevant software and conformance parts of AVC, HEVC, MPEG-2 aka H.262, CICP, and request these in bulk.

## Draft standards progression status (update)

* AVC colour type indicators for YCgCo-Re, YCgCo-Ro, and SMPTE ST 2128 (IPT-PQ-C2) and the addition of support for the neural-network post-filter characteristics, neural-network activation, and phase indication SEI messages specified in Rec. ITU-T H.274 | ISO/IEC 23002-7 are in a DIS issued at 32nd meeting 2023-10, DAM ballot closed 2024-04-15, ready to proceed with H.264 V15 Consent and ISO/IEC (Ed. 11) FDIS at current meeting.
* HEVC 23008-2:202x (5th ed.) DAM1 New profiles, colour descriptors, and SEI messages, with colour type indicators for YCgCo-Re, YCgCo-Ro, and SMPTE ST 2128 (IPT-PQ-C2), the specification of a Multiview Main 10 profile, and the addition of support for the neural-network post-filter characteristics, neural-network activation, and phase indication SEI messages specified in Rec. ITU-T H.274 | ISO/IEC 23002-7 was issued at 32nd meeting 2023-10, DAM ballot closed 2024-04-08, ready to proceed at the current meeting with H.265 V10 Consent and ISO/IEC 23008-2 (Ed. 6) FDIS.
* VVC new level and systems-related supplemental enhancement information (from JVET-AA2005) – VVC DAM was issued from 27th meeting, ballot closed 2023-01-03, ballot comments in the Summary of Voting document [m61833](https://dms.mpeg.expert/doc_end_user/current_document.php?id=85618&id_meeting=193). This was converted into a preliminary FDIS of VVC 3rd edition ([WG 5 N 183](https://dms.mpeg.expert/doc_end_user/current_document.php?id=86365&id_meeting=193)) at the 29th meeting of January 2023, anticipating that some alignment would be necessary with the ongoing VSEI amendment. Another preliminary FDIS was issued (WG 5 N 202) from the April 2023 meeting. The FDIS was then issued (WG 5 N 228) from the 31st meeting in July 2023, FDIS ballot opened 2024-05-11, to close 2024-06-26. A new edition of H.266 was Consented in July 2023, approved 2023-09-29 and pre-published 2023-09, and published 2023-11-29.
* VVC Conformance testing for operation range extensions – (from JVET-Y2026) – the DAM ballot closed 2022-11-15 (ballot comments in the Summary of Voting document [m61832](https://dms.mpeg.expert/doc_end_user/current_document.php?id=85617&id_meeting=193)), and this was consolidated into an FDIS at the 29th meeting, ballot opened 2024-04-08, to close 2024-06-03. ITU-T H.266.1 was Consented in July 2023, approved 2023-09-13 and pre-published in 2023-09, and published 2023-10-19.
* VSEI additional SEI messages (from JVET-AB2006) – VSEI DAM (JVET draft 3) was issued from the 28th meeting and a DAM ballot was issued. The FDIS of a new edition of ISO/IEC 23002-7 was issued (WG 5 N 220) from the 31st meeting in July 2023 and also reached ITU-T Consent at that meeting. H.274 V3 was approved 2023-09-29, pre-published 2023-10-11, and published 2024-03-12. The FDIS ballot remained pending at the time of the current meeting.
* Film grain synthesis technology for video applications – JVET draft 4 and the ISO/IEC 23002-9 CDTR were issued at the 29th meeting (JVET-AC2020) (a request to start work on the TR had been made at the 25th meeting), and the CDTR consultation period ended 2023-07-09. A DTR text was issued from the 31st meeting in July 2023, put on hold by ISO staff editors, DTR ballot opened 2024-03-05, to close 2024-04-30, no action planned for current meeting. (It was noted that a second DTR could become necessary in case of comments). ITU-T approval would be anticipated to be delayed to January 2025 due to the delay on the ISO/IEC side.
* Video CICP new edition draft for YCgCo-Re and YCgCo-Ro (from JVET-Z1003), an ISO/IEC 23091-2 preliminary FDIS was issued from the 30th meeting and the Summary of Voting document was available as [m62572](https://dms.mpeg.expert/doc_end_user/current_document.php?id=86621&id_meeting=194) and a draft DoC had been issued as WG 5 [N 205](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/Draft%20disposition%20of%20comments%20received%20on%20ISO-IEC%20DIS%2023091-2%3A202X). There was a delay in the submittal of the FDIS due to dependency on the status of SMPTE ST 2128, which was tentatively included in the preliminary FDIS, based on an NB comment. The video CICP colour type indicator for SMPTE ST 2128 had been drafted and incorporated into the preliminary FDIS issued at the 30th meeting of April 2023. It had been reported that the specification was expected to become finalized in the SMPTE meeting in March 2023, but this had not yet happened, so the production of the FDIS was delayed. ITU-T Consent for H.273 v3 proceeded at the 31st meeting of July 2023 (to prevent undue delay since SG16 does not meet very frequently) and the text was approved in September 2023, but the text was on hold pending the publication of SMPTE ST 2128.
* Optimization of encoders and receiving systems for machine analysis of coded video content – ISO/IEC 23888-3 Request for subdivision issued from 33rd JVET meeting 2024-01, ITU-T provisional name H.Sup-FGST
* A request for free availability in ISO/IEC has to be made for each edition, amendment and corrigendum, and the request needs to be approved in the WG 5 Recommendations. A request form also needs to be filled out (but the form does not need to be issued as a WG 5 document). A freely available URL for the ITU publication should be provided for the following parts:
  + For the ongoing work items, when they become finalized
  + ISO/IEC 23008-2:2020/Amd.1:2021 – HEVC FDAM issued 20th meeting (October 2020), public availability not yet requested but may not be necessary as it becomes included in next edition

## Opening remarks

Remarks during the opening session of the meeting Friday 12 July at 0900 JST were as follows.

[JVET-AI0316](https://jvet-experts.org/doc_end_user/current_document.php?id=14575) Logistical Information for the JVET meeting at Sapporo, 2024 [JPNB of SC29]

This was presented in the beginning of the meeting.

* Timing and organization of the meeting and online access, calendar posting of session plans
  + The initial number of documents was similar as in last meeting (approximately 190 by the time of opening the meeting) – parallel sessions will be necessary.
  + Evening sessions may also be necessary, ACU open until 2100, SCC until 2200
  + Avoid overlap with JPEG-AI – try to review NNVC until Saturday
* Plans for subsequent F2F meetings (with online access) in Nov. 2024 (Antalya), Jan. 2025 (Geneva, likely to start on Jan. 13), June/July 2025 (Daejeon), and Oct. 2025 (Geneva, likely to start on Oct. 2)
* March/April 2025 and Jan. 2026 meetings will be virtual; offers exist for April 2026
* The meeting logistics, agenda, working practices, policies, and document allocation considerations were reviewed.
  + Access to the meeting was provided using Zoom. Recording of the meeting notes by the session chair will also permanently be shared via 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-AH1000 were reviewed. The following small issues in the meeting report were noted and were not considered sufficient to warrant issuing a revision. These are obviously left over from a previous report, and the correct information can be found in other places of the report:
  + Few editorial oversights, such as misalignmemts in doc number counts.
  + Some experts were listed in annex B1 as on-site attendees, though somebody pointed out they never attended a meeting session. This cannot be controlled as they registered online for JVET via the SG16 site, and also picked up the JVET badge.
* At the current meeting, on-site attendance will be recorded via the traditional sign-in sheet. Please correct your affiliation and email in case that you changed company. In the previous meeting, a few cases were found (mostly for the group of those mentioned in the previous bullet point) where the affiliation was outdated.
* There were some late non-cross-check documents, slightly more than in the last meeting.
* There were again a few documents registered where authors’ given names were not abbreviated, and/or company affiliation was missing in the authors’ list. Participants were reminded to stick to JVET’s conventions.
* Experts were asked not to pick a specific JVET number for regular documents – this function is reserved for AHG reports, summary reports, and output docs
* Experts were asked to always register JVET documents via the “jvet-experts.org” site, not via the MPEG dms site as WG 5 docs.
* Experts were asked to inform the chair when the title of a document is changed, or if authors are added. Otherwise, that might not be correct in the meeting notes.
* Old sites on “Phenix” (JCT-VC, -3V) are currently down due to numerous attacks.
* TRs can be made public according to new ISO rules -> versions with software attached might be beneficial, e.g. for the TR on machine analysis, or updated versions of FGS, HDR, etc.
* CDAMs VVC/VSEI and CD of VVC reference software could not be issued with ballot results returning before meeting, therefore documents were not delivered to allow discussing them. Various inputs on VVC/VSEI, new versions from this meeting could be issued.
* DAM/DIS could be in November, but cannot have ballot results in March/April meeting -> FDAM/FDIS can be in July 2025 at earliest.
* CDTR on machine analysis was also not submitted, otherwise referring to SEI in a non-existing CDAM.
* The primary goals of the meeting were:
  + New versions of VVC and VSEI (CDAMs)
  + New version of CDTR for machine analysis (depending on input review)
  + New version of VVC software (CD)? – needs to be clarified/revisit, as ITU version is already on its way (is it VTM 23.3? Are relevant changes expected relative to that?). Potentially another ITU version in January 2025.
  + New ed. HEVC software in January 2025 in ITU. This should also include the software for the new Multiview profiles (implemented in HTM, but not complete yet).
  + TR on film grain synthesis technology for video applications – see notes under AHG13.
  + Preparation of subjective tests for film grain, new content available – viewing sessions could start from Sunday
  + Informal viewing for multi-layer verification test – potentially some HDR cases from JVET-AI0059
  + Any action items on reference software JM?
  + Exploration Experiments
    - Neural network-based video coding
    - Enhanced compression beyond VVC
* Liaison communication:
  + Incoming liaison statement review and outgoing liaison statements to be generated
* Joint meetings were expected with MPEG AG 5 (on matters involving visual quality assessment, sec. 4.5 and 4.6) with MPEG WG 2 Requirements & ITU-T VCEG on future video standardization, and potentially with MPEG WG 4 Video, as well as JPEG.
* Principles of standards development were discussed.
* Scheduling of sessions was discussed – see under sections 2.6 and 2.12.

## Scheduling of discussions

The times of meeting sessions followed the needs of the face-to-face meeting, with highest priority given to the aim of achieving the goals of the meeting. Typical meeting hours were in the range of 0900-1900 JST with coffee breaks and lunch breaks as appropriate, however some early morning or late-night sessions might be necessary. Sessions were announced in the JVET calendar and the ITU posting system in advance as far as possible, although it was acknowledged that some activities (such as breakout sessions) might be held at short notice.

Particular scheduling notes are shown below, although not necessarily 100% accurate or complete. Times are recorded in the local timezone of the meeting venue, except as otherwise noted:

Coffee breaks 1030, 1630

* Fri. 12 July, 1st day
  + Morning session:
    - 0910–1010 Opening remarks, review of practices, agenda, IPR policy reminder
    - XXXX–1300 Reports of AHGs 1–14
  + Afternoon sessions:
    - 1430–1500 AHG15/AHG16 reports
    - 1500–2100 EE1 and EE2 summary reports
    - 1500–XXXX HLS (Jill Boyce)
* Sat. 13 July, 2nd day
  + Morning sessions:
    - 0900–1300 EE1/NNVC
    - 0900–1300 HLS (Jill Boyce)
  + Afternoon sessions:
    - 1430–XXXX EE2/ECM
    - 1430–XXXX HLS (Jill Boyce)
* …
* Mon. 15 July, 4th day
  + 0900-1200 MPEG WGs information sharing (outside of JVET)
  + XXX session:
    - XXXX–XXXX TBD
  + Joint meetings:
    - XXXX–XXXX TBD
    - 1635–1710 with WG 4 on VCM CTC
    - 1710–1810 with AG 5 on visual test planning multilayer (section 4.7), film grain (section 4.12) and other issues
* …
* Wed. 17 July, 6th day
  + 0900–1000 MPEG information sharing session (outside of JVET)
* …
* Fri. 19 July, 8th day
  + 0900–1300 Closing plenary:
    - Remaining revisit(s)/TBPs
    - Establishment of AHGs
    - Review and approval of output docs
    - Review of WG 5 meeting recommendations
    - Future planning, a.o.b.
  + 1400–XXXX MPEG information sharing session (out of JVET)
  + XXXX–XXXX Approval of WG 5 meeting recommendations, closing

## 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 summary reports, and may not be completely accurate; documents which are allocated to multiple sections are only counted in one of them):

* AHG reports (16) (section 3)
* Project development (section 4)
  + AHG1: Development, deployment and advertisement of standards (4) (2 for joint mtg. PB)
  + AHG2: Text development and errata reporting (2)
  + AHG3: Test conditions (0)
  + AHG3: Software development (0)
  + AHG4: Subjective quality testing and verification testing (3)
  + AHG4: Test and training material (1)
  + AHG4: Codec performance with alternative test material and non-CTC conditions (1)
  + AHG5: Conformance test development (0)
  + AHG7: ECM tool assessment (0)
  + AHG8: Optimization of encoders and receiving systems for machine analysis of coded video content (6)
  + AHG10: Encoding algorithm optimization (1)
  + AHG13: Film grain synthesis (0)
  + Implementation studies (0)
  + Profile/tier/level specification (1)
  + Gaming content compression (2)
  + Generative face video (3)
* Low-level tool technology proposals (section 4.16) with subtopics (number counts excluding BoG and summary reports)
  + AHG11/AHG14 and EE1: Neural network-based video coding (29) (section 5.1)
  + AHG6/AHG12 and EE2: Enhanced compression beyond VVC capability (90) (section 5.2)
* AHG9: High-level syntax (HLS) proposals (section 6) with subtopics
  + SEI messages in VSEIv4 (19) (section 6.1)
  + SEI messages in TuC doc (14) (section 6.2)
  + SEI processing order and PON (6) (section 6.3)
  + SEI messages on other topics (10) (section 6.4)
  + Non-SEI HLS aspects (0) (section 6.5)
* Joint meetings, plenary discussions, BoG reports (X) liaison (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 (16)

These reports were discussed during 1010–1300 and 1430–1500 on Friday 12 July 2024 (chaired by JRO).

[JVET-AI0001](https://jvet-experts.org/doc_end_user/current_document.php?id=14378) JVET AHG report: Project Management (AHG1) [J.-R. Ohm (chair), G. J. Sullivan (vice chair)]

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[JVET-AI0002](https://jvet-experts.org/doc_end_user/current_document.php?id=14379) JVET AHG report: Draft text and test model algorithm description editing (AHG2) [B. Bross, C. Rosewarne (co-chairs), F. Bossen, A. Browne, S. Kim, S. Liu, J.-R. Ohm, G. J. Sullivan, A. Tourapis, Y.-K. Wang, Y. Ye (vice chairs)]

2 Ad hoc group activity

2.1 Output documents produced

2.1.1 JVET-AH1003 Coding-independent code points for video signal type identification (Draft 3)

This document contains the draft text for the specification of additional colour type identifiers for CICP (Rec. ITU-T H.273 | ISO/IEC 23091-2). Text modifications are provided for specification of code point identifiers for a colour representation under development in SMPTE that is referred to as IPT-C2 and for a YCgCo-R colour representation with equal luma and chroma bit depths. The new code points for YCgCo-R are referred to as YCgCo-Re and YCgCo-Ro, where the number of bits added to a source RGB bit depth is 2 (i.e., even) and 1 (odd), respectively. Some corrections and clarifications of the basis text are also included. The most recently affected aspects are highlighted as revision-marked changes relative to the prepublished text of Rec. ITU-T H.273 v3.

Recent changes were included in response to JVET-AH0169 and JVET-AH0175. A corresponding text was submitted for ITU last call of ITU-T H.273 V4, and the changes were also used as the basis for ISO/IEC FDIS 23091-2:202X (Ed. 3), produced as WG 5 N 288.

2.1.2 JVET-AH1004 Errata report items for VVC, VSEI, HEVC, AVC, and Video CICP

This document contains a list of reported errata items for VVC, VSEI, HEVC, AVC, and Video CICP, for tracking purposes. Some of the items have been confirmed by the JVET and have been agreed to require fixing. This document also provides publication status backgrounds of these standards.

Incorporated items at the JVET-AH meeting:

• For VVC: Updated the publication status

• For VVC: Updated the publication status

• For HEVC: Removed errata items that have been integrated into JVET-AH1006 as well as into the ITU-T consent text and the ISO FDIS text.

• For AVC: Removed errata items that have been integrated into JVET-AH1016 as well as into the ITU-T consent text and the ISO FDIS text.

2.1.3 JVET-AH1006 HEVC with extensions and corrections (draft 3)

This document contains draft text changes for the High Efficiency Video Coding (HEVC) standard (Rec. ITU-T H.265 | ISO/IEC 23008-2), for six additional profiles (the Multiview Extended, Multiview Extended 10, Multiview Monochrome, Multiview Monochrome 10, Multiview Monochrome 12, and Multiview Monochrome 16 profiles), three additional colour type identifiers, three additional SEI messages for neural network post-filter characteristics (NNPFC), neural-network post-filter activation (NNPFA), and phase indication (through referencing to Rec. ITU-T H.274 | ISO/IEC 23002 7), and corrections to various minor defects in the prior content of the specification.

2.1.4 JVET-AH1016 AVC with extensions and corrections (draft 3)

This document contains draft text for changes of the Advanced Video Coding (AVC) standard (Rec. ITU-T H.264 | ISO/IEC 14496-10). This draft specifies additional SEI messages for neural-network post-filter characteristics, neural-network post-filter activation, and phase indication (through referencing to Rec. ITU-T H.274 | ISO/IEC 23002 7), additional colour type identifiers, and contains miscellaneous minor corrections and clarifications.

2.1.5 JVET-AH2005 Additions and corrections for VVC version 4 (Draft 8)

This document contains the draft text for changes to the Versatile Video Coding (VVC) standard (Rec. ITU-T H.266 | ISO/IEC 23090-3), to specify the SEI processing order (SPO) and processing order nesting (PON) SEI messages.

Changes that have been integrated:

1) (JVET-AH0121) Agreed to allow RWP as a process, and generalized cubemap and ERP as properties in SPO. A list of “property SEIs” should be generated.

2) (JVET-AH0121) Item 3: Agreed to remove “or alternative processes that can be applied” from the spec. text.

3) (JVET-AH0123) Decision: For now, we should specify that all processes and properties in a processing chain that follow an NNPF in an SPO chain are applied to all pictures produced by the NNPF.

4) (JVET-AH0132) Editor action item: The editors are asked to check if the existing text could provide further clarification in the identified situation.

5) (JVET-AH0159) Decision: Adopt Item 2 Option 2, with possible editorial improvement by the editors.

6) (JVET-AH0352) Decision: Adopt JVET-AH0352v2 (resolves item #1 from JVET-AH0159)

Changes to be integrated or checked:

7) Elements from JVET-AG1004 (errata), and bug fixes from JVET-AH0002 for tickets #1609 (NoBackwardPredFlag derivation ambiguity), #1617 (Not initialized NumCtusInSlice[ 0 ] to 0), #1624 (Incorrect indexing in computation of motion vector offset), #1628 (Derivation of ModeTypeCondition should say “one or more”), #1630 (Missing equations for applying AmvrShift), #1631 (Should “Motion vector storing process for geometric partitioning mode” store HpelIfIdx? BBross: HpekIfIdx should always be written since it might be accessed later so it is definitely missing in "Motion vector storing process for geometric partitioning mode".), #1632 (Incorrect indexing used for choosing matrix intra sample prediction), #1634 (Matrices QStateTransTable,levelScale,AlfFixFiltCoeff,AlfClassToFiltMap are incorrectly transposed).

8) (JVET-AH0121 item 5) fix the ChromaFormatIdc derivation for the use of the colour transform information SEI message as a part of a processing chain in a similar manner as done for the film grain characteristics SEI message in JVET-AG2027 (to carefully check and communicate offline for correctness, e.g., w.r.t. JVET-AH0047).

9) (JVET-AH0121 item 6) fix the interface variable derivation for the use of the NNPFC and NNPFA SEI messages as a part of a processing chain in a similar manner as done for the film grain characteristics SEI message in JVET-AG2027 (to carefully check and communicate offline for correctness, e.g., w.r.t. JVET-AH0047).

10) Referencing to messages in VSEI: JVET-AH0343 Text description SEI.

11) A sentence should be added that a decoder should operate at most one processing chain at one time. Check sentence saying processing chains “can be complementary, i.e., such that more than one processing chain is chosen and applied separately, with each processing chain generating one output”.

12) (JVET-AH0350) Breadth-first: All the pictures (in the entire bitstream, for ease of text specification writing purposes) are processed by a processing stage before moving on to the next processing stage. Depth-first: A picture is processed by all the processing stages, before moving on the next picture in output order. It was suggested, and agreed, to document both approaches as TuC text specification to determine whether depth-first has some advantage.

2.1.6 JVET-AH2006 Additional SEI messages for VSEI version 4 (Draft 2)

This document contains the draft text for changes to the versatile supplemental enhancement information messages for coded video bitstreams (VSEI) standard (Rec. ITU-T H.274 | ISO/IEC 23002-7), to specify additional SEI messages, including encoder optimization information, source picture timing information , object mask information, modality information, and text description information SEI messages and updates to the neural-network post-filter characteristics SEI message.

3 Changes yet to be integrated:

4 Changes that have been integrated:

In this document, relative to JVET-AG2034:

Changes incorporate JVET-AH0108, JVET-AH0111, JVET-AH0174, JVET-AH0175, JVET-AH0343, JVET-AH0346

• Encoder optimization information SEI modifications (JVET-AH0108, JVET-AH0111)

• Text description SEI (JVET-AH0343)

• Object mask information SEI modifications (JVET-AH0346)

• NNPFC SEI message modifications (JVET-AH0174)

• Film grain characteristics SEI message constraints (JVET-AH0175 item 1)

5 Related input contributions

None of the input contributions were noted as relevant to the work of this ad hoc group:

6 Remaining VVC bug tickets

Closed since JVET-AH0002 was reported:

• #1594 Mismatch between VVC spec and VTM for sample generation in CCLM process

• #1607 Wrong sign (+ instead of -) in Fig 16 Flowchart for decoding a decision in the ITU text

Carried over:

• #1609 NoBackwardPredFlag derivation ambiguity

• #1617 Not initialized NumCtusInSlice[0] to 0.

• #1618 [Multilayer Profiles] Potential Mismatch of VTM22.0 & Specification Related To Derivation Process For Merge Motion Vector Difference

• #1624 Incorrect indexing in computation of motion vector offset

• #1628 Derivation of ModeTypeCondition should say "one or more"

• #1629 mtt\_split\_cu\_vertical\_flag context uses undefined variable chType

• #1630 Missing equations for applying AmvrShift

• #1631 Should "Motion vector storing process for geometric partitioning mode" store HpelIfIdx?

• #1632 Incorrect indexing used for choosing matrix intra sample prediction

• #1634 Matrices QStateTransTable,levelScale,AlfFixFiltCoeff,AlfClassToFiltMap are incorrectly transposed

• #1635 Incorrect inference for tu\_y\_coded\_flag

New (since JVET-AH0002 was reported):

• #1637 The wording of H.266 B.3 seems to require byte streams to start with at least three zeros

7 Remaining HEVC bug tickets

Carried over:

• #1427 (8-155) and (8-157) do not seem to be used

• #1491 Duplicate invocation of 9.3.4.3 arithmetic decoding process

• #1498 Typos in the Table 9-43

• #1500 Typo in equation (8-69),(8-70)

• #1504 Small typos in profile\_tier\_level syntax in tabular form (7.3.3)

• #1505 Misleading bitstream requirement related to EOB NAL unit

• #1507 Duplicate row entries for CU QP delta syntax elements in Table 9-48

• #1520 Some smaller errors in the multiview spec

New (since JVET-AH0002 was reported):

• #1522 Offset issue in clause 8.5.4.3

8 Recommendations

The AHG recommends to:

• Approve JVET-AH1003, JVET-AH1004, JVET-AH1006, JVET-AH1016, JVET-AH2005 and JVET-AH2006 documents as JVET outputs,

• Compare the VVC documents with the VVC software and resolve any discrepancies that may exist, in collaboration with the software AHG,

• Encourage the use of the issue tracker to report issues with the text of both the VVC specification text and the algorithm and encoder description,

• Continue to improve the editorial consistency of VVC text specification and Test Model documents,

• Ensure that, when considering changes to VVC, properly drafted text for addition to the VVC Test Model and/or the VVC specification text is made available in a timely manner,

• Review bug tickets, and other AHG2 related inputs and act on them if found to be necessary.

[JVET-AI0003](https://jvet-experts.org/doc_end_user/current_document.php?id=14380) JVET AHG report: Test model software development (AHG3) [F. Bossen, X. Li, K. Sühring (co-chairs), E. François, Y. He, K. Sharman, V. Seregin, A. Tourapis (vice chairs)]

The software model versions prior to the start of the meeting were:

• VTM 23.3 (Apr. 2024)

• HM-18.0 (Apr. 2023)

• HM-16.21+SCM-8.8 (Mar. 2020)

• SHM 12.4 (Jan. 2018)

• HTM 16.3 (Jul. 2018)

• JM 19.1 (Apr. 2023)

• JSVM 9.19.15

• JMVC 8.5

• 3DV ATM 15.0 (no version history)

• HDRTools 0.24 (March 2023)

Software for MFC and MFCD is only available as published by ITU-T and ISO/IEC. It is planned to create repositories with the latest versions available in ITU-T H.264.2 (02/2016). All development history is lost.

2 Software development

Development was continued on the GitLab server, which allows participants to register accounts and use a distributed development workflow based on git.

The server is located at:

https://vcgit.hhi.fraunhofer.de

The registration and development workflow are documented at:

https://vcgit.hhi.fraunhofer.de/jvet/VVCSoftware\_VTM/wikis/VVC-Software-Development-Workflow

Although the development process is described in the context of the VTM software, it can be applied to all other software projects hosted on the GitLab server as well.

Between the 31st and 32nd meetings, the GitLab server was affected by a huge number of spam issues, which were generated using newly registered accounts. Administrator user account confirmation was enabled to protect the server from spam postings. Proponents should plan for some time for server admins to confirm new accounts.

3 VTM related activities

The VTM software can be found at

https://vcgit.hhi.fraunhofer.de/jvet/VVCSoftware\_VTM/

The software development continued on the GitLab server. VTM versions 23.2 was tagged on Apr. 20, 2024, VTM version 23.3 was tagged an Apr. 22, 2024 and VTM 23.4 is expected during the 35th JVET meeting.

VTM 23.2 was tagged on Apr. 20, 2024. Changes include:

• Modified ALF error function

• Removed obsolete isSDR config parameter causing HBD and HDR CTCs to fail

• Clean up Scalable Nesting SEI

• Fix encoder when MMVD=1 and MaxNumMergeCand=1

• JVET-AG0089: Temporal extrapolation purpose for the neural-network post-filter...

• Clean up Window data structure and Picture::isRefScaled and their use

• fix missing xCalDebCost in function xCheckRDCostInterAmvr

• Clean up SLI SEI message

VTM 23.3 was tagged on Apr. 22, 2024. Changes include:

• Remove macros from JVET-AF and JVET-AG contributions

• Fix build when GREEN\_METADATA\_SEI\_ENABLED is enabled

VTM 23.4 is expected to be tagged during the 35th JVET meeting. Changes are expected to include:

• Fix SEI payload types

• Fix picUnitRepConSeiList to match spec

• Remove tone mapping SEI from software manual

• Fix #1641: make conversion to 64-bit explicit

• Fix #1640: fix SEIReader::getSEIDecodingUnitInfoDuiIdx

• Fix #1642: use 64-bit arithmetic in SIMD ALF classifier

• Fix for remining bins and rice parameter handling at EOS in DQ

• JVET-AF2032: NNPFC-AIS Conditionally signal application tag URI presence

• JVET-AH2006: Encoder Optimization Information SEI message

• JVET-AG2034: SPTI SEI Message

• Make model parameters signed for use by AR mode in FGC SEIs

• JVET-AH0078: AhG10: Distortion Propagation Factor for VVC Low-Delay Configuration

3.1 CTC Performance

VTM 23.2 shows only minor changes in coding performance compared to VTM 23.1 in SDR CTC. Partial results of the code that is expected to be tagged as VTM 23.4 also shows only minor changes compared to VTM-23.2 in SDR CTC.

For the HDR CTCs, there are minor differences in coding performance or run time between VTM 23.0 and VTM 23.3.

For the high bit depth CTCs, there is no change in coding performance or run time between VTM 23.1 and VTM 23.3 for the low QP tests. For the standard QP range tests, there are minor differences for the random-access configuration.

3.2 Issues in VTM affecting conformance

The following issues in VTM master branch may affect conformance:

• A syntax parsing issue was found in Picture Timing SEI (MR#2722). Checking of conformance streams is still pending.

• Missing HLS features (see sections below)

3.3 Status of implementation of proposals of previous JVET meetings

The following list contains all adoptions of the Q and R meetings that were not marked as merged (or submitted) or specification only change in the software coordinator tracking sheet:

• JVET-Q0112

• JVET-Q0154: Disallow mixing of GDR and IRAP (Disallow mixing of GDR with any non-GDR).

• JVET-Q0164

• JVET-Q0402

• JVET-R0178: Require that when no\_aps\_constraint\_flag is equal to 1, sps\_lmcs\_enabled\_flag and sps\_scaling\_list\_enabled\_flag shall be equal to 0

• JVET-R0221

• JVET-R0046: Change the description of the bitstream extraction process per the value of max\_tid\_il\_ref\_pics\_plus1[ ][ ] (aspect 1.2 per JVET-R0046-v4).

• JVET-R0065: Specify that GDR AUs shall be complete – i.e., all of the layers in the CVS shall have a picture in the AU (as with IRAP AUs).

• JVET-R0191: Update the range value for num\_ols\_hrd\_params\_minus1.

• JVET-R0222 aspect 1: Infer vps\_max\_sublayers\_minus1 to be equal to 6 when sps\_video\_parameter\_set\_id is equal to 0 (i.e. VPS is not present). The exact editorial expression is at the discretion of the editor.

• JVET-S0196 (JVET-S0144 item 17)

• JVET-S0227 (JVET-S0144 item 22)

• JVET-S0077 (JVET-S0139 item 5)

• JVET-S0174 aspect 2 (JVET-S0139 item 18.b)

• JVET-S0156 aspect 3 (JVET-S0139 item 21)

• JVET-S0139 item 26 (no source listed, text only?)

• JVET-S0188 aspect 1 (JVET-S0139 item 28)

• JVET-S0139 item 40 (item does not exist)

• JVET-S0042 (JVET-S0142 item 1.b)

• JVET-S0174 aspect 1 (JVET S0143 item 19)

• JVET-S0096 aspect 3 (JVET-S0140 item 10)

• JVET-S0096 aspect 4 (JVET-S0140 item 13)

• JVET-S0159 aspect 3 (JVET-S0140 item 16)

• JVET-S0171 (JVET-S0256)

• JVET-S0118 (JVET-S0141 item 7)

• JVET-S0102 (JVET-S0141 item 9.a)

• JVET-S0157 item 2 (JVET-S0141 item 13)

• JVET-S0157 item 4 (JVET-S0141 item 14)

• JVET-S0175 aspect 3 (JVET-S0141 item 16)

• JVET-S0175 aspect 1, 2 (JVET-S0141 item 17)

• JVET-S0175 aspects 4 and 5 (JVET-S0141 item 18)

• JVET-S0175 aspect 6 (JVET-S0141 item 19)

• JVET-S0198/ JVET-S0223 (JVET-S0141 item 24)

• JVET-S0173 aspect 2 (JVET-S0141 item 40.b)

• JVET-S0173 item 1 (JVET-S0141 item 51)

• JVET-S0173 item 3 (JVET-S0141 item 52)

• JVET-S0173 item 5 (JVET-S0141 item 53)

• JVET-S0173 item 6 (JVET-S0141 item 54)

• JVET-S0173 item 4 (JVET-S0141 item 56)

• JVET-S0176 item 4 (JVET-S0141 item 60)

• JVET-S0154 aspect 5 (JVET-S0141 item 68)

• JVET-S0154 aspect 6 (JVET-S0141 item 69)

• JVET-S0154 aspect 8 (JVET-S0141 item 71)

• JVET-S0095 aspect 5 (JVET-S0145 item 5)

• JVET-S0095 aspect 6 (JVET-S0145 item 6)

• JVET-S0100 aspect 1, depends on JVET-R0193 (JVET-S0147 item 2)

• FINB ballot comments

• Make high tier support up to 960.

3.4 SEI TuC software

Per the decision during the 32nd JVET meeting, an SEI TuC repository was created based on VTM-22.2. The repository is located at:

https://vcgit.hhi.fraunhofer.de/jvet-tuc/VVCSoftware\_VTM

VTM-22.2-TuC-1.0 was expected to be tagged during the 33rd JVET meeting. It was tagged during the 34th JVET meeting. Changes include:

• JVET-AF0088: object mask info SEI

• JVET-AF0167: MPII SEI message

• Remove unused variable in JVET\_AF0088\_OMI\_SEI

• Update CI pipeline configuration to build jvet-tuc branch and merge requests

• Add macOS on ARM build to CI pipeline

VTM-22.2-TuC-2.0 was expected to be tagged during the 34th JVET meeting. Merge requests were submitted for:

• JVET-AF0107-TuC: Implementation of Encoder Optimization Info SEI message

• JVET-AG0045

• JVET-AG0044

• JVET-AF0141

JVET-AF0107 could not be merged due to conflicts. The MR was later closed, since EOI SEI was moved to VTM. VTM-22.2-TuC-2.0 can be tagged now before moving on with TuC-3 implementations.

VTM-22.2-TuC-3.0 is expected to be tagged during the 35th JVET meeting. Merge requests were submitted for:

• JVET-AH0346 OMI SEI updates

• JVET-AH0239 GFV SEI messages

• JVET-AH0161: packed regions Info SEI

4 HM related activities

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

The following MRs are pending [with status indicated]:

• Implement phase indication SEI message (JVET-AE0101) [waiting review]

• Port the Y4M support [one issue remains]

• Mark the current picture as short-term ref (for SCM) [need SCC expert reviewer]

The HM SCC (SCM) branch (HM-16.21+SCM-8.8) has not been updated for the recent HM versions. Updating SCM to, for example, HM-18.0+SCM-8.8 should be considered. It may though be helpful to move SCC related functionality into separate source files. Volunteer work towards merging the branches would be appreciated.

As reported in the previous reports, further information on lambda optimisation in HM would be appreciated, including comparison of allocation of bits within the GOP structures between HM and VTM.

Otherwise the HEVC bug tracker lists:

• 43 tickets for “HM”, most of which are more than 5 years,

• 1 ticket for “HM RExt”,

• 9 tickets for “HM SCC”, most of which are at least 3 years old,

• 1 ticket for “RExt Text” (8 years old)

• 1 ticket for “SCC Text” (8 years old)

• 6 tickets for text (3-5 years old)

• 2 tickets for encoder description (3-9 years old)

Help to address these tickets would be appreciated.

5 360Lib related activities

The latest 360Lib software can be found at https://vcgit.hhi.fraunhofer.de/jvet/360lib/-/tags/360Lib-13.6

The following table is for the projection formats comparison using VTM-23.0 according to 360-degree video CTC (JVET-U2012) compared to that using VTM-22.0 (VTM-22.0 as anchor).

End-to-end WS-PSNR End-to-end S-PSNR-NN

Y U V Y U V

Class S1 0.00% -0.01% 0.05% 0.00% 0.00% 0.05%

Class S2 0.08% 0.16% 0.34% 0.08% 0.15% 0.34%

Overall 0.03% 0.06% 0.17% 0.03% 0.06% 0.16%

The following table compares generalized cubemap (GCMP) coding and padded equi-rectangular projection (PERP) coding using VTM-23.0 (PERP as anchor).

End-to-end WS-PSNR End-to-end S-PSNR-NN

Y U V Y U V

Class S1 -11.52% -5.47% -6.09% -11.50% -5.41% -6.03%

Class S2 -3.65% 0.98% 1.48% -3.62% 1.08% 1.56%

Overall -8.37% -2.89% -3.06% -8.35% -2.82% -3.00%

The following tables are for PERP and GCMP coding comparison between VTM-23.0 and HM-16.22 (HM as anchor), respectively.

End-to-end WS-PSNR End-to-end S-PSNR-NN

Y U V Y U V

Class S1 -30.91% -38.82% -41.24% -30.91% -38.88% -41.24%

Class S2 -36.84% -37.23% -39.43% -36.82% -37.27% -39.49%

Overall -33.28% -38.19% -40.51% -33.28% -38.23% -40.54%

End-to-end WS-PSNR End-to-end S-PSNR-NN

Y U V Y U V

Class S1 -34.64% -40.04% -42.14% -34.59% -40.02% -42.09%

Class S2 -38.34% -38.18% -40.06% -38.32% -38.19% -40.11%

Overall -36.12% -39.30% -41.31% -36.08% -39.29% -41.30%

6 SCM related activities

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

7 SHM related activities

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

8 HTM related activities

There had not been any releases of HTM of MV-HEVC and 3D-HEVC.

One merge request is was merged:

• JVET-AE0295: MV Main 10 profile support (waiting for proponent response)

The next release will also include the following changes:

• JVET-Z0209: Early termination during calculating RDcost of depth

9 HDRTools related activities

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

10 JM, JSVM, JMVM related activities

There had not been any further developments to JM, JSVM or JMVM during this meeting cycle.

For the previous release of JM only basic testing was performed to confirm that the code still works, but performance testing is pending. Performance changes are unlikely but may occur due to bug fixes. A possible encoder/decoder mismatch was reported privately, but needs more investigation.

11 Bug tracking

The bug tracker for VTM and specification text is located at:

https://jvet.hhi.fraunhofer.de/trac/vvc

The bug tracker uses the same accounts as the HM software bug tracker. Users may need to log in again due to the different sub-domain. For spam fighting reasons account registration is only possible at the HM software bug tracker at

https://hevc.hhi.fraunhofer.de/trac/hevc

Bug tracking for HDRTools is located at:

https://gitlab.com/standards/HDRTools/-/issues

Please file all issues related to the VVC reference software and HDRTools into the appropriate bug tracker. Try to provide all the details, which are necessary to reproduce the issue. Patches for solving issues and improving the software are always appreciated.

12 CTC alignment and merging

There are currently 8 JVET CTC documents:

JVET-Y2010 VTM/HM 4:2:0 test conditions

JVET-Z2011 VTM/HM HDR test conditions

JVET-AA2018 VTM/HM high bit depth test conditions (without spreadsheet)

JVET-T2013 VTM non-4:2:0 test conditions

JVET-AA1100 HM non-4:2:0 test conditions

JVET-U2012 VTM 360 video test conditions

JVET-AC1009 SHVC test conditions

JVET-AC1015 SCM test conditions

JVET-AE1013 3DV test conditions

Further merging of HM RExt CTC into the appropriate VVC CTC was investigated (non 4:2:0 chroma formats), but proper comparable HM configuration files were not yet available by the beginning of this meeting.

The HM HDR test conditions require additional post-processing stages, due to WPSNR, deltaE100 and PSNRL100 values not being generated directly by the HM encoder. Merging of respective functions from VTM is recommended to streamline the process.

13 Guidelines for reference software development

No further work was conducted on Guidelines for VVC and HEVC reference software development and documents JVET-AC2003 and JVET-AC1001 remain current.

14 Recommendations

The AHG recommends to:

- Continue to develop reference software.

- Improve documentation, especially the software manual.

- Encourage people to test VTM and other reference software more extensively outside of common test conditions.

- Encourage people to report all (potential) bugs that they are finding.

- Encourage people to submit bit-streams/test cases that trigger bugs in VTM and other reference software.

- Encourage people to submit non-normative changes that either reduce encoder run time without significantly sacrificing compression performance or improve compression performance without significantly increasing encoder run time.

- Design and add configuration files to the VTM software for testing of HLS features.

- Review VTM-related contributions and determine whether features should be added (or removed) from the software.

- Continue to investigate the merging of branches.

- Continue to investigate merging of CTC documents.

- Verify correctness of CTC documents and issue updates as appropriate

- Keep common test conditions aligned for the different standards.

It was suggested to clarify with HLS experts which new SEI messages are currently in TuC and which are in VSEI version4 draft. They should only be in one of the software branches, e.g. OMI should be moved from TuC branch to VTM.

[JVET-AI0004](https://jvet-experts.org/doc_end_user/current_document.php?id=14381) JVET AHG report: Test material and visual assessment (AHG4) [V. Baroncini, T. Suzuki, M. Wien (co-chairs), W. Husak, S. Iwamura, P. de Lagrange, S. Liu, X. Meng, S. Puri, A. Segall, S. Wenger (vice-chairs)]

2 Activities

2.1 Viewing tests for performance assessment of the ECM

The report on the visual quality comparison of ECM/VTM encoding which was conducted at the 34th meeting has been delivered on July 8th.

2.2 Verification tests for VVC multilayer coding

The verification test plan has been updated to output JVET-AH2021 of the previous JVET meeting. The document has been extended by an annex detailing the VTM software operation and configuration files needed for multi-layer encoding. Otherwise, no group activity has been performed in this meeting period.

2.3 Plan for subjective quality testing of FGC SEI message

The plan for subjective quality testing has been updated as output JVET-AH2022 of the previous JVET meeting. The document includes an update on test material under consideration. It is suggested to run expert viewing experiments at this meeting in order to determine test sequences and rate points for the evaluation in categories 1 and 2.

2.4 Test sequences

The test sequences used for CfP/CTC are available on ftp://jvet@ftp.ient.rwth-aachen.de in directory “/ctc” (accredited members of JVET may contact the JVET chair for login information).

Due to copyright restrictions, the JVET database of test sequences is only available to accredited members of JVET (i.e., members of ISO/IEC MPEG and ITU-T VCEG).

The current JVET ftp site will be replaced by a NextCloud server at RWTH Aachen University. The date for the switch to the new server and the access handling are suggested to be settled at this meeting.

3 Related contributions

JVET-AI0138 AHG4: preparation of test material for film grain visual testing P. de Lagrange (InterDigital)

JVET-AI0266 AHG4: Proposed text for a Call for new HDR materials for future video coding development E. Francois (InterDigital),A. Segall (Amazon),D. Rusanovskyy (Qualcomm),S. Iwamura (NHK)

4 Recommendations

The AHG recommends:

• To review input contribution JVET-AI0138 and conduct corresponding viewing sessions at this meeting, jointly with SC 29/AG 5.

• To review the proposed draft call for new HDR material and prepare a corresponding output document of this meeting.

• To collect volunteers to conduct further verification tests and subjective quality tests.

• To continue to discuss and to update the non-finalized categories of the verification test plan for multilayer VVC and the subjective quality test plan for FGC, including those which have not been addressed yet.

• To collect volunteers to actively contribute to the verification test development.

• To review the set of available test sequences for the verification tests as well as subjective quality tests and potentially collect more test sequences with a variety of content.

• To continue to collect new test sequences available for JVET with licensing statement.

[JVET-AI0005](https://jvet-experts.org/doc_end_user/current_document.php?id=14382) JVET AHG report: Conformance testing (AHG5) [I. Moccagatta (chair), F. Bossen, K. Kawamura, P. de Lagrange, T. Ikai, S. Iwamura, H.-J. Jhu, S. Paluri, K. Sühring, Y. Yu (vice chairs)]

2 Activities

The AHG communication is conducted through the main JVET reflector, jvet@lists.rwth-aachen.de, with [AHG5] in message headers. However, no correspondence marked as AHG5 was sent between the 34th and 35th meetings.

3 Timeline

The progress on the Conformance testing specification is proceeding per the timeline below:

• VVCv1 conformance:

o ISO/IEC FDIS 23090-15 issued from 2021-10 meeting, FDIS registered for formal approval 2022-07-11, FDIS ballot closed 2022-11-04, standard published 2022-11-24

o H.266.1 V1 Consent 2022-01-28, Last Call began 2022-04-01, Approved 2022-04-29, pre-published 2022-05-17, standard published 2022-07-12.

• VVCv2 conformance:

o ISO/IEC 23090-15/Amd.1 CDAM: 2021-10

o ISO/IEC 23090-15/Amd.1 DAM: 2022-01

o DAM ballot closed 2022-11-15

o ISO/IEC FDIS 23090-15:202x 2nd edition text output of 2023-01, preparation delayed to 2023-09

o H.266.1 V2 forwarded by JVET and Q6/16 for ITU-T Consent: 2023-07

o H.266.1 V2 approved 2023-09-13

o H.266.2 V2 pre-published 2023-10-06

4 Status on bitstream submission

The status at the time of preparation of this report is as follows:

• conformance bitstreams for VVC:

o 104 bitstream categories have been identified

o At least one bitstream has been submitted in each identified category

o 283 total bitstreams have been provided, checked, and made available

o Two streams have been re-generated

• conformance bitstreams for VVC operation range extensions:

o 57 bitstream categories have been identified

o 1 bitstream of 1 identified category has been re-generated

o 128 bitstreams of 57 identified categories have been cross-checked and uploaded.

o No changes between 34th and 35th meeting.

• additional conformance bitstreams for VVC Multilayer:

o 3 bitstream categories have been identified

o At least one bitstream has been submitted in each identified category

o 7 total bitstreams have been provided, checked, and made available

• conformance bitstreams for new HEVC Multiview profiles

o 2 HEVC Multiview Extended 10 bitstreams have been provided and checked.

o 2 HEVC Multiview Extended bitstreams have been provided and checked.

5 Activities and Discussion

The AHG activities are on schedule with the preliminary timeline shown in section 2.

VVC activities:

An issue about the value of SPS syntax element sps\_log2\_diff\_max\_bt\_min\_qt\_intra\_slice\_luma = 3 in TREE\_C has been reported in https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/1638. In this test implicit QT split is done because of dual Intra tree, and maximum BT after implicit QT split is 64. Therefore sps\_log2\_diff\_max\_bt\_min\_qt\_intra\_slice\_luma = 3 (maximum BT = 128) should be replaced by sps\_log2\_diff\_max\_bt\_min\_qt\_intra\_slice\_luma = 2 (maximum BT = 64). A new version of TREE\_C (TREE\_C\_HHI\_4) has been generated with the correct values of sps\_log2\_diff\_max\_bt\_min\_qt\_intra\_slice\_luma and is available at https://www.itu.int/wftp3/av-arch/jvet-site/bitstream\_exchange/VVC2ndEd\_regenerated.

An expert reported that HRD\_B failed to be parsed by VTM after fix #1626 added a missing syntax element in picture buffering SEI message. A new version of HRD\_B (HRD\_B\_3) has been generated to fix this parsing problem and is available at https://www.itu.int/wftp3/av-arch/jvet-site/bitstream\_exchange/VVC2ndEd\_regenerated.

VVC operation range extensions activities:

No change in bitstreams and/or packages, 2nd edition packages are available at https://www.itu.int/wftp3/av-arch/jvet-site/bitstream\_exchange/VVC2ndEd/

VVC Multilayer activities:

Cross check of ILRPL\_B\_InterDigital\_1 is done.

Following cross check, the remaining 3 conformance bitstreams for VVC multilayer configurations (PPSScalWin\_A\_NHK\_1, PPSScalWin\_B\_NHK\_1, PPSScalWin\_C\_NHK\_1) have been re-generated and cross-checked. Streams are as expected, and minor changes in the collateral files have been identified and are in the process of being corrected.

HEVC Multiview supporting extended bit depth activities:

Two HEVC Multiview Extended 10 (MVHEVCS\_J\_APPLE\_1 and MVHEVCS\_K\_APPLE\_1) and two HEVC Multiview Extended (MVHEVCS\_L\_Bytedance\_1 and MVHEVCS\_M\_Bytedance\_1) streams have been generated and cross-checked. All four are available at https://www.itu.int/wftp3/av-arch/jvet-site/bitstream\_exchange/HEVCMultiview/under\_test/ These streams replace the ones provided in AD0232 and AE0295.

The HTM merge request https://vcgit.hhi.fraunhofer.de/jvet/HTM/-/merge\_requests/5 implementing the new HEVC Multiview Main 10 profile in JVET-AF1006-v2 and in WG5 N0244 has been merged.

An additional HTM merge request (JVET-AH0046 (!8) · Merge requests · jvet / HTM · GitLab (fraunhofer.de) to implement changes for Multiview Extended and Multiview Extended 10 from JVET-AH0046 has been submitted. This MR is needed to decode the HEVC Multiview Extended and Multiview Extended 10 streams.

No updates on the implementation for the HEVC Multiview monochrome profiles (Multiview Monochrome, Multiview Monochrome 10, Multiview Monochrome 12, and Multiview Monochrome 16 profiles) in JVET-AH1006 and in WG5 N0281.

The regular JVET e-mail reflector was used for discussions (jvet@lists.rwth-aachen.de).

The AHG5 chairs and JVET chairs can be reached at jvet-conformance@lists.rwth-aachen.de. Participants should not subscribe to this list but may send emails to it.

6 Contributions

JVET-AI0045 – 4:4:4 MV-HEVC profiles [A. M. Tourapis, D. Podborski, S. Paluri].

7 Ftp site information

The procedure to exchange the bitstream (ftp cite, bitstream files, etc.) is specified in Sec 2 “Procedure” of JVET-R2008. The ftp and http sites for downloading bitstreams are

• VVC:

ftp://ftp3.itu.int/jvet-site/bitstream\_exchange/VVC

https://www.itu.int/wftp3/av-arch/jvet-site/bitstream\_exchange/VVC/

• VVC operation range extensions:

ftp://ftp3.itu.int/jvet-site/bitstream\_exchange/VVCv2

https://www.itu.int/wftp3/av-arch/jvet-site/bitstream\_exchange/VVCv2

The ftp site for uploading bitstream file is as follows.

ftp://ftp3.itu.int/jvet-site/dropbox/

(user id: avguest, passwd: Avguest201007)

8 Recommendations

The AHG recommends the following:

• Maintain and update the conformance bitstream database and contribute to report problems in JVET document 1004.

• Continue the generation, cross-checking, and documentation of the conformance streams for the HEVC Multiview profiles supporting extended bit depth.

It was suggested during the discussion to potentially issue a new edition of VVC conformance with the new multi-layer streams and the corrections of the existing streams. January 2025 could be a reasonable date for that (ITU consent).

[JVET-AI0006](https://jvet-experts.org/doc_end_user/current_document.php?id=14383) JVET AHG report: ECM software development (AHG6) [V. Seregin (chair), J. Chen, R. Chernyak, F. Le Léannec, K. Zhang (vice-chairs)]

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It is noted that the major gain comes by shifting benefits from chroma to luma. Due to newly adopted tools, gain may be likely ess than 1%.

[JVET-AI0007](https://jvet-experts.org/doc_end_user/current_document.php?id=14384) JVET AHG report: ECM tool assessment (AHG7) [X. Li (chair), L.-F. Chen, Z. Deng, J. Gan, E. François, H.-J. Jhu, X. Li, H. Wang (vice chairs)]

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It was commented that runtime differences reported were found to highly depend on compiler version (at least if the runtime difference is large).

[JVET-AI0008](https://jvet-experts.org/doc_end_user/current_document.php?id=14385) JVET AHG report: Optimization of encoders and receiving systems for machine analysis of coded video content (AHG8) [C. Hollmann, S. Liu, S. Wang, M. Zhou (AHG chairs)]

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It was suggested that the range of QP values in CTC should be aligned with WG 4.

It was suggested to investigate combination of tools in the software repository, in order to make a reasonable package (configurable for various purposes) available together with the technical report. New mandate of AHG, potentially BoG.

[JVET-AI0009](https://jvet-experts.org/doc_end_user/current_document.php?id=14386) JVET AHG report: SEI message studies (AHG9) [S. McCarthy, Y.-K. Wang (co-chairs), J. Boyce, T. Chujoh, S. Deshpande, C. Fogg, M. M. Hannuksela, Hendry, P. de Lagrange, G. J. Sullivan, A. Tourapis, S. Wenger (vice-chairs)]

2 Related contributions

A total of 48 contributions are identified relating to the mandates of AHG9. Some contributions relate to more than one mandate and/or SEI message. Some contributions also relate to the work of AHG16.

The following is a list of contributions related to the mandates of AHG9.

2.1 Study the SEI messages in VSEI, VVC, HEVC and AVC (6)

2.1.1 JVET-AH2005 Additions and corrections for VVC version 4 (7)

JVET-AI0071 AHG8/AHG9: Indication of NNPFs and processing chains for human viewing and/or machine consumption [M. M. Hannuksela, F. Cricri, H. Zhang, J. Boyce (Nokia)]

Also relates to mandate to study JVET-AH2006 (NNPF SEI messages)

JVET-AI0073 AHG9: On the handling of a processing chain specified by an SPO SEI message [M. M. Hannuksela, F. Cricri, J. Boyce (Nokia)]

JVET-AI0098 [AHG9] Study on SEI processing order SEI message use cases [Y. Gao, P. Wu, Y. Bai, S. Xie, M. Jia, W. Niu, C. Huang (ZTE)]

JVET-AI0100 [AHG9] On byte alignment design in SEI processing order SEI message [Y. Gao, P. Wu, Y. Bai, S. Xie, M. Jia, W. Niu, C. Huang (ZTE)]

JVET-AI0146 AHG9: Moving the SPO and PON SEI messages from VVC to VSEI [Y.-K. Wang (Bytedance)]

JVET-AI0147 AHG9: On handling of processing chains and grouping of post-processing filters [Y.-K. Wang, J. Li, L. Zhang, C. Lin, J. Xu (Bytedance)]

JVET-AI0212 AHG9: On handling processing chain in VSEI [H. Tan, J. Lee, J. Nam, C. Kim, J. Lim, S. Kim (LGE)]

2.2 Study JVET-AH2006 Additional SEI messages for VSEI version 4 (17)

2.2.1 NNPF SEI messages (7)

JVET-AI0061 AHG9: On Neural Network Post Filter for Spatial Extrapolation [S. Deshpande (Sharp)]

JVET-AI0062 [AHG9]: Neural network post-filter for tone mapping operations [C.-H. Demarty, F. Aumont, L. Blondé, E. Reinhard, O. Le Meur (InterDigital)]

JVET-AI0070 AHG9: On an extension of NNPFC SEI message [T. Chujoh, Z. Fan, R. Ishimoto, T. Ikai (Sharp), L. Jin, H. Watanabe (Waseda Univ.)]

JVET-AI0071 AHG8/AHG9: Indication of NNPFs and processing chains for human viewing and/or machine consumption [M. M. Hannuksela, F. Cricri, H. Zhang, J. Boyce (Nokia)]

Also relates to mandate to study SEI messages in VVC (SPO SEI message)

JVET-AI0072 AHG9: Activating an NNPF in a processing chain for temporally interpolated or extrapolated pictures [M. M. Hannuksela, F. Cricri (Nokia)]

JVET-AI0202 AHG9: NNPFC SEI modifications to support spatial extraction [J. Xu, Y.-K. Wang (Bytedance)]

JVET-AI0207 AHG9: A clean-up for spatial resampling NNPF design [J. Xu, Y.-K. Wang (Bytedance)]

2.2.2 Encoder optimization information SEI message (3)

JVET-AI0122 AHG9: Signaling source and added pictures in EOI SEI message [J. Lee, H. Tan, C. Kim, J. Nam, J. Lim, S. Kim (LGE)]

JVET-AI0180 AHG9: Adding original source picture dimensions to EOI SEI [J. Boyce, M. M. Hannuksela (Nokia)]

JVET-AI0214 AHG9: Editorial updates for SPTI and EOI SEI messages [H. Tan, J. Lee, C. Kim, J. Nam, J. Lim, S. Kim (LGE)]

Also relates to SPTI SEI message

2.2.3 Source picture timing information SEI message (3)

JVET-AI0117 AHG9: On the signaling related to temporal sublayer in SPTI SEI message [J. Lee, H. Tan, C. Kim, J. Nam, J. Lim, S. Kim (LGE)]

JVET-AI0120 AHG9: Proposed changes for miscellaneous aspects of SEIs in VSEI v4 draft [J. Lee, H. Tan, C. Kim, J. Nam, J. Lim, S. Kim (LGE)]

Also relates to OMI and TDI SEI messages

JVET-AI0214 AHG9: Editorial updates for SPTI and EOI SEI messages [H. Tan, J. Lee, C. Kim, J. Nam, J. Lim, S. Kim (LGE)]

Also relates to EOI SEI message

2.2.4 Object mask information SEI message (4)

JVET-AI0116 AHG9: On object mask auxiliary layer list and mask Id in OMI SEI message [J. Nam, H. Tan, J. Lee, C. Kim, J. Lim, S. Kim (LGE)]

JVET-AI0120 AHG9: Proposed changes for miscellaneous aspects of SEIs in VSEI v4 draft [J. Lee, H. Tan, C. Kim, J. Nam, J. Lim, S. Kim (LGE)]

Also relates to SPTI and TDI SEI messages

JVET-AI0153 AHG9: Updates on software implementation and text of the object mask information SEI message [Z. Zhang, J. Chen, Y. Ye, S. Wang(Alibaba)]

JVET-AI0211 AHG9: On the design of OMI SEI message [H. Tan, C. Kim, J. Nam, J. Lee, J. Lim, S. Kim (LGE)]

2.2.5 Text description information SEI message (3)

JVET-AI0059 AHG9: Comments on Text Description Information SEI Message [S. Deshpande (Sharp)]

JVET-AI0060 AHG9: Photosensitive Content Information Signaling [S. Deshpande (Sharp)]

Also relates to mandate to identify potential needs for additional SEI messages

JVET-AI0120 AHG9: Proposed changes for miscellaneous aspects of SEIs in VSEI v4 draft [J. Lee, H. Tan, C. Kim, J. Nam, J. Lim, S. Kim (LGE)]

Also relates to SPTI and OMI SEI messages

2.3 Study JVET-AH2032 TuC for VSEI (15)

2.3.1 Generative face video SEI messages (11)

JVET-AI0137 AHG16: Update on Pupil position SEI message for Generative Face Video [F. Ma, A. Trioux, Y. Gao, Y. Yao, F. Yang (Xidian Univ.), F. Xing, Z. Wang (Hisense)]

JVET-AI0156 AHG9/AHG16: On generative face video SEI messages [J. Chen, B. Chen, Y. Ye(Alibaba), S. Yin, S. Wang(CityU), P. Yin, S. McCarthy(Dolby), H.-B. Teo(Panasonic)]

JVET-AI0184 AHG9: Some comments and editorial changes on the GFV and GFVE SEI messages [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

JVET-AI0186 AHG9: On picture order count and timing information for gfv generated pictures [L.chen, O. Chubach, Y.-W. Huang, L. Shaw (MediaTek)]

JVET-AI0189 AHG9: On signalling and/or specifying the translator and the generator NNs for the GFV SEI message [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

JVET-AI0190 AHG9: On GFV SEI persistence and picture presence [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

JVET-AI0191 AHG9: On GFV facial parameters signalling [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

JVET-AI0192 AHG9: On GFV picture order and timing [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

JVET-AI0193 AHG9/AHG16: On no display flag in generative face video SEI message [S. McCarthy, S. Gehlot, G. J. Sullivan, P. Yin (Dolby)]

JVET-AI0194 AHG9/AHG16: On chroma key fusion for the generative face video SEI message [S. Gehlot, G.-M. Su, P. Yin, S. McCarthy, G. J. Sullivan (Dolby)]

Also relates to mandate to collect software and showcase information

JVET-AI0195 AhG9/16: Updates on GFVC common software tools and GFV SEI message [B. Chen, J. Chen, Y. Ye, R.-L. Liao(Alibaba), S.Yin, S. Wang(CityU)]

Also relates to mandate to collect software and showcase information

2.3.2 Film grain regions characteristics SEI message (1)

JVET-AI0099 AHG9: Showcases on the implementation of applying separate film grain models in different regions [S. Xie, P. Wu, Y. Gao, Y. Bai, M. Jia, W. Niu, C. Huang (ZTE)]

Also relates to mandate to collect software and showcase information

2.3.3 Constituent rectangle SEI messages (2)

JVET-AI0177 AHG9: Constituent Rectangle Nesting SEI [J. Boyce, M. M. Hannuksela (Nokia)]

JVET-AI0178 AHG9: On constituent rectangles SEI [J. Boyce, M. M. Hannuksela (Nokia)]

2.3.4 Alternative persistence signalling in SEI messages (1)

JVET-AI0179 AHG9: Persistence cancellation of SEI messages with IDs [J. Boyce, M. M. Hannuksela (Nokia)]

2.4 Collect software and showcase information for SEI messages (3)

JVET-AI0099 AHG9: Showcases on the implementation of applying separate film grain models in different regions [S. Xie, P. Wu, Y. Gao, Y. Bai, M. Jia, W. Niu, C. Huang (ZTE)]

Also relates to mandate to study JVET-AH2032 TuC for VSEI

JVET-AI0194 AHG9/AHG16: On chroma key fusion for the generative face video SEI message [S. Gehlot, G.-M. Su, P. Yin, S. McCarthy, G. J. Sullivan (Dolby)]

Also relates to mandate to study JVET-AH2032 TuC for VSEI

JVET-AI0195 AhG9/16: Updates on GFVC common software tools and GFV SEI message [B. Chen, J. Chen, Y. Ye, R.-L. Liao(Alibaba), S.Yin, S. Wang(CityU)]

Also relates to mandate to study JVET-AH2032 TuC for VSEI

2.5 Identify potential needs for additional SEI messages, including study of AVC and HEVC SEI messages for use in VVC (11)

JVET-AI0060 AHG9: Photosensitive Content Information Signaling [S. Deshpande (Sharp)]

Also relates to mandate to study JVET-AH2006 (TDI SEI message)

JVET-AI0077 AHG9: Design for content usage information SEI message [C. Kim, H. Tan, J. Lee, J. Nam, J. Lim, S. Kim (LGE)]

JVET-AI0078 AHG9: Design for preservation information SEI message [C. Kim, H. Tan, J. Lee, J. Nam, J. Lim, S. Kim (LGE)]

JVET-AI0127 AHG9: Digitally Signed Content Authentication SEI [K. Suehring, T. Hinz, Y. Sanchez, J. Pfaff, H. Schwarz, D. Marpe, T. Wiegand (Fraunhofer HHI)]

JVET-AI0158 [AHG9] Lens Optical Correction SEI message [G. Teniou, S. Wenger (Tencent)]

JVET-AI0160 [AHG9] Lens Optical Correction SEI message implementation [G. Teniou, S. Wenger]

JVET-AI0181 AHG9: Display overlays SEI [J. Boyce, M. M. Hannuksela (Nokia)]

JVET-AI0182 AHG9: Bitdepth range information SEI [J. Boyce, M. M. Hannuksela (Nokia)]

JVET-AI0203 AHG9: SEI message for signalling AI usage restrictions and context [A. T. Hinds, S. Wenger, G. Teniou (Tencent)]

JVET-AI0205 AHG9: Combined SEI messages for common image metadata formats [A. T. Hinds, S. Wenger, G. Teniou (Tencent)]

JVET-AI0206 AHG9: Additional information for SEI message for International Color Consortium (ICC) profiles [A. T. Hinds, S. Wenger, M. Derhak, W. Li (Tencent)]

3 Activities

The regular JVET e-mail reflector was used for discussions (jvet@lists.rwth-aachen.de) with [AHG9] in message headers. No emails with [AHG9] were exchanged.

4 Recommendations

The AHG recommends to:

• Review all related contributions; and

• Continue SEI messages studies.

[JVET-AI0010](https://jvet-experts.org/doc_end_user/current_document.php?id=14387) JVET AHG report: Encoding algorithm optimization (AHG10) [P. de Lagrange, A. Duenas, R. Sjöberg, A. Tourapis (AHG chairs)]

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Informal viewing potentially for some HDR cases from JVET-AI0059.

[JVET-AI0011](https://jvet-experts.org/doc_end_user/current_document.php?id=14388) JVET AHG report: Neural network-based video coding (AHG11) [E. Alshina, F. Galpin, S. Liu, A. Segall (co-chairs), J. Li, R.-L. Liao, D. Rusanovskyy, M. Santamaria, T. Shao, M. Wien, P. Wu (vice chairs)]

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Weird results with new training material – error in script found. Needs to be re-run.

[JVET-AI0012](https://jvet-experts.org/doc_end_user/current_document.php?id=14389) JVET AHG report: Enhanced compression beyond VVC capability (AHG12) [M. Karczewicz, Y. Ye, L. Zhang (co-chairs), B. Bross, R. Chernyak, X. Li, K. Naser, Y. Yu (vice-chairs)]

2 Activities

The primary activity of the AHG was the “Exploration experiment on enhanced compression beyond VVC capability” (JVET-AH2024). The combined improvements of the ECM-13.0 over VTM-11.0ecm13.0 anchor for AI, RA and LB configurations are:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | All Intra Main10 | | | | |
|  | Y | U | V | EncT | DecT |
| Class A1 | -13.18% | -13.89% | -24.88% | 980.4% | 467.2% |
| Class A2 | -20.15% | -22.13% | -26.46% | 984.0% | 487.8% |
| Class B | -13.54% | -20.05% | -18.04% | 920.7% | 475.4% |
| Class C | -13.58% | -10.35% | -11.48% | 937.0% | 437.6% |
| Class E | -17.30% | -20.19% | -17.25% | 898.4% | 497.5% |
| Overall | **-15.22%** | **-17.24%** | **-18.99%** | **940.6%** | **470.9%** |
| Class D | -11.47% | -7.48% | -7.91% | 920.9% | 477.3% |
| Class F | -29.12% | -32.42% | -32.73% | 571.1% | 498.7% |
| Class TGM | -42.06% | -47.48% | -46.92% | 459.9% | 468.9% |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Random Access Main 10 | | | | |
|  | Y | U | V | EncT | DecT |
| Class A1 | -26.04% | -21.59% | -33.88% | 946.3% | 892.5% |
| Class A2 | -29.16% | -31.81% | -36.71% | 887.1% | 1036.9% |
| Class B | -23.43% | -28.98% | -26.76% | 747.6% | 846.1% |
| Class C | -24.99% | -20.48% | -21.31% | 821.5% | 922.3% |
| Class E |  |  |  |  |  |
| Overall | **-25.51%** | **-25.80%** | **-28.72%** | **831.6%** | **911.4%** |
| Class D | -25.69% | -21.07% | -22.42% | 785.7% | 1008.7% |
| Class F | -31.65% | -34.02% | -34.69% | 660.1% | 557.6% |
| Class TGM | -40.63% | -45.97% | -46.06% | 634.7% | 487.9% |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Low Delay B Main 10 | | | | |
|  | Y | U | V | EncT | DecT |
| Class A1 |  |  |  |  |  |
| Class A2 |  |  |  |  |  |
| Class B | -20.42% | -32.78% | -30.25% | 739.1% | 718.3% |
| Class C | -22.71% | -23.31% | -24.26% | 755.1% | 802.1% |
| Class E | -20.11% | -22.85% | -22.09% | 694.2% | 500.6% |
| Overall | **-21.11%** | **-27.14%** | **-26.21%** | **732.8%** | **680.9%** |
| Class D | -23.81% | -25.09% | -24.57% | 745.0% | 892.1% |
| Class F | -28.69% | -36.15% | -36.26% | 627.5% | 550.3% |
| Class TGM | -38.57% | -47.78% | -48.13% | 584.2% | 493.6% |

The rate reduction for natural sequences over VTM in RA configuration for {Y, U, V} increased from ECM-12.0’s {-24.01%, -33.20%, -35.34%} to ECM-13.0’s {-25.51%, -25.80%, -28.72%}. For SCC sequences (class TGM) the rate reduction for RA configuration increased from ECM-21.0’s { -38.31%, -45.25%, -45.36%} to ECM-13.0’s { -40.63%, -45.97%, -46.06%}.

3 Contributions

In addition to 39 EE2 contributions, 51 (comparing to 51 last meeting) EE2-related and AHG12-related contributions were received. The EE2-related and AHG12-related contributions can be subdivided as follows:

3.1 Intra (21)

JVET-AI0076, "AHG12: The Modification of BV candidate List Construction", T. Lee, S. Kim, B. Park, D. Lee, J. Seo, D. Jun (DONG-A Univ.)

JVET-AI0079, "Non-EE2: Improved OBIC with PDP", J. Fu, Z. Li, J. Zhang, C. Jia, S. Ma (PKU), Y. Gao, C. Huang (ZTE)

JVET-AI0080, "Non-EE2: Disabling the combination of TIMD-ISP and TIMD-MRL", Z. Fan, T. Chujoh, T. Ikai (Sharp)

JVET-AI0085, "Non-EE2: Matrix-based position dependent intra prediction for TIMD", Y. Kidani, H. Kato, K. Kawamura (KDDI)

JVET-AI0106, "AHG12: Adaptive HoG for DIMD", S. Blasi, J. Lainema (Nokia)

JVET-AI0108, "Non-EE2: Unified reference area of IBC and IntraTMP", N. Zhang, K. Zhang, Y. Wang, Z. Deng, L. Zhao, W. Yin, L. Zhang (Bytedance)

JVET-AI0101, "Non-EE2: High-level control of intra prediction methods for screen contents", K. Kim, J.-H. Son, J.-S. Kwak (WILUS)

JVET-AI0102, "Non-EE2: Regression-based SGPM blending", X. Li, R.-L. Liao, J. Chen, Y. Ye (Alibaba)

JVET-AI0125, "Non-EE2: DIMD with filtered-template", Z. Lv, C. Zhou (vivo)

JVET-AI0132, "AHG12: SGPM improvements", K. Ding, H. Qin, J. Konieczny, A. Filippov, V. Rufitskiy (TCL)

JVET-AI0139, "Non-EE2: Modified L-shape template in IntraTMP", J. Lee, J. Kim, W. Lim, D. Kim, S.-C. Lim (ETRI)

JVET-AI0140, "Non-EE2: On DIMD edge operators", A. Filippov, V. Rufitskiy, J. Konieczny, H. Qin, T. Dong, Z. Xu (TCL)

JVET-AI0148, "Non-EE2: Non-adjacent DIMD mode derivation for TMRL intra mode candidate list construction", V. Rufitskiy, A. Filippov, J. Konieczny, H. Qin (TCL)

JVET-AI0149, "Non-EE2: Unified design of DIMD and non-adjacent DIMD", A. Filippov, V. Rufitskiy, J. Konieczny, H. Qin, K. Ding, T. Dong, Z. Xu (TCL)

JVET-AI0167, "Non-EE2: Improvements on EIP", L. Zhang, Z. Xie, Y. Yu, H. Yu, D. Wang (OPPO)

JVET-AI0168, "Non-EE2: Chroma TMRL", H. Huang, Y. Yu, H. Yu, D. Wang (OPPO)

JVET-AI0201, "AHG12: neural network-based intra prediction", F. Urban, T. Dumas, F. Galpin, E. François (Interdigital)

JVET-AI0224, "EE2-related: Intra merge mode extension with BV improvement", J. Fu, Z. Li, J. Zhang, C. Jia, S. Ma (PKU), Y. Gao, C. Huang (ZTE)

JVET-AI0225, "AhG12: Neural network-based intra prediction with DIMD mode derivation", S. Eadie, P. Garus, T. Ryder, P. Nikitin, M. Coban, V. Seregin, M. Karczewicz (Qualcomm)

JVET-AI0253, "EE2 related: BV Merge List Improvement", K. Naser, Y. Chen, M. Radosavljević, F. Le Léannec (InterDigital)

JVET-AI0262, "AHG 12: OBIC mode from reconstruction", R. G. Youvalari, M. Abdoli, A. Tissier (Xiaomi)

3.2 Inter (14)

JVET-AI0051, "Template Matching Picture Boundary Padding for ECM", N. Neumann, M. Wien (RWTH Aachen Univ.)

JVET-AI0067, "AHG12: GPM mode extension", Y. Ahn, J. Nam, N. Park, J. Lim, S. Kim (LGE)

JVET-AI0109, "Non-EE2: A dual merge mode", R.-L. Liao, J. Chen, Y. Ye, X. Li (Alibaba)

JVET-AI0115, "Non-EE2: Regression-based GPM extension", K. Jia, J. Chen, X. Li, R.-L. Liao, Y. Ye (Alibaba)

JVET-AI0118, "AHG 12: Alternative affine motion model for affine DMVR", K. Andersson (Ericsson)

JVET-AI0121, "AHG 12: Fast hierarchical Subblock based DMVR", K. Andersson, C. Hollmann (Ericsson)

JVET-AI0126, "Non-EE2: Enhanced inter AMVP", Z. Deng, K. Zhang, N. Zhang, Y. Wang, W. Yin, L. Zhao, L. Zhang (Bytedance)

JVET-AI0154, "Non-EE2: OBMC extension with intra prediction", D. Kim, J. Lee, J. Kim, W. Lim, S.-C. Lim, J. S. Choi (ETRI)

JVET-AI0169, "Non-EE2: On sub-block merge mode", F. Wang, Y. Yu, H. Yu, D. Wang(OPPO)

JVET-AI0198, "Non-EE2: On POC conditions of BDOF", N. Yan, X. Xiu, W. Chen, X. Wang (Kwai)

JVET-AI0217, "EE2-related: on the sharp motion compensation filter for bi-prediction", H. Huang, R. Yu, V. Seregin, M. Karczewicz (Qualcomm)

JVET-AI0218, "Non-EE2: On subblock inter mode improvement", H. Huang, Y. Zhang, J.-L Lin, Z. Zhang, P.-H Lin, C.-C Chen, V. Seregin, M. Karczewicz (Qualcomm)

JVET-AI0226, "AHG 12: Longer motion compensation interpolation filter", R. Yu, H. Huang, V. Seregin, M. Karczewicz (Qualcomm)

JVET-AI0229, "EE2-Related: LIC for Screen Content", T.M. Bae, S. Deshpande (Sharp)

3.3 In Loop Filters (5)

JVET-AI0081, "AHG12: Adaptive Mantissa Precision for ALF Coefficients", V. Shchukin, P. Wennersten, J. Ström (Ericsson)

JVET-AI0135, "Non-EE2: Extended Usage of Fixed-Filters", W. Yin, K. Zhang, Y. Wang, Z. Deng, L. Zhao, N. Zhang, L. Zhang (Bytedance)

JVET-AI0152, "Non-EE2: Coding Information based Classification for ALF", W. Yin, K. Zhang, Y. Wang, Z. Deng, L. Zhao, N. Zhang, L. Zhang (Bytedance)

JVET-AI0200, "Non-EE2: Using Luma Reconstruction Signal for Chroma ALF", C. Ma, X. Xiu, X. Wang (Kwai)

JVET-AI0280, "No-EE2: Reuse of ALF control information", M. Karczewicz, H. Wang, N. Hu, V. Seregin (Qualcomm)

3.4 Transform (2)

JVET-AI0223, "AHG12: Improved implicit MTS", C. Bonnineau, S. Puri, I. Marzuki, R. Utida, K. Naser, T. Poirier, F. Le Léannec (InterDigital)

JVET-AI0255, "Non-EE2: NSPT kernels for non-regular intra modes", M. Karczewicz, G. Verba, B. Ray, P. Garus, M. Coban, V. Seregin (Qualcomm)

3.5 Entropy Coding (3)

JVET-AI0145, "AHG12: CABAC slice-level model switch", F. Lo Bianco, F. Galpin (InterDigital)

JVET-AI0119, "Context modeling for tu\_cb\_coded\_flag", M. Chen, L. Wang, W. Zhang, F. Yang, J. Huo (Xidian Univ.), Z. Yu, W. Li, B. Li, F. Xing (Hisense)

JVET-AI0281, "AHG12: Context retraining for ECM-13.0", P. Mahdavinia, P. Nikitin, V. Seregin, M. Karczewicz (Qualcomm)

3.6 Inter and Intra (3)

JVET-AI0063, "AHG12: Improvements on GPM partitioning splits", K. Reuzé, Y. Chen, M. Le Pendu, P. Bordes (InterDigital)

JVET-AI0096, "AHG12: Fixes for Adaptive Clipping and Sign Prediction", J. Samuelsson-Allendes (Sharp)

JVET-AI0114, "Non-EE2: SATD-based reordering", Y. Wang, K. Zhang, W. Yin, Z. Deng, N. Zhang, L. Zhao, L. Zhang (Bytedance)

3.7 Partitioning (2)

JVET-AI0261, "AHG 12: Rectangular Partitioning Restrictions A. Tissier", M. Abdoli, R. G. Youvalari (Xiaomi)

JVET-AI0282, "AHG12: Corner and center subblocks for SBT", V. Seregin, M. Coban, B. Ray, H. Wang, N. Hu, M. Karczewicz (Qualcomm)

3.8 CTC (1)

JVET-AI0097, "AHG12: A follow-up CTC modification for encoding runtime reduction under low-delay configuration", Z. Deng, K. Zhang, L. Zhao, W. Yin, Y. Wang, N. Zhang, L. Zhang (Bytedance), R. Utida, S. Puri, I. Marzuki, C. Bonnineau (InterDigital)

4 Recommendations

The AHG recommends to:

• To review all the related contributions.

[JVET-AI0013](https://jvet-experts.org/doc_end_user/current_document.php?id=14390) JVET AHG report: Film grain technologies (AHG13) [W. Husak, P. de Lagrange (co-chairs), A. Duenas, D. Grois, Y. He, X. Meng, M. Radosavljević, A. Segall, G. Teniou, A. Tourapis (vice-chairs)]

The Technical Report was out for DTR ballot during this AHG period. The group had minimal meetings except for addressing editorial deficiencies and short discussions on second edition topics. Given the DTR ballot is the last ballot, the document went from the ballot phase directly to the ISO editors skipping WG5 (JVET) review. The ISO editors addressed comments received from the National Bodies along with applying ISO styles. The ISO editors created a Comment Resolution document and forwarded the documents for the document editors’ review.

The document editors found several editorial errors and updated the document. The Technical Report was then returned to the ISO editors for publication along with a comment resolution document.

The following items began as topics for a second version of the technical report; however, it was agreed that the items are diverse and may result in different actions and/or activities.

The topics identified for potential inclusion in a second edition are as follows:

• Updated text

• Updated tools

• Content

• Metrics – discussion and/or survey of available techniques or metrics

• Subjective testing of Film Grain

• Analysis – preprocessing analysis (parameter estimation)

Topics that are identified for other disposition include:

• EG/RP (?) – What would be useful information for guiding usage? (guidance document)

• Conformance – this is interesting due to being an SEI

• Future parameters and signaling – not a second edition topic

3 Related contributions

Three contributions related to AHG13 were identified as of 07/11/2024.

• One contribution was the AHG report:

o JVET-AI0013 JVET AHG report: Film grain technologies (AHG13)

• Two other contributions were uploaded at the time of the report drafting:

o JVET-AI0099 AHG9: Showcases on the implementation of applying separate film grain models in different regions

o JVET-AI0138 AHG4: preparation of test material for film grain visual testing

3.1 Contributions

There were two contributions uploaded other than the AHG report.

3.1.1 JVET-AI0099 AHG9: Showcases on the implementation of applying separate film grain

This contribution provides some showcase examples on the implementation of applying separate film grain models in different regions, where the model adaptation proposed in JVET-AH0166 was adopted into the VSEI TuC at the April meeting, as recorded in the meeting report [1]. In the showcase examples, we apply two film grain models (i.e., Frequency filtering based method and Auto-regression based method) simultaneously in two separate regions of each video

3.1.2 JVET-AI0138 AHG4: preparation of test material for film grain visual testing

This contribution lists the test sequences considered for film grain visual testing in JVET-AH2021, how they are obtained, and encodings available. 9 UHD and 4 HD sequences are prepared, and encoded with HM and VTM, using a wide range of QPs to address the first two test categories of JVET-AH2021.

4 Recommendations

The AHG recommends:

• the related input contributions are reviewed;

• any liaisons are reviewed;

• testing of FGC be discussed;

• continued conformance discussion;

• future extensions to the Technical Report;

• SEI message extensions;

• topics for an EG/RP; and

• continue the study of film grain technologies in JVET.

It was verbally reported that a new version of VVEnc also supports film grain models.

It was suggested to have the supplement on film grain approved by the ITU WP3 meeting in August, aligned with the ISO text.

Consider starting work on TR v2 by the next meeting, provided that input would be available. Potentially, results on subjective testing might also be available then.

[JVET-AI0014](https://jvet-experts.org/doc_end_user/current_document.php?id=14280) JVET AHG report: NNVC software development (AHG14) [F. Galpin (chair), R. Chang, Y. Li, Y. Li, J. N. Shingala, Z. Xie (vice-chairs)]

2 Software development

2.1 Location

NNVC repository is located at https://vcgit.hhi.fraunhofer.de/jvet-ahg-nnvc/VVCSoftware\_VTM

NNVC software is based on VTM-11.0 with enabled MCTF including the update from JVET-V0056, GOP32, enabling deblocking in the RDO and JVET-AH0054 with improved MCTF.

NNVC-9.1 anchor at https://vcgit.hhi.fraunhofer.de/jvet-ahg-nnvc/nnvc-ctc/-/blob/master/Anchor%20performance/NNVC-current\_Reporting\_Template-with-anchor-data.xlsm?ref\_type=heads is used for NNVC performance evaluation.

2.2 Software changes

2.3 NNVC-9.0

Several commits were merged in the NNVC repository.

The following changes were integrated:

- JVET-AH0080 (LOP3): training scripts + models + NNVC changes

- JVET-AH0081 (LOP3): models

- JVET-AH0064: improved MCTF, port from ECM

- JVET-AH0099 (rpr 1.5)

- JVET-AH0051 VLOP

- JVET-AH0096: LOP2 adaptive content: training scripts

- JVET-AH0088: new SADL

The following fixes and clean-up were performed:

- Build for ARM

- Fixes many implicit cast to pass MSVC strict build

- Clean model name

- Add support for Y4M

- Fix memory issue with padding

2.4 NNVC-9.1

The following changes were integrated:

- JVET-AH0096: LOP2 adaptive content: models and NNVC inference

- JVET-AH00189 + JVET-AH0205: HOP4 models + training scripts + NNVC changes

- Extend SPS model ID to support new models

- SADL update for HOP4 support

The following fixes and clean-up were performed:

- Fixes on issues avec NNVC-9.0 integration

- Fixes legacy memory issues from VTM

- JVET-AH0096: fix parameter value for training

2.5 Software version

NNVC-9.1 was tagged May 28th, 2024

NNVC-9.0 was tagged May 13th, 2024

NNVC-8.0 was tagged February 20th, 2024

NNVC-8.0rc3 was tagged February 20th, 2024.

NNVC-7.1 was tagged November 29th, 2023.

NNVC-7.0 was tagged November 3rd, 2023.

NNVC-6.1 was tagged September 25th, 2023 (fix).

NNVC-6.0 was tagged September 6th, 2023.

NNVC-5.1 was tagged July 19th, 2023.

NNVC-5.0 was tagged May 11th, 2023.

NNVC-3.0 (a.k.a VTM-11.0\_nnvc3.0) was tagged December 1st, 2022.

NCS-1.0 (a.k.a NNVC-3.0wip2) was tagged September 4th, 2022 (first release containing the FilterSets, using NNVC 2.0 as a base).

VTM-11.0\_nnvc-2.0 was tagged August 4th, 2022 (add deblocking in RDO).

VTM-11.0\_nnvc-1.0 was tagged May 6th, 2021 (VTM-11.0 base with MCTF enabled).

3 CTC performance

See configurations section for naming convention.

Please note that all results are using the Full CatRobot sequence (but using half the frames) which might give slightly different results due to the MCTF processing.

3.1 Comparison to VTM

NNVC-8.0 VTM vs NNVC-9.1 VTM

AI results are unchanged compared to NNVC-8.0.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random access Main10** | | | | | | | |
|  | **BD-rate Over NNVC-8.0** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | -0.07% | -0.44% | -0.23% | -0.10% | -0.28% | -0.27% | 103% | 100% |
| Class A2 | -0.07% | -0.25% | -0.38% | -0.14% | -0.17% | -0.41% | 100% | 102% |
| Class B | -0.27% | -0.49% | -0.52% | -0.31% | -0.63% | -0.48% | 101% | 98% |
| Class C | -0.01% | -0.22% | 0.00% | -0.03% | 0.03% | -0.03% | 102% | 98% |
| Class E |  |  |  |  |  |  |  |  |
| **Overall** | -0.12% | -0.36% | -0.29% | -0.16% | -0.29% | -0.30% | 101% | 99% |
| Class D | 0.10% | -0.58% | -0.33% | -0.33% | -1.43% | -0.67% | 99% | 97% |
| Class F | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 99% | 95% |
| Class H | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! | #DIV/0! |
|  |  |  |  |  |  |  |  |  |
|  | **Low delay B Main10** | | | | | | | |
|  | **BD-rate Over NNVC-8.0** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! | #DIV/0! |
| Class A2 | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! | #DIV/0! |
| Class B | -0.93% | -0.65% | -1.76% | -0.37% | -0.29% | -1.23% | 105% | 104% |
| Class C | 0.12% | 0.18% | -0.04% | -0.14% | 0.38% | 0.71% | 103% | 112% |
| Class E | -0.85% | -1.11% | -1.17% | -0.57% | -0.79% | -0.59% | 103% | 109% |
| **Overall** | -0.56% | -0.49% | -1.04% | -0.34% | -0.19% | -0.42% | 104% | 108% |
| Class D | 0.36% | -0.52% | -0.82% | 0.23% | -0.42% | -1.37% | 103% | 108% |
| Class F | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 104% | 108% |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra Main10** | | | | | | | |
|  | **BD-rate Over NNVC-8.0** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 96% | 96% |
| Class A2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 94% | 94% |
| Class B | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 96% | 91% |
| Class C | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100% | 98% |
| Class E | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 97% | 97% |
| **Overall** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 97% | 95% |
| Class D | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 103% | 105% |
| Class F | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 98% | 95% |

Note: Results from InterDigital, crosschecked by OPPO.

NNVC-9.1 VTM vs NNVC-9.1 anchor

The NNVC-9.1 anchor includes LOP.3 filter and Intra Prediction tools activated.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random access Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1 VTM** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | -8.81% | -11.81% | -12.53% | -9.44% | -13.31% | -14.42% | 122% | 8345% |
| Class A2 | -7.55% | -12.21% | -8.04% | -8.14% | -12.90% | -7.89% | 120% | 7955% |
| Class B | -6.90% | -14.15% | -12.10% | -7.52% | -15.40% | -14.41% | 124% | 8291% |
| Class C | -6.53% | -13.48% | -11.91% | -7.52% | -14.12% | -12.83% | 120% | 7846% |
| Class E |  |  |  |  |  |  |  |  |
| **Overall** | -7.31% | -13.11% | -11.32% | -8.03% | -14.14% | -12.69% | 122% | 8113% |
| Class D | -6.71% | -11.81% | -11.15% | -6.82% | -12.00% | -12.02% | 122% | 7597% |
| Class F | -3.82% | -7.53% | -6.07% | -5.01% | -10.67% | -9.12% | 131% | 3845% |
| Class H | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! | #DIV/0! |
|  |  |  |  |  |  |  |  |  |
|  | **Low delay B Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1 VTM** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! | #DIV/0! |
| Class A2 | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! | #DIV/0! |
| Class B | -5.49% | -9.96% | -7.87% | -6.52% | -9.48% | -12.65% | 115% | 7876% |
| Class C | -5.32% | -11.84% | -9.04% | -6.95% | -10.18% | -9.07% | 113% | 6950% |
| Class E | -5.66% | -4.34% | -3.26% | -7.88% | -1.94% | -4.39% | 130% | 8302% |
| **Overall** | -5.48% | -9.18% | -7.11% | -7.00% | -7.83% | -9.39% | 118% | 7654% |
| Class D | -6.05% | -9.91% | -7.88% | -7.22% | -4.80% | -9.28% | 111% | 6863% |
| Class F | -3.04% | -6.16% | -2.21% | -5.15% | -6.27% | -7.41% | 123% | 3760% |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1 VTM** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | -9.23% | -14.16% | -14.92% | -9.43% | -16.70% | -16.37% | 177% | 5844% |
| Class A2 | -7.53% | -13.55% | -10.64% | -8.25% | -14.07% | -10.25% | 174% | 5098% |
| Class B | -7.62% | -14.07% | -14.34% | -8.02% | -15.93% | -16.06% | 173% | 4941% |
| Class C | -7.45% | -13.40% | -13.11% | -8.33% | -16.12% | -15.73% | 164% | 3691% |
| Class E | -10.96% | -16.02% | -16.23% | -11.83% | -16.26% | -17.00% | 173% | 5427% |
| **Overall** | -8.39% | -14.17% | -13.86% | -9.00% | -15.85% | -15.23% | 172% | 4862% |
| Class D | -7.26% | -11.65% | -12.23% | -7.61% | -14.59% | -15.44% | 156% | 3266% |
| Class F | -5.20% | -9.48% | -8.66% | -5.59% | -12.06% | -11.70% | 136% | 4106% |

Note: Results from Interdigital, crosschecked by OPPO.

NNVC-9.1 VTM mode vs NNVC-9.1 HOP.4

The NNVC-9.1 where LOP.3 filter is replaced by HOP.4 and Intra Prediction tools activated.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random access Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1 VTM** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | -15.50% | -13.07% | -21.94% | -16.86% | -18.06% | -24.05% | 309% | 158621% |
| Class A2 | -14.88% | -19.05% | -25.60% | -14.34% | -18.43% | -23.26% | 305% | 148560% |
| Class B | -12.86% | -23.89% | -16.58% | -11.95% | -21.96% | -15.22% | 311% | 157039% |
| Class C | -13.88% | -17.91% | -16.95% | -12.80% | -14.69% | -14.09% | 235% | 119442% |
| Class E |  |  |  |  |  |  |  |  |
| **Overall** | -14.06% | -19.16% | -19.55% | -13.63% | -18.54% | -18.29% | 287% | 144665% |
| Class D | -14.88% | -17.91% | -18.12% | -11.21% | -13.74% | -12.83% | 234% | 125200% |
| Class F | -8.92% | -12.64% | -11.21% | -9.49% | -12.53% | -11.40% | 430% | 74404% |
| Class H | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! | #DIV/0! |
|  |  |  |  |  |  |  |  |  |
|  | **Low delay B Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1 VTM** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! | #DIV/0! |
| Class A2 | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! | #DIV/0! |
| Class B | -10.06% | -10.48% | -4.81% | -9.97% | -4.02% | -1.83% | 281% | 143293% |
| Class C | -12.09% | -9.21% | -5.43% | -11.14% | -3.23% | 2.09% | 233% | 121119% |
| Class E | -11.42% | -6.10% | -3.59% | -10.72% | -5.98% | -4.87% | 549% | 131867% |
| **Overall** | -11.07% | -8.96% | -4.71% | -10.55% | -4.25% | -1.28% | 313% | 132698% |
| Class D | -13.33% | -7.49% | -2.98% | -10.68% | 1.01% | 9.81% | 228% | 112300% |
| Class F | -9.11% | -10.04% | -7.67% | -10.25% | -6.42% | -8.11% | 405% | 81716% |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1 VTM** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | -13.50% | -11.49% | -19.38% | -15.11% | -16.89% | -21.60% | 360% | #NUM! |
| Class A2 | -13.07% | -17.24% | -21.11% | -13.81% | -18.17% | -18.36% | 272% | #NUM! |
| Class B | -11.80% | -17.15% | -14.49% | -11.73% | -17.33% | -14.85% | 253% | #NUM! |
| Class C | -12.82% | -14.55% | -16.57% | -12.58% | -13.97% | -15.75% | 192% | #NUM! |
| Class E | -16.51% | -20.23% | -19.51% | -16.28% | -19.24% | -20.02% | 264% | #NUM! |
| **Overall** | -13.31% | -16.16% | -17.71% | -13.59% | -16.97% | -17.62% | 257% | #NUM! |
| Class D | -12.10% | -13.61% | -17.02% | -11.17% | -13.72% | -15.80% | 171% | #NUM! |
| Class F | -9.63% | -13.10% | -12.71% | -9.43% | -13.31% | -13.59% | 166% | #NUM! |

Note: Results from InterDigital, crosschecked by OPPO.

NNVC-9.1 VTM mode vs NNVC-9.1 VLOP

The NNVC-9.1 where LOP.3 filter is replaced by VLOP and Intra Prediction tools activated.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random access Main10** | | | | | | | | | | | | |
|  | **BD-rate Over NNVC-9.1 VTM** | | | | | | | | | | | | |
|  | Y-PSNR | U-PSNR | | V-PSNR | | Y-MSIM | | U-MSIM | | V-MSIM | | EncT | DecT CPU |
| Class A1 | -6.10% | -4.74% | | -5.50% | | -6.36% | | -4.97% | | -5.27% | | 118% | 3201% |
| Class A2 | -5.24% | -4.48% | | -3.39% | | -5.19% | | -4.01% | | -1.87% | | 117% | 3008% |
| Class B | -5.05% | -5.92% | | -5.74% | | -5.30% | | -5.49% | | -4.97% | | 118% | 3017% |
| Class C | -5.07% | -6.05% | | -5.52% | | -5.47% | | -5.72% | | -4.13% | | 118% | 2800% |
| Class E |  |  | |  | |  | |  | |  | |  |  |
| **Overall** | -5.30% | -5.43% | | -5.16% | | -5.54% | | -5.15% | | -4.19% | | 118% | 2991% |
| Class D | -5.39% | -5.88% | | -6.18% | | -5.27% | | -4.80% | | -4.98% | | 116% | 2855% |
| Class F | -2.85% | -4.21% | | -3.48% | | -3.37% | | -4.35% | | -2.50% | | 121% | 1174% |
| Class H | #VALUE! | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #DIV/0! | #DIV/0! |
|  |  |  | |  | |  | |  | |  | |  |  |
|  | **Low delay B Main10** | | | | | | | | | | | | |
|  | **BD-rate Over NNVC-9.1 VTM** | | | | | | | | | | | | |
|  | Y-PSNR | U-PSNR | | V-PSNR | | Y-MSIM | | U-MSIM | | V-MSIM | | EncT | DecT CPU |
| Class A1 | #VALUE! | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #DIV/0! | #DIV/0! |
| Class A2 | #VALUE! | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #DIV/0! | #DIV/0! |
| Class B | -3.66% | -4.81% | | -3.13% | | -4.43% | | -7.41% | | -6.02% | | 113% | 4079% |
| Class C | -3.74% | -4.15% | | -2.68% | | -4.77% | | -6.62% | | -3.88% | | 112% | 3624% |
| Class E | -3.72% | 0.58% | | -0.44% | | -4.97% | | -1.40% | | -3.85% | | 113% | 3580% |
| **Overall** | -3.70% | -3.24% | | -2.31% | | -4.68% | | -5.64% | | -4.76% | | 113% | 3795% |
| Class D | -4.46% | -2.04% | | -0.73% | | -5.27% | | -5.46% | | -3.49% | | 108% | 3429% |
| Class F | -1.90% | -1.33% | | -0.89% | | -2.84% | | -2.04% | | -3.15% | | 117% | 1761% |
|  | **All Intra Main10** | | | | | | | | | | | | | |
|  | **BD-rate Over NNVC-9.1 VTM** | | | | | | | | | | | | | |
|  | Y-PSNR | | U-PSNR | | V-PSNR | | Y-MSIM | | U-MSIM | | V-MSIM | EncT | DecT CPU | |
| Class A1 | -7.49% | | -8.00% | | -8.23% | | -7.78% | | -9.35% | | -8.33% | 159% | 2970% | |
| Class A2 | -6.26% | | -7.29% | | -6.16% | | -6.41% | | -6.81% | | -4.63% | 165% | 2456% | |
| Class B | -6.48% | | -7.64% | | -8.22% | | -6.58% | | -7.43% | | -7.36% | 161% | 2549% | |
| Class C | -6.37% | | -7.86% | | -7.91% | | -6.89% | | -8.04% | | -7.10% | 160% | 2054% | |
| Class E | -9.27% | | -8.43% | | -7.81% | | -9.29% | | -7.53% | | -6.13% | 157% | 2823% | |
| **Overall** | -7.05% | | -7.82% | | -7.74% | | -7.27% | | -7.80% | | -6.80% | 160% | 2519% | |
| Class D | -6.42% | | -7.61% | | -8.31% | | -6.52% | | -7.95% | | -8.06% | 153% | 1943% | |
| Class F | -4.39% | | -6.21% | | -5.97% | | -4.40% | | -5.66% | | -4.67% | 134% | 1839% | |

Note: Results from Qualcomm crosschecked by InterDigital, OPPO.

NNVC-9.1 VTM vs NNVC-9.1 LOP2 adaptive content

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random access Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1 VTM** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | -10.05% | -10.93% | -15.36% | -11.89% | -12.13% | -14.22% | 236% | 6826% |
| Class A2 | -7.44% | -14.06% | -10.75% | -6.93% | -12.79% | -8.64% | 235% | 6185% |
| Class B | -7.85% | -17.68% | -15.71% | -6.12% | -16.58% | -13.56% | 236% | 7166% |
| Class C | -6.96% | -15.00% | -15.18% | -6.88% | -13.50% | -13.15% | 237% | 6142% |
| Class E |  |  |  |  |  |  |  |  |
| **Overall** | -7.97% | -14.89% | -14.51% | -7.64% | -14.11% | -12.60% | 236% | 6613% |
| Class D | -7.27% | -14.40% | -15.26% | -6.61% | -12.21% | -12.92% | 236% | 5540% |
| Class F | -4.08% | -10.03% | -10.20% | -4.25% | -10.91% | -10.91% | 255% | 3628% |

Note: Results from Nokia crosscheck by xxx,

NNVC-9.1 VTM vs NNVC-9.1 RPR 2x

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random access Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1 VTM** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | 7.24% | -11.66% | -7.75% | -35.92% | -31.51% | -23.94% | 76% | 60% |
| Class A2 | -19.19% | -23.88% | -15.45% | -40.34% | -28.89% | -33.49% | 78% | 68% |
| Class B | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100% | 100% |
| Class C | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100% | 100% |
| Class E |  |  |  |  |  |  |  |  |
| **Overall** | -2.39% | -7.11% | -4.64% | -15.25% | -12.08% | -11.49% | 90% | 83% |
| Class D | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100% | 100% |
| Class F | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100% | 100% |

Note: Results from InterDigital, crosschecked by xxx.

Please note that some rate-distortion curves are not monotonic and cause bad bdrate estimation.

NNVC-9.1 VTM RPR 2x vs NNVC-9.1 NNSR

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random access Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1 VTM** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | 1387.23% | -14.29% | -13.06% | -12.15% | 4.13% | -24.17% | 147% | 7636% |
| Class A2 | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #NUM! | #NUM! |
| Class B | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100% | 100% |
| Class C | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100% | 100% |
| Class E |  |  |  |  |  |  |  |  |
| **Overall** | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #NUM! | #NUM! |
| Class D | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100% | 100% |
| Class F | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100% | 100% |

Please note that some rate-distortion curves are not monotonic and cause bad bdrate estimation.

Note: Results from InterDigital crosscheck by xxx,

Comparison to previous NNVC anchor

NNVC-8.0 anchor vs NNVC-9.1 anchor

The results reflect LOP/nnvc progress between NNVC 8.0 (as anchor) and NNVC 9.1 (as test).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random access Main10** | | | | | | | | | | | | | | |
|  | **BD-rate Over NNVC-8.0** | | | | | | | | | | | | | | |
|  | Y-PSNR | U-PSNR | | V-PSNR | | Y-MSIM | | U-MSIM | | V-MSIM | | EncT | | DecT CPU | |
| Class A1 | -1.04% | -2.39% | | -2.41% | | -1.05% | | -2.66% | | -4.67% | | 103% | | 109% | |
| Class A2 | -0.88% | 0.23% | | 1.54% | | -1.45% | | -1.81% | | -0.81% | | 105% | | 115% | |
| Class B | -0.61% | -0.82% | | 0.14% | | -1.08% | | -3.42% | | -3.23% | | 103% | | 109% | |
| Class C | 0.06% | 1.35% | | 2.93% | | -0.47% | | -1.22% | | 0.03% | | 102% | | 107% | |
| Class E |  |  | |  | |  | |  | |  | |  | |  | |
| **Overall** | -0.57% | -0.35% | | 0.65% | | -0.98% | | -2.36% | | -2.17% | | 103% | | 110% | |
| Class D | 0.62% | 2.93% | | 4.18% | | -0.61% | | -0.26% | | 0.55% | | 102% | | 101% | |
| Class F | -0.08% | 2.26% | | 3.86% | | -0.59% | | -0.29% | | 1.36% | | 101% | | 111% | |
| Class H | #VALUE! | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #DIV/0! | | #DIV/0! | |
|  |  |  | |  | |  | |  | |  | |  | |  | |
|  | **Low delay B Main10** | | | | | | | | | | | | | | |
|  | **BD-rate Over NNVC-8.0** | | | | | | | | | | | | | | |
|  | Y-PSNR | U-PSNR | | V-PSNR | | Y-MSIM | | U-MSIM | | V-MSIM | | EncT | | DecT CPU | |
| Class A1 | #VALUE! | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #DIV/0! | | #DIV/0! | |
| Class A2 | #VALUE! | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #DIV/0! | | #DIV/0! | |
| Class B | -1.10% | 3.48% | | 4.33% | | -0.70% | | 6.23% | | 4.30% | | 108% | | 108% | |
| Class C | 0.37% | 2.66% | | 7.10% | | 0.33% | | 7.33% | | 10.62% | | 106% | | 109% | |
| Class E | -0.33% | 3.36% | | 7.97% | | -0.48% | | 7.76% | | 9.19% | | 112% | | 116% | |
| **Overall** | -0.42% | 3.18% | | 6.16% | | -0.30% | | 6.98% | | 7.63% | | 108% | | 110% | |
| Class D | 0.87% | 3.34% | | 7.48% | | 0.41% | | 9.41% | | 9.45% | | 104% | | 105% | |
| Class F | 0.04% | 2.85% | | 7.71% | | -0.68% | | 4.50% | | 7.73% | | 105% | | 105% | |
|  | **All Intra Main10** | | | | | | | | | | | | | |
|  | **BD-rate Over NNVC-8.0** | | | | | | | | | | | | | |
|  | Y-PSNR | | U-PSNR | | V-PSNR | | Y-MSIM | | U-MSIM | | V-MSIM | EncT | DecT CPU | |
| Class A1 | -0.68% | | -1.78% | | -2.99% | | -0.47% | | -2.33% | | -4.43% | 102% | 107% | |
| Class A2 | -0.42% | | -1.01% | | 0.74% | | -0.88% | | -2.35% | | -1.07% | 102% | 109% | |
| Class B | -0.29% | | -1.22% | | -0.90% | | -0.60% | | -3.14% | | -3.12% | 100% | 103% | |
| Class C | 0.09% | | 0.39% | | 1.59% | | -0.41% | | -2.35% | | -1.49% | 99% | 102% | |
| Class E | -0.28% | | -2.24% | | -1.38% | | -1.01% | | -3.35% | | -3.39% | 100% | 104% | |
| **Overall** | -0.29% | | -1.09% | | -0.50% | | -0.65% | | -2.73% | | -2.68% | 100% | 105% | |
| Class D | 0.43% | | 1.23% | | 3.33% | | -0.17% | | -1.25% | | -0.11% | 102% | 99% | |
| Class F | 0.08% | | 1.52% | | 1.99% | | -0.46% | | -1.06% | | -0.16% | 100% | 102% | |

Note: Results from InterDigital, crosschecked by OPPO.

Comparison to NNVC-9.1 anchor

NNVC-9.1 vs NNVC-9.1 HOP.4

The results below reflect LOP/HOP performance differences (LOP set as anchor, HOP as test).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random access Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | -7.32% | -1.69% | -10.91% | -8.17% | -5.85% | -11.57% | 254% | 1901% |
| Class A2 | -7.92% | -7.75% | -19.12% | -6.71% | -6.17% | -16.82% | 254% | 1867% |
| Class B | -6.44% | -11.72% | -5.26% | -4.78% | -8.28% | -0.97% | 250% | 1894% |
| Class C | -7.88% | -5.13% | -5.77% | -5.70% | -0.63% | -1.43% | 196% | 1522% |
| Class E |  |  |  |  |  |  |  |  |
| **Overall** | -7.30% | -7.16% | -9.30% | -6.09% | -5.33% | -6.39% | 236% | 1783% |
| Class D | -8.77% | -6.96% | -8.00% | -4.70% | -1.95% | -1.19% | 192% | 1648% |
| Class F | -5.40% | -5.74% | -5.57% | -4.77% | -2.25% | -2.61% | 327% | 1935% |
| Class H | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! | #DIV/0! |
|  |  |  |  |  |  |  |  |  |
|  | **Low delay B Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! | #DIV/0! |
| Class A2 | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! | #DIV/0! |
| Class B | -4.85% | -0.58% | 3.15% | -3.71% | 6.63% | 11.85% | 244% | 1819% |
| Class C | -7.16% | 2.91% | 3.66% | -4.53% | 7.72% | 11.87% | 207% | 1743% |
| Class E | -6.10% | -1.79% | -0.04% | -3.05% | -3.92% | -0.25% | 423% | 1588% |
| **Overall** | -5.94% | 0.28% | 2.52% | -3.82% | 4.35% | 8.83% | 265% | 1734% |
| Class D | -7.75% | 2.21% | 5.28% | -3.83% | 6.27% | 19.44% | 206% | 1636% |
| Class F | -6.31% | -4.23% | -5.47% | -5.40% | -0.20% | -0.92% | 330% | 2173% |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | -4.68% | 3.02% | -5.16% | -6.22% | -0.31% | -6.40% | 204% | 1902% |
| Class A2 | -6.01% | -3.84% | -11.56% | -6.02% | -4.25% | -8.88% | 156% | 1811% |
| Class B | -4.56% | -3.45% | -0.16% | -4.01% | -1.72% | 1.52% | 146% | 1809% |
| Class C | -5.87% | -1.24% | -4.07% | -4.63% | 2.73% | -0.06% | 117% | 1574% |
| Class E | -6.28% | -5.06% | -4.02% | -4.96% | -3.63% | -3.78% | 153% | 1726% |
| **Overall** | -5.40% | -2.22% | -4.41% | -5.01% | -1.24% | -2.77% | 150% | 1755% |
| Class D | -5.25% | -2.16% | -5.67% | -3.86% | 1.13% | -0.90% | 110% | 1514% |
| Class F | -4.76% | -4.01% | -4.46% | -4.06% | -1.37% | -2.16% | 123% | 1811% |

Note: Results from InterDigital, crosschecked by OPPO.

NNVC-9.1 vs NNVC-9.1 VLOP

The results below reflect LOP/VLOP performance differences (LOP set as anchor, VLOP as test).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random access Main10** | | | | | | | | | | | | | | |
|  | **BD-rate Over NNVC-9.1** | | | | | | | | | | | | | | |
|  | Y-PSNR | U-PSNR | | V-PSNR | | Y-MSIM | | U-MSIM | | V-MSIM | | EncT | | DecT CPU | |
| Class A1 | 2.97% | 8.41% | | 8.07% | | 3.39% | | 10.44% | | 10.88% | | 94% | | 50% | |
| Class A2 | 2.52% | 9.31% | | 5.15% | | 3.20% | | 10.92% | | 6.59% | | 96% | | 49% | |
| Class B | 1.98% | 9.72% | | 7.32% | | 2.39% | | 12.05% | | 11.20% | | 95% | | 50% | |
| Class C | 1.57% | 8.72% | | 7.39% | | 2.19% | | 10.18% | | 10.34% | | 95% | | 50% | |
| Class E |  |  | |  | |  | |  | |  | |  | |  | |
| **Overall** | 2.18% | 9.11% | | 7.05% | | 2.70% | | 11.00% | | 9.99% | | 95% | | 50% | |
| Class D | 1.41% | 6.80% | | 5.70% | | 1.64% | | 8.37% | | 8.06% | | 95% | | 49% | |
| Class F | 1.03% | 3.79% | | 2.84% | | 1.76% | | 7.63% | | 7.75% | | 91% | | 43% | |
| Class H | #VALUE! | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #DIV/0! | | #DIV/0! | |
|  |  |  | |  | |  | |  | |  | |  | |  | |
|  | **Low delay B Main10** | | | | | | | | | | | | | | |
|  | **BD-rate Over NNVC-9.1** | | | | | | | | | | | | | | |
|  | Y-PSNR | U-PSNR | | V-PSNR | | Y-MSIM | | U-MSIM | | V-MSIM | | EncT | | DecT CPU | |
| Class A1 | #VALUE! | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #DIV/0! | | #DIV/0! | |
| Class A2 | #VALUE! | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #VALUE! | | #DIV/0! | | #DIV/0! | |
| Class B | 1.94% | 5.77% | | 5.15% | | 2.25% | | 2.38% | | 7.78% | | 98% | | 52% | |
| Class C | 1.67% | 8.76% | | 7.14% | | 2.35% | | 4.00% | | 6.14% | | 99% | | 52% | |
| Class E | 2.05% | 5.07% | | 3.09% | | 3.09% | | 0.67% | | 0.73% | | 87% | | 43% | |
| **Overall** | 1.88% | 6.59% | | 5.29% | | 2.49% | | 2.50% | | 5.47% | | 95% | | 50% | |
| Class D | 1.68% | 8.61% | | 7.64% | | 2.11% | | 0.30% | | 6.77% | | 97% | | 50% | |
| Class F | 1.19% | 5.27% | | 1.50% | | 2.50% | | 4.69% | | 4.63% | | 95% | | 47% | |
|  | **All Intra Main10** | | | | | | | | | | | | | |
|  | **BD-rate Over NNVC-9.1** | | | | | | | | | | | | | |
|  | Y-PSNR | | U-PSNR | | V-PSNR | | Y-MSIM | | U-MSIM | | V-MSIM | EncT | DecT CPU | |
| Class A1 | 1.93% | | 7.48% | | 8.02% | | 1.80% | | 9.39% | | 9.84% | 100% | 56% | |
| Class A2 | 1.39% | | 7.55% | | 5.10% | | 1.98% | | 8.84% | | 6.33% | 107% | 59% | |
| Class B | 1.24% | | 7.54% | | 7.17% | | 1.53% | | 10.28% | | 10.44% | 107% | 61% | |
| Class C | 1.17% | | 6.61% | | 6.17% | | 1.56% | | 10.09% | | 10.56% | 104% | 62% | |
| Class E | 1.90% | | 8.98% | | 10.11% | | 2.80% | | 10.45% | | 13.08% | 100% | 57% | |
| **Overall** | 1.47% | | 7.57% | | 7.23% | | 1.87% | | 9.88% | | 10.12% | 104% | 59% | |
| Class D | 0.91% | | 4.68% | | 4.67% | | 1.19% | | 8.02% | | 9.01% | 98% | 65% | |
| Class F | 0.88% | | 3.78% | | 3.02% | | 1.25% | | 7.71% | | 8.03% | 100% | 55% | |

Note: Results from InterDigital, crosschecked by OPPO.

NNVC-9.1 vs NNVC-9.1 LOP2 adaptive content

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random access Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1 VTM** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | -1.38% | 1.12% | -3.34% | -2.73% | 1.77% | 0.33% |  |  |
| Class A2 | 0.14% | -1.93% | -2.95% | 1.39% | 0.59% | -0.76% |  |  |
| Class B | -1.02% | -4.26% | -4.20% | 1.48% | -1.37% | 0.95% |  |  |
| Class C | -0.46% | -1.76% | -3.74% | 0.69% | 0.88% | -0.30% |  |  |
| Class E |  |  |  |  |  |  |  |  |
| **Overall** | -0.71% | -2.05% | -3.65% | 0.41% | 0.25% | 0.15% |  |  |
| Class D | -0.60% | -2.98% | -4.63% | 0.22% | -0.21% | -1.09% |  |  |
| Class F | -0.29% | -2.82% | -4.53% | 0.58% | -0.66% | -2.37% |  |  |

Note: Results from Nokia crosschecked by xxxx.

NNVC-9.1 RPR 2x vs NNVC-9.1 NNSR

Please note that some rate-distortion curves are not monotonic and cause bad bdrate estimation.

Note: Results from InterDigital crosscheck by xxx,

Other tools

Other results remain the same as tools were not changed. Please note that VTM anchor and NNVC variants results changed due to MCTF improvement.

NNVC-9.1-HOP3 vs NNVC-9.1-HOP4

These results show the progress of the HOP model, other aspects being the same.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Random access Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1 HOP3** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | -0.35% | -3.58% | -3.71% | -0.67% | -4.90% | -3.91% | 117% | 125% |
| Class A2 | -0.13% | -5.84% | -16.86% | 0.01% | -6.38% | -17.41% | 121% | 127% |
| Class B | -0.44% | -12.24% | -4.14% | -0.21% | -11.18% | -2.66% | 121% | 129% |
| Class C | -0.48% | -0.42% | -0.07% | -0.22% | -0.96% | -0.48% | 108% | 113% |
| Class E |  |  |  |  |  |  |  |  |
| **Overall** | -0.37% | -6.07% | -5.51% | -0.26% | -6.24% | -5.28% | 117% | 123% |
| Class D | -0.22% | -1.43% | -0.53% | 0.24% | -2.16% | -0.18% | 108% | 110% |
| Class F | -0.36% | 0.35% | -0.23% | -0.42% | 0.58% | 0.57% | 122% | 126% |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Low delay B Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1 HOP3** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! | #DIV/0! |
| Class A2 | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! | #DIV/0! |
| Class B | 0.99% | -1.59% | 1.60% | 1.28% | 7.83% | 9.54% | 112% | 114% |
| Class C | 0.32% | 5.48% | 7.87% | 1.35% | 9.49% | 16.90% | 109% | 112% |
| Class E | 1.27% | 4.47% | 4.45% | 2.74% | 3.71% | 9.37% | 121% | 85% |
| **Overall** | 0.83% | 2.28% | 4.40% | 1.67% | 7.35% | 11.95% | 113% | 105% |
| Class D | 0.45% | 8.10% | 7.40% | 1.89% | 12.59% | 19.33% | 109% | 107% |
| Class F | -0.24% | 2.23% | 1.78% | -0.07% | 6.06% | 9.63% | 117% | 124% |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra Main10** | | | | | | | |
|  | **BD-rate Over NNVC-9.1 HOP3** | | | | | | | |
|  | Y-PSNR | U-PSNR | V-PSNR | Y-MSIM | U-MSIM | V-MSIM | EncT | DecT CPU |
| Class A1 | -0.73% | -2.83% | -4.12% | -0.84% | -3.96% | -4.72% | 114% | 135% |
| Class A2 | -0.64% | -7.19% | -13.62% | -0.49% | -8.45% | -12.83% | 110% | 137% |
| Class B | -0.73% | -8.21% | -4.42% | -0.68% | -7.38% | -3.67% | 110% | 141% |
| Class C | -0.61% | -1.69% | -1.55% | -0.71% | -1.46% | -1.49% | 101% | 137% |
| Class E | -0.83% | -5.77% | -5.28% | -0.33% | -6.29% | -5.68% | 108% | 140% |
| **Overall** | -0.70% | -5.29% | -5.41% | -0.62% | -5.49% | -5.22% | 108% | 138% |
| Class D | -0.30% | -1.80% | -1.72% | -0.27% | -1.97% | -2.97% | 99% | 138% |
| Class F | -0.82% | -1.57% | -2.78% | -0.94% | -1.58% | -2.20% | 103% | 139% |

Note: Results from InterDigital, crosschecked by OPPO.

4 Contributions

We have 8 contributions for AhG14.

JVET-AI0041[AHG11] [AHG14] Teleconference on NNVC E. Alshina, F. Galpin

JVET-AI0053AHG14: The extension of SADL library N. Fu, W. Bao, J. Zhang, Z. Chen (Wuhan Univ.)

JVET-AI0057 AHG14: SADL update F. Galpin, F. Urban, T. Poirier (InterDigital)

JVET-AI0124 AHG 14: Alignment of reference picture setting in NNVC with those in VTM K. Andersson, D. Liu, J.Ström (Ericsson)

JVET-AI0128 AHG14: Update of Guidelines for NNVC software development F. Galpin, E. Francois (InterDigital)

JVET-AI0155 AhG14: Report of HOP3 training using additional dataset from JVET-AH0120 F.galpin, T. Poirier (InterDigital),

JVET-AI0174 AhG 14: SADL library extension Y. Li, D. Rusanovskyy, M. Karczewicz (Qualcomm)

JVET-AI0230 AHG14: Fix for mismatch between encoding and decoding in the NNVC with palette on Zhengang Li, Xing Zeng, Mneghu Jia, Zhen Zhang, Yonghua Wang, Jinchi Zhang, Cheng Huang(ZTE)

5 Configurations

The following configurations is used to generate the different NNVC results.

The column “tested” is read as follow:

- Y: the configuration has been tested using the new NNVC software

- P: the results are the ones from previous NNVC software basis

- N: not tested.

The column “xcheck” is read as follow:

- Y: the test has been cross-checked

- P: no cross-checked performed but results are consistent with previous version on NNVC

- N: no cross-check available

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Tools | Configuration | Tested | Xcheck |
| NNVC VTM mode | none | encoder\_xxx\_vtm.cfg | Y |  |
| NNVC Anchor/EE1 | Intra Pred + LOP.3 | encoder\_xxx\_nnvc.cfg | Y |  |
| NNVC. HOP | Intra Pred + HOP.4 | encoder\_xxx\_nnvc.cfg + nn-based/HOP4.cfg | Y |  |
| HOP only | HOP | encoder\_xxx\_vtm.cfg + nn-based/HOP4.cfg |  |  |
| Intra lower complexity | NN Intra lower complexity | nn-based/intra2.cfg |  |  |
| Sr | Super-resolution | nn-based/nnsr.cfg + nn-based/nnsr\_classAx.cfg |  |  |
| Pf | Adaptive post-filters | nn-based/nnpf/nnpf\_xxx.cfg |  |  |
| ALOP | Intra pred+adaptive LOP | encoder\_xxx\_vtm.cfg +nn-based/intra2.cfg+xxx |  |  |

Deprecated options:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| set0 | Loop filter set #0 | encoder\_xxx\_vtm.cfg + nn-based/NnlfOption\_1.cfg | P |  |
| set1 | Loop filter set #1 | encoder\_xxx\_vtm.cfg + nn-based/NnlfOption\_2.cfg | P |  |
| set0+rdo | Loop filter set #0 + Rdo | nn-based/NnlfOption\_1.cfg + --EncNnlfOpt=1 | P |  |
| set1+rdo+intra+temporal filter | Loop filter set #1 + Temporal filter | nn-based/NnlfOption\_2.cfg  + --NnlfSet1Multiframe=1 | P |  |

6 Recommendations

The AHG recommends to:

- Continue to develop NNVC software.

- Improve the software documentation.

- Encourage people to report all (potential) bugs that they are finding using GitLab Issues functionality <https://vcgit.hhi.fraunhofer.de/jvet-ahg-nnvc/VVCSoftware_VTM/-/issues>

- Encourage people to submit merge requests fixing identified bugs.

[JVET-AI0015](https://jvet-experts.org/doc_end_user/current_document.php?id=14391) JVET AHG report: Gaming content compression (AHG15) [S. Puri, J. Sauer (co-chairs), R. Chernyak, A. Duenas, L. Wang (vice chairs)]

**Results** based **on draft CTC**

More details in JVET-AI0043.

***ECM-12.1 vs VTM-11ecm12.0***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra Main 10** | | | | | |
|  | **Over Anchor** | | | | | |
|  | Y | U | V | EncT | DecT | VmPeak |
| Class G1 | -10.07% | -30.41% | -25.28% | 918.83% | 410.75% | #DIV/0! |
| Class G2 | -14.57% | -26.96% | -27.88% | 830.50% | 482.62% | #DIV/0! |
| **Overall** | -12.84% | -28.29% | -26.88% | 866.22% | 451.26% | #DIV/0! |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Random Access Main 10** | | | | | |
|  | **Over Anchor** | | | | | |
|  | Y | U | V | EncT | DecT | VmPeak |
| Class G1 | -25.61% | -45.42% | -39.46% | 782.32% | 1045.63% | #DIV/0! |
| Class G2 | -20.13% | -36.32% | -36.36% | 761.79% | 913.85% | #DIV/0! |
| **Overall** | -22.24% | -39.82% | -37.55% | 770.28% | 966.61% | #DIV/0! |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Low delay B Main 10** | | | | | |
|  | **Over Anchor** | | | | | |
|  | Y | U | V | EncT | DecT | VmPeak |
| Class G1 | -17.60% | -55.86% | -47.82% | 743.02% | 878.87% | #DIV/0! |
| Class G2 | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! |
| Class G2 w/o BaoleiMan | -14.77% | -46.75% | -47.64% |  |  |  |
| **Overall** | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #VALUE! | #DIV/0! |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Low delay P Main 10** | | | | | |
|  | **Over Anchor** | | | | | |
|  | Y | U | V | EncT | DecT | VmPeak |
| Class G1 | -16.29% | -55.48% | -47.34% | 678.44% | 730.67% | #DIV/0! |
| Class G2 | -13.42% | -45.77% | -44.79% | 881.12% | 861.67% | #DIV/0! |
| **Overall** | -14.61% | -49.81% | -45.85% | 790.19% | 804.45% | #DIV/0! |

**Input documents**

***New test sequences***

* JVET-AI0044: AHG15: Improved versions of gaming content sequences by Huawei

***Auxililary data***

* JVET-AI0054: AHG15: Reading the camera parameters for gaming sequences of class G1

***Recommendations***

The AHG recommends to:

* Review input documents on gaming content compression
* Review testing conditions and refine them, if necessary
* Review gaming content testset (classes G1 and G2) and shorten them, if necessary
* Identify if/how auxiliary information can be used for coding of gaming content

[JVET-AI0016](https://jvet-experts.org/doc_end_user/current_document.php?id=14392) JVET AHG report: Generative face video compression (AHG16) [Y. Ye (chair), H.-B. Teo, Z. Lyu, S. McCarthy, S. Wang (vice chairs)]

AHG activities

Regarding the mandate on GFVC software, the AHG16 GFVC software tool and accompanying usage instructions and exemplar configurations for experimentation are maintained in the GIT repository at https://vcgit.hhi.fraunhofer.de/jvet-ahg-gfvc. During this AHG period, the AHG16 software was updated by adding two additional GFVC models (DAC and HDAC), and replacing the previous lightweight CFTE model with a new lightweight CFTE model with lower model complexity and computational complexity. As a result, the current AHG16 software supports a total of six GFVC models, FOMM, FV2V, DAC, HDAC, CFTE and lightweight CFTE. Further, initial implementation of the GFV SEI message was submitted to the TuC branch of VTM as a new merge request. The submitted GFV SEI software implementation integrates the GFV SEI signaling and parsing into the VTM software, following the syntax defined in the VSEI TuC draft (JVET-AH2032). Currently, the GFV SEI software is invoked as a standalone software separately from the AHG16 software: at the encoder side, the AHG16 software performs analysis on the input video and writes the GFV parameters into a file, which is then read and packaged into GFV SEI messages by the SEI software; at the decoder, this process is reversed, where the GFV SEI messages are parsed by the SEI software into a file containing the GFV parameters, which is then fed into the AHG16 software together with VVC-decoded key pictures to render the reconstructed video. At this meeting, a new input contribution JVET-AI0195 proposes to streamline the process by combining the AHG16 software and the SEI software into one automated process that can encode and decode the key pictures, generate and parse the GFV SEI messages, and generate the final output video without manual intervention.

Regarding the mandate on GFVC performance evaluation, JVET-AI0047 proposes a new set of higher resolution (512x512) test content for GFVC experimentation, and provides experimental results of 512x512 content following GFVC test configurations. JVET-AI0048 proposes to improve GFVC performance, esp. for head-and-shoulder content, by retraining the models with more diverse training data.

A number of new input contributions are related to the mandate on coordination with AHG9 to develop the GFV SEI message. JVET-AI0137 proposes to add pupil information. JVET-AI0156, JVET-AI0184, JVET-AI189, JVET-AI190, JVET-AI0191, and JVET-AI0193 propose various bug fixes and refinements to GFV SEI and raise some topics for discussion. JVET-AI0156 also proposes to move GFV and GFVE SEI messages into VSEI v4 draft. JVET-AI0186 and JVET-AI0192 propose to add timing information to GFV SEI. JVET-AI0194 proposes to add chroma key information to GFV SEI. Besides the streamlined software process as mentioned above, JVET-AI0195 also proposes modified syntax coding in order to reduce GFV SEI overhead.

Related contributions

The following list of input contributions to this meeting are identified as being related to the activities of AHG16:

1. JVET-AI0047 AhG16: Higher-resolution Test Sequences and Test Results for Generative Face Video Compression [B. Chen, S. Yin, Y. Ye, R.-L. Liao, J. Chen (Alibaba), S. Wang (CityU)]

2. JVET-AI0048 AhG16: Improving GFVC Performance with Diverse Training Data [B. Chen, Y. Ye, J. Chen, R.-L. Liao (Alibaba), Z. Zhang, S. Yin, S. Wang (CityU)]

3. JVET-AI0137 AHG16: Update on Pupil position SEI message for Generative Face Video [F. Ma, A. Trioux, Y. Gao, Y. Yao, F. Yang (Xidian Univ.), F. Xing, Z. Wang (Hisense)] [late] [miss]

4. JVET-AI0156 AHG9/AHG16: On generative face video SEI messages [J. Chen, B. Chen, Y. Ye (Alibaba), S. Yin, S. Wang (CityU), P. Yin, S. McCarthy (Dolby), H.-B. Teo (Panasonic)]

5. JVET-AI0184 AHG9: Some comments and editorial changes on the GFV and GFVE SEI messages [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

6. JVET-AI0186 AHG9: On picture order count and timing information for gfv generated pictures [L. Chen, O. Chubach, Y.-W. Huang, L. Shaw (MediaTek)]

7. JVET-AI0189 AHG9: On signalling and/or specifying the translator and the generator NNs for the GFV SEI message [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

8. JVET-AI0190 AHG9: On GFV SEI persistence and picture presence [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

9. JVET-AI0191 AHG9: On GFV facial parameters signalling [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

10. JVET-AI0192 AHG9: On GFV picture order and timing [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

11. JVET-AI0193 AHG9/AHG16: On no display flag in generative face video SEI message [S. McCarthy, S. Gehlot, G. J. Sullivan, P. Yin (Dolby)]

12. JVET-AI0194 AHG9/AHG16: On chroma key fusion for the generative face video SEI message [S. Gehlot, G.-M. Su, P. Yin, S. McCarthy, G. J. Sullivan (Dolby)]

13. JVET-AI0195 AhG9/16: Updates on GFVC common software tools and GFV SEI message [B. Chen, J. Chen, Y. Ye, R.-L. Liao (Alibaba), S. Yin, S. Wang (CityU)] [late]

Recommendations

The AHG recommends to:

- Review related contributions;

- To continue AHG16 to study GFVC-related topics.

# Project development (24)

## AHG1: Development, deployment and advertisement of standards (4)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0020](https://jvet-experts.org/doc_end_user/current_document.php?id=14289) Deployment status of the HEVC standard [G. J. Sullivan]

[JVET-AI0021](https://jvet-experts.org/doc_end_user/current_document.php?id=14290) Deployment status of the VVC standard [G. J. Sullivan]

[JVET-AI0216](https://jvet-experts.org/doc_end_user/current_document.php?id=14475) On Future Video Codec Design and Evaluation [A. Stein, S. Ferrara (V-Nova)]

[JVET-AI0247](https://jvet-experts.org/doc_end_user/current_document.php?id=14506) Proposed timeline and requirements for the next generation video coding standard Y. Ye (Alibaba), M. Karczewicz (Qualcomm), M.-L. Champel (Xiaomi), P. Onno (Canon), L. Zhang (Bytedance), X. Wang (Kwai), D. Wang (OPPO), Z. Lyu (vivo), Y. Huo (Transsion), A. Luthra (Picsel Labs), E. François (InterDigital), H.-B. Teo (Panasonic) [late]

## AHG2: Text development and errata reporting (2)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0256](https://jvet-experts.org/doc_end_user/current_document.php?id=14515) Subpicture support in HEVC [A. Tourapis, D. Podborski, S. Paluri, J. Kim (Apple)] [late] [miss]

[JVET-AI0257](https://jvet-experts.org/doc_end_user/current_document.php?id=14516) Derived chroma formats using layered HEVC [A. Tourapis, D. Podborski, S. Paluri, J. Kim (Apple)] [late] [miss]

## AHG3: Test conditions (0)

This section is kept as a template for future use.

## AHG3: Software development (0)

This section is kept as a template for future use.

## AHG4: Subjective quality testing and verification testing (3)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0042](https://jvet-experts.org/doc_end_user/current_document.php?id=14281) AHG10: Teleconference on encoder optimization for multi-layer coding [P. de Lagrange]

[JVET-AI0069](https://jvet-experts.org/doc_end_user/current_document.php?id=14310) Additional Objective Results of VVC Multilayer Reference Implementation (VTM-21.0) on SDR and HDR UHD (4K) Content [O. Chubach, Y.-L. Hsiao, C.-Y. Chen, T.-D. Chuang, Y.-W. Chen, C.-W. Hsu, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-AI0138](https://jvet-experts.org/doc_end_user/current_document.php?id=14397) AHG4: preparation of test material for film grain visual testing [P. de Lagrange (InterDigital)]

[JVET-AI0319](https://jvet-experts.org/doc_end_user/current_document.php?id=14578) A historic analysis of Multi-Layer VVC (MLVVC) Verification Test (VT) Plan [S. Battista (UNIVPM)] [late]

## AHG4: Test and training material (1)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0266](https://jvet-experts.org/doc_end_user/current_document.php?id=14525) AHG4: Proposed text for a Call for new HDR materials for future video coding development [E. François (InterDigital), A. Segall (Amazon), D. Rusanovskyy (Qualcomm), S. Iwamura (NHK)] [late]

## Codec performance with alternative test materials and under non-CTC conditions (1)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0317](https://jvet-experts.org/doc_end_user/current_document.php?id=14576) Preliminary improvements to configurations for LTM [L. Ciccarelli, M. Razaak, Y. Joti, G. Cobianchi, S- Ferrara (V-Nova)] [late]

Relevance for JVET to be clarified.

## AHG5: Conformance test development (0)

This section is kept as a template for future use.

## AHG7: ECM tool assessment (0)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

## AHG8: Optimization of encoders and receiving systems for machine analysis of coded video content (6)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0071](https://jvet-experts.org/doc_end_user/current_document.php?id=14312) AHG8/AHG9: Indication of NNPFs and processing chains for human viewing and/or machine consumption [M. M. Hannuksela, F. Cricri, H. Zhang, J. Boyce (Nokia)]

See 6.1.1

[JVET-AI0131](https://jvet-experts.org/doc_end_user/current_document.php?id=14373) AHG8: RPR for machine consumption [C. Hollmann, J. Ström (Ericsson)]

[JVET-AI0142](https://jvet-experts.org/doc_end_user/current_document.php?id=14401) AHG8: MI-RPR for machine consumption [A. Kim, E.-V. An, K.-D. Seo (Yonsei Univ.), S.-H. Jung, S. Kwak, W.-S. Cheong, J. Y. Lee, H.-G. Choo (ETRI)] [late]

[JVET-AI0144](https://jvet-experts.org/doc_end_user/current_document.php?id=14403) AHG8: 444 processing for VCM [S. Keating (Sony)]

[JVET-AI0238](https://jvet-experts.org/doc_end_user/current_document.php?id=14497) Crosscheck of JVET-AI0144 (AHG8: 444 processing for VCM) [C. Hollmann (Ericsson)] [late] [miss]

[JVET-AI0196](https://jvet-experts.org/doc_end_user/current_document.php?id=14455) AHG8: On combined pre- and post-processing and ROI-based adaptive QP for machine vision [S. Wang, B. Li, J. Chen, Y. Ye (Alibaba), S. Wang (CityU)]

[JVET-AI0199](https://jvet-experts.org/doc_end_user/current_document.php?id=14458) AHG8: A new performance evaluation method for object detection [S. Wang, B. Li, J. Chen, Y. Ye (Alibaba), S. Wang (CityU)]

[JVET-AI0254](https://jvet-experts.org/doc_end_user/current_document.php?id=14513) AHG8: Pre-analysis based adaptive spatial resampling algorithm for machine vision [S. Wang, B. Li, J. Chen, Y. Ye (Alibaba)] [late]

## AHG10: Encoding algorithm optimization (1)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0248](https://jvet-experts.org/doc_end_user/current_document.php?id=14507) AHG3/AHG10: explicit configuration of inter-layer reference pictures [M. Le Pendu, P. de Lagrange, F. Urban (InterDigital)] [late]

## AHG13: Film grain synthesis (0)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

## Implementation studies (0)

Section kept as a template for future use.

## Profile/tier/level specification (1)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0045](https://jvet-experts.org/doc_end_user/current_document.php?id=14284) 4:4:4 MV-HEVC profiles [A. M. Tourapis, D. Podborski, S. Paluri (Apple)]

## Gaming content compression (AHG15) (2)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0043](https://jvet-experts.org/doc_end_user/current_document.php?id=14282) AHG15: Teleconference on gaming content compression [J. Sauer, S. Puri (co-chairs), R. Chernyak, A. Duenas, L. Wang (vice chairs)]

[JVET-AI0044](https://jvet-experts.org/doc_end_user/current_document.php?id=14283) AHG15: Improved versions of gaming content sequences by Huawei [W. Chen, Z. Lin, Y. Zhao, K. Cai, J. Sauer, E. Alshina, Y. Zhao (Huawei)]

[JVET-AI0054](https://jvet-experts.org/doc_end_user/current_document.php?id=14295) AHG15: Reading the camera parameters for gaming sequences of class G1 [S. Thiebaud, S. Puri, T. Poirier, F. Galpin (InterDigital)]

## Generative face video (AHG16) (3)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0047](https://jvet-experts.org/doc_end_user/current_document.php?id=14286) AhG16: Higher-resolution Test Sequences and Test Results for Generative Face Video Compression [B. Chen, S. Yin, Y. Ye, R.-L. Liao, J. Chen (Alibaba), S. Wang (CityU)]

[JVET-AI0048](https://jvet-experts.org/doc_end_user/current_document.php?id=14287) AhG16: Improving GFVC Performance with Diverse Training Data [B. Chen, Y. Ye, J. Chen, R.-L. Liao (Alibaba), Z. Zhang, S. Yin, S. Wang (CityU)]

[JVET-AI0137](https://jvet-experts.org/doc_end_user/current_document.php?id=14396) AHG16: Update on Pupil position SEI message for Generative Face Video [F. Ma, A. Trioux, Y. Gao, Y. Yao, F. Yang (Xidian Univ.), F. Xing, Z. Wang (Hisense)] [late]

[JVET-AI0156](https://jvet-experts.org/doc_end_user/current_document.php?id=14415) AHG9/AHG16: On generative face video SEI messages [J. Chen, B. Chen, Y. Ye (Alibaba), S. Yin, S. Wang (CityU), P. Yin, S. McCarthy (Dolby), H.-B. Teo (Panasonic)]

See 6.2.1

[JVET-AI0193](https://jvet-experts.org/doc_end_user/current_document.php?id=14452) AHG9/AHG16: On no display flag in generative face video SEI message [S. McCarthy, S. Gehlot, G. J. Sullivan, P. Yin (Dolby)]

See 6.2.1

[JVET-AI0194](https://jvet-experts.org/doc_end_user/current_document.php?id=14453) AHG9/AHG16: On chroma key fusion for the generative face video SEI message [S. Gehlot, G.-M. Su, P. Yin, S. McCarthy, G. J. Sullivan (Dolby)]

See 6.2.1

[JVET-AI0195](https://jvet-experts.org/doc_end_user/current_document.php?id=14454) AhG9/16: Updates on GFVC common software tools and GFV SEI message [B. Chen, J. Chen, Y. Ye, R.-L. Liao (Alibaba), S. Yin, S. Wang (CityU)] [late]

See 6.2.1

# Low-level tool technology proposals (119)

## AHG11/AHG14: Neural network-based video coding (29)

### Summary, BoG reports, and information documents (2)

Contributions in this area were discussed at 1500–1650 on Friday 12 July 2024 (chaired by JRO).

[JVET-AI0023](https://jvet-experts.org/doc_end_user/current_document.php?id=14394) EE1: Summary report of exploration experiment on neural network-based video coding [E. Alshina, F. Galpin, Y. Li, D. Rusanovskyy, M. Santamaria, J. Ström, R. Chang, Z. Xie (EE coordinators)]

**List of tests**

This round of EE1 tests includes:

* EE1-1: LOP and VLOP in-loop filters
  + EE1-1.1: LOP input adjustment with trainable components
    - [JVET-AI0173](https://jvet-experts.org/doc_end_user/current_document.php?id=14432) [(Qualcomm)](mailto:martak@qti.qualcomm.com)
  + EE1-1.2: Partial Convolution and Over-Parameterization
    - [JVET-AI0068](https://jvet-experts.org/doc_end_user/current_document.php?id=14309) [(UESTC)](mailto:hwguo@uestc.edu.cn),  [(Transsion)](mailto:yutian.liu@transsion.com)
  + EE1-1.3: On Low Complexity Operational Point for In-Loop Filtering
    - [JVET-AI0221](https://jvet-experts.org/doc_end_user/current_document.php?id=14480) [(Qualcomm)](mailto:martak@qti.qualcomm.com)
  + EE1-1.4: Content-adaptive VLOP-filter
    - [JVET-AI0157](https://jvet-experts.org/doc_end_user/current_document.php?id=14416), [(Nokia)](mailto:honglei.1.zhang@nokia.com),   [(Qualcomm)](mailto:martak@qti.qualcomm.com)
  + EE1-1.5: VLOP using LOP3 architecture
    - [JVET-AI0107](https://jvet-experts.org/doc_end_user/current_document.php?id=14349) [(Ericsson)](mailto:per.wennersten@ericsson.com),  [(Qualcomm)](mailto:martak@qti.qualcomm.com)
* EE1-2: HOP in-loop filter
  + EE1-2.1: On the detailed analysis of integer Transformer ILF with luma-chroma component balancing and complexity trade-off
    - [JVET-AI0176](https://jvet-experts.org/doc_end_user/documents/35_Sapporo/wg11/JVET-AI0176-v1.zip) [(Qualcomm)](mailto:martak@qti.qualcomm.com)
  + EE1(AhG 11): On the complexity adjustment of HOP4
    - [JVET-AI0172](https://jvet-experts.org/doc_end_user/current_document.php?id=14431) [Qualcomm)](mailto:martak@qti.qualcomm.com),  [(Interdigital)](mailto:franck.galpin@interdigital.com),  (Bytedance)
* EE1-3: NN-inter prediction
  + withdrawn
* EE1-4: NN-super-resolution
  + EE1-4.1: Multiple scaling ratios coding for NNVC with NNSR
    - [JVET-AI0074](https://jvet-experts.org/doc_end_user/current_document.php?id=14315)[(vivo)](mailto:chuan.zhou@vivo.com)
  + EE1-4.2: On simplified super resolution model
    - [JVET-AI0093](https://jvet-experts.org/doc_end_user/current_document.php?id=14335) [(Bytedance)](mailto:lizhang.idm@bytedance.com)
* EE1-5: Neural network based Intra coding
  + EE1-5.1 : combination of the neural network-based intra prediction mode and ISP
    - [JVET-AI0130](https://jvet-experts.org/doc_end_user/current_document.php?id=14372) [(Interdigital)](mailto:franck.galpin@interdigital.com)

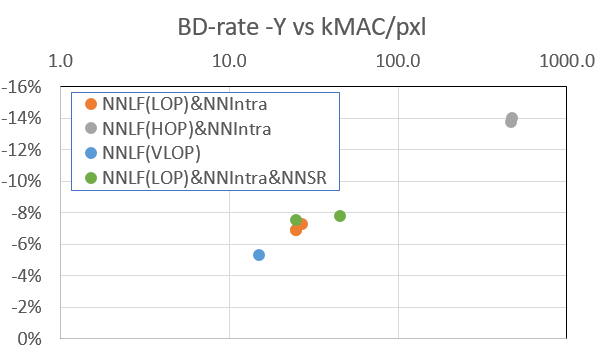
All neural network tools combinations tested are summarized in Table 1. Results in this table reported relatively to NNVC-9.1 configures as VTM.

Gain in MS-SSIM is 1-2% higher than in PSNR for NN-based tools.

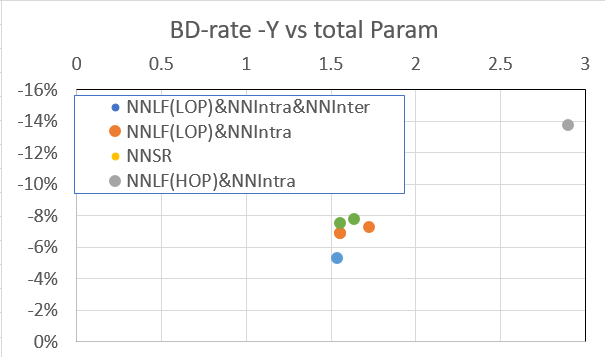
*Table 1 Summary of all test results vs NNVC (configured as VTM)*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test | Random Access cfg BD-rate vs VTM | | | | | All Intra cfg BD-rate vs VTM | | | | | # tools combi-ned | Total  kMAC  /pxl | Total Num Param |
| **Y** | U | V | Enc | Dec | **Y** | U | V | Enc | Dec |
| NN-Intra & LOP NN-filter | | | | | | | | | | | | | |
| NNVC-9.1 | **-7.3%** | -13.1% | -11.3% | 1.2 | 81 | **-8.4%** | -14.2% | -13.9% | 1.7 | 49 | 2 | 24.8 | 1.72 |
| NNVC-8.0 | **-6.9%** | -13.2% | -12.1% | 1.2 | 73 | **-8.1%** | -13.3% | -13.4% | 1.7 | 44 | 2 | 24.9 | 1.55 |
| NNVC-7.1 | **-6.9%** | -13.2% | -12.1% | 1.3 | 86 | **-8.1%** | -13.3% | -13.4% | 1.8 | 56 | 2 | 24.9 | 1.55 |
| NN-Intra & HOP NN-filter | | | | | | | | | | | | | |
| NNVC-9.1 | **-14.0%** | -19.1% | -19.5% | 2.9 | 1446 | **-13.3%** | -16.2% | -17.7% | 2.6 | 853 | **2** | 483.6 | 3.0 |
| NNVC-8.0 | **-13.7%** | -13.9% | -14.5% | 2.5 | 1092 | **-12.7%** | -11.6% | -13.0% | 2.4 | 56 | 2 | 473.8 | 2.9 |
| NN-Intra & VLOP NN-filter | | | | | | | | | | | | | |
| NNVC-9.1 | -5.3% | -5.4% | -5.2% | 1.2 | 40 | -7.1% | -7.8% | -7.7% | 1.8 | 29 | 2 | 15.0 | 0.4 |
| NN-Intra & LOP NN-filter & Adaptive resolution coding NNVC-8.0 (\*) | | | | | | | | | | | | | |
| SR RPR | -7.5% | -10.9% | -9.7% |  |  | -8.5% | -11.3% | -11.0% |  |  | 3 | 24.9 | 1.55 |
| NNSR | -7.8% | -11.9% | -10.5% |  |  | -8.6% | -11.8% | -11.3% |  |  | 3 | 45.2 | 1.63 |

Tabulated results are visualized ion Figure 1 and Figure 2. Blue dots show combination of neural network-based filters with neural network based Intra. On Figure 1 we see that compression gain (BD-rate) for filters increases linearly with log of computational complexity.

**

*Figure 1 BD-rate (Y) relatively to VTM anchor in random access (RA) configuration vs kMAC/pxl for different tools combinations.*

**

*Figure 2 BD-rate (Y) relatively to VTM anchor in random access (RA) configuration total number of parameters for different tools combinations.*

More details about tested tools can be found in presentation attached to this report.

**Improvements for NNVC-LOP filter**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test | Random Access | | | All Intra | | | kMAC/pxl | | | Param | | | Source |
| Y | U | V | Y | U | V | Total | Filter | Intra | Total | Filter | Intra |  |
| **NNVC9.1** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **24.8** | **16.9** | **7.9** | **1.72** | **0.205** | **1.52** | [JVET-AI0014](https://jvet-experts.org/doc_end_user/current_document.php?id=14280) |
| EE1-1.1 | -0.1% | 0.5% | 0.7% | 0.0% | 0.0% | 0.5% | 26.8 | 16.9 | 7.9 | 1.72 | 0.205 | 1.52 | [JVET-AI0173](https://jvet-experts.org/doc_end_user/current_document.php?id=14432) |
| EE1-1.2.1 |  |  |  | 0.0% | 2.3% | 2.3% | 24.8 | 16.9 | 7.9 | 1.5 | 0.205 | 1.52 | JVET-AI0068 |
| EE1-1.2.2 |  |  |  | 0.0% | -1.2% | -1.7% | 24.8 | 16.9 | 7.9 | 1.5 | 0.205 | 1.52 | JVET-AI0068 |
| EE1-1.2.3 |  |  |  | 0.0% | -1.6% | -2.6% | 24.8 | 16.9 | 7.9 | 1.5 | 0.205 | 1.52 | JVET-AI0068 |
| EE1-1.2.3 (int) |  |  |  | 0.1% | -1.7% | -2.5% | 24.8 | 16.9 | 7.9 | 1.5 | 0.205 | 1.52 | JVET-AI0068 |
| EE1-1.3.a | -0.8% | 1.2% | 0.1% | -0.7% | 1.4% | 1.3% | 23.5 | 15.6 | 7.9 | 1.5 | 0.055 | 1.52 | [JVET-AI0221](https://jvet-experts.org/doc_end_user/current_document.php?id=14480) |

EE1-1.1 – trainable ‘DCT’ for LOP filter

EE1-1.2.1 – over parametrization (training hint)

EE1-1.2.2 – partial convolution (total number of convolutions 94 🡪 74)

EE1-1.2.3 – over parametrization and – partial convolution

EE1-1.3.a – new architecture for LOP filter (full float32 results made available on July 9th 2024).

**Improvements for NNVC-VLOP filter**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test | Random Access | | | All Intra | | | kMAC/pxl | | | Param | | | Source |
| Y | U | V | Y | U | V | Total | Filter | Intra | Total | Filter | Intra |  |
| **NNVC9.1** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **13.0** | **5.12** | **7.9** | **1.5** | **0.061** | **1.52** | [JVET-AI0014](https://jvet-experts.org/doc_end_user/current_document.php?id=14280) |
| EE1-1.3b | -0.7% | -1.5% | -1.2% | -0.6% | -1.5% | -1.3% | 12.6 | 4.66 | 7.9 | 1.5 | 0.012 | 1.52 | [JVET-AI0221](https://jvet-experts.org/doc_end_user/current_document.php?id=14480) |
| EE1-1.4 | -1.0% | -1.7% | -1.0% |  |  |  | 13.4 | 5.48 | 7.9 | 1.5 | 0.017 | 1.52 | [JVET-AI0157](https://jvet-experts.org/doc_end_user/current_document.php?id=14416) |
| EE1-1.5 | -0.2% | -1.6% | -0.7% | -0.1% | -1.4% | -0.9% | 13.1 | 5.16 | 7.9 | 1.5 | 0.0607 | 1.52 | [JVET-AI0107](https://jvet-experts.org/doc_end_user/current_document.php?id=14349) |

EE1-1.3.b – new architecture for VLOP filter (full float32 results made available on July 9th 2024).

EE1-1.4 – content adaptive VLOP.

EE1-1.5 – VLOP with LOP architecture

**Improvements for NNVC-HOP filter**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test | Random Access | | | All Intra | | | kMAC/pxl | | | Param | | | Source |
| Y | U | V | Y | U | V | Total | Filter | Intra | Total | Filter | Intra |  |
| **NNVC9.1** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **484** | 476 | 7.9 | 2.96 | 1.439 | 1.52 | [JVET-AI0014](https://jvet-experts.org/doc_end_user/current_document.php?id=14280) |
| EE1-2.1.1 | -1.2% | 1.6% | 0.7% | -1.1% | 3.4% | 3.7% | 476 | 468 | 8 | 2.89 | 1.39 | 1.5 | [JVET-AI0176](https://jvet-experts.org/doc_end_user/current_document.php?id=14435) |
| EE1-2.1.4 | -0.1% | -2.9% | -3.3% | -0.1% | -2.2% | -1.3% | 473 | 465 | 8 | 2.85 | 1.35 | 1.5 | [JVET-AI0176](https://jvet-experts.org/doc_end_user/current_document.php?id=14435) |
| HOP4+ | -0.1% | -0.2% | -0.4% | -0.2% | 0.3% | 0.7% | 474 | 466 | 7.9 | 1.5 | 0.0607 | 1.52 | [JVET-AI0172](https://jvet-experts.org/doc_end_user/current_document.php?id=14431) |

EE1-2.1.1 – transformers in all BBBs.

EE1-2.1.2 – transformers in two BBBs.

‘HOP4+’ design is recommended during AhG11&14 teleconference

**Improvements for NNSR**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test | Random Access | | | All Intra | | | kMAC/pxl | | | Param | | | Source |
| Y | U | V | Y | U | V | Total | F&I | SR | Total | F&I | SR |  |
| NNVC-9.1 | -7.3% | -13.1% | -11.3% | -8.4% | -14.2% | -13.9% | 24.8 | 24.8 | 0 | 1.72 | 1.72 | 0 | [JVET-AI0014](https://jvet-experts.org/doc_end_user/current_document.php?id=14280) |
| NNVC-8.0 NNSR | -7.8% | -12.8% | -10.5% | -8.6% | -11.8% | -11.3% | 45.2 | 24.8 | 20.3 | 1.79 | 1.72 | 0.083 | [JVET-AH0014](https://jvet-experts.org/doc_end_user/current_document.php?id=13925) |
| NNVC-9.1-NNSR | - | - | - | - | - | - | 45.2 | 24.8 | 20.3 | 1.79 | 1.72 | 0.083 | [JVET-AI0014](https://jvet-experts.org/doc_end_user/current_document.php?id=14280) |
| EE1-4.1.1 (RPR) | -7.9% | -10.9% | -8.7% | -8.8% | -11.2% | -10.9% | 24.8 | 24.8 | 0 | 1.73 | 1.72 | 0 | JVET-AI0074 |
| EE1-4.1.2 (NNSR) | -8.1% | -10.3% | -8.9% | -9.2% | -11.5% | -11.0% | 29.5 | 24.8 | 4.7 | 1.78 | 1.72 | 0.050 | JVET-AI0074 |
| EE1-4.2 | -8.1% | -11.4% | -9.4% | -9.0% | -12.6% | -11.8% | 30.1 | 24.8 | 5.3 | 1.77 | 1.72 | 0.038 | [JVET-AI0093](https://jvet-experts.org/doc_end_user/current_document.php?id=14335) |

EE1-4.1.1 Encoder strategy for adaptive resolution (RPR filter for re-sampling)

EE1-4.1.2 same as EE1-4.1.1 but with NNSR filter (simpler than one in NNVC-9.1)

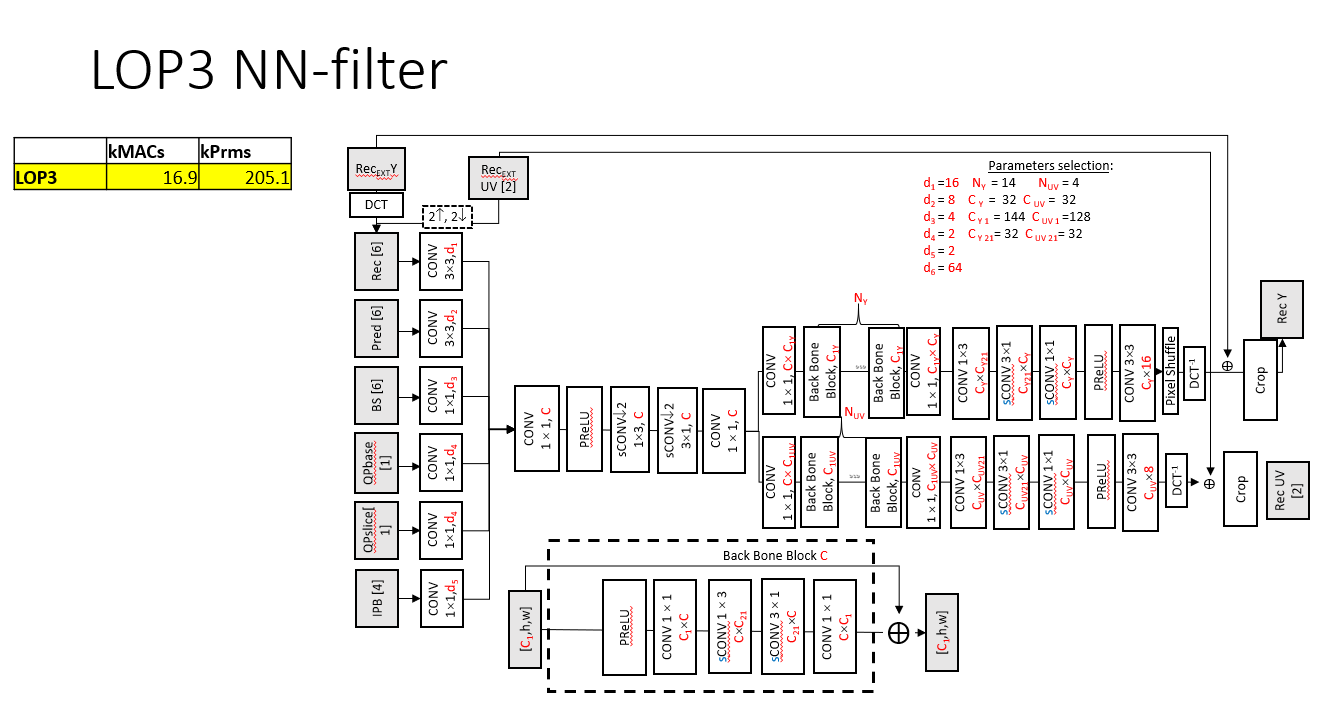
EE1-4.2 NNSR but simpler than one in NNVC-9.1.

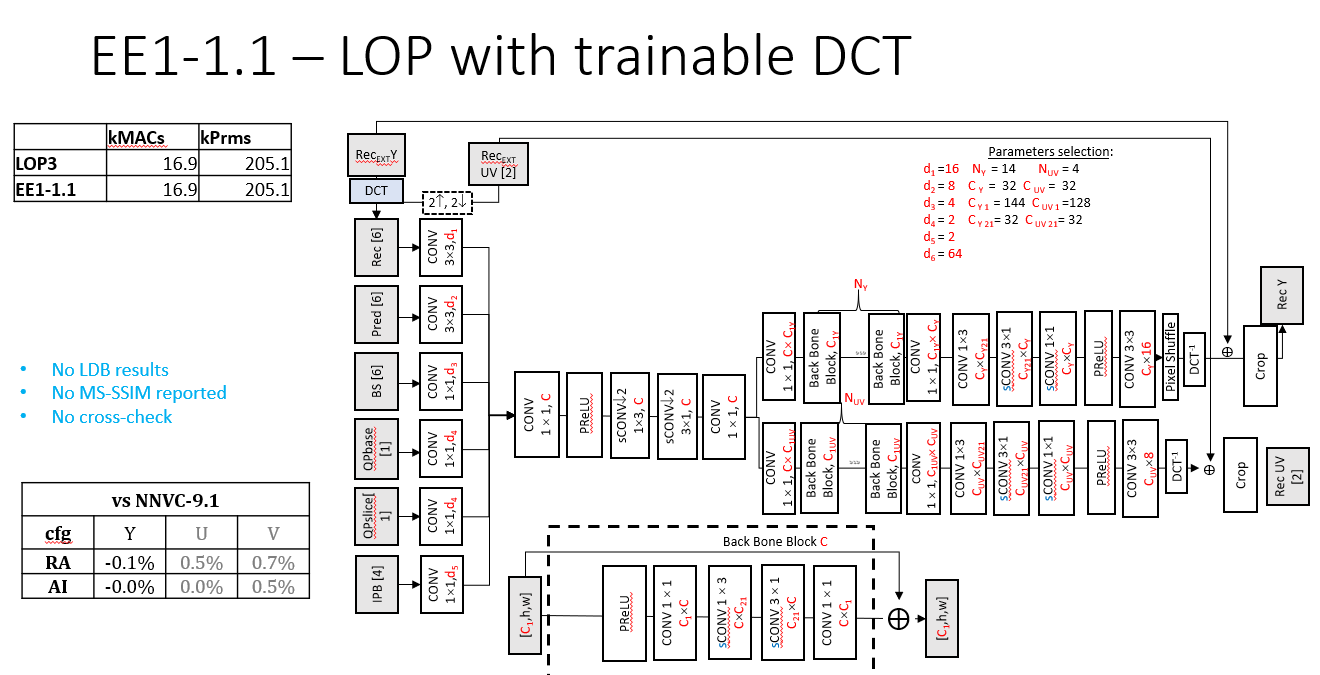
BD-rate gain measured based on MS-SSIM for adaptive resolution coding is 2…2.2% higher compared to PSNR gain (both for RPR and NN-based filters)

**Improvements for NN-Intra**

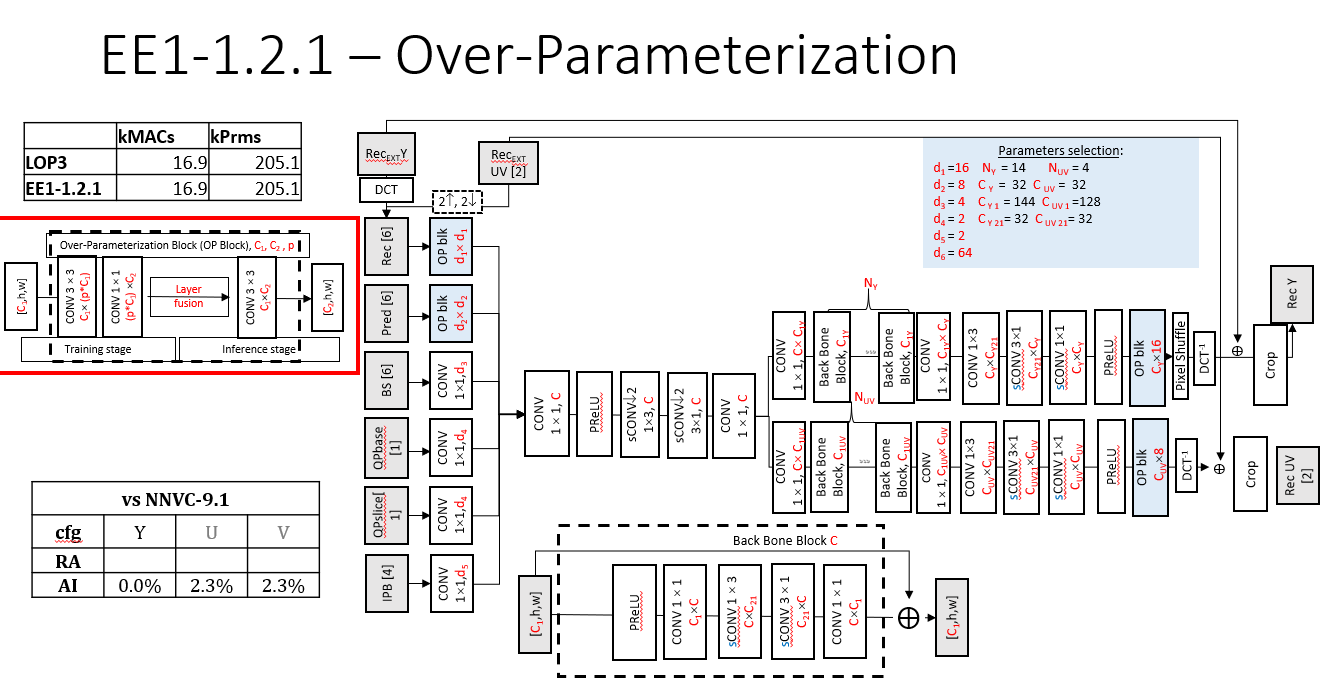
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test | Random Access | | | All Intra | | | kMAC/pxl | | | | Param | | | | Source |
| Y | U | V | Y | U | V | Total | Filter | Intra | Total | | Filter | Intra |  | |
| **NNVC9.1** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **24.8** | **16.9** | **7.9** | **1.72** | | **0.205** | **1.52** | [JVET-AI0014](https://jvet-experts.org/doc_end_user/current_document.php?id=14280) | |
| NNVC9.1-LCnnIntra | 0.1% | 0.0% | 0.0% | 0.4% | 0.3% | 0.3% | 21.7 | 16.9 | 4.8 | 1.53 | | 0.205 | 1.33 | [JVET-AI0014](https://jvet-experts.org/doc_end_user/current_document.php?id=14280) | |
| EE1-5.1 | -0.1% | -0.5% | -0.4% | -0.1% | -0.2% | -0.1% | 21.7 | 16.9 | 4.8 | 1.53 | | 0.205 | 1.33 | [JVET-AI0130](https://jvet-experts.org/doc_end_user/current_document.php?id=14372) | |

EE1-5.1 improved NN-INTRA with ISP design and better loss-function in training.

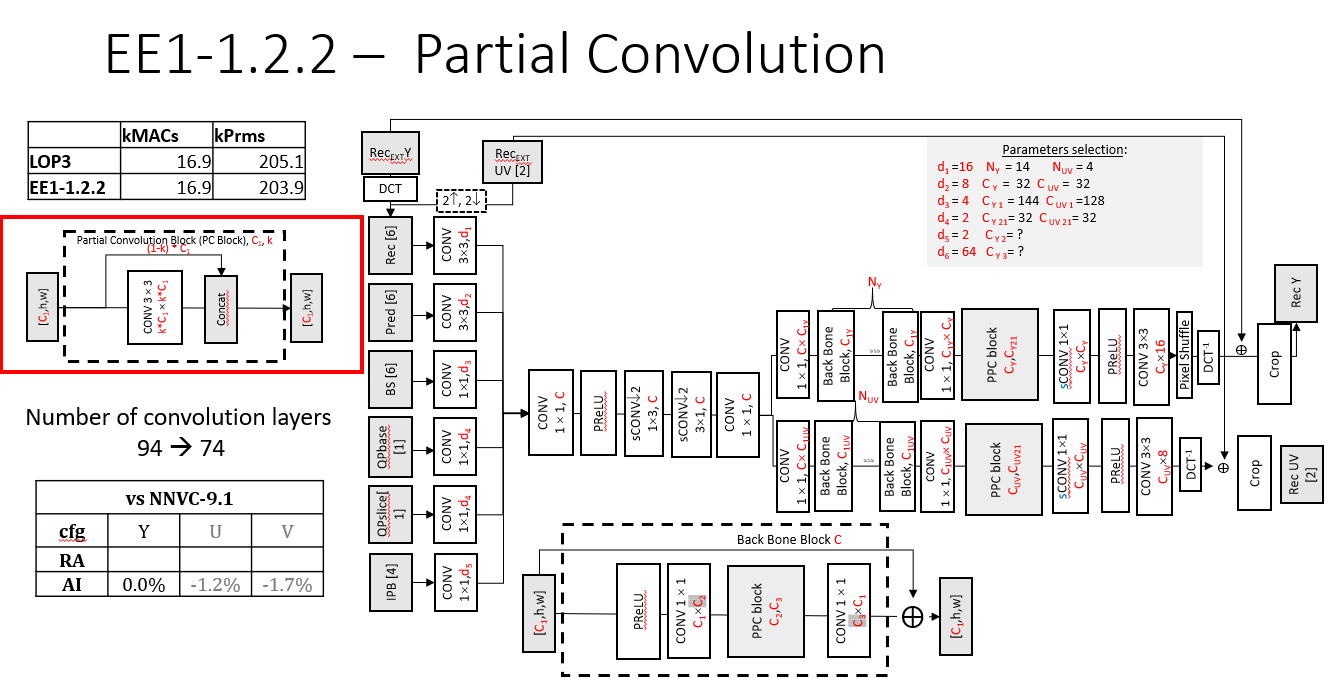




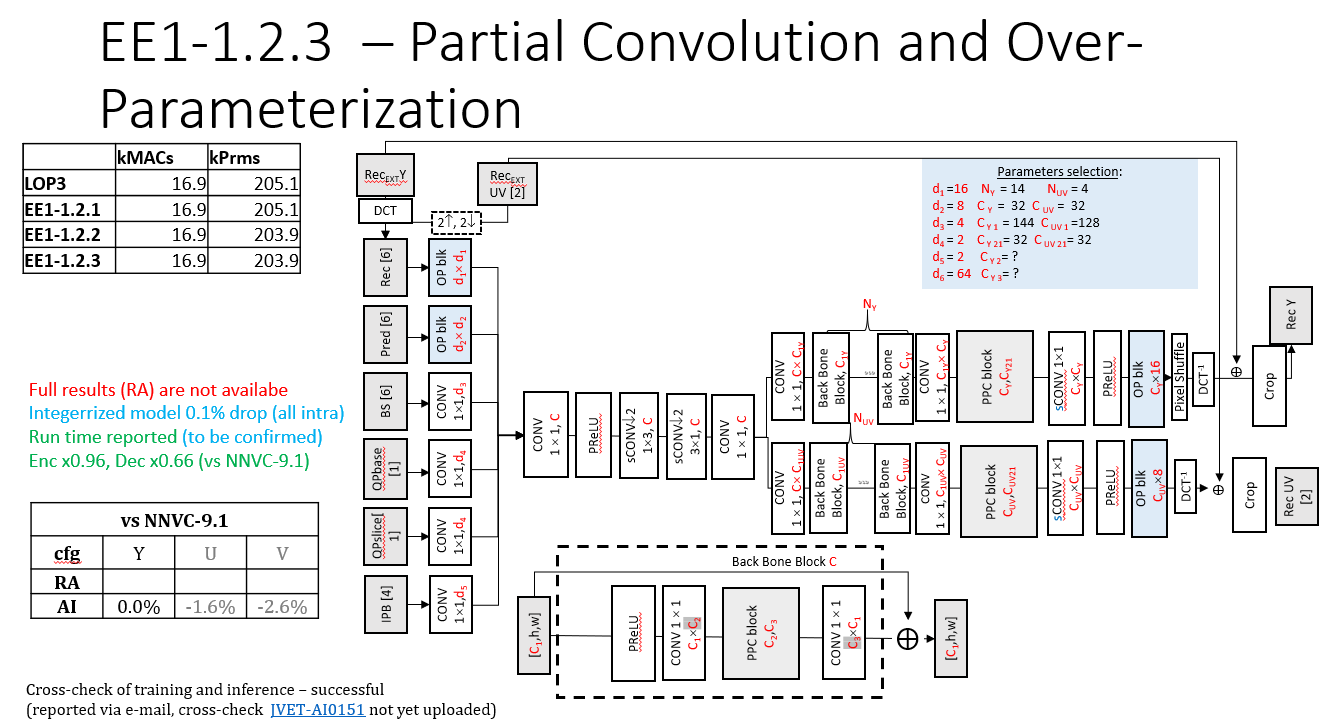
Not conclusive yet – no action at this meeting



Results only for AI, chroma loss



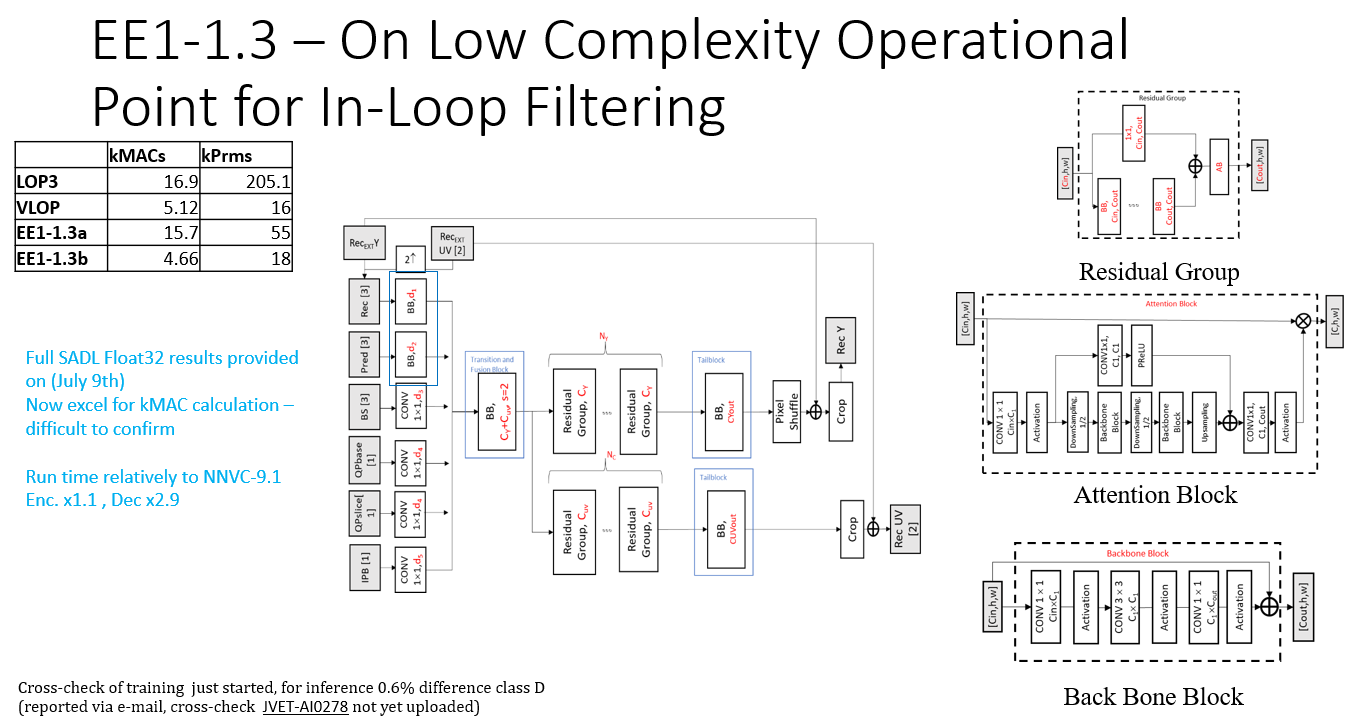
Reduction of computation, benefit in chroma, but only float implementation, while current integer implementation has loss in luma.



In this combination, the chroma losses of 2.1 and gains of 2.2 somewhat compensate.

Further investigation in EE, to improve integerization of 2.2 and understand if the combination with 2.1 provides benefit

It was requested to also test a configuration with number of channels divisible by 16, as this might have advantage in SIMD run time, and simpler implementation in some hardware platforms. Kmac/pxl may not always unveil every complexity/runtime aspect.

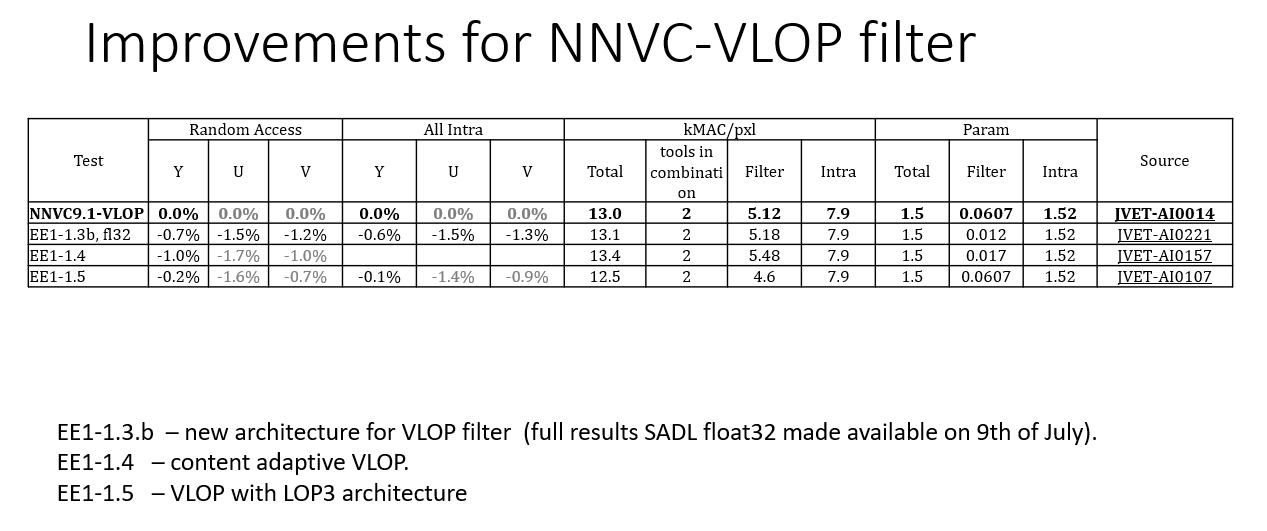


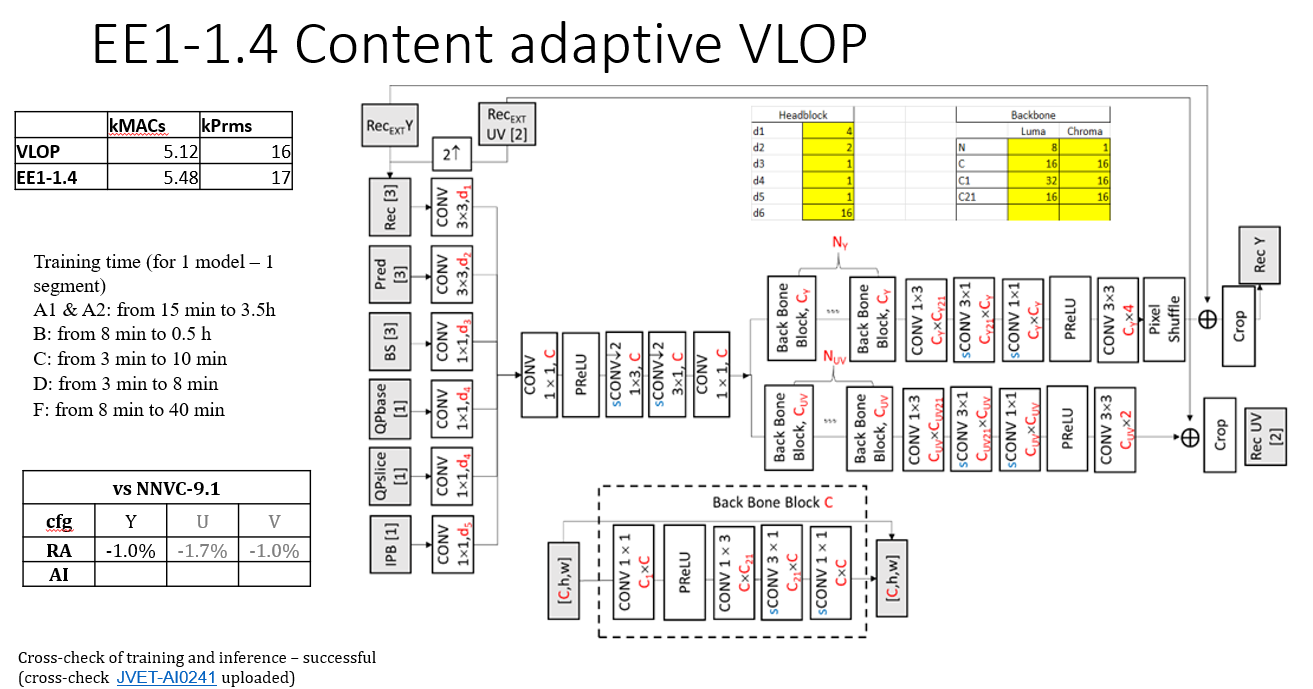
Due to inconsistency in training scripts used, non confirmation by cross-check available. It was pointed out that this might be a problem with git, but proponents should also take care that cross-checkers are informed about later changes.

It was also mentioned that some aspect may not be 100% implementable in SADL.

Further verification in EE, also about the calculation of kMAC/pix.

It was also requested to report about the benefit of changing the training strategy.

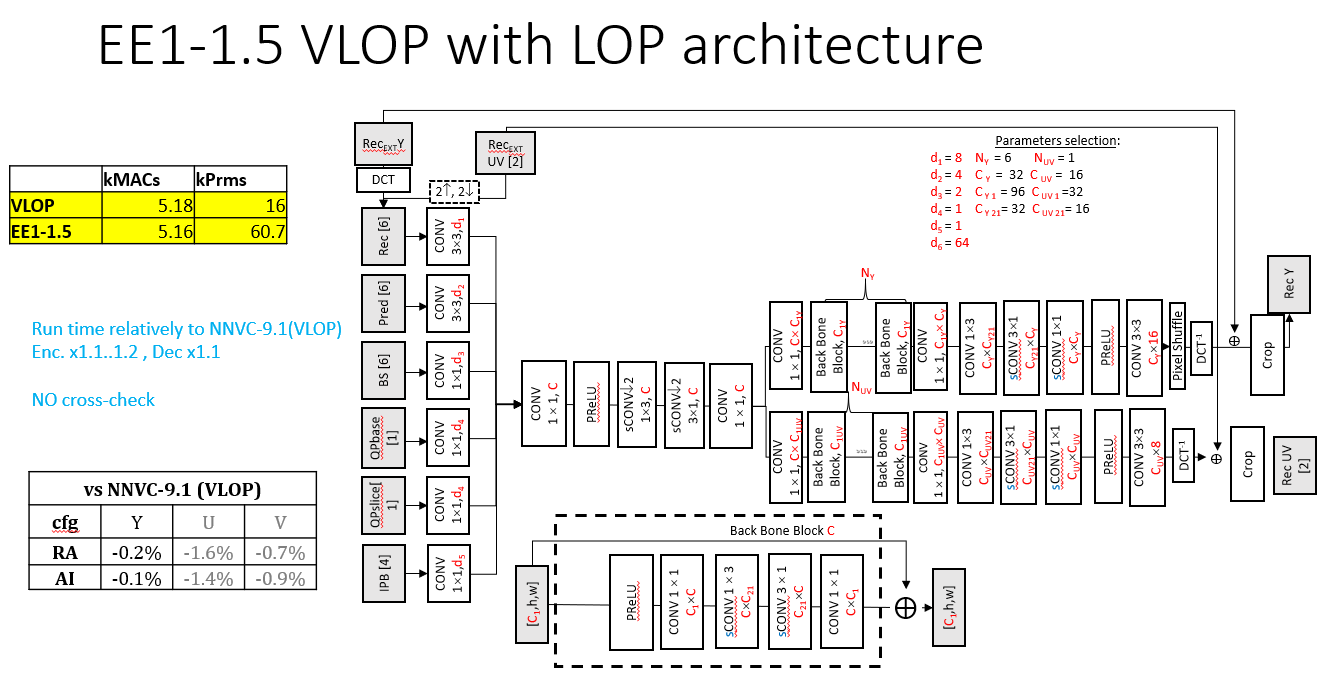




Successful verification

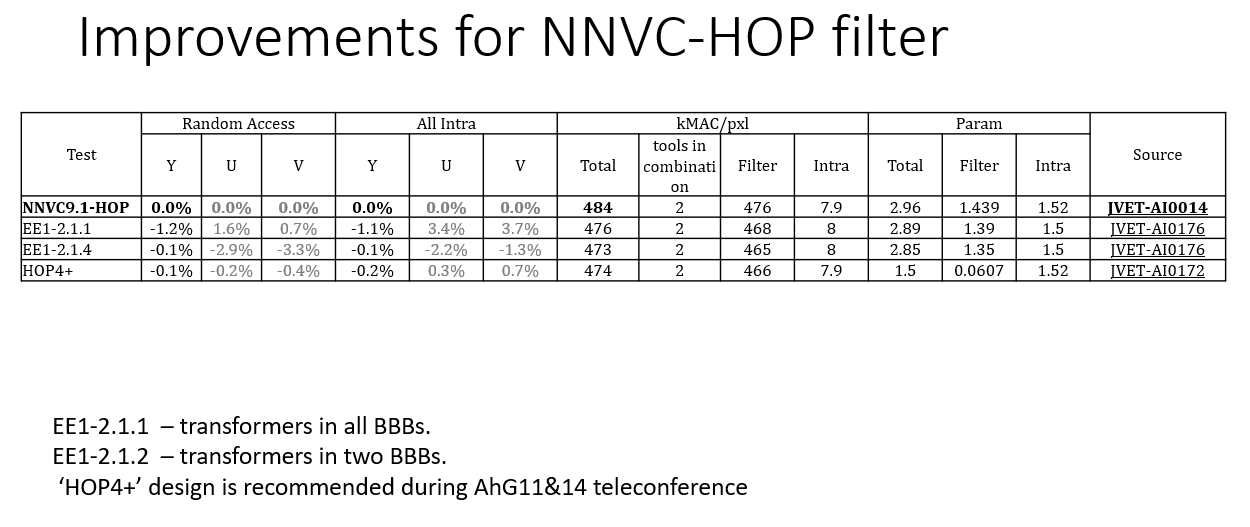
Decision: Adopt JVET-AI0157 (disabled by default)

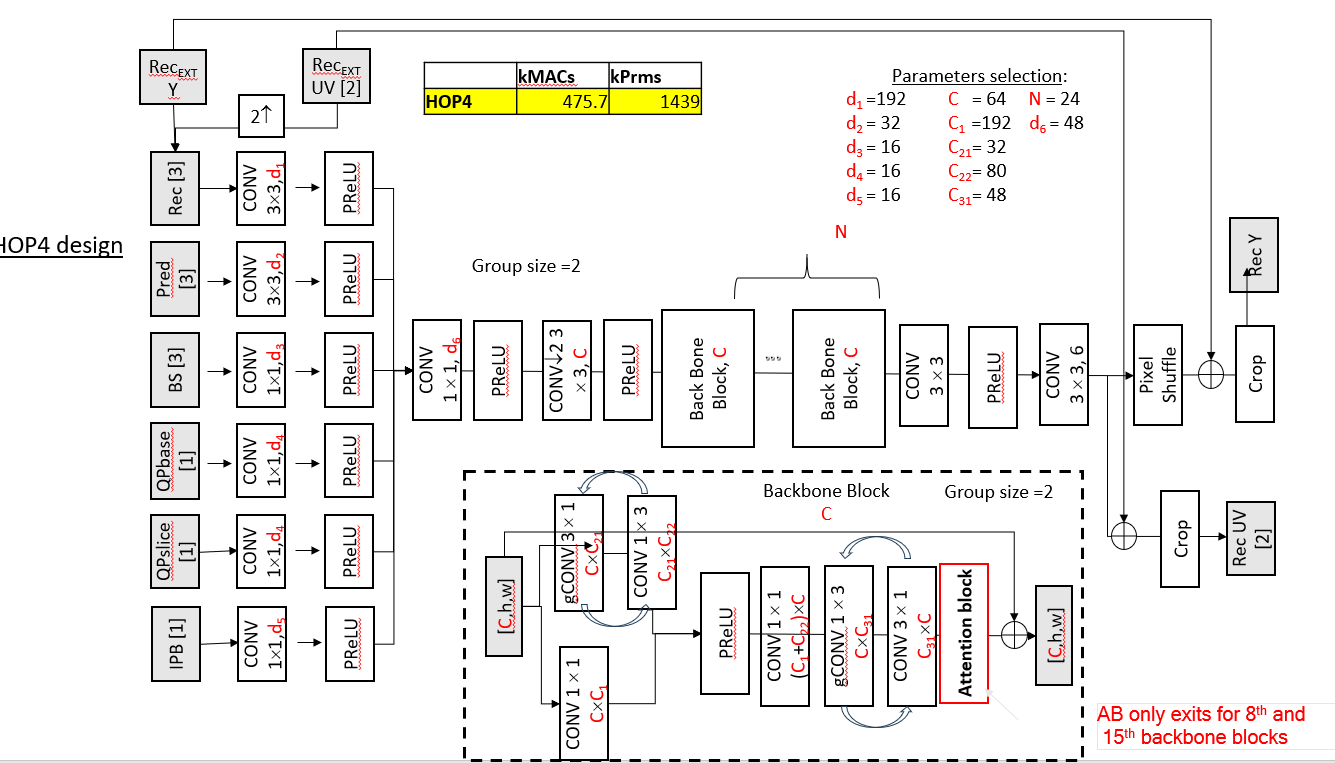
It was pointed out that an implementation as post filter, and enabling by NNPF SEI would also be desirable.

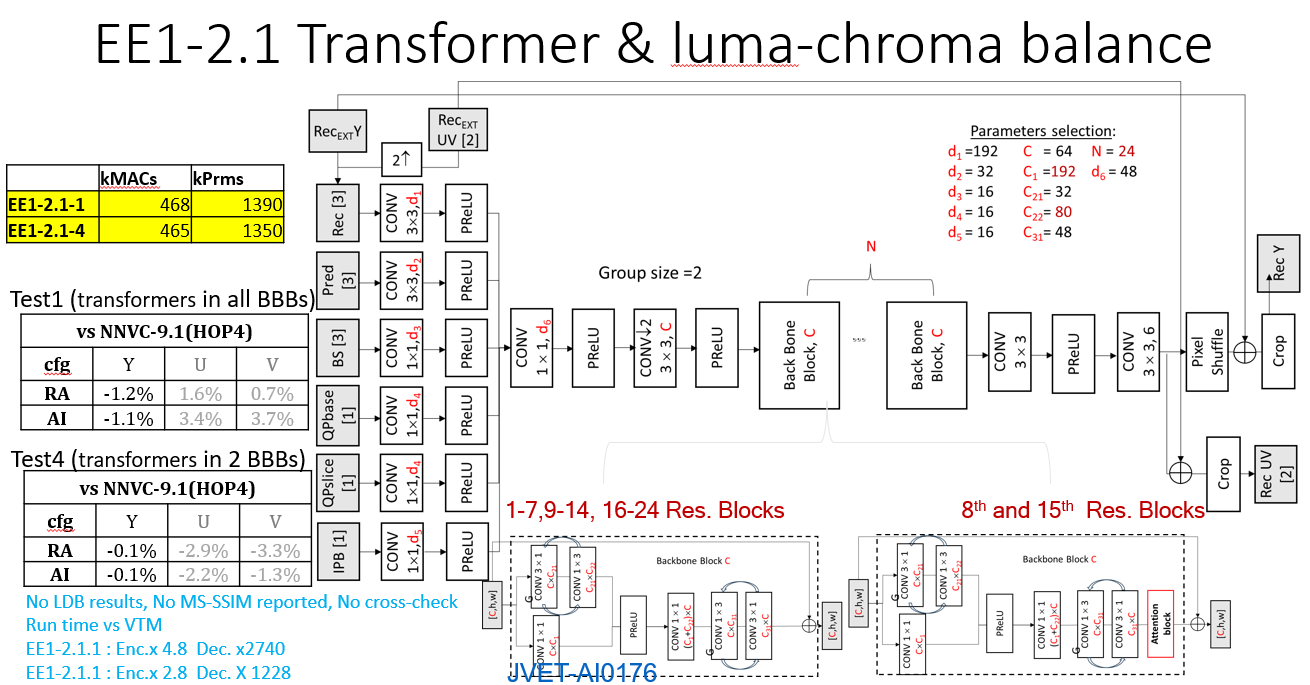


Successful verification, and unification with LOP3 beneficial

Decision: Adopt JVET-AI0107 (disabled by default)

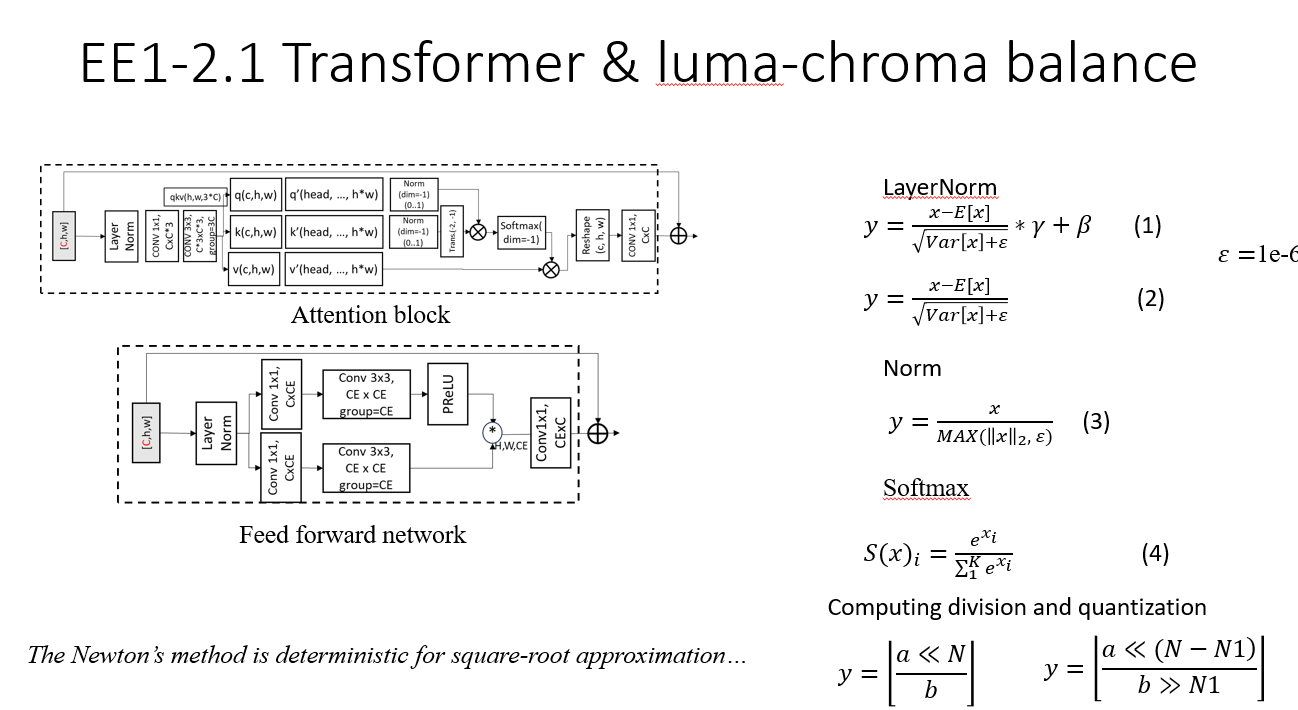






HOP4+ is well understood, and provides benefit against the previous HOP designs.

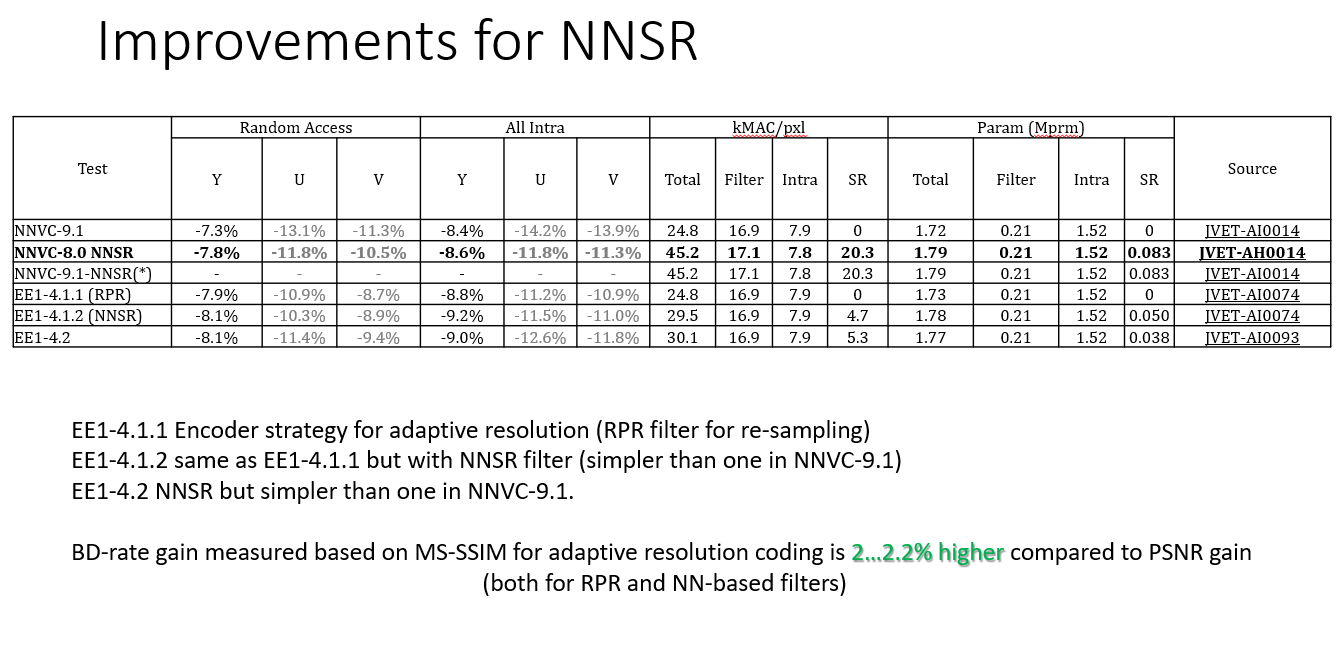
Decision: Adopt JVET-AI0172 (next HOP design).



Various concerns were raised about suitability of integer implementation of the strong nonlinearities in transformer blocks, and their possible deterministic implementation in SADL, and would give up some compatibility with other frameworks.

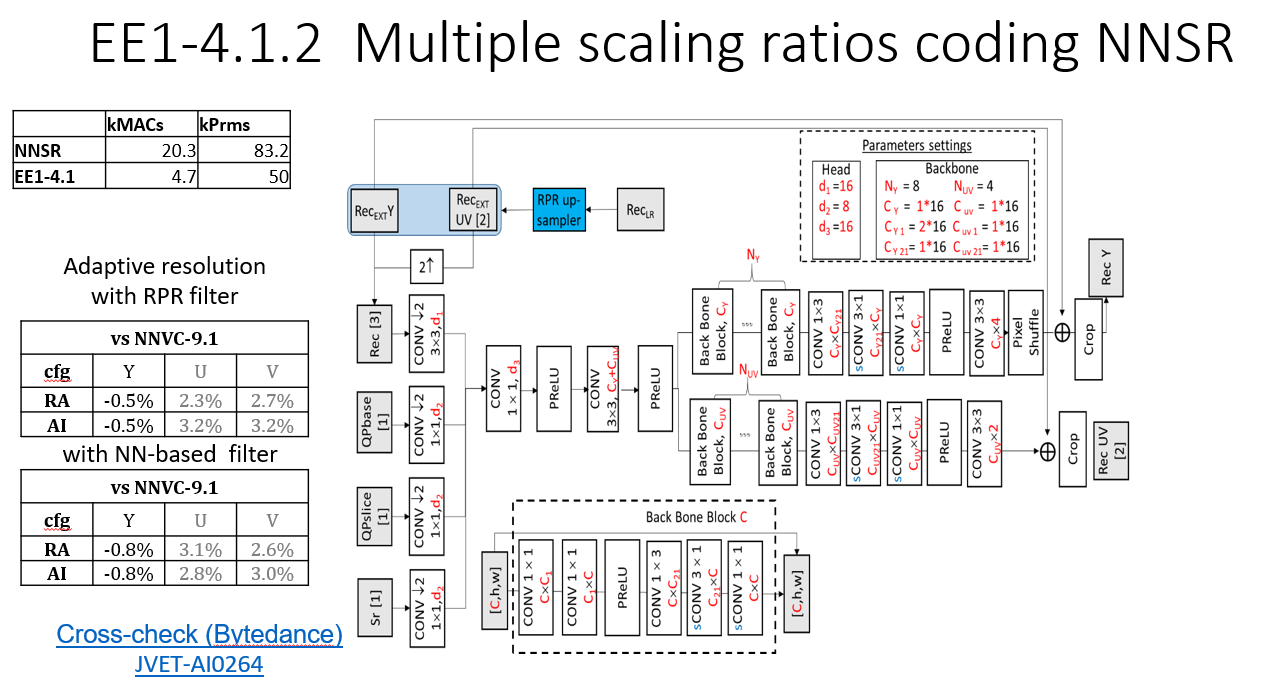
For the more reasonable approach with transformers in two BBB, benefit is not large compared to HOP4+. Neither of the configurations is fully cross-checked.

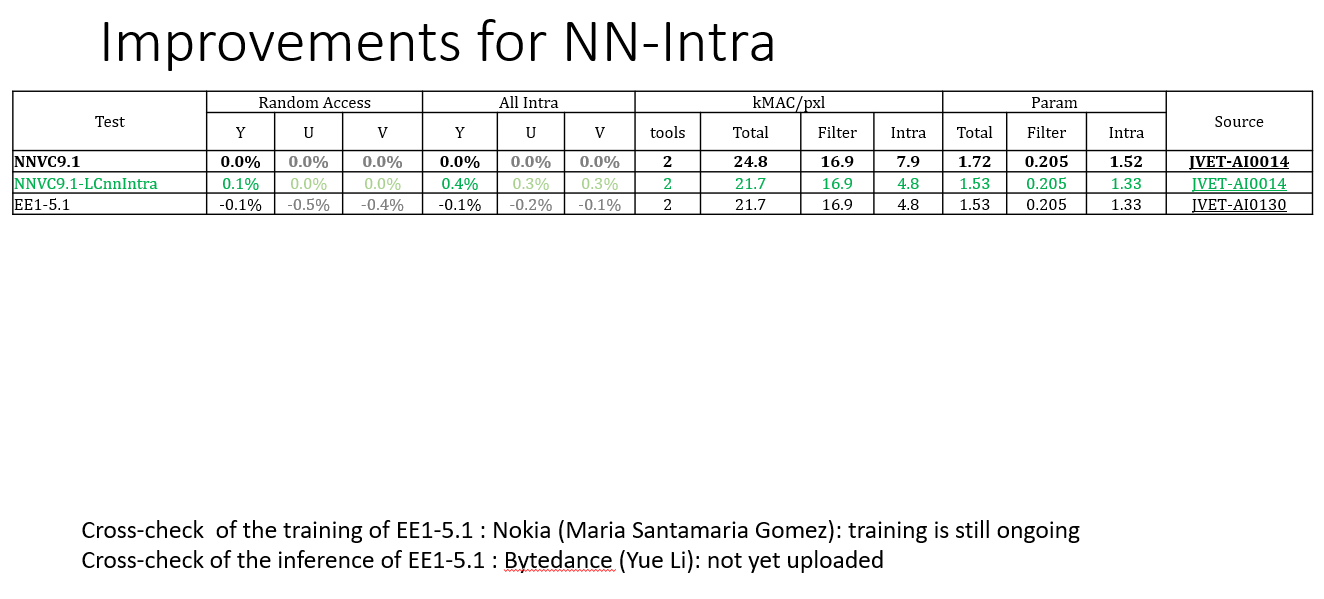
Further investigation in EE. It was also suggested to investigate as post filter, which might not need integer implementation.

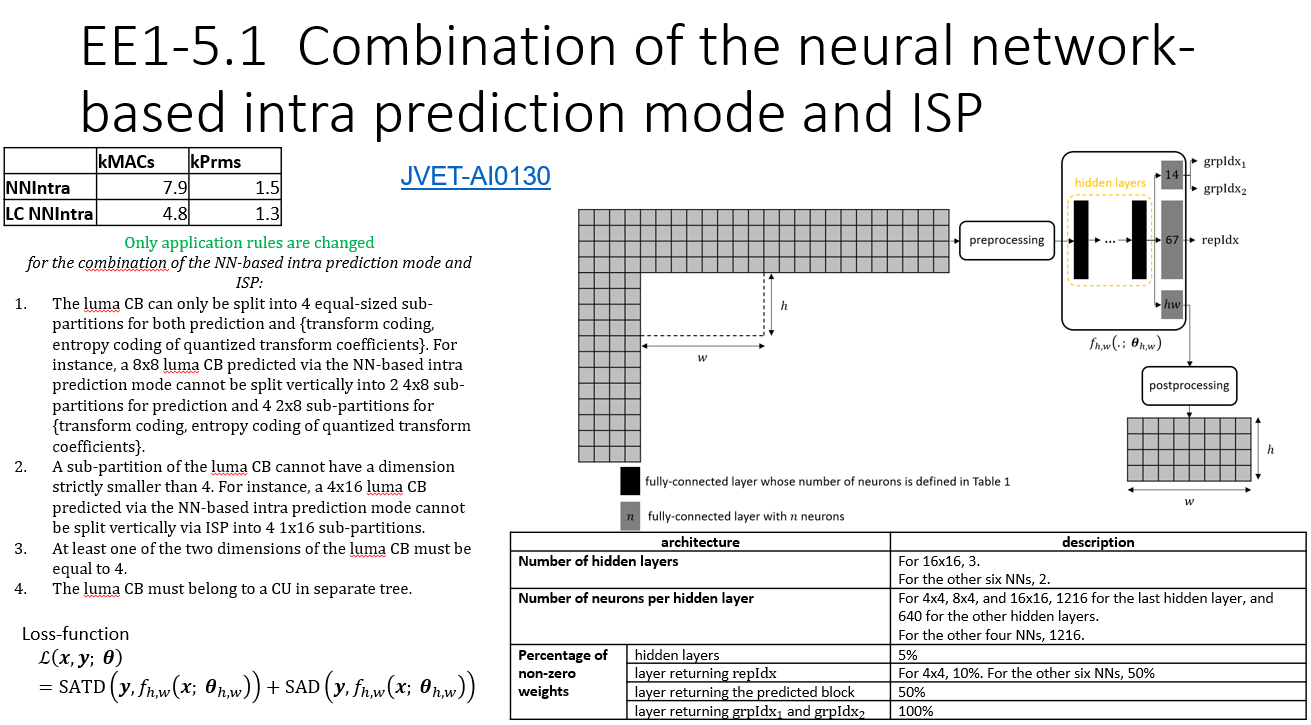


4.1.2 and 4.2 have comparable performance and complexity (minor advantage of 4.1.2 could be seen), but 4.1.2 has additional benefit of arbitrary scaling factors.

Decision: Adopt JVET-AI0074 test 4.1.2







Training cross-check not finished, and likely expected to finish before end of meeting.

It was asked how the zero weights are distributed which are providing the complexity reduction. It is however pointed out that SADL takes care of this in a way commonly used for sparse networks.

Revisit: conditional adoption?

[JVET-AI0041](https://jvet-experts.org/doc_end_user/current_document.php?id=14279) [AHG11] [AHG14] Teleconference on NNVC [E. Alshina, F. Galpin]

### EE1 contributions: Neural network-based video coding (9)

Contributions in this area were discussed in the context of the EE summary report JVET-AI0023.

[JVET-AI0068](https://jvet-experts.org/doc_end_user/current_document.php?id=14309) EE1-1.2: Partial Convolution and Over-Parameterization [A. Li, J. Chi, C. Zhu, L. Luo, H. Guo (UESTC), Y. Huo, Y. Liu (Transsion)]

[JVET-AI0151](https://jvet-experts.org/doc_end_user/current_document.php?id=14410) Crosscheck of JVET-AI0068 (EE1-1.2: Partial Convolution and Over-Parameterization) [D. Liu (Ericsson)] [late] [miss]

[JVET-AI0074](https://jvet-experts.org/doc_end_user/current_document.php?id=14315) EE1-4.1: Multiple scaling ratios coding for NNVC with NNSR [Z. Lv, C. Zhou (vivo)]

[JVET-AI0264](https://jvet-experts.org/doc_end_user/current_document.php?id=14523) Cross-check of JVET-AI0074 (EE1-4.1: Multiple scaling ratios coding for NNVC with NNSR) [C. Lin (Bytedance)] [late]

[JVET-AI0093](https://jvet-experts.org/doc_end_user/current_document.php?id=14335) EE1-4.2: On simplified super resolution model [C. Lin, Y. Li, J. Li, K. Zhang, L. Zhang (Bytedance)]

[JVET-AI0258](https://jvet-experts.org/doc_end_user/current_document.php?id=14517) Crosscheck of JVET-AI0093 (EE1-4.2: On simplified super resolution model) [Z. Lv (vivo)] [late]

[JVET-AI0107](https://jvet-experts.org/doc_end_user/current_document.php?id=14349) EE1-1.5: VLOP using LOP3 architecture [D. Liu, J. Ström, M. Damghanian, P. Wennersten (Ericsson), D. Rusanovskyy, Y. Li, M. Karczewicz (Qualcomm)]

[JVET-AI0130](https://jvet-experts.org/doc_end_user/current_document.php?id=14372) EE1-5.1: combination of the neural network-based intra prediction mode and ISP [T. Dumas, F. Galpin, P. Bordes (InterDigital)]

[JVET-AI0273](https://jvet-experts.org/doc_end_user/current_document.php?id=14532) Crosscheck of JVET-AI0130 (EE1-5.1: combination of the neural network-based intra prediction mode and ISP) [M. Santamaria (Nokia)] [late] [miss]

[JVET-AI0283](https://jvet-experts.org/doc_end_user/current_document.php?id=14542) Crosscheck of JVET-AI0130 (EE1-5.1: combination of the neural network-based intra prediction mode and ISP) [Y. Li (Bytedance)] [late] [miss]

[JVET-AI0157](https://jvet-experts.org/doc_end_user/current_document.php?id=14416) EE1-1.4: Content-adaptive VLOP-filter [R. Yang, M. Santamaria, F. Cricri, M. M. Hannuksela, D. Bugdayci Sansli, A. Hallapur, J. Lainema, H. Zhang (Nokia Technologies), D. Rusanovskyy, Y. Li, M. Karczewicz (Qualcomm)]

[JVET-AI0241](https://jvet-experts.org/doc_end_user/current_document.php?id=14500) Crosscheck of JVET-AI0157 (EE1-1.4: Content-adaptive VLOP-filter) [D. Liu (Ericsson)] [late]

[JVET-AI0173](https://jvet-experts.org/doc_end_user/current_document.php?id=14432) EE1-1.1: LOP input adjustment with trainable components [Y. Li, D. Rusanovskyy, M. Karczewicz (Qualcomm)]

[JVET-AI0174](https://jvet-experts.org/doc_end_user/current_document.php?id=14433) EE1-2.1: On the detailed analysis of integer Transformer ILF with luma-chroma component balancing and complexity trade-off [Y. Li, D. Rusanovskyy, M. Karczewicz (Qualcomm)]

[JVET-AI0221](https://jvet-experts.org/doc_end_user/current_document.php?id=14480) EE1-1.3: On Low Complexity Operational Point for In-Loop Filtering [S. Eadie, T. Ryder, Y. Li, D. Rusanovskyy, M. Karczewicz (Qualcomm)]

[JVET-AI0278](https://jvet-experts.org/doc_end_user/current_document.php?id=14537) Crosscheck of JVET-AI0221 (EE1-1.3: On Low Complexity Operational Point for In-Loop Filtering) [J. Ström (Ericsson)] [late] [miss]

### EE1 related contributions: Neural network-based video coding (4)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0095](https://jvet-experts.org/doc_end_user/current_document.php?id=14337) EE1-related: Improved gain for NN in-loop filters using early cropping [J. Ström, M. Damghanian, D. Liu, P. Wennersten (Ericsson)]

[JVET-AI0172](https://jvet-experts.org/doc_end_user/current_document.php?id=14431) EE1 (AhG11): On the complexity adjustment of HOP4 [Y. Li, D. Rusanovskyy, M. Karczewicz (Qualcomm), F. Galpin (Interdigital), Y. Li, J. Li, C. Lin, K. Zhang, L. Zhang (Bytedance)]

[JVET-AI0175](https://jvet-experts.org/doc_end_user/current_document.php?id=14434) EE1 related: Block-size invariant implementation of HOP4 [Y. Li, D. Rusanovskyy, M. Karczewicz (Qualcomm)]

[JVET-AI0204](https://jvet-experts.org/doc_end_user/current_document.php?id=14463) EE1-Related: EE1-1.5 with reduced complexity reduced complexity input feature extraction [D. Rusanovskyy, Y. Li, M. Karczewicz (Qualcomm)]

### Improvements of NNVC beyond EE1 (9)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0089](https://jvet-experts.org/doc_end_user/current_document.php?id=14331) AHG11: RA/LDB Unified Reference Frame Synthesis for VVC Inter Coding [Q. Qin, C. Jung (Xidian Univ.)]

[JVET-AI0090](https://jvet-experts.org/doc_end_user/current_document.php?id=14332) AHG11: Deep Reference Frame Generation for VVC Inter Coding [H. Zhang, C. Jung, Q. Qin (Xidian Univ.)]

[JVET-AI0092](https://jvet-experts.org/doc_end_user/current_document.php?id=14334) AHG11: QP Distance-Based Progressive Learning for Enhancing HOP In-Loop Filter [P. Fu, C. Jung, Q. Qin (Xidian Univ.)]

[JVET-AI0105](https://jvet-experts.org/doc_end_user/current_document.php?id=14347) AHG11: Wavelet transform for super-resolution loss function [J. Ye, K. Wu, Q. Liu (HUST)] [late]

[JVET-AI0111](https://jvet-experts.org/doc_end_user/current_document.php?id=14353) AhG11: Content-adaptive LOP3 filter [M. Santamaria, R. Yang, F. Cricri, M. M. Hannuksela, D. Bugdayci Sansli, A. Hallapuro, J. Lainema, H. Zhang (Nokia)]

[JVET-AI0134](https://jvet-experts.org/doc_end_user/current_document.php?id=14376) AhG11: LOP3 filter with multiscale blocks [R. Yang, F. Cricri, M. Santamaria, H. Zhang, J. Lainema, M.M. Hannuksela (Nokia)]

[JVET-AI0150](https://jvet-experts.org/doc_end_user/current_document.php?id=14409) AHG11: Report of retraining LOP3 with new sequences from JVET-AH0120 [D. Liu (Ericsson)]

[JVET-AI0155](https://jvet-experts.org/doc_end_user/current_document.php?id=14414) AhG14: Report of HOP3 training using additional dataset from JVET-AH0120 [F. Galpin, T. Poirier (InterDigital)] [late]

[JVET-AI0188](https://jvet-experts.org/doc_end_user/current_document.php?id=14447) AhG11: Block based QP information in NN loop filters [F. Galpin, T. Poirier, T. Dumast, P. Bordes (InterDigital)]

[JVET-AI0301](https://jvet-experts.org/doc_end_user/current_document.php?id=14560) Crosscheck of JVET-AI0088 (EE2-related: Block Vector-Guided Chain Motion Vector Prediction) [Y. Kidani, K. Kawamura (KDDI)] [late] [miss]

### SADL and NNVC implementation (7)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0052](https://jvet-experts.org/doc_end_user/current_document.php?id=14293) AHG11: Add checksums of sequences to NNVC CTC [J. Pardo (Huawei)]

[JVET-AI0235](https://jvet-experts.org/doc_end_user/current_document.php?id=14494) Crosscheck of JVET-AI0052 (AHG11: Add checksums of sequences to NNVC CTC) [F. Galpin (InterDigital)] [late] [miss]

[JVET-AI0053](https://jvet-experts.org/doc_end_user/current_document.php?id=14294) AHG14: The extension of SADL library [N. Fu, W. Bao, J. Zhang, Z. Chen (Wuhan Univ.)]

[JVET-AI0057](https://jvet-experts.org/doc_end_user/current_document.php?id=14298) AHG14: SADL update [F. Galpin, F. Urban, T. Poirier (InterDigital), X. Li (Google)]

[JVET-AI0124](https://jvet-experts.org/doc_end_user/current_document.php?id=14366) AHG 14: Alignment of reference picture setting in NNVC with those in VTM [K. Andersson, D. Liu, J. Ström (Ericsson)]

[JVET-AI0236](https://jvet-experts.org/doc_end_user/current_document.php?id=14495) Crosscheck of JVET-AI0124 (AHG 14: Alignment of reference picture setting in NNVC with those in VTM) [F. Galpin (InterDigital)] [late] [miss]

[JVET-AI0128](https://jvet-experts.org/doc_end_user/current_document.php?id=14370) AHG14: Update of Guidelines for NNVC software development [F. Galpin (InterDigital)]

[JVET-AI0176](https://jvet-experts.org/doc_end_user/current_document.php?id=14435) AhG11: SADL update [Y. Li, D. Rusanovskyy, M. Karczewicz (Qualcomm)]

[JVET-AI0230](https://jvet-experts.org/doc_end_user/current_document.php?id=14489) AHG14: Fix for mismatch between encoding and decoding in the NNVC with palette on [Z. Li, X. Zeng, M. Jia, Z. Zhang, Y. Wang, J. Zhang, C. Huang (ZTE)] [late] [placeholder]

Initial version without any results – rejected as “placeholder”

## AHG6/AHG12: Enhanced compression beyond VVC capability (90)

### Summary and BoG reports (1)

Contributions in this area were discussed at 1710–2100 on Friday 12 July 2024 (chaired by JRO).

[JVET-AI0024](https://jvet-experts.org/doc_end_user/current_document.php?id=14395) EE2: Summary report of exploration experiment on enhanced compression beyond VVC capability [V. Seregin, J. Chen, R. Chernyak, K. Naser, J. Ström, F. Wang, M. Winken, X. Xiu, K. Zhang (EE coordinators)]

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tests** | **Tester** | **Cross-checker** |
| **1 Partitioning** | | | |
| 1.1 | Adaptive dual tree coding in inter slices | F. Le Léannec (InterDigital) | P. Andrivon (Ofinno)  JVET-AI0265 |
| 1.1a | Adaptive dual tree coding in inter slices (trade-off 1) | F. Le Léannec (InterDigital) | P. Andrivon (Ofinno)  JVET-AI0265 |
| 1.1b | Adaptive dual tree coding in inter slices (trade-off 2) | F. Le Léannec (InterDigital) | P. Andrivon (Ofinno)  JVET-AI0265 |
| 1.1c | Adaptive dual tree coding in inter slices (trade-off 3) | F. Le Léannec (InterDigital) | P. Andrivon (Ofinno)  JVET-AI0265 |
| 1.2a | Restricting BT CUs to apply QT-like partitioning structure | W. Ahmad (Ericsson) | A.Tissier (Xiaomi)  JVET-AI0263 |
| 1.2b | Restricting BT CUs to apply QT-like partitioning structure (also at smaller block sizes) | W. Ahmad (Ericsson) | T. Dumas  (InterDigital)  JVET-AI0272 |
| 1.2c | Restricting BT CUs to apply QT-like partitioning structure (non-normative solution) | W. Ahmad (Ericsson) | A. Sidiya  (Sharp) |
| **2 Intra prediction** | | | |
| 2.1 | TIMD merge | M. Abdoli (Xiaomi) | M. Salehifar  (ByteDance) |
| 2.2 | TIMD with enhanced block vectors deployment | K. Naser (InterDigital)  J. Fu (Peking Univ.) | M. Blestel (Ofinno) |
| 2.3 | Test 2.1 + Test 2.2 | M. Abdoli (Xiaomi)  K. Naser (InterDigital)  J. Fu  (Peking Univ.) | M. Blestel (Ofinno) |
| 2.4a | Additional TIMD mode with different cost metric | D. Bugdayci Sansli (Nokia) | J. Konieczny (TCL) |
| 2.4b | Additional TIMD mode with different cost metric (no template size change) | D. Bugdayci Sansli (Nokia) | J. Konieczny (TCL) |
| 2.4c | Test 2.2 + Test 2.4a | D. Bugdayci Sansli (Nokia) | D. Ruiz Coll  (Ofinno)  X. Zhihuang (OPPO) |
| 2.4d | Test 2.1 + Test 2.2 + Test 2.4a | D. Bugdayci Sansli (Nokia) | W. Ahmad (Ericsson)  JVET-AI0310 |
| 2.5a | Intra merge mode | Y.-J. Chang (Qualcomm) | M. Blestel (Ofinno) |
| 2.5b | Intra merge mode without TIMD candidate | Y.-J. Chang (Qualcomm) | M. Blestel (Ofinno) |
| 2.5c | Intra merge mode with adjacent and non-adjacent neighbours used in current ECM intra tools | Y.-J. Chang (Qualcomm) | Y. Kidani (KDDI) |
| 2.5d | Intra merge mode with larger candidate list | Y.-J. Chang (Qualcomm) | J. Fu (PKU) |
| 2.6a | IntraTMP merge candidates clustering based on refinement window | D. Ruiz Coll  (Ofinno) | T.M. Bae  (Sharp) |
| 2.6b | IntraTMP search arIntraTMP search area shifting and plus-shape refinement for LIC candidates | K. Naser (InterDigital) | W. Ahmad(Ericsson)  JVET-AI0215 |
| 2.6c | Test 2.6a + Test 2.6b | D. Ruiz Coll  (Ofinno)  K. Naser (InterDigital) | Z. Deng  (Bytedance) |
| 2.7a | Regularized EIP | H. Qin  (TCL) | R. Ishimoto  (Sharp) |
| 2.7b | Regularized CCCM | H. Qin  (TCL) | R. Ishimoto  (Sharp) |
| 2.7c | Test 2.7a + Test 2.7b | H. Qin  (TCL) | R. Ishimoto  (Sharp) |
| 2.8a | MIP with mode and block shape dependent matrices. | H. Wang (Qualcomm) | J. Konieczny (TCL)  [Y. Wang (Bytedance)](mailto:wangyang.cs@bytedance.com) JVET-AI0260 |
| 2.8b | MIP with downsampling/upsampling in the process. | H. Wang (Qualcomm) | [Y. Wang (Bytedance)](mailto:wangyang.cs@bytedance.com) JVET-AI0260 |
| 2.9a | Derived modes with fusion | Z. Xie  (OPPO) | C. Zhou  (vivo)  JVET-AI0284  T. Dumas  (InterDigital)  JVET-AI0271 |
| 2.9b | MIP-LFNST transform set derivation by upsampled prediction | Z. Xie  (OPPO) | C. Zhou  (vivo)  JVET-AI0284  T. Dumas  (InterDigital)  JVET-AI0271 |
| 2.9c | Test 2.9a + Test 2.9b | Z. Xie  (OPPO) | C. Zhou  (vivo)  JVET-AI0284  T. Dumas  (InterDigital)  JVET-AI0271 |
| **3** **Inter prediction** | | | |
| 3.1a | High accuracy sample based BDOF | M. Salehifar  (Bytedance) | X. Xiu  (Kwai) |
| 3.1b | High accuracy sample based BDOF with no weight | M. Salehifar  (Bytedance) |  |
| 3.2 | Temporal BV for IBC merge list construction | L. Xu  (OPPO)  N. Zhang  (Bytedance) | X. Li  (Alibaba) |
| 3.3a | GPM with inter prediction and IBC | Y. Wang  (Bytedance) | L. Xu  (OPPO)  JVET-AI0295 |
| 3.3b | Test 3.2 + Test 3.3a | Y. Wang  (Bytedance)  L. Xu  (OPPO) | C. Ma  (Kwai)  JVET-AI0291 |
| 3.4a | Merge candidates with alternative reference indices | Z. Zhang  (Qualcomm) | C. Ma,  X. Xiu(Kwai)  JVET-AI0292 |
| 3.4b | Additional TMVP and SbTMVP candidates | Z. Zhang  (Qualcomm) | C. Ma, X. Xiu  (Kwai)  JVET-AI0292 |
| 3.4c | Additional bi-TMVP candidates | Z. Zhang  (Qualcomm) | C. Ma, X. Xiu  (Kwai)  JVET-AI0292 |
| 3.4d | Test 3.4a + Test 3.4b + Test 3.4c | Z. Zhang  (Qualcomm) | C. Ma, X. Xiu  (Kwai)  JVET-AI0292 |
| 3.4e | Test 3.4b + Test 3.4c | Z. Zhang  (Qualcomm) | C. Ma, X. Xiu  (Kwai)  JVET-AI0292 |
| 3.5a | Additional CMVP candidates introduced in the pairwise merge candidate list. | N. Zhang  (Bytedance) | [Y.Kidani](mailto:yo-kidani@kddi.com) (KDDI)  [JVET-AI0302](https://jvet-experts.org/doc_end_user/current_document.php?id=14561) |
| 3.5b | Additional CMVP candidates introduced in the initial merge candidate list. | N. Zhang  (Bytedance) | [Y.Kidani](mailto:yo-kidani@kddi.com) (KDDI)  [JVET-AI0302](https://jvet-experts.org/doc_end_user/current_document.php?id=14561) |
| 3.6 | Adaptive cost function selection in merge mode | K. Cui  (Qualcomm) | N. Zhang  (Bytedance)  JVET-AI0249 |
| 3.7 | TMVP for chained motion vector prediction | P.-H. Lin  (Qualcomm) | [Y.Kidani](mailto:yo-kidani@kddi.com) (KDDI)  JVET-  AI0305 |
| 3.8a | GPM-affine with MMVD | Y. Wang  (Bytedance) | H. Wang  (Qualcomm)  JVET-AI0293 |
| 3.8b | GPM-affine with TM | Y. Wang  (Bytedance) | H. Wang  (Qualcomm)  JVET-AI0293 |
| 3.8c | Test 3.8a + Test 3.8b | Y. Wang  (Bytedance) | H. Wang  (Qualcomm)  JVET-AI0293 |
| 3.9 | Affine candidates derived from temporal collocated pictures | C. Ma  (Kwai) | N. Zhang  (ByteDance)  JVET-AI0250 |
| 3.10a | Sharp motion compensation filter for bi-prediction | J. Samuelsson-Allendes  (Sharp) | L. Chen  (Tencent) |
| 3.10b | Test 3.10a applied to blocks 8x8 and larger | J. Samuelsson-Allendes  (Sharp) | L. Chen  (Tencent) |
| **4** **Transform and coefficients coding** | | | |
| 4.1a | Multiple kernel set selection for inter LFNST/NSPT | L. Zhao  (Bytedance) | F. Wang  (OPPO)  JVET-AI0267 |
| 4.1b | LFNST/NSPT for SBT-coded blocks | L. Zhao  (Bytedance) | F. Wang  (OPPO)  JVET-AI0267 |
| 4.1c | Test 4.1a + Test 4.1b | L. Zhao  (Bytedance) | F. Wang  (OPPO)  JVET-AI0267 |
| 4.2a | Shifting quantization center for transform skip coefficient | Y. Yu  (OPPO) | M. Balcilar  (InterDigital)  JVET-AI0274  H.-J. Jhu  (Kwai)  JVEG-AI0277 |
| 4.2b | Shifting quantization amount derived from quantization level of individual quantizer | Y. Yu  (OPPO) | M. Balcilar  (InterDigital)  JVET-AI0274  H.-J. Jhu  (Kwai)  JVEG-AI0277 |
| 4.2c | Test 4.2a + Test 4.2b | Y. Yu  (OPPO) | M. Balcilar  (InterDigital)  JVET-AI0274  H.-J. Jhu  (Kwai)  JVEG-AI0277 |
| 4.3 | 16 States TCQ | M. Balcilar  (InterDigital) |  |
| 4.4a | Multiple transform set selection for intra LFNST/NSPT without complexity reduction | F. Wang  (OPPO)  L. Zhao  (Bytedance)  M. Coban  (Qualcomm) | M. Koo  (LGE)  JVET-AI0269  X. Li  (Google)  JVET-AI0228 |
| 4.4b | Test 4.4a with CU size restriction | F. Wang  (OPPO) | M. Koo  (LGE)  JVET-AI0269  X. Li  (Google)  JVET-AI0228 |
| 4.4c | Test 4.4a with implicit kernel derivation | C. Bonnineau (InterDigital) | S. Blasi  (Nokia) JVET-AI0275  JVET-AI0275  F. Wang  (OPPO)  JVET-AI0297 |
| 4.4d | Test 4.4c with CU size restriction | C. Bonnineau (InterDigital) | S. Blasi  (Nokia) JVET-AI0275  F. Wang  (OPPO)  JVET-AI0297 |
| 4.4e | Test 4.4a with reduced number of transform candidates | M. Coban  (Qualcomm) | M. Koo  (LGE)  JVET-AI0269 |
| 4.4f | Test 4.1c from the previous EE | F. Wang  (OPPO) | M. Koo  (LGE)  JVET-AI0269 |
| 4.4g | Test 4.4c (for blocks area >= 128 && area < 256) + Test 4.4a (for blocks area >= 256) | C. Bonnineau (InterDigital) | J.-K. Lee  (Ofinno)  JVET-AI0251 |
| 4.5a | Multiple transform set selection for intra MTS | C. Bonnineau (InterDigital) | D. Ruiz Coll  (Ofinno)  JVET-AI0133 |
| 4.5b | Test 4.4a + Test 4.5a | C. Bonnineau (InterDigital) | D. Ruiz Coll  (Ofinno)  JVET-AI0133 |
| **5 In-loop filtering** | | | |
| 5.1a | Modification of ALF RDO criterion | G. Boisson  (InterDigital) | C.-W. Kuo  (Kwai)  JVET-AI0244 |
| 5.1b | Modification of ALF APS syntax | G. Boisson  (InterDigital) | C.-W. Kuo  (Kwai)  JVET-AI0244 |
| 5.1c | Modification of CTU-level ALF syntax | G. Boisson  (InterDigital) | C.-W. Kuo  (Kwai)  JVET-AI0244 |
| 5.1d | Test 5.1b + Test 5.1c | G. Boisson  (InterDigital) | V. Shchukin  (Ericsson)  JVET-AI0112 |
| 5.1e | Test 5.1a + Test 5.1d | G. Boisson  (InterDigital) | V. Shchukin  (Ericsson)  JVET-AI0112 |
| 5.2 | ALF residuals scaling | P.Bordes  (InterDigital) | Z. Dai  (OPPO)  JVET-AI0240 |
| 5.3a | CCALF with chroma SAO outputs | Z.Dai, N. Song  (OPPO) | P.Bordes (InterDigital)  JVET-  AI0170  C. Ma  (Kwai)  JVET-AI0290 |
| 5.3b | CCALF with chroma fixed filter outputs | Z.Dai, N. Song (OPPO) | C. Ma  (Kwai)  JVET-AI0290 |
| 5.3c | CCALF with chroma ALF outputs | N. Hu  (Qualcomm) | W. Yin  (Bytedance)  JVET-AI0288 |
| 5.3d | Test 5.3a + Test 5.3b + Test 5.3c | N. Hu  (Qualcomm)  Z.Dai, N. Song (OPPO) | P.Bordes (InterDigital)  JVET-  AI0170 |
| 5.3e | Test 5.3a + Test 5.3c | N. Hu  (Qualcomm)  Z.Dai, N. Song (OPPO) | W. Yin  (Bytedance)  JVET-AI0288 |
| **6 Entropy coding** | | | |
| 6.1a | Retrained CABAC contexts | F. Galpin (InterDigital) | X. Li  (Google)  JVET-AI0227 |
| 6.1b | Test 6.1a + some EP bins converted to NEP | F. Galpin (InterDigital) | X. Li  (Google)  JVET-AI0227 |
| 6.1c | Test 6.1b + some EP bins converted to context or NEP coded | F. Galpin (InterDigital) | X. Li  (Google)  JVET-AI0227 |
| 6.2a | Context offset for gtX | P.Nikitin  (Qualcomm) | K. Naser  (InterDigital) |
| 6.2b | Test 6.1a + Test 6.2a | P.Nikitin  (Qualcomm) | K. Naser  (InterDigital) |

Partitioning

**Test 1.1: Adaptive dual tree coding in inter slices ([JVET-AI0136](https://jvet-experts.org/doc_end_user/current_document.php?id=14393))**

In this method, adaptive dual tree selection is introduced to intra regions in B- and P-slices. A single tree is used in the beginning, and at a certain block size and if CU is intra coded, a flag is signalled indicating whether the tree continues to be in a single or in dual mode.

If the dual tree mode is indicated then luma and chroma are separately partitioned, and all block in that region are intra coded as shown in the next figure.

A black and white squares

Description automatically generated

Three trade-offs are evaluated.

Test 1.1a: Adaptive dual tree coding in inter slices (trade-off 1)

Test 1.1b: Adaptive dual tree coding in inter slices (trade-off 2)

Test 1.1c: Adaptive dual tree coding in inter slices (trade-off 3)

**Test 1.2: Restricting BT CUs to apply QT-like partitioning structure ([JVET-AI0087](https://jvet-experts.org/doc_end_user/current_document.php?id=14329))**

In ECM, a BT partitioned block may be further partitioned by BT in the orthogonal direction producing a QT-like partitioned block.

In the test, such BT splits are disallowed shown in the next figure in red.



In particular, when the BTH split is applied on a CU and its first subblock selects the BTV split then for the second subblock BTV split is disallowed. Similarly, when the BTV split is applied on a CU and its first subblock selects the BTH split then for the second subblock BTH split is disallowed. The restriction is only applied to a square CUs for which QT split is allowed.

A new CABAC context is added to signal split\_cu\_flag. The context is used when the binary split is applied on a luma channel CU, and the first subblock selects a different binary split compared to the binary split selected by its parent CU.

When the dual tree is enabled for I-slices, the restriction is only applied to the luma channel.

The QT early termination is avoided for CU sizes where the restriction is applied.

Three tests are performed.

Test 1.2a: Restricting BT CUs to apply QT-like partitioning structure. The restriction is applied to 128x128, 64x64 and 32x32 CU sizes.

Test 1.2b: Restricting BT CUs to apply QT-like partitioning structure (also at smaller block sizes). The restriction is applied to 128x128, 64x64, 32x32, and 16x16 CU sizes.

Test 1.2c: Restricting BT CUs to apply QT-like partitioning structure (non-normative solution). The restriction is applied to 128x128, 64x64 and 32x32 CU sizes at encoder.



Test 1.1c has best tradeoff for RA (some chroma gain, while 1.3 % encoding time increase), where encoding time reduction relative to other 1.1x is achieved by disabling for some QPs and some temporal layers. Some loss in LB.

Confirmation and support by cross-checker and another independent expert.

Decision: Adopt JVET-AI0136 test 1.1c, enable in CTC for RA.

Test 1.2x is removing “redundant signalling”, also saving some encoder checks. It was commented that the same idea was proposed for VVC, and seems more at a level of “fine-tuning” rather than investigating benefit of tools. Several experts commented that the benefit in terms of encoding time reduction is attractive in the ECM context, in particular for 1.2b

Decision: Adopt JVET-AI0077 test 1.2b, enable in CTC for all slice types.

***Intra prediction***

**Test 2.1: TIMD merge mode ([JVET-AI0110](https://jvet-experts.org/doc_end_user/current_document.php?id=14352))**

In ECM, TIMD prediction is derived by a fusion of up to 3 intra modes with the smallest SATD cost with the weights corresponding to the template cost.

In the test, TIMD merge list of size 5 is constructed by adding TIMD information (prediction modes, fusion flag, fusion weights and wide-angle conditions of TIMD modes, MTS transform types) from adjacent and non-adjacent neighbouring blocks shown in the next figure.

A screenshot of a game

Description automatically generated

TIMD candidates are sorted in the list based on SAD template cost.

The TIMD merge mode is applied to only luma blocks and is disabled for 4x4 block sizes. A flag is signalled in TIMD branch to indicate the mode usage and if more than one candidate is used, a syntax element is signalled to indicate the selected candidate.

**Test 2.2: TIMD with enhanced block vectors deployment ([JVET-AI0104](https://jvet-experts.org/doc_end_user/current_document.php?id=14346))**

In ECM, in addition to IBC and IntraTMP modes, the block-vector-based prediction in ECM is further used in combination with directional prediction of SGPM and DIMD, where the merge candidates (adjacent and non-adjacent) are evaluated with the template cost to select the best block vector predictor to be combined with the directional modes.

In the test, BV combination with TIMD is evaluated. Any of the three fusion modes of TIMD can be replaced by a block-vector-based prediction from the merge candidates based on the template cost. Auto-relocated block vector candidates of IntraTMP are combined with DIMD and TIMD modes.

* Allow TIMD with block vectors: When deriving the intra modes of TIMD (2 angular and 1 non-angular), the block vectors of the merge candidates of IntraTMP mode are also checked. If the template cost is smaller than any of the other modes, the mode is replaced by the block vector.
* Use ARBVP merge list in DIMD and TIMD: The additional block vector candidates generated by ARBVP process are included in the merge list of DIMD and TIMD, in the same manner as in IntraTMP.

**Test 2.3: Combination of TIMD related tests ([JVET-AI0171](https://jvet-experts.org/doc_end_user/current_document.php?id=14430))**

It is a combination test of TIMD merge mode Test 2.1/2.5 and BV prediction combinations Test 2.2.

**Test 2.4: Additional TIMD mode with different cost metric ([JVET-AI0113](https://jvet-experts.org/doc_end_user/current_document.php?id=14355))**

In this test, an additional TIMD based intra mode is introduced, where the cost metric is changed from SATD to MR SAD, the number of template lines/columns around the current block are doubled to 4/8, and the list of TIMD candidate modes is modified to avoid redundancy with respect to the conventional TIMD mode.

The new TIMD based intra mode is signalled as a sub mode of TIMD with a context coded flag, the method is disabled for a block with the minimum size (either width or height) is equal to 4. Also, the candidate list is derived based on the sorted modes determined by the conventional TIMD process. An additional refinement to the candidate list is used based on the DIMD modes.

Two tests are performed.

Test 2.4a: Additional TIMD mode with different cost metric

Test 2.4b: Test 2.4a without template size change

The following combined tests are performed.

Test 2.4c: Test 2.2 + Test 2.4a ([JVET-AI0141](https://jvet-experts.org/doc_end_user/current_document.php?id=14400))

Test 2.4d: Test 2.1 + Test 2.2 + Test 2.4a ([JVET-AI0143](https://jvet-experts.org/doc_end_user/current_document.php?id=14402))

**Test 2.5: Intra-merge mode ([JVET-AI0110](https://jvet-experts.org/doc_end_user/current_document.php?id=14352))**

In the test, a list of intra mode candidates is constructed using the intra modes from the neighbour blocks. It is similar to inter merge mode, but instead of motion vector the neighbour intra modes are added to the list. In this test, the merged neighbouring blocks are those coded by DIMD and TIMD modes.

A flag is signalled to indicate whether to enable the intra merge mode. If the flag is true, the intra merge list is constructed with 5 candidates at most. Then the best candidate is selected among these 5 candidates by comparing the template costs. Adjacent and non-adjacent blocks considered for the intra merge list construction are the same as in Test 2.1.

Four tests are performed.

Test 2.5a: Intra merge mode

Test 2.5b: Test 2.5a without TIMD candidate

Test 2.5c: Test 2.5a with neighbour blocks pattern as in ECM intra tools

Test 2.5d: Test 2.5a with larger candidate list (3 candidates).

**Test 2.6: IntraTMP candidates with overlapping refinement window enhanced ([JVET-AI0129](https://jvet-experts.org/doc_end_user/current_document.php?id=14371))**

In ECM, IntraTMP has sparse, merge (adjacent, non-adjacent), and auto-relocated BV candidates. The 30 BVP candidates with the lowest template cost are further refined. The refinement window around each BVP candidate varies based on the candidate type: merge candidates use an 11x11 window size, and ARBVP and sparse candidates use a 3x3 window size. The distance between the merge, ARBVP, and sparse candidates is not constrained, so the refinement windows may overlap.

In Test 2.6a, a check is performed for merge, ARBVP, and sparse candidate refinement windows overlapping. If two refinement windows overlap, the BV candidate with the lower template cost is selected and ranked in the sparse list for further refinement. Subsequently, a new refinement window that comprises both individual refinement windows is determined for the best candidate.

* The ARBVP list is enlarged by 5 additional ARBVP candidates, using the sparse candidates instead of the merge candidates as the guiding vector.
* For block sizes 8x8 or smaller, a search region fully overlapped by a BVP candidate refinement window is skipped during the sparse searching.
* In each sparse region, the searching pattern is shifted by one sample per row to increase the candidate diversity.

It was observed that overlap may occur between the IntraTMP BVs in LIC and non-LIC modes. Although the two use different cost metric: SAD for non-LIC mode and MR-SAD for LIC mode, the overlap may occur in the sparse search as the same starting point is used.

In Test 2.6b, LIC search region is shifted by half of the subsampling factor, as shown in the next figure, where the non-LIC positions are marked with “x”, while “o” denotes the positions using MR-SAD metric for LIC.

A grid of squares with black and white letters

Description automatically generated

Test 2.6c: Test 2.6a + Test 2.6b.

**Test 2.7: Regularized EIP/CCCM ([JVET-AI0066](https://jvet-experts.org/doc_end_user/current_document.php?id=14307))**

Regularization term is added in solving a system of linear equations.

In Test 2.7a, regularization is applied to EIP mode as follows:

* , where is the number of filter taps in EIP.
  + when the number of input samples , and thus .
  + otherwise, and thus .
* The bias term of EIP is unregularized: the bottom-right entry of the diagonal matrix is set to zero.

In Test 2.7b, regularization is applied to EIP mode as follows:

* , where is the number of filter taps of the respective CCCM model.
* The first luma and bias terma of CCCM are unregularized: the top-left and bottom-right entries of the diagonal matrix is set to zero.

Test 2.7c: Test 2.7a + Test 2.7b.

**Test 2.8: Modifications to matrix-based intra prediction ([JVET-AI0208](https://jvet-experts.org/doc_end_user/current_document.php?id=14467))**

In this test, matrix sizes of the MIP modes are increased for the blocks with sizes up to 32x32, excluding of 4x32, 32x4, 8x32 and 32x8. The proposed matrices use the L-shaped causal template as input to generate the WxH prediction block.

The prediction of a sample P(x,y) can be derived as:

P(x,y) = ∑k F(x,y,k)\*r(k),

Where r(k) is the kth item in the L-shaped template, and F(x,y) is the matrix weights corresponding to the position (x,y).

A blue rectangular object with arrows

Description automatically generated

In Test 2.8a, the size of the prediction block generated by matrix multiplication equals to the current block size.

In Test 2.8b, for blocks sizes of 32x16, 16x32 and 32x32, a prediction block of 16x16 is generated by matrix multiplication and then upsampled to the size of the current block.

The memory usage of matrix coefficients is summarized in the following table.

|  |  |  |
| --- | --- | --- |
|  | Test 2.8a | Test 2.8b |
| Memory usage | 3.68MB | 1.92MB |

The filters are trained with ~105K images of the Open Images Dataset.

**Test 2.9: Derived MIP modes with fusion ([JVET-AI0159](https://jvet-experts.org/doc_end_user/current_document.php?id=14418))**

In Test 2.9a, a fusion mode of two MIP modes is introduced. Similar to other template tools, the top and left neighbouring areas are used as templates to derive the MIP modes and the transposed flags for the current block, where the size of templates is width2 and 2height, respectively. Two best candidates {MIP modes, transposed flag} with the smallest template SATD cost are fused with the weights dependent on the cost.

This fusion process is applied only when the SATD cost of the best candidate is larger than half of the cost of the second-best candidate, otherwise the prediction is derived using only the best candidate without fusion.

In Test 2.9b, the DIMD process in MIP-LFNST transform set derivation is applied to the upsampled prediction samples for non-square blocks with either width or height equal to 4, which is shown in figure (b). For other blocks, the DIMD process is applied directly to the prediction samples as shown in (a).

A black background with white squares

Description automatically generated

Test 2.9a: MIP modes with fusion

Test 2.9b: MIP-LFNST transform set derivation by upsampled prediction

Test 2.9c: Test 2.9a + Test 2.9b



Tests 2.1…2.5 are related to each other.

One expert pointed out that the encoder run time in 2.4a is much higher in the cross-check. Also for 2.1 no runtimes are reported in the crosscheck.

It was further pointed out that 2.3 and 2.4d don’t contain elements of 2.5.

The combinations 2.3 and 2.4d seem to be most attractive, where 2.3 indicates the 2.1 and 2.2 are additive, whereas 2.4a on top of those does give less gain than standalone (which may be due to some encoder modification), and also decoder run time is more increased. Revisit when full results including RA are available, and run time numbers are completely confirmed by crosscheckers.

Test 2.6c has reasonable tradeoff, support expressed.

Decision: Adopt JVET-AI0129 test 2.6c

Test 2.7a has some benefit in compression with very small modification. The combination with 2.7b does not give additional benefit.

Decision: Adopt JVET-AI0066 test 2.7a

Test 2.8x builds on top of the modification introduced in last meeting, replacing regular modes by MIP-like matrix multiplication, but without subsampling. Here, MIP modes are modified in a similar fashion with re-trained matrices. The tradeoff bit rate vs. encoding is attractive. Several proponents including cross-checkers supported 2.8a, deemed to be a better unification, even though memory usage for matrices becomes roughly doubled.

Decision: Adopt JVET-AI0208 test 2.8a

Test 2.9a has worse tradeoff than comparable proposals in this category (0.04% and 100.5% encoding run time, the latter not exactly matched in cross-check). Test 2.9b does not show any benefit. No action on these.

***Inter prediction***

**Test 3.1: High precision sample based BDOF ([JVET-AI0046](https://jvet-experts.org/doc_end_user/current_document.php?id=14285))**

In this test, he high precision formula used for BDOF DMVR is applied to sample based BDOF as follwos.

(åGx.Gx+R1) \* vx + åGx.Gy \* vy = ådI . Gx - dM . åGx

åGx.Gy \* vx + (åGy.Gy+R1) \* vy = ådI . Gy - dM . åGy

where Gx/Gy are the summation of the two horizontal/vertical gradients derived for each reference block.

Summations (S) are weighted sums in test a, and not weighted sum in test b.

Test 3.1a: High accuracy sample based BDOF.

Test 3.1b: High accuracy sample based BDOF with no weights.

**Test 3.2: Temporal BV for IBC merge/AMVP list construction ([JVET-AI0161](https://jvet-experts.org/doc_end_user/current_document.php?id=14420))**

In ECM, the IBC merge/AMVP list is constructed from adjacent spatial candidates, non-adjacent spatial candidates, HBVP candidates, ARBVP candidates, pairwise average candidates, and some predefined BV candidates. However, temporal BV candidates are not utilized.

In the test, temporal BV candidates are added to the IBC merge/AMVP list after the non-adjacent BV candidates. The temporal BVs are derived from collocated positions (corners and center of the block) and shifted collocated positions (five neighbouring positions) in the collocated pictures.

Two collocated pictures are utilized which are the two reference pictures with the first two least POC distances relative to the current picture, same as for TMVP in ECM.

**Test 3.3: GPM with inter prediction and IBC ([JVET-AI0082](https://jvet-experts.org/doc_end_user/current_document.php?id=14324))**

In Test 3.3a, the two geometric sub-partitions are predicted using inter prediction and IBC, individually. To generate the prediction signal of IBC, an IBC candidate list is constructed, and the index of the selected block vector is signalled. The prediction signal of IBC for one sub-partition can be blended with regular GPM, GPM-MMVD, and GPM-affine for the other sub-partition.

Test 3.3b: Test 3.2 and Test 3.3a.

**Test 3.4: MVP extension ([JVET-AI0183](https://jvet-experts.org/doc_end_user/current_document.php?id=14442))**

In the test, scaled merge candidates, TMVP candidates with alternative reference indices, and TMVP candidates based on motion trajectory crossing the current block are introduced.

Scaled merge candidates are added before the default zero MV candidates with the reference index 1 when the existing candidates already included in the merge list has reference index 0, otherwise it adds a candidate with the reference index 0. MV is scaled accordingly.

In ECM, for TMVP and SbTMVP candidates derivation, a reference picture is determined and the MV is then scaled accordingly. In the test, an additional candidate is added where instead of the determined reference picture a reference index corresponding to the collocated block’s reference picture is used and the collocated MV is scaled accordingly. If the picture is not in the reference picture list of the current block, it selects a reference picture between the collocated picture and the collocatd reference picture with the largest POC distance to the current picture.

Finally, it adds a bi-TMVP candidate (MV0, MV1 shown in the next figure) after HMVP if a motion trajectory between a block in a reference picture and its reference block crosses the current block. For a given MV shown in red, which is a reference block MV, a pair of MV0 and MV1 is constructed and if it crosses the current block then those MVs are used as bi-TMVP.



The tested aspects are applied to random access pictures when the low delay condition is false.

All elements are tested individually and all combined.

Test 3.4a: Scaled merge candidates

Test 3.4b: Additional TMVP and SbTMVP candidates

Test 3.4c: Additional bi-TMVP candidates

Test 3.4d: Test 3.4a + Test 3.4b + Test 3.4c

Test 3.4e: Test 3.4b + Test 3.4c

**Test 3.5: Additional chained motion vector prediction candidates ([JVET-AI0103](https://jvet-experts.org/doc_end_user/current_document.php?id=14345))**

In Test 3.5a, additional CMVP candidates are added in the pairwise merge candidate list.

The maximum size of the pairwise merge candidate list is increased by 6 and 2 for low delay and non-low delay pictures, respectively. The maximum number of pairwise candidates is kept unchanged.

In Test 3.5b, additional CMVP candidates are introduced before the zero padding candidates in the initial merge candidate list.

The maximum size of the initial merge candidate list is increased by 4. The maximum number of the candidates before the original CMVP candidates is kept unchanged.

In both Test 3.5a and Test 3.5b, when deriving the additional CMVP candidates, only the center position of the current block is checked to find traced MVs or BVs.

**Test 3.6: Adaptive cost function selection in merge mode ([JVET-AI0185](https://jvet-experts.org/doc_end_user/current_document.php?id=14444))**

In the test, two cost functions are alternately selected for every other candidate in a merge list to refine the corresponding merge candidate. If the merge index is an even number, the first cost function is selected for the refinement process, otherwise the second cost function is selected. It is applied to regular merge mode, template matching merge mode, bilateral matching merge mode, and affine merge mode.

For bilateral matching merge and affine merge, the two cost functions are set to SATD and SAD. For template matching merge, the two cost functions are set to weighted SAD and SAD.

**Test 3.7: TMVP for chained motion vector prediction ([JVET-AI0187](https://jvet-experts.org/doc_end_user/current_document.php?id=14446))**

In the test, TMVP candidates with MV scaled to reference picture with index 0 are added if the existed TMVP candidates has non-zero reference index. The additional TMVP candidates are used to derive CMVP candidates. After TMVP and the related CMVP candidates are derived, ARMC reordering is performed. CMVP candidates are derived in BM merge mode as well.

**Test 3.8: GPM-affine with MMVD and TM ([JVET-AI0083](https://jvet-experts.org/doc_end_user/current_document.php?id=14325))**

In ECM, GPM partition can be predicted using affine MC and the second partition can be a regular GPM, GPM affine, or GPM-intra. However, the second partition cannot be predicted by GPM-MMVD.

In Test 3.8a (GPM-affine with GPM-MMVD), an MV offset, which is signalled, is added to all CPMVs of an affine candidate and the modified CPMVs are used for predicting a GPM sub-partition.

In Test 3.8b (GPM-affine with GPM-TM), an affine candidate is refined by template matching using the same method as in affine mode. A GPM sub-partition can be predicted by GPM-affine with GPM-TM or GPM-TM.

Test 3.8c: Test 3.8a + Test 3.8b.

**Test 3.9: Affine candidates derived from temporal collocated pictures ([JVET-AI0197](https://jvet-experts.org/doc_end_user/current_document.php?id=14456))**

In the test, affine candidates derived from temporal collocated pictures are added to the affine merge candidate list. The same sampling pattern from the regular inter merge mode is reused to scan the predefined positions in the collocated pictures to derive the temporal affine candidates.

If the scanned position belongs to an affine coded CU, a new affine candidate is derived by scaling its CPMVs to the current CU based on its position and block-size in the collocated picture and the derived new affine candidates are inserted into the existing affine merge list and reordered together with the other affine merge candidates by ARMC process.

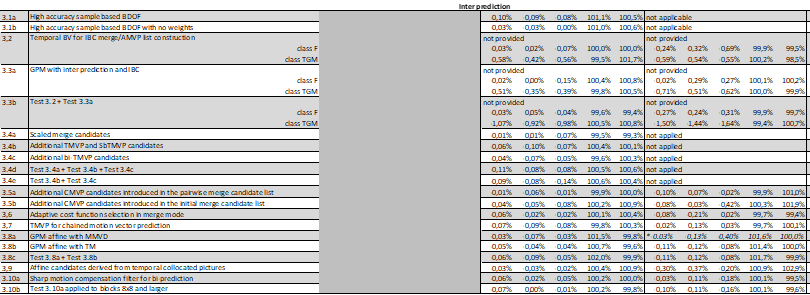
**Test 3.10: Sharp motion compensation filter for bi-prediction ([JVET-AI0094](https://jvet-experts.org/doc_end_user/current_document.php?id=14336))**

In Test 3.10a, an additional MC filter used for bi-predicted blocks is introduced, while the existed MC filter is applied to uni-predicted blocks. Like in ECM, the new filter is based on a cos-windowed sinc function. However, a more generalized form has been used, and unlike the current ECM MC filter, and have been selected to be slightly lower than 1 (instead of equal to 1).

,

where A is a scaling factor to provide the desired number of filter taps.

In Test 3.10b, the new filter is applied to bi-predicted blocks, where both width and height are greater than 4 (for all other blocks the existing MC filter is used).



Test 3.1a is asserted as a reasonable approach, as higher accuracy in MC is already used in other tools in ECM, and tradeoff is reasonable.

Decision: Adopt JVET-AI0046 test 3.1a

According to crosschecker of 3.3b, both 3.2 and 3.3a are straightforward and give attractive benefit for class TGM. Support is also expressed by another non-proponent expert.

Decision: Adopt JVET-AI0082 test 3.3b (only for CTC in screen content classes)

It was clarified that for 3.4c up to 4 additional candidates need to be checked.

The combinations 3.4d and 3.4e were supported by other experts.

Benefit of 3.4a is not obvious, no real complexity reduction, run time results also in the combination 3.4d may be somewhat random.

Decision: Adopt JVET-AI0183 test 3.4e (only for CTC in RA)

3.5x (additional candidates in chained MVP) are deemed to be straightforward extensions, also supported by original CMVP proponents and other experts. 3.5b is preferred due to the higher gain in RA.

Decision: Adopt JVET-AI0103 test 3.5b

For test 3.6, it is asserted that the variation of cost function is increasing the diversity of candidates, which explains the gain (similar approach used already in intra TMP). It was asked if by changing the order of cost functions, results would be different. According to proponents it would still give similar gain.

Several experts supported the idea.

Decision: Adopt JVET-AI0185 test 3.6

Test 3.7 is asserted to provide attractive gain and straightforward to implement. A number of independent experts supported the idea.

Decision: Adopt JVET-AI0187 test 3.7

Test 3.8b has best tradeoff in the 3.8x test, but still worse than comparable proposals in the inter category (0.05% and 100.7% encoding run time in RA, 0.11% and 101.4% encoding run time in LB). Cross-checkers supported the proposal, and confirmed run times at least for class D. Further investigate test 3.8b in EE provided that GPM related proposals from non-EE category would be tested.

Test 3.9 has attractive benefit for LB, and still reasonable for RA. Supported by various experts.

Additional memory (1 flag per 8x8 block to signal usage of affine mode) is needed per reference picture, which does not seem to be a heavy burden compared to other memory usage in ECM.

Decision: Adopt JVET-AI0197 test 3.9

Test 3.10x gives attractive tradeoff. Test 3.10a follows the original proposal and 3.10b was introduced after finding a bug in SIMD implementation, some preference was expressed for 3.10a, but the majority of experts including proponents preferred b.

It was asked if the sharp filters might have visual impact, but according to proponents this was not the case. They did not test with metrics other than PSNR.

It was asked if the gain was consistent over different sequences. According to proponents, this is the case, except for one class F sequence which shows losses, and some higher gain for smaller resolution classes.

Decision: Adopt JVET-AI0094 test 3.10b

### EE2 contributions: Enhanced compression beyond VVC capability (36)

There was no presentation or discussion about specific proposals in this category.

For actions decided to be taken, see section 5.2.1, unless otherwise noted.

[JVET-AI0046](https://jvet-experts.org/doc_end_user/current_document.php?id=14285) EE2-3.1: High Precision Sample Based Bi-Directional Optical Flow [M. Salehifar, Y. He, K. Zhang, L. Zhang (Bytedance)]

[JVET-AI0050](https://jvet-experts.org/doc_end_user/current_document.php?id=14291) EE2-4.1: Improvements on Inter LFNST/NSPT [L. Zhao, K. Zhang, L. Zhang (Bytedance)]

[JVET-AI0267](https://jvet-experts.org/doc_end_user/current_document.php?id=14526) Crosscheck of JVET-AI0050 (EE2-4.1: Improvements on Inter LFNST/NSPT) [F. Wang (OPPO)] [late] [miss]

[JVET-AI0056](https://jvet-experts.org/doc_end_user/current_document.php?id=14297) EE2-6.1: Entropy coding extension [F. Galpin, F. Le Léannec, F. Lo Bianco, C. Salmon-Legagneur, M. Balcilar (InterDigital)]

[JVET-AI0227](https://jvet-experts.org/doc_end_user/current_document.php?id=14486) Crosscheck of JVET-AI0056 on EE2-6.1: Entropy coding extension [X. Li (Google)] [late] [miss]

[JVET-AI0058](https://jvet-experts.org/doc_end_user/current_document.php?id=14299) EE2-5.1: Modifications in ALF syntax [G. Boisson, F. Galpin, P. Bordes (InterDigital)]

[JVET-AI0112](https://jvet-experts.org/doc_end_user/current_document.php?id=14354) Crosscheck of JVET-AI0058 (EE2-5.1: Modifications in ALF syntax) [V. Shchukin (Ericsson)] [late] [miss]

[JVET-AI0244](https://jvet-experts.org/doc_end_user/current_document.php?id=14503) Crosscheck of JVET-AI0058 (EE2-5.1abc: Modifications in ALF syntax) [C.-W. Kuo (Kwai)] [late] [miss]

[JVET-AI0064](https://jvet-experts.org/doc_end_user/current_document.php?id=14305) EE2-4.5: Multiple Transform Set Selection for Intra MTS [C. Bonnineau, K. Naser, S. Puri, F. Le Léannec (InterDigital)]

[JVET-AI0133](https://jvet-experts.org/doc_end_user/current_document.php?id=14375) Crosscheck of JVET-AI0064 (EE2-4.5: Multiple Transform Set Selection for Intra MTS) [D. Ruiz Coll, J.-K. Lee (Ofinno)] [late] [miss]

[JVET-AI0065](https://jvet-experts.org/doc_end_user/current_document.php?id=14306) EE2-4.3: 16 States TCQ [M. Balcilar, K. Naser, Y. Chen, F. Galpin, F. Le Léannec (InterDigital)]

[JVET-AI0309](https://jvet-experts.org/doc_end_user/current_document.php?id=14568) Crosscheck of JVET-AI0065 (EE2-4.3: 16 States TCQ) [M. Coban (Qualcomm)] [late] [miss]

[JVET-AI0066](https://jvet-experts.org/doc_end_user/current_document.php?id=14307) EE2-2.7: Regularized EIP/CCCM [H. Qin, J. Konieczny, K. Ding, Z. Xu (TCL)]

[JVET-AI0232](https://jvet-experts.org/doc_end_user/current_document.php?id=14491) Crosscheck of JVET-AI0066 (EE2-2.7: Regularized EIP/CCCM) [R. Ishimoto, Z. Fan, T. Ikai (Sharp)] [late]

[JVET-AI0082](https://jvet-experts.org/doc_end_user/current_document.php?id=14324) EE2-3.3: GPM with inter prediction and IBC [Y. Wang, N. Zhang, K. Zhang, L. Zhang (Bytedance), L. Xu, Y. Yu, H. Yu, D. Wang (OPPO)]

[JVET-AI0291](https://jvet-experts.org/doc_end_user/current_document.php?id=14550) Crosscheck of JVET-AI0082 (EE2-3.3: GPM with inter prediction and IBC) (EE2-3.3b) [C. Ma (Kwai)] [late] [miss]

[JVET-AI0295](https://jvet-experts.org/doc_end_user/current_document.php?id=14554) Crosscheck of JVET-AI0082 (EE2-3.3: GPM with inter prediction and IBC) [L. Xu (OPPO)] [late]

[JVET-AI0083](https://jvet-experts.org/doc_end_user/current_document.php?id=14325) EE2-3.8: GPM-affine with MMVD and TM [Y. Wang, K. Zhang, L. Zhang (Bytedance)]

[JVET-AI0293](https://jvet-experts.org/doc_end_user/current_document.php?id=14552) Crosscheck of JVET-AI0083 (EE2-3.8: GPM-affine with MMVD and TM) [H. Wang (Qualcomm)] [late] [miss]

[JVET-AI0084](https://jvet-experts.org/doc_end_user/current_document.php?id=14326) EE2-5.2: ALF residuals scaling [P. Bordes, F. Galpin, G. Boisson, F. Urban (InterDigital), N. Hu, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-AI0240](https://jvet-experts.org/doc_end_user/current_document.php?id=14499) Crosscheck of JVET-AI0084 (EE2-5.2: ALF residuals scaling) [Z. Dai (OPPO)] [late] [miss]

[JVET-AI0087](https://jvet-experts.org/doc_end_user/current_document.php?id=14329) EE2-1.2: Restricting BT CUs to apply QT-like partitioning structure [W. Ahmad, P. Wennersten, K. Andersson (Ericsson)]

[JVET-AI0263](https://jvet-experts.org/doc_end_user/current_document.php?id=14522) Crosscheck of JVET-AI0087 (EE2-1.2 Restricting BT CUs to apply QT-like partitioning structure) [A. Tissier, R. G. Youvalari, M. Abdoli (Xiaomi)] [late]

[JVET-AI0272](https://jvet-experts.org/doc_end_user/current_document.php?id=14531) Cross-check of JVET-AI0087 (EE2-1.2: restricting BT CUs to apply QT-like partitioning structure) [T. Dumas (InterDigital)] [late] [miss]

[JVET-AI0094](https://jvet-experts.org/doc_end_user/current_document.php?id=14336) EE2-3.10 Sharp motion compensation filter for bi-prediction [J. Samuelsson-Allendes (Sharp)]

[JVET-AI0318](https://jvet-experts.org/doc_end_user/current_document.php?id=14577) Crosscheck of JVET-AI0094 (EE2-3.10 Sharp motion compensation filter for bi-prediction) [Lien-Fei Chen (Tencent)] [late] [miss]

[JVET-AI0103](https://jvet-experts.org/doc_end_user/current_document.php?id=14345) EE2-3.5: Additional chained motion vector prediction candidates [N. Zhang, K. Zhang, L. Zhang (Bytedance)]

[JVET-AI0302](https://jvet-experts.org/doc_end_user/current_document.php?id=14561) Crosscheck of JVET-AI0103 (EE2-3.5: Additional chained motion vector prediction candidates) [Y. Kidani, K. Kawamura (KDDI)] [late]

[JVET-AI0104](https://jvet-experts.org/doc_end_user/current_document.php?id=14346) EE2-2.2: TIMD with enhanced block vectors deployment [K. Naser, Y. Chen, F. Le Léannec, M. Radosavljević, K. Reuzé (InterDigital), J. Fu, J. Zhang, S. Ma (PKU), Y. Gao, C. Huang (ZTE)]

[JVET-AI0242](https://jvet-experts.org/doc_end_user/current_document.php?id=14501) Crosscheck of JVET-AI0104 (EE2-2.2: TIMD with enhanced block vectors deployment) [M. Blestel (Ofinno)] [late]

[JVET-AI0110](https://jvet-experts.org/doc_end_user/current_document.php?id=14352) EE2-2.1/EE2-2.5: Merge-based intra prediction [M. Abdoli, R. G. Youvalari, A. Tissier (Xiaomi), Y.-J. Chang, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-AI0237](https://jvet-experts.org/doc_end_user/current_document.php?id=14496) Crosscheck of JVET-AI0110 (EE2-2.5d: Merge-based intra prediction) [J. Fu, J. Zhang, S. Ma (PKU), L. Zhao (China Mobile)] [late] [miss]

[JVET-AI0243](https://jvet-experts.org/doc_end_user/current_document.php?id=14502) Crosschecks of Test EE2-2.5a and EE2-2.5b from JVET-AI0110 (EE2-2.1/EE2-2.5: Merge-based intra prediction) [M. Blestel (Ofinno)] [late] [miss]

[JVET-AI0304](https://jvet-experts.org/doc_end_user/current_document.php?id=14563) Crosscheck of Test EE2-2.5c from JVET-AI0110 (EE2-2.1/EE2-2.5: Merge-based intra prediction) [Y. Kidani, K. Kawamura (KDDI)] [late]

[JVET-AI0306](https://jvet-experts.org/doc_end_user/current_document.php?id=14565) Crosscheck of JVET-AI0110, Test EE2-2.1 (Merge-based intra prediction) [M. Salehifar (Bytedance)] [late]

[JVET-AI0113](https://jvet-experts.org/doc_end_user/current_document.php?id=14355) EE2-2.4a/b: Additional TIMD mode with different cost metric [D. Bugdayci Sansli, S. Blasi, J. Lainema (Nokia)]

[JVET-AI0312](https://jvet-experts.org/doc_end_user/current_document.php?id=14571) Crosscheck of JVET AI0113 (EE2-2.4a/b: Additional TIMD mode with different cost metric) [J. Konieczny, H. Qin, T. Dong (TCL)] [late]

[JVET-AI0129](https://jvet-experts.org/doc_end_user/current_document.php?id=14371) EE2-2.6: IntraTMP candidates with overlapping refinement window enhanced [D. Ruiz Coll, J.-K. Lee (Ofinno), K. Naser, T. Dumas, F. Le Léannec, T. Poirier (InterDigital)]

[JVET-AI0210](https://jvet-experts.org/doc_end_user/current_document.php?id=14469) Crosscheck of JVET-AI0129 (EE2-2.6a: IntraTMP candidates with overlapping refinement window enhanced) [T. M. Bae, S. Deshpande (Sharp)] [late]

[JVET-AI0215](https://jvet-experts.org/doc_end_user/current_document.php?id=14474) Crosscheck of JVET-AI0129 (EE2-2.6b: IntraTMP candidates with overlapping refinement window enhanced) [W. Ahmad (Ericsson)]

[JVET-AI0233](https://jvet-experts.org/doc_end_user/current_document.php?id=14492) Crosscheck of JVET-AI0129 (EE2-2.6c: IntraTMP candidates with overlapping refinement window enhanced) [Z. Deng (Bytedance)] [late] [miss]

[JVET-AI0307](https://jvet-experts.org/doc_end_user/current_document.php?id=14566) Crosscheck of JVET-AI0129 (EE2-2.6: IntraTMP candidates with overlapping refinement window enhanced) sub-test 2.6b RA [Z. Xie (OPPO)] [late]

[JVET-AI0136](https://jvet-experts.org/doc_end_user/current_document.php?id=14393) EE2-1.1: adaptive dual tree in inter Slices [F. Le Léannec, K. Naser, T. Dumas, T. Poirier, F. Galpin, E. François (InterDigital)]

[JVET-AI0265](https://jvet-experts.org/doc_end_user/current_document.php?id=14524) Crosscheck of JVET-AI0136 (EE2-1.1: adaptive dual tree in inter slices) [P. Andrivon (Ofinno)] [late] [miss]

[JVET-AI0141](https://jvet-experts.org/doc_end_user/current_document.php?id=14400) EE2-2.4c: Combination of EE tests 2.2 and 2.4 [D. Bugdayci Sansli, S. Blasi, J. Lainema (Nokia), K. Naser, Y. Chen, F. Le Léannec (InterDigital), J. Fu, J. Zhang, S. Ma (PKU), Y. Gao, C. Huang (ZTE)] [late] [miss]

[JVET-AI0279](https://jvet-experts.org/doc_end_user/current_document.php?id=14538) Crosscheck of JVET-AI0141 (EE2-2.4c: Combination of EE2 tests 2.2 and 2.4a) [D. Ruiz Coll, J.-K. Lee (Ofinno)] [late] [miss]

[JVET-AI0308](https://jvet-experts.org/doc_end_user/current_document.php?id=14567) Crosscheck of JVET-AI0141 (EE2-2.4c: Combination of EE2 tests 2.2 and 2.4a) [Z. Xie (OPPO)] [late] [miss]

[JVET-AI0143](https://jvet-experts.org/doc_end_user/current_document.php?id=14402) EE2-2.4d: Combination of EE tests 2.1, 2.2 and 2.4 [D. Bugdayci Sansli, S. Blasi, J. Lainema (Nokia), K. Naser, Y. Chen, F. Le Léannec, M. Radosavljević, K. Reuze (InterDigital), J. Fu, J. Zhang, S. Ma (PKU), Y. Gao, C. Huang (ZTE), M. Abdoli, R. G. Youvalari, A. Tissier (Xiaomi), Y.-J. Chang, V. Seregin, M. Karczewicz (Qualcomm)] [late] [miss]

[JVET-AI0310](https://jvet-experts.org/doc_end_user/current_document.php?id=14569) Crosscheck of JVET-AI0143 (EE2-2.4d: Combination of EE2 tests 2.1, 2.2 and 2.4a) [W. Ahmad (Ericsson)] [late]

[JVET-AI0159](https://jvet-experts.org/doc_end_user/current_document.php?id=14418) EE2-2.9: derived MIP modes with fusion [Z. Xie, Y. Yu, H. Yu, D. Wang (OPPO)]

[JVET-AI0271](https://jvet-experts.org/doc_end_user/current_document.php?id=14530) Cross-check of JVET-AI0159 (EE2-2.9: derived MIP modes with fusion (sub-test EE2-2.9b)) [T. Dumas (InterDigital)] [late] [miss]

[JVET-AI0284](https://jvet-experts.org/doc_end_user/current_document.php?id=14543) Crosscheck of 2.9a and 2.9c in JVET-AI0159 (EE2-2.9: derived MIP modes with fusion) [C. Zhou (vivo)] [late] [miss]

[JVET-AI0161](https://jvet-experts.org/doc_end_user/current_document.php?id=14420) EE2-3.2: Temporal BV for IBC merge/AMVP list construction [L. Xu, Y. Yu, H. Yu, D. Wang (OPPO), N. Zhang, K. Zhang, L. Zhang (Bytedance)]

[JVET-AI0246](https://jvet-experts.org/doc_end_user/current_document.php?id=14505) Crosscheck of JVET-AI0161 (EE2-3.2: Temporal BV for IBC merge/AMVP list construction) [X. Li (Alibaba)] [late] [miss]

[JVET-AI0162](https://jvet-experts.org/doc_end_user/current_document.php?id=14421) EE2-4.2: On Shifting Quantization Center [Y. Yu, H. Yu, L. Xu, J. Gan, F. Wang, Z. Xie, D. Wang (OPPO)]

[JVET-AI0274](https://jvet-experts.org/doc_end_user/current_document.php?id=14533) Crosscheck of JVET-AI0162 (EE2-4.2: On Shifting Quantization Center) [M. Balcilar (InterDigital)] [late] [miss]

[JVET-AI0277](https://jvet-experts.org/doc_end_user/current_document.php?id=14536) Crosscheck of JVET-AI0162 (EE2-4.2: On Shifting Quantization Center) [H.-J. Jhu (Kwai)] [late] [miss]

[JVET-AI0163](https://jvet-experts.org/doc_end_user/current_document.php?id=14422) EE2-4.4a: Multiple transform set selection for intra LFNST/NSPT without complexity reduction [F. Wang, Y. Yu, H. Yu, D. Wang (OPPO), L. Zhao, K. Zhang, L. Zhang (Bytedance), M. Coban, M. Karczewicz (Qualcomm)]

[JVET-AI0164](https://jvet-experts.org/doc_end_user/current_document.php?id=14423) EE2-4.4b: Test 4.4a with CU size restriction [F. Wang, Y. Yu, H. Yu, D. Wang (OPPO)]

[JVET-AI0228](https://jvet-experts.org/doc_end_user/current_document.php?id=14487) Crosscheck of JVET-AI0163/0164: EE2-4.4a and EE2-4.4b [X. Li (Google)] [late] [miss]

[JVET-AI0165](https://jvet-experts.org/doc_end_user/current_document.php?id=14424) EE2-4.4f: Test 4.1c from the previous EE [F. Wang, Y. Yu, H. Yu, D. Wang (OPPO)]

[JVET-AI0269](https://jvet-experts.org/doc_end_user/current_document.php?id=14528) Crosscheck of JVET-AI0163 (EE2-4.4a: Multiple transform set selection for intra LFNST/NSPT without complexity reduction), JVET-AI0164 (EE2-4.4b: Test 4.4a with CU size restriction) and JVET-AI0165 (EE2-4.4f: Test 4.1c from the previous EE) [M. Koo (LGE)] [late] [miss]

[JVET-AI0166](https://jvet-experts.org/doc_end_user/current_document.php?id=14425) EE2-5.3: CCALF with Chroma inputs [Z. Dai, N. Song, Y. Yu, H. Yu, D. Wang (OPPO), N. Hu, M. Karczewicz, V. Seregin (Qualcomm)]

[JVET-AI0170](https://jvet-experts.org/doc_end_user/current_document.php?id=14429) Crosscheck of JVET-AI0166 (EE2- 5.3a & 5.3d CCALF with Chroma inputs) [P. Bordes (InterDigital)] [late] [miss]

[JVET-AI0288](https://jvet-experts.org/doc_end_user/current_document.php?id=14547) Crosscheck of JVET-AI0166 (EE2-5.3c and EE2-5.3e) [W. Yin (Bytedance)] [late] [miss]

[JVET-AI0290](https://jvet-experts.org/doc_end_user/current_document.php?id=14549) Crosscheck of JVET-AI0166 (EE2-5.3: CCALF with Chroma inputs) (EE2-5.3a and EE2-5.3b) [C. Ma (Kwai)] [late] [miss]

[JVET-AI0171](https://jvet-experts.org/doc_end_user/current_document.php?id=14430) EE2-2.3: Combination of EE2-2.1/EE-2-2.5a and EE2-2.2 [M. Abdoli, R. G. Youvalari, A. Tissier (Xiaomi), K. Naser, Y. Chen, F. Le Léannec, M. Radosavljević, K. Reuzé (InterDigital), Y-J. Chang, V. Seregin, M. Karczewicz (Qualcomm), J. Fu, Z. Li, J. Zhang, C. Jia, S. Ma (PKU), Y. Gao, C. Huang (ZTE)]

[JVET-AI0245](https://jvet-experts.org/doc_end_user/current_document.php?id=14504) Crosscheck of test EE2-2.3 from JVET-AI0171 (EE2-2.3: Combination of EE2-2.1/EE-2-2.5a and EE2-2.2) [M. Blestel (Ofinno)] [late] [miss]

[JVET-AI0183](https://jvet-experts.org/doc_end_user/current_document.php?id=14442) EE2-3.4: MVP extension [Z. Zhang, J.-L. Lin, H. Huang, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-AI0292](https://jvet-experts.org/doc_end_user/current_document.php?id=14551) Crosscheck of JVET-AI0183 (EE2-3.4: MVP extension) [C. Ma, X. Xiu (Kwai)] [late] [miss]

[JVET-AI0185](https://jvet-experts.org/doc_end_user/current_document.php?id=14444) EE2-3.6: Adaptive cost function selection in merge mode [K. Cui, Z. Zhang, Y. Zhang, H. Huang, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-AI0249](https://jvet-experts.org/doc_end_user/current_document.php?id=14508) Crosscheck of JVET-AI0185 (EE2-3.6: Adaptive cost function selection in merge mode) [N. Zhang (Bytedance)] [late] [miss]

[JVET-AI0187](https://jvet-experts.org/doc_end_user/current_document.php?id=14446) EE2-3.7: TMVP for chained motion vector prediction [P.-H. Lin, Z. Zhang, J.-L. Lin, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-AI0305](https://jvet-experts.org/doc_end_user/current_document.php?id=14564) Crosscheck of JVET-AI0187 (EE2-3.7: TMVP for chained motion vector prediction) Y. Kidani, K. Kawamura (KDDI) [late]

[JVET-AI0197](https://jvet-experts.org/doc_end_user/current_document.php?id=14456) EE2-3.9: Affine candidates derived from temporal collocated pictures [C. Ma, X. Xiu, C.-W. Kuo, W. Chen, X. Wang (Kwai)]

[JVET-AI0250](https://jvet-experts.org/doc_end_user/current_document.php?id=14509) Crosscheck of JVET-AI0197 (EE2-3.9: Affine candidates derived from temporal collocated pictures) [N. Zhang (Bytedance)] [late] [miss]

[JVET-AI0208](https://jvet-experts.org/doc_end_user/current_document.php?id=14467) EE2-2.8: Modifications to Matrix-based intra prediction [H. Wang, P. Garus, B. Ray, M. Coban, V. Seregin, M. Karczewicz, S. Eadie (Qualcomm)]

[JVET-AI0260](https://jvet-experts.org/doc_end_user/current_document.php?id=14519) Crosscheck of JVET-AI0208 (EE2-2.8: Modifications to Matrix-based intra prediction) [Y. Wang (Bytedance)] [late] [miss]

[JVET-AI0311](https://jvet-experts.org/doc_end_user/current_document.php?id=14570) Crosscheck of JVET-AI0208 (EE2-2.8a: Modifications to Matrix-based intra prediction) [J. Konieczny, H. Qin, T. Dong (TCL)] [late]

[JVET-AI0209](https://jvet-experts.org/doc_end_user/current_document.php?id=14468) EE2-6.2: Context offset for gtX flags for transform coefficients [P. Nikitin, M. Coban, M. Karczewicz, V. Seregin (Qualcomm)]

[JVET-AI0298](https://jvet-experts.org/doc_end_user/current_document.php?id=14557) crosscheck of JVET-AI0209: EE2-6.2: Context offset for gtX flags for transform coefficients [K. Naser] [late] [miss]

[JVET-AI0213](https://jvet-experts.org/doc_end_user/current_document.php?id=14472) EE2-4.4c, EE2-4.4d and EE2-4.4g: Multiple Transform Set Selection for LFNST/NSPT using implicit kernel derivation [C. Bonnineau, K. Naser, S. Puri, F. Le Léannec (InterDigital)]

[JVET-AI0251](https://jvet-experts.org/doc_end_user/current_document.php?id=14510) Crosscheck of JVET-AI0213 (EE2-4.4c, EE2-4.4d and EE2-4.4g: Multiple Transform Set Selection for LFNST/NSPT using implicit kernel derivation) [J.-K Lee, D. Ruiz Coll (Ofinno)] [late]

[JVET-AI0275](https://jvet-experts.org/doc_end_user/current_document.php?id=14534) Crosscheck of JVET-AI0213 (EE2 Tests 4.4c and 4.4d: Multiple Transform Set Selection for LFNST/NSPT using implicit kernel derivation) [S. Blasi (Nokia)] [late] [miss]

[JVET-AI0297](https://jvet-experts.org/doc_end_user/current_document.php?id=14556) Crosscheck of JVET-AI0213 (EE2-4.4c, EE2-4.4d) [F. Wang (OPPO)] [late]

[JVET-AI0219](https://jvet-experts.org/doc_end_user/current_document.php?id=14478) EE2-4.4e: Test 4.4a with reduced number of transform candidates [M. Coban, M. Karczewicz, V. Seregin (Qualcomm)]

[JVET-AI0270](https://jvet-experts.org/doc_end_user/current_document.php?id=14529) Crosscheck of JVET-AI0219 (EE2-4.4e: Test 4.4a with reduced number of transform candidates) [M. Koo (LGE)] [late] [miss]

### EE2 related contributions (5)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0086](https://jvet-experts.org/doc_end_user/current_document.php?id=14328) EE2-2.5 related: History-based merge candidate for intra merge mode [Y. Kidani, H. Kato, K. Kawamura (KDDI)]

[JVET-AI0313](https://jvet-experts.org/doc_end_user/current_document.php?id=14572) Crosscheck of JVET-AI0086 (EE2-2.1/2.5 related: History-based merge candidate for merge-based intra prediction) [Y.-J. Chang (Qualcomm)] [late]

[JVET-AI0088](https://jvet-experts.org/doc_end_user/current_document.php?id=14330) EE2-related: Block Vector-Guided Chain Motion Vector Prediction [M. Jia, Y. Gao, Y. Bai, S. Xie, W. Niu, C. Huang (ZTE)]

[JVET-AI0294](https://jvet-experts.org/doc_end_user/current_document.php?id=14553) Crosscheck of JVET-AI0088 (EE2-related: Block Vector-Guided Chain Motion Vector Prediction) [Z. Li, J. Fu (PKU)] [late]

[JVET-AI0220](https://jvet-experts.org/doc_end_user/current_document.php?id=14479) EE2-4.4b related: Encoder optimization for Test EE2-4.4b [M. Karczewicz, M. Coban, H. Wang (Qualcomm)]

[JVET-AI0229](https://jvet-experts.org/doc_end_user/current_document.php?id=14488) EE2-Related: LIC for Screen Content [T. M. Bae, S. Deshpande (Sharp)] [late]

[JVET-AI0253](https://jvet-experts.org/doc_end_user/current_document.php?id=14512) EE2 related: BV Merge List Improvement [K. Naser, Y. Chen, M. Radosavljević, F. Le Léannec (InterDigital)] [late]

### ECM modifications and software improvements beyond EE2 (48)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

#### Intra and CIIP (19)

[JVET-AI0076](https://jvet-experts.org/doc_end_user/current_document.php?id=14317) AHG12: The Modification of BV candidate List Construction [T. Lee, S. Kim, B. Park, D. Lee, J. Seo, D. Jun (Dong-A Univ.)]

[JVET-AI0259](https://jvet-experts.org/doc_end_user/current_document.php?id=14518) Crosscheck of JVET-AI0076 (AHG12: The Modification of BV candidate List Construction) [Y. Ahn (LGE)] [late] [miss]

[JVET-AI0079](https://jvet-experts.org/doc_end_user/current_document.php?id=14321) Non-EE2: Improved OBIC with PDP [J. Fu, Z. Li, J. Zhang, C. Jia, S. Ma (PKU), Y. Gao, C. Huang (ZTE)]

[JVET-AI0080](https://jvet-experts.org/doc_end_user/current_document.php?id=14322) Non-EE2: Disabling the combination of TIMD-ISP and TIMD-MRL [Z. Fan, T. Chujoh, T. Ikai (Sharp)]

[JVET-AI0268](https://jvet-experts.org/doc_end_user/current_document.php?id=14527) Crosscheck of JVET-AI0080 (Non-EE2: Disabling the combination of TIMD-ISP and TIMD-MRL) [F. Wang (OPPO)] [late] [miss]

[JVET-AI0085](https://jvet-experts.org/doc_end_user/current_document.php?id=14327) Non-EE2: Matrix-based position dependent intra prediction for TIMD [Y. Kidani, H. Kato, K. Kawamura (KDDI)]

[JVET-AI0101](https://jvet-experts.org/doc_end_user/current_document.php?id=14343) Non-EE2: High-level control of intra prediction methods for screen contents [K. Kim, J.-H. Son, J.-S. Kwak (WILUS)]

[JVET-AI0106](https://jvet-experts.org/doc_end_user/current_document.php?id=14348) AHG12: Adaptive HoG for DIMD [S. Blasi, J. Lainema (Nokia)]

[JVET-AI0108](https://jvet-experts.org/doc_end_user/current_document.php?id=14350) Non-EE2: Unified reference area of IBC and IntraTMP [N. Zhang, K. Zhang, Y. Wang, Z. Deng, L. Zhao, W. Yin, L. Zhang (Bytedance)]

[JVET-AI0303](https://jvet-experts.org/doc_end_user/current_document.php?id=14562) Crosscheck of JVET-AI0108 (Non-EE2: Unified reference area of IBC and IntraTMP) [Y. Kidani, K. Kawamura (KDDI)] [late]

[JVET-AI0125](https://jvet-experts.org/doc_end_user/current_document.php?id=14367) Non-EE2: DIMD with filtered-template [Z. Lv, C. Zhou (vivo)]

[JVET-AI0234](https://jvet-experts.org/doc_end_user/current_document.php?id=14493) Crosscheck of JVET-AI0125 (Non-EE2: DIMD with filtered-template) [Z. Deng (Bytedance)} [late] [miss]

[JVET-AI0139](https://jvet-experts.org/doc_end_user/current_document.php?id=14398) Non-EE2: Modified L-shape template in IntraTMP [J. Lee, J. Kim, W. Lim, D. Kim, S.-C. Lim (ETRI)]

[JVET-AI0299](https://jvet-experts.org/doc_end_user/current_document.php?id=14558) Cross-check of JVET-AI0139: Non-EE2: Modified L-shape template in IntraTMP [F. Le Léannec (InterDigital)] [late] [miss]

[JVET-AI0140](https://jvet-experts.org/doc_end_user/current_document.php?id=14399) Non-EE2: On DIMD edge operators [A. Filippov, V. Rufitskiy, J. Konieczny, H. Qin, T. Dong, Z. Xu (TCL)]

[JVET-AI0148](https://jvet-experts.org/doc_end_user/current_document.php?id=14407) Non-EE2: Non-adjacent DIMD mode derivation for TMRL intra mode candidate list construction [V. Rufitskiy, A. Filippov, J. Konieczny, H. Qin (TCL)]

[JVET-AI0149](https://jvet-experts.org/doc_end_user/current_document.php?id=14408) Non-EE2: Unified design of DIMD and non-adjacent DIMD [A. Filippov, V. Rufitskiy, J. Konieczny, H. Qin, K. Ding, T. Dong, Z. Xu (TCL)]

[JVET-AI0154](https://jvet-experts.org/doc_end_user/current_document.php?id=14413) Non-EE2: OBMC extension with intra prediction [D. Kim, J. Lee, J. Kim, W. Lim, S.-C. Lim, J. S. Choi (ETRI)]

[JVET-AI0167](https://jvet-experts.org/doc_end_user/current_document.php?id=14426) Non-EE2: Improvements on EIP [L. Zhang, Z. Xie, Y. Yu, H. Yu, D. Wang (OPPO)]

[JVET-AI0285](https://jvet-experts.org/doc_end_user/current_document.php?id=14544) Crosscheck of JVET-AI0167 (Non-EE2: Improvements on EIP) [C. Zhou (vivo)] [late] [miss]

[JVET-AI0168](https://jvet-experts.org/doc_end_user/current_document.php?id=14427) Non-EE2: Chroma TMRL [H. Huang, Y. Yu, H. Yu, D. Wang (OPPO)]

[JVET-AI0321](https://jvet-experts.org/doc_end_user/current_document.php?id=14580) Crosscheck of JVET-AI0168 (Non-EE2: Chroma TMRL) [Z. Deng (Bytedance)] [late] [miss]

[JVET-AI0201](https://jvet-experts.org/doc_end_user/current_document.php?id=14460) AHG12: neural network-based intra prediction [F. Urban, T. Dumas, F. Galpin, E. François (InterDigital)]

[JVET-AI0224](https://jvet-experts.org/doc_end_user/current_document.php?id=14483) EE2-related: Intra merge mode extension with BV improvement [J. Fu, Z. Li, J. Zhang, C. Jia, S. Ma (PKU)]

[JVET-AI0314](https://jvet-experts.org/doc_end_user/current_document.php?id=14573) Crosscheck of JVET-AI0224 (EE2-related: Intra merge mode extension with BV improvement) [Y.-J. Chang (Qualcomm)] [late]

[JVET-AI0225](https://jvet-experts.org/doc_end_user/current_document.php?id=14484) AhG12: Neural network-based intra prediction with DIMD mode derivation [S. Eadie, P. Garus, T. Ryder, P. Nikitin, M. Coban, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-AI0262](https://jvet-experts.org/doc_end_user/current_document.php?id=14521) AHG 12: OBIC mode from reconstruction [R. G. Youvalari, M. Abdoli, A. Tissier (Xiaomi)] [late]

#### Inter (10)

[JVET-AI0109](https://jvet-experts.org/doc_end_user/current_document.php?id=14351) Non-EE2: A dual merge mode [R.-L. Liao, J. Chen, Y. Ye, X. Li (Alibaba)]

[JVET-AI0114](https://jvet-experts.org/doc_end_user/current_document.php?id=14356) Non-EE2: SATD-based reordering [Y. Wang, K. Zhang, W. Yin, Z. Deng, N. Zhang, L. Zhao, L. Zhang (Bytedance)]

[JVET-AI0118](https://jvet-experts.org/doc_end_user/current_document.php?id=14360) AHG 12: Alternative affine motion model for affine DMVR [K. Andersson (Ericsson)]

[JVET-AI0286](https://jvet-experts.org/doc_end_user/current_document.php?id=14545) Crosscheck of JVET-AI0118 (AHG 12: Alternative affine motion model for affine DMVR) [Y. Huo, Y. Liu (Transsion)] [late] [miss]

[JVET-AI0121](https://jvet-experts.org/doc_end_user/current_document.php?id=14363) AHG 12: Fast hierarchical Subblock based DMVR [K. Andersson, C. Hollmann (Ericsson)]

[JVET-AI0126](https://jvet-experts.org/doc_end_user/current_document.php?id=14368) Non-EE2: Enhanced inter AMVP [Z. Deng, K. Zhang, N. Zhang, Y. Wang, W. Yin, L. Zhao, L. Zhang (Bytedance)]

[JVET-AI0169](https://jvet-experts.org/doc_end_user/current_document.php?id=14428) Non-EE2: On sub-block merge mode [F. Wang, Y. Yu, H. Yu, D. Wang (OPPO)]

[JVET-AI0198](https://jvet-experts.org/doc_end_user/current_document.php?id=14457) Non-EE2: On POC conditions of BDOF [N. Yan, X. Xiu, W. Chen, X. Wang (Kwai)]

[JVET-AI0217](https://jvet-experts.org/doc_end_user/current_document.php?id=14476) EE2-related: on the sharp motion compensation filter for bi-prediction [H. Huang, R. Yu, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-AI0218](https://jvet-experts.org/doc_end_user/current_document.php?id=14477) Non-EE2: On subblock inter mode improvement [H. Huang, Y. Zhang, J.-L Lin, Z. Zhang, P.-H Lin, C.-C Chen, V. Seregin, M. Karczewicz (Qualcomm)]

[JVET-AI0226](https://jvet-experts.org/doc_end_user/current_document.php?id=14485) AHG 12: Longer motion compensation interpolation filter [R. Yu, H. Huang, V. Seregin, M. Karczewicz (Qualcomm)]

#### GPM and other partitioning modes (6)

[JVET-AI0063](https://jvet-experts.org/doc_end_user/current_document.php?id=14304) AHG12: Improvements on GPM partitioning splits [K. Reuzé, Y. Chen, M. Le Pendu, P. Bordes (InterDigital)]

[JVET-AI0067](https://jvet-experts.org/doc_end_user/current_document.php?id=14308) AHG12: GPM mode extension [Y. Ahn, J. Nam, N. Park, J. Lim, S. Kim (LGE)]

[JVET-AI0300](https://jvet-experts.org/doc_end_user/current_document.php?id=14559) Crosscheck of JVET-AI0067 (AHG12: GPM mode extension) [Y. Kidani, K. Kawamura (KDDI)] [late]

[JVET-AI0102](https://jvet-experts.org/doc_end_user/current_document.php?id=14344) Non-EE2: Regression-based SGPM blending [X. Li, R.-L. Liao, J. Chen, Y. Ye (Alibaba)]

[JVET-AI0287](https://jvet-experts.org/doc_end_user/current_document.php?id=14546) Crosscheck of JVET-AI0102 (Non-EE2: Regression-based SGPM blending) [Z. Lv (vivo)] [late] [miss]

[JVET-AI0115](https://jvet-experts.org/doc_end_user/current_document.php?id=14357) Non-EE2: Regression-based GPM extension [K. Jia, J. Chen, X. Li, R.-L. Liao, Y. Ye (Alibaba)]

[JVET-AI0289](https://jvet-experts.org/doc_end_user/current_document.php?id=14548) Crosscheck of JVET-AI0115 (Non-EE2: Regression-based GPM extension) [Y. Wang (Bytedance)] [late] [miss]

[JVET-AI0132](https://jvet-experts.org/doc_end_user/current_document.php?id=14374) AHG12: SGPM improvements [K. Ding, H. Qin, J. Konieczny, A. Filippov, V. Rufitskiy (TCL)]

[JVET-AI0261](https://jvet-experts.org/doc_end_user/current_document.php?id=14520) AHG 12: Rectangular Partitioning Restrictions [A. Tissier, M. Abdoli, R. G. Youvalari (Xiaomi)] [late]

#### In-Loop Filters (5)

[JVET-AI0081](https://jvet-experts.org/doc_end_user/current_document.php?id=14323) AHG12: Adaptive Mantissa Precision for ALF Coefficients [V. Shchukin, P. Wennersten, J. Ström (Ericsson)]

[JVET-AI0135](https://jvet-experts.org/doc_end_user/current_document.php?id=14377) Non-EE2: Extended Usage of Fixed-Filters [W. Yin, K. Zhang, Y. Wang, Z. Deng, L. Zhao, N. Zhang, L. Zhang (Bytedance)]

[JVET-AI0152](https://jvet-experts.org/doc_end_user/current_document.php?id=14411) Non-EE2: Coding Information based Classification for ALF [W. Yin, K. Zhang, Y. Wang, Z. Deng, L. Zhao, N. Zhang, L. Zhang (Bytedance)]

[JVET-AI0200](https://jvet-experts.org/doc_end_user/current_document.php?id=14459) Non-EE2: Using Luma Reconstruction Signal for Chroma ALF [C. Ma, X. Xiu, X. Wang (Kwai)]

[JVET-AI0280](https://jvet-experts.org/doc_end_user/current_document.php?id=14539) No-EE2: Reuse of ALF control information [M. Karczewicz, H. Wang, N. Hu, V. Seregin (Qualcomm)] [late]

#### Entropy coding, transforms, quantization, and transform coefficient coding (5)

[JVET-AI0119](https://jvet-experts.org/doc_end_user/current_document.php?id=14361) Context modeling for tu\_cb\_coded\_flag [M. Chen, L. Wang, W. Zhang, F. Yang, J. Huo (Xidian Univ.), Z. Yu, W. Li, B. Li, F. Xing (Hisense)]

[JVET-AI0145](https://jvet-experts.org/doc_end_user/current_document.php?id=14404) AHG12: CABAC slice-level model switch [F. Lo Bianco, F. Galpin (InterDigital)]

[JVET-AI0223](https://jvet-experts.org/doc_end_user/current_document.php?id=14482) AHG12: Improved implicit MTS [C. Bonnineau, S. Puri, I. Marzuki, R. Utida, K. Naser, T. Poirier, F. Le Léannec (InterDigital)]

[JVET-AI0255](https://jvet-experts.org/doc_end_user/current_document.php?id=14514) Non-EE2: NSPT kernels for non-regular intra modes M. Karczewicz, G. Verba, B. Ray, P. Garus, M. Coban, V. Seregin (Qualcomm) [late]

[JVET-AI0282](https://jvet-experts.org/doc_end_user/current_document.php?id=14541) AHG12: Corner and center subblocks for SBT [V. Seregin, M. Coban, B. Ray, H. Wang, N. Hu, M. Karczewicz (Qualcomm)] [late]

#### Other (1)

[JVET-AI0051](https://jvet-experts.org/doc_end_user/current_document.php?id=14292) Template Matching Picture Boundary Padding for ECM [N. Neumann, M. Wien (RWTH Aachen Univ.)]

### CTC for EE2/ECM and general ECM improvements (3)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0096](https://jvet-experts.org/doc_end_user/current_document.php?id=14338) AHG12: Fixes for Adaptive Clipping and Sign Prediction [J. Samuelsson-Allendes (Sharp)]

[JVET-AI0097](https://jvet-experts.org/doc_end_user/current_document.php?id=14339) AHG12: A follow-up CTC modification for encoding runtime reduction under low-delay configuration [Z. Deng, K. Zhang, L. Zhao, W. Yin, Y. Wang, N. Zhang, L. Zhang (Bytedance), R. Utida, S. Puri, I. Marzuki, C. Bonnineau (InterDigital)]

[JVET-AI0320](https://jvet-experts.org/doc_end_user/current_document.php?id=14579) Crosscheck of JVET-AI0097 (AHG12: A follow-up CTC modification for encoding runtime reduction under low-delay configuration) [D. Ruiz Coll, J.-K. Lee, (Ofinno)] [late] [miss]

[JVET-AI0281](https://jvet-experts.org/doc_end_user/current_document.php?id=14540) AHG12: Context retraining for ECM-13.0 [P. Mahdavinia, P. Nikitin, V. Seregin, M. Karczewicz (Qualcomm)] [late] [miss]

# High-level syntax (HLS) and related proposals (49)

## AHG9: Aspects on SEI messages in VSEIv4 and related (19)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

### NNPF modifications (9)

[JVET-AI0061](https://jvet-experts.org/doc_end_user/current_document.php?id=14302) AHG9: On Neural Network Post Filter for Spatial Extrapolation [S. Deshpande (Sharp)]

[JVET-AI0062](https://jvet-experts.org/doc_end_user/current_document.php?id=14303) [AHG9]: Neural network post-filter for tone mapping operations [C.-H. Demarty, F. Aumont, L. Blondé, E. Reinhard, O. Le Meur (InterDigital)]

[JVET-AI0070](https://jvet-experts.org/doc_end_user/current_document.php?id=14311) AHG9: On an extension of NNPFC SEI message [T. Chujoh, Z. Fan, R. Ishimoto, T. Ikai (Sharp), L. Jin, H. Watanabe (Waseda Univ.)]

[JVET-AI0071](https://jvet-experts.org/doc_end_user/current_document.php?id=14312) AHG8/AHG9: Indication of NNPFs and processing chains for human viewing and/or machine consumption [M. M. Hannuksela, F. Cricri, H. Zhang, J. Boyce (Nokia)]

[JVET-AI0072](https://jvet-experts.org/doc_end_user/current_document.php?id=14313) AHG9: Activating an NNPF in a processing chain for temporally interpolated or extrapolated pictures [M. M. Hannuksela, F. Cricri (Nokia)]

[JVET-AI0202](https://jvet-experts.org/doc_end_user/current_document.php?id=14461) AHG9: NNPFC SEI modifications to support spatial extraction [J. Xu, Y.-K. Wang (Bytedance)]

[JVET-AI0207](https://jvet-experts.org/doc_end_user/current_document.php?id=14466) AHG9: A clean-up for spatial resampling NNPF design [J. Xu, Y.-K. Wang (Bytedance)]

[JVET-AI0296](https://jvet-experts.org/doc_end_user/current_document.php?id=14555) AHG9: Questions regarding NNPFC SEI message with temporal extrapolation purpose [E. François, D. Doyen, P. de Lagrange, F. Urban, (InterDigital)] [late]

[JVET-AI0322](https://jvet-experts.org/doc_end_user/current_document.php?id=14581) AHG9: On Neural Network Post Filter with Multiple Temporal Extrapolations [S. Deshpande (Sharp)] [late] [miss]

### Object mask information (3)

[JVET-AI0116](https://jvet-experts.org/doc_end_user/current_document.php?id=14358) AHG9: On object mask auxiliary layer list and mask Id in OMI SEI message [J. Nam, H. Tan, J. Lee, C. Kim, J. Lim, S. Kim (LGE)]

[JVET-AI0153](https://jvet-experts.org/doc_end_user/current_document.php?id=14412) AHG9: Updates on software implementation and text of the object mask information SEI message [Z. Zhang, J. Chen, Y. Ye, S. Wang (Alibaba)]

[JVET-AI0211](https://jvet-experts.org/doc_end_user/current_document.php?id=14470) AHG9: On the design of OMI SEI message [H. Tan, C. Kim, J. Nam, J. Lee, J. Lim, S. Kim (LGE)]

### Encoder optimization information (3)

[JVET-AI0122](https://jvet-experts.org/doc_end_user/current_document.php?id=14364) AHG9: Signaling source and added pictures in EOI SEI message [J. Lee, H. Tan, C. Kim, J. Nam, J. Lim, S. Kim (LGE)]

[JVET-AI0180](https://jvet-experts.org/doc_end_user/current_document.php?id=14439) AHG9: Adding original source picture dimensions to EOI SEI [J. Boyce, M. M. Hannuksela (Nokia)]

[JVET-AI0214](https://jvet-experts.org/doc_end_user/current_document.php?id=14473) AHG9: Editorial updates for SPTI and EOI SEI messages [H. Tan, J. Lee, C. Kim, J. Nam, J. Lim, S. Kim (LGE)]

### Source picture timing information (3)

[JVET-AI0117](https://jvet-experts.org/doc_end_user/current_document.php?id=14359) AHG9: On the signaling related to temporal sublayer in SPTI SEI message [J. Lee, H. Tan, C. Kim, J. Nam, J. Lim, S. Kim (LGE)]

[JVET-AI0120](https://jvet-experts.org/doc_end_user/current_document.php?id=14362) AHG9: Proposed changes for miscellaneous aspects of SEIs in VSEI v4 draft [J. Lee, H. Tan, C. Kim, J. Nam, J. Lim, S. Kim (LGE)]

[JVET-AI0214](https://jvet-experts.org/doc_end_user/current_document.php?id=14473) AHG9: Editorial updates for SPTI and EOI SEI messages [H. Tan, J. Lee, C. Kim, J. Nam, J. Lim, S. Kim (LGE)]

### Text description information (3)

[JVET-AI0059](https://jvet-experts.org/doc_end_user/current_document.php?id=14300) AHG9: Comments on Text Description Information SEI Message [S. Deshpande (Sharp)]

[JVET-AI0060](https://jvet-experts.org/doc_end_user/current_document.php?id=14301) AHG9: Photosensitive Content Information Signaling [S. Deshpande (Sharp)]

[JVET-AI0120](https://jvet-experts.org/doc_end_user/current_document.php?id=14362) AHG9: Proposed changes for miscellaneous aspects of SEIs in VSEI v4 draft [J. Lee, H. Tan, C. Kim, J. Nam, J. Lim, S. Kim (LGE)]

## AHG9: Aspects on SEI messages in TuC and related (14)

Contributions in this area were discussed at 1500–XXXX on Friday 12 July 2024 (chaired by Jill Boyce).

### Generative face video (10)

[JVET-AI0156](https://jvet-experts.org/doc_end_user/current_document.php?id=14415) AHG9/AHG16: On generative face video SEI messages [J. Chen, B. Chen, Y. Ye (Alibaba), S. Yin, S. Wang (CityU), P. Yin, S. McCarthy (Dolby), H.-B. Teo (Panasonic)]

In this contribution, three editorial bugs in the GFV SEI message in the VSEI TuC draft 4 are fixed. Further, the proponents consider the GFV and GFVE SEI messages to be sufficiently mature with software implementation, test conditions and experimental results showing the benefits of generative face video compression. Therefore, it is suggested to adopt GFV and GFVE SEI messages into the next draft of VSEI version 4 WD.

Decision (Adopt): the three bug fixes in section 1.

The proponents and another participant have expressed support for moving to the VSEI WD.

Revisit promotion of the GFV SEI to the VSEI WD after other GFV contributions are presented.

[JVET-AI0184](https://jvet-experts.org/doc_end_user/current_document.php?id=14443) AHG9: Some comments and editorial changes on the GFV and GFVE SEI messages [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

This contribution proposes the following changes to the GFV and GFVE SEI messages:

1. Some asserted purely editorial changes
2. Specifying the missing value ranges for the following ue(v)-coded syntax elements: gfv\_coordinate\_precision\_factor\_minus1, gfv\_coordinate\_z\_max\_value\_minus1, gfv\_matrix\_element\_precision\_factor\_minus1, gfv\_num\_matrices\_info[ i ], gfv\_matrix\_width\_minus1[ i ], gfv\_matrix\_height\_minus1[ i ], gfv\_num\_matrices\_minus1[ i ], gfv\_matrix\_element\_int[ i ][ j ][ k ][ m ], gfve\_matrix\_element\_precision\_factor, gfve\_matrix\_height\_minus1[ i ], gfve\_matrix\_width\_minus1[ i ], and gfve\_matrix\_element[ i ][ j ][ k ]
3. Speciying the missing decoder handling of reserved values for the syntax element gfv\_matrix\_type\_idx[ i ]

The above asserted purely editorial changes are included in the 1st attachment with "editorial" in the filename, and the other changes are included in the 2nd attachment with "technical" in the filename.

Furthermore, this contribution includes discussions on the following topics:

1. The definition of the terms "base picture" and "driving picture"
2. An "empty" GFV SEI message

Decision (Adopt): the editorial fixes in the first attachment. In the second attachment, adopt gfv\_matrix\_type\_idx[ i ] semantics change.

There is support for specifying ranges. Revisit to discuss specific range limits.

It is asserted that the terms “base picture” and “driving picture” should be better defined within the SEI message semantics. It was suggested to use the gfv\_base\_pic\_flag to define the base picture. Agreed to delegate to the editors.

Agreed to impose a semantic constraint to disallow both gfv\_coordinate\_present\_flag and gfv\_matrix\_present\_flag being equal to 0.

[JVET-AI0186](https://jvet-experts.org/doc_end_user/current_document.php?id=14445) AHG9: On picture order count and timing information for gfv generated pictures [L. Chen, O. Chubach, Y.-W. Huang, L. Shaw (MediaTek)]

This contribution as a follow-up of JVET-AH0137 proposes to add picture order count information in addition to the timing information for the GFV generated pictures and proposes to unify the DPB management for the decoded pictures and the GFV generated pictures in terms of picture order count.

It was suggested that it is not possible to modify the normative DPB process in an SEI message.

It was suggested that JVET-A0192 is related. See notes in JVET-AI0192.

It was not clear that the additional signaling is necessary given the changes in the adoption of JVET-AI0192 option 2. Further justification of the problem of skipped frames in encoding is necessary.

[JVET-AI0189](https://jvet-experts.org/doc_end_user/current_document.php?id=14448) AHG9: On signalling and/or specifying the translator and the generator NNs for the GFV SEI message [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

[JVET-AI0190](https://jvet-experts.org/doc_end_user/current_document.php?id=14449) AHG9: On GFV SEI persistence and picture presence [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

[JVET-AI0191](https://jvet-experts.org/doc_end_user/current_document.php?id=14450) AHG9: On GFV facial parameters signalling [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

[JVET-AI0192](https://jvet-experts.org/doc_end_user/current_document.php?id=14451) AHG9: On GFV picture order and timing [Y.-K. Wang (Bytedance), K. Yang, Y. Li, Y. Xu (SJTU)]

This contribution proposes the following changes regarding order and timing of GFV-generated pictures (i.e., output pictures derived by the process StoreOutputTensors( ) specified in the semantics of the GFV SEI message):

1. When gfv\_cnt is greater than 0, an indication that indicates the picture order count value of the GFV-generated picture corresponding to the current GFV SEI message is signalled in the GFV SEI message.
2. When gfv\_cnt is equal to 0, timing information is present for the CLVS, and the specific timing information of the number of clock ticks corresponding to a difference of picture order count values equal to 1 (denoted as NumTicksPocDiff1Minus1) is not present, a syntax element indicating NumTicksPocDiff1Minus1 is optionally signalled, the presence of which depends on a presence flag.
3. Add the following constraint to disallow arbitrary output order of GFV-generated pictures: *For any two pictures picA and picB wherein picA precedes picB in output order, any GFV-generated picture corresponding to a GFV SEI message with a particular gfv\_id value and associated with picA shall precede, in output order, any GFV-generated picture corresponding to a GFV SEI message with the particular gfv\_id value and associated with picB.*

The detailed proposed text changes are included in an attachment to this document.

[Need to copy entire abstract]

There was support for option 2, which is similar to how the NNPF handles temporally interpolated pictures.

Decision (Adopt): Option 2 which imposes two constraints.

[JVET-AI0193](https://jvet-experts.org/doc_end_user/current_document.php?id=14452) AHG9/AHG16: On no display flag in generative face video SEI message [S. McCarthy, S. Gehlot, G. J. Sullivan, P. Yin (Dolby)]

[JVET-AI0194](https://jvet-experts.org/doc_end_user/current_document.php?id=14453) AHG9/AHG16: On chroma key fusion for the generative face video SEI message [S. Gehlot, G.-M. Su, P. Yin, S. McCarthy, G. J. Sullivan (Dolby)]

[JVET-AI0195](https://jvet-experts.org/doc_end_user/current_document.php?id=14454) AhG9/16: Updates on GFVC common software tools and GFV SEI message [B. Chen, J. Chen, Y. Ye, R.-L. Liao (Alibaba), S.Yin, S. Wang (CityU)] [late]

[JVET-AI0137](https://jvet-experts.org/doc_end_user/current_document.php?id=14396) AHG16: Update on Pupil position SEI message for Generative Face Video [F. Ma, A. Trioux, Y. Gao, Y. Yao, F. Yang (Xidian Univ.), F. Xing, Z. Wang (Hisense)] [late]

### Other (4)

[JVET-AI0099](https://jvet-experts.org/doc_end_user/current_document.php?id=14341) AHG9: Showcases on the implementation of applying separate film grain models in different regions [S. Xie, P. Wu, Y. Gao, Y. Bai, M. Jia, W. Niu, C. Huang (ZTE)] [late]

[JVET-AI0177](https://jvet-experts.org/doc_end_user/current_document.php?id=14436) AHG9: Constituent Rectangle Nesting SEI [J. Boyce, M. M. Hannuksela (Nokia)]

[JVET-AI0178](https://jvet-experts.org/doc_end_user/current_document.php?id=14437) AHG9: On constituent rectangles SEI [J. Boyce, M. M. Hannuksela (Nokia)]

[JVET-AI0179](https://jvet-experts.org/doc_end_user/current_document.php?id=14438) AHG9: Persistence cancellation of SEI messages with IDs [J. Boyce, M. M. Hannuksela (Nokia)]

## AHG9: SEI processing order and processing order nesting SEI message aspects (6)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0073](https://jvet-experts.org/doc_end_user/current_document.php?id=14314) AHG9: On the handling of a processing chain specified by an SPO SEI message [M. M. Hannuksela, F. Cricri, J. Boyce (Nokia)]

[JVET-AI0098](https://jvet-experts.org/doc_end_user/current_document.php?id=14340) [AHG9] Study on SEI processing order SEI message use cases [Y. Gao, P. Wu, Y. Bai, S. Xie, M. Jia, W. Niu, C. Huang (ZTE)]

[JVET-AI0100](https://jvet-experts.org/doc_end_user/current_document.php?id=14342) [AHG9] On byte alignment design in SEI processing order SEI message [Y. Gao, P. Wu, Y. Bai, S. Xie, M. Jia, W. Niu, C. Huang (ZTE)]

[JVET-AI0146](https://jvet-experts.org/doc_end_user/current_document.php?id=14405) AHG9: Moving the SPO and PON SEI messages from VVC to VSEI [Y.-K. Wang (Bytedance)]

[JVET-AI0147](https://jvet-experts.org/doc_end_user/current_document.php?id=14406) AHG9: On handling of processing chains and grouping of post-processing filters [Y.-K. Wang, J. Li, L. Zhang, C. Lin, J. Xu (Bytedance)]

[JVET-AI0212](https://jvet-experts.org/doc_end_user/current_document.php?id=14471) AHG9: On handling processing chain in VSEI [H. Tan, J. Lee, J. Nam, C. Kim, J. Lim, S. Kim (LGE)]

## AHG9: Other SEI topics (10)

Contributions in this area were discussed at XXXX–XXXX on XXday 1X July 2024 (chaired by XXX).

[JVET-AI0077](https://jvet-experts.org/doc_end_user/current_document.php?id=14319) AHG9: Design for content usage information SEI message [C. Kim, H. Tan, J. Lee, J. Nam, J. Lim, S. Kim (LGE)]

[JVET-AI0078](https://jvet-experts.org/doc_end_user/current_document.php?id=14320) AHG9: Design for preservation information SEI message [C. Kim, H. Tan, J. Lee, J. Nam, J. Lim, S. Kim (LGE)]

[JVET-AI0127](https://jvet-experts.org/doc_end_user/current_document.php?id=14369) AHG9: Digitally Signed Content Authentication SEI [K. Sühring, T. Hinz, Y. Sanchez, J. Pfaff, H. Schwarz, D. Marpe, T. Wiegand (Fraunhofer HHI)]

[JVET-AI0158](https://jvet-experts.org/doc_end_user/current_document.php?id=14417) [AHG9] Lens Optical Correction SEI message [G. Teniou, S. Wenger (Tencent)]

[JVET-AI0160](https://jvet-experts.org/doc_end_user/current_document.php?id=14419) [AHG9] Lens Optical Correction SEI message implementation [G. Teniou, S. Wenger (Tencent)]

[JVET-AI0181](https://jvet-experts.org/doc_end_user/current_document.php?id=14440) AHG9: Display overlays SEI [J. Boyce, M. M. Hannuksela (Nokia)]

[JVET-AI0182](https://jvet-experts.org/doc_end_user/current_document.php?id=14441) AHG9: Bitdepth range information SEI [J. Boyce, M. M. Hannuksela (Nokia)]

[JVET-AI0203](https://jvet-experts.org/doc_end_user/current_document.php?id=14462) AHG9: SEI message for signalling AI usage restrictions and context [A. T. Hinds, S. Wenger, G. Teniou (Tencent)]

[JVET-AI0205](https://jvet-experts.org/doc_end_user/current_document.php?id=14464) AHG9: Combined SEI messages for common image metadata formats [A. T. Hinds, S. Wenger, G. Teniou (Tencent)]

[JVET-AI0206](https://jvet-experts.org/doc_end_user/current_document.php?id=14465) AHG9: Additional information for SEI message for International Color Consortium (ICC) profiles [A. T. Hinds, S. Wenger, M. Derhak, W. Li (Tencent)]

## Non-SEI HLS aspects (0)

Kept as template for future use.

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

## General

Further detail on scheduling is recorded in section 2.12.

Joint meetings involving JVET were held as follows:

* XXXX-XXXX XXday 1X July on XXXX, with SC 29/WG X (see section X)
* …

Further detail about these sessions with other groups is provided in the other subsections of this section.

Break-out group reports are discussed in section 7.6.

General plenary wrap-up discussions are recorded under sections 8, 9, and 10.

## Information sharing meetings

Information sharing sessions with other WGs and AGs of the MPEG community were held on Monday 15 July 0900–1200, Wednesday 17 July 0900–1000, and Friday 19 July 1400–1600.

The status and plans for the work in the MPEG WGs and AGs was reviewed at these information sharing sessions.

## Joint session XXXX-XXXX XXday 1X July on XXX: MPEG WG 5 / JVET and MPEG WG X

(The notes for this session were recorded by XXX.)

Chaired by Jens-Rainer Ohm and XXX.

…

The session was closed at XXX

## BoGs (X)

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

…

## Liaison communications (X)

[m6xxxx](https://dms.mpeg.expert/doc_end_user/current_document.php?id=93146&id_meeting=198) Liaison statement from XXXX to WG 5 on XXX [XXX via SC 29 Secretariat]

…

# Project planning

## Software timeline (update)

ECM 13.0 software (including all adoptions) was planned to be available 3 weeks after the meeting (17 May).

The NNVC 9.0 codebase software was planned to be available 2 weeks after the meeting (10 May). NNVC 9.1 with retrained HOP4 models will be released after the telco to be held on 17 May.

Extensions on top of VTM23.3 software will be released as appropriate (e.g., updates of SPO and other SEI messages promoted to JVET-AH2005 and JVET-AH2006 by the current meeting).

It is noted that VTM23.3 (the version submitted for ITU consent) includes a version of SPO that likely matches draft 7 of SPO. SW coordinators will try to disable this, as it is not supported by v3 of VVC and VSEI.

Updates on top of HM17.0 software were not planned, but might be released after merging pending requests, as appropriate.

As a general rule in software development, a person who is executing a merge shall not be from the same company as the person who submitted that merge request.

## Core experiment and exploration experiment planning

An EE on neural network-based video coding was established, as recorded in output document JVET-AI2023.

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-AI2024.

Initial versions of these documents were presented and approved.

## 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:

* Normative contributions (relating to changes in bitstream/decoder) shall include draft specification text
* Proposals shall contain all details relevant for understanding and be self-contained. In cases where the document is a follow-up of a previous contribution, the overall concept and the novelties should be highlighted at minimum
* Coding tool and encoder optimization proposals shall contain Excel sheets that allow assessment on a per-sequence basis
* Algorithm description text is strongly encouraged for non-normative contributions that are intended to be included in model description documents (VTM, ECM, etc.), and that is required for inclusion in TR drafts.
* Early upload deadline to enable substantial study prior to the meeting
* Using a clock timer to ensure efficient proposal presentations (5 min) and discussions (not exercised currently)

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 the near future. The 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. Withdrawing parts of experiments that were intended to show the individual benefits of a tool or parts of a tool is strongly discouraged. Combination tests may not be considered in such cases. Any changes made to individual tools in a combination shall be documented.
* 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 mandatory to report encoder optimizations made for the benefit of a tool, and if an equivalent optimization could be applied on the anchor, a comparison against the improved anchor shall be provided.
* A new proposal can be included in a CE based on group decision, regardless if an independent party has already performed a cross-check in the meeting when it was first proposed.

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”, “enhanced”, 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 informal ftp area (IFA) 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 was 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, JVET would like to see comprehensive cross-checking done, with analysis of whether the description matches the software, and a recommendation of the value of the tool and 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 or test model.

Availability of specification text is important to have a detailed understanding of the technology and also to judge what its impact on the complexity of the specification will be. There must also be sufficient time to study this in detail. CE contributions without sufficiently mature draft specification 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

AHG chairs are asked to send draft mandates to JRO by XXX.

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

Review of AHG plans was conducted during the plenary on XXday 1X July 2024 at XXXX-XXXX.

|  |  |  |
| --- | --- | --- |
| **Title and Email Reflector** | **Chairs** | **Mtg** |
| **Project Management (AHG1)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Coordinate overall JVET interim efforts. * Supervise AHG and experiment studies. * Report on project status to JVET reflector. * Provide a report to the next meeting on project coordination status. * Supervise processing and delivery of output documents | J.-R. Ohm (chair), G. J. Sullivan (vice‑chair) | N |
| **Draft text and test model algorithm description editing (AHG2)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Produce and finalize draft text outputs of the meeting (JVET-AH1003, JVET-AH1006, JVET-AH1016, JVET-AH2005 and JVET-AH2006). * Collect reports of errata for the VVC, VSEI, HEVC, AVC, CICP, and the published related technical reports and produce the JVET-AH1004 errata output collection. * 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, C. Rosewarne (co-chairs), F. Bossen, 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](mailto: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, and SEI messages in TuC (the latter in a separate branch of VTM). * Discuss and make recommendations on the software development process. * Perform comparative tests of test model behaviour using common test conditions, including HDR, high bit depth and high bit rate. * 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 and updated CTC documents for HM and VTM, as applicable. | F. Bossen, X. Li, K. Sühring (co-chairs), E. François, Y. He, K. Sharman, V. Seregin, A. Tourapis (vice‑chairs) | N |
| **Test material and visual assessment (AHG4)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Consider plans for additional verification testing of VVC capability, particularly target conducting a first test for VVC multi-layer features by the next meeting, and update the test plan according to subsequent tests. * Coordinate with AHG13 on assessing new test material and investigating metrics that could be used to assess quality of synthesized film grain; improve and update the draft test plan for subjective quality testing of the FGC SEI message. * 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 of available and proposed video test material. * Identify and recommend appropriate test material for testing the VVC standard and potential future extensions, as well as exploration activities. * Identify and characterize missing types of video material, solicit contributions, collect, and make available a variety of video sequence test material, in coordination with other AHGs, as appropriate. * 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 expert viewing for purposes of subjective quality evaluation. * Coordinate with AG 5 in studying and developing further methods of subjective quality evaluation, e.g. based on crowd sourcing. * Coordinate with AHG15 on investigating sequences with gaming content, and make such sequences available for study. * Prepare availability of viewing equipment and facilities arrangements for future meetings. | V. Baroncini, T. Suzuki, M. Wien (co-chairs), W. Husak, S. Iwamura, P. de Lagrange, S. Liu, X. Meng, S. Puri, A. Segall, S. Wenger (vice-chairs) | N |
| **Conformance testing (AHG5)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the draft of additional conformance bitstreams for VVC multilayer configurations JVET-AE2028, and investigate the need for future improvements of conformance testing specifications. * Study the draft conformance bitstreams for new HEVC multiview profiles in JVET-AH1008, and further develop related conformance bitstreams. * Study the requirements of VVC, HEVC, and AVC conformance testing to ensure interoperability. * Maintain and update the conformance bitstream database, and contribute to report problems, and suggest actions to resolve these. * Study additional testing methodologies to fulfil the needs for VVC conformance testing. | I. Moccagatta (chair), F. Bossen, K. Kawamura, P. de Lagrange, T. Ikai, S. Iwamura, H.-J. Jhu, S. Paluri, K. Sühring, Y. Yu (vice‑chairs) | N |
| **ECM software development (AHG6)**  ([jvet@lists.rwth-aachen.de](mailto: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-13.0 software version (and potential updates), corresponding VTM anchor, and the reference configuration encodings according to the ECM common test conditions. * Investigate encoder speedup and other software optimization such as reduction of memory consumption. * 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, R. Chernyak, F. Le Léannec, K. Zhang (vice-chairs) | N |
| **ECM tool assessment (AHG7)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Investigate methodology of tool assessment. * Coordinate with AHG6 on resolving tool-off test related software issues (missing tool controls and software bugs). * Prepare configuration files and generate bitstreams and results of tool-on/tool-off testing. * Prepare reporting of tool assessment results. * Collect simulation results on non-CTC sequences (e.g., those used in previous verification tests), and identify a set of non-CTC sequences that would be appropriate for additional testing. * Develop methodology of more reliable runtime measurement | X. Li (chair), L.-F. Chen, Z. Deng, J. Gan, E. François, H.-J. Jhu, X. Li, H. Wang (vice‑chairs) | N |
| **Optimization of encoders and receiving systems for machine analysis of coded video content (AHG8)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Solicit and study non-normative encoder and receiving systems technologies that enhance performance of machine analysis tasks on coded video content. * Identify and collect test materials that are suitable to be used by JVET for machine analysis tasks. * Generate anchors according to the common test conditions JVET-AH2031. * Discuss improvements on the evaluation framework, including evaluation procedures and methodologies. * Coordinate software development, and continue to migrate the software basis used in AHG8 to newest VTM version. * Coordinate experiments on optimization of encoders and receiving systems for machine analysis of coded video content. * Maintain the software implementation example algorithms in the repository, including sufficient documentation in terms of operation and performance. * Evaluate proposed technologies and their suitability for machine analysis applications. * Propose improvements to JVET-AH2030 on optimization of encoders and receiving systems for machine analysis of coded video content. * Study the potential of using SEI messages for the purpose of machine analysis in coordination with AHG9. * Investigate the impact of using different machine task models in the evaluation of the compression performance of tools optimized for machine analysis tasks. * Coordinate with WG 4 VCM AHG on aspects such as unified common test conditions, evaluation metrics, test and training materials, usage of SEI messages, and on studying characteristics and requirements of machine analysis tasks, etc. | C. Hollmann, S. Liu, S. Wang, M. Zhou (AHG chairs) | N |
| **SEI message studies (AHG9)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the SEI messages in VSEI, VVC, HEVC and AVC. * Study JVET-AH2006 and identify any issues and propose solutions as appropriate. * Study JVET-AH2032 and propose improvements. * 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, including the study of SEI messages defined in HEVC and AVC for potential use in the VVC context. * Study the alignments of the same SEI messages in different standards. * Coordinate with AHG8 and WG 4 to study mechanisms for signalling metadata in the context of machine analysis of coded video content. * Coordinate with AHG3 for software support of SEI messages. | S. McCarthy, Y.-K. Wang (co-chairs), J. Boyce, T. Chujoh, S. Deshpande, C. Fogg, M. M. Hannuksela, Hendry, P. de Lagrange, G. J. Sullivan, A. Tourapis, S. Wenger (vice-chairs) | N |
| **Encoding algorithm optimization (AHG10)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the impact of using techniques such as tool adaptation and configuration, and perceptually optimized adaptive quantization for encoder optimization. * Study the impact of non-normative techniques of preprocessing 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, and coordinate with AHG4 on improving encoders and test settings for multi-layer verification testing. * Study optimized encoding and suitable test settings for noisy materials, such as sequences containing film grain. * Study optimized encoding and tool combinations for low latency and low complexity. * 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 default or alternate software configuration settings and test conditions optimized for either subjective quality, or higher objective quality, and coordinate such efforts with AHG3 and AHG6. * Study the effect of varying configuration parameters depending on temporal layer, such as those related to deblocking, partitioning, chroma QP. | P. de Lagrange, A. Duenas, R. Sjöberg, A. Tourapis (AHG chairs) | Y (tel., 2 weeks notice) |
| **Neural network-based video coding (AHG11)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Evaluate and quantify the performance improvement potential of NN-based video coding technologies compared to existing video coding standards such as VVC, including both individual coding tools, architectures and content adaptation with NN parameters overfitting. * Discuss potential refinements of the test conditions for NN-based video coding in JVET-AF2016. Generate and distribute anchor encoding, and develop supporting software as needed. * Study the impact of training (including the impact of loss functions) on the performance of candidate technologies and identify suitable material for testing and training. * Analyse complexity characteristics for technologies under study, including transformers, perform complexity analysis, and develop complexity reductions of candidate technology. * Finalize and discuss the EE on neural network-based video coding. * Promote the call for training materials, distribute it, and actively communicate with content owners. * Coordinate with other groups, including SC 29/AG 5 on the evaluation and assessment of visual quality, and AHG12 on the interaction with ECM coding tools. If possible, prepare encodings with combinations of tools included in the NNVC software for visual quality assessment at the next meeting. * Coordinate with AHG14 on items related to NNVC software development and studying the impact of training set extension. | E. Alshina, F. Galpin, S. Liu, A. Segall (co-chairs), J. Li, R.-L. Liao, D. Rusanovskyy, M. Santamaria, T. Shao, M. Wien, P. Wu (vice chairs) | Y (tel., 2 weeks notice), first on May 17 |
| **Enhanced compression beyond VVC capability (AHG12)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Solicit and study non-neural-network video coding tools with enhanced compression capabilities beyond VVC. * Discuss and propose refinements to the ECM13 algorithm description JVET-AH2025. * Coordinate with AHG7 to study the performance and complexity tradeoff of these video coding tools. * Coordinate with AHG6 on ECM software development. * Support AHG6 in generating anchors according to the test conditions in JVET-AF2017. * Analyse the results of exploration experiments described in JVET-AH2024 in coordination with the EE coordinators. * Coordinate with AHG11 to study the interaction with neural network-based coding tools. | M. Karczewicz, Y. Ye, L. Zhang (co-chairs), B. Bross, R. Chernyak, X. Li, K. Naser, Y. Yu (vice-chairs) | N |
| **Film grain technologies (AHG13)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the benefits and characteristics of film grain technologies, including autoregressive and frequency-filtering technologies. * Study alternative film grain models and their associated documentation. * Study the technical report JVET-AG2020, and suggest improvements for possible future versions. * In consultation with AHG4, study and define content characteristics and test conditions that are desirable for the study and testing of film grain technologies, and perform an assessment of newly available test materials in that regard. * Investigate metrics for measuring film grain fidelity in itself, or as present in a video. * Discuss the potential need for film grain conformance guidelines. * Given the study of desirable content characteristics, solicit or create new test material for further determining the operational characteristics of, testing, and developing any related technologies. * Study preprocessing and encoder technologies for determining values for FGC (Film Grain Characteristics) SEI message syntax elements. * Identify potential need for additional film grain technology and signalling, if needed. * Coordinate development of film grain technology software and configuration files. * Coordinate with AG 5 on improving the draft plan for subjective quality testing of the FGC SEI message JVET-AG2022, and conduct preparations for such testing. * Coordinate with AHG3 for software support of the FGC SEI message. | W. Husak, P. de Lagrange (co-chairs), A. Duenas, D. Grois, Y. He, X. Meng, M. Radosavljević, A. Segall, G. Teniou, A. Tourapis (vice-chairs) | Y (tel., 2 weeks notice) |
| **NNVC software development (AHG14)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Coordinate development of the NNVC software and associated configuration files. * Prepare and deliver NNVC-9.0 software version (and potential updates), and provide reference configuration encodings according to the NNVC common test conditions as described in JVET-AF2016. Study the impact of the addition of new dataset on the already integrated models. * Investigate and bridge coding performance of NNVC VTM anchor compared to the latest VTM version and/or VTM anchor in ECM software. * Investigate combinations of tools included in the NNVC software, prepare and release anchor data for all configurations of the software, including anchors for High and Low Operation Point (HOP/LOP) configurations. * Study and maintain the SADL (Small Adhoc Deep-Learning Library). Identify gaps in functionality and develop improvements as needed. * Coordinate with NNVC algorithm and software description (JVET-AH2019) editors to identify any mismatches between software and description document, suggest further updates to the description document as appropriate. * Coordinate with AHG11 on items related to NNVC activities. | F. Galpin (chair), R. Chang, Y. Li, Y. Li, M. Santamaria, J. N. Shingala, Z. Xie (vice chairs) | Y (tel., 2 weeks notice), first on May 17 |
| **Gaming content compression (AHG15)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Identify gaming content application scenarios and their requirements for codec operation. * Identify and characterize required types of content; solicit contributions, collect, and make a variety of gaming content available, in coordination with AHG4 and AG 5. * Propose test conditions appropriate for gaming applications, based on the draft CTC JVET-AH2027. * Evaluate JVET test models (such as ECM, VTM, NNVC, etc.) under the proposed test conditions. * Investigate possibilities to enhance compression capability for gaming content. * Solicit contributions from industry on typical bitrate/quality/resolution used for gaming content compression. | S. Puri, J. Sauer (co-chairs), R. Chernyak, A. Duenas, L. Wang (vice chairs) | Y (tel., 2 weeks notice) |
| **Generative face video compression (AHG16)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Maintain GFVC software tools, associated configuration files, and software usage documentation. * Identify additional test content suitable for use in GFVC performance evaluation. * Investigate GFVC performance under test conditions beyond those defined in JVET-AG2035, including performance on additional test content and wider bitrate ranges. * Coordinate with AHG9 on further development of the GFVC SEI message in JVET-AG2032. | Y. Ye (chair), H.-B. Teo, Z. Lyu, S. McCarthy, S. Wang (vice chairs) | N |

It was confirmed that the rules which can be found in document ISO/IEC JTC 1/‌SC 29/‌AG 2 [N 046](https://www.mpegstandards.org/wp-content/uploads/2022/01/ISO-IECJTC1-SC29-AG2_N0046_AhG.pdf) “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 pointed out that JVET does not maintain 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 XXX) 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 XXX, as noted in section 9.

[JVET-AH1000](https://jvet-experts.org/doc_end_user/current_document.php?id=14258) Meeting Report of the 34th JVET Meeting [J.-R. Ohm] [WG 5 N 274] (2024-05-22)

Initial versions of the meeting notes (d0 … d7) were made available on a daily basis during the meeting.

Remains valid – not updated: [JVET-AC1001](https://jvet-experts.org/doc_end_user/current_document.php?id=12566) Guidelines for HM-based software development [K. Sühring, F. Bossen, X. Li (software coordinators)]

Remains valid – not updated: [JVET-Y1002](https://jvet-experts.org/doc_end_user/current_document.php?id=11463) High Efficiency Video Coding (HEVC) Test Model 16 (HM 16) Encoder Description Update 16 [C. Rosewarne (primary editor), K. Sharman, R. Sjöberg, G. J. Sullivan (co-editors)] [WG 5 [N 103](https://dms.mpeg.expert/doc_end_user/current_document.php?id=82085&id_meeting=189)]

[JVET-AH1003](https://jvet-experts.org/doc_end_user/current_document.php?id=14259) Coding-independent code points for video signal type identification (Draft 3) [G. J. Sullivan, A. Tourapis] (2024-06-28)

This includes changes from JVET-AH0169 and JVET-AH0175.

A corresponding text was submitted for ITU consent of ITU-T H.273 V4, and the changes were also used as the basis for ISO/IEC FDIS 23091-2:202X (Ed. 3), submitted as WG 5 N 288.

A DoCR on ISO/IEC 23091-2/DIS was issued as WG 5 N 287 (reviewed on Sun 21 April 1100-1230).

Primary editor: G. J. Sullivan.

[JVET-AH1004](https://jvet-experts.org/doc_end_user/current_document.php?id=14260) Errata report items for VVC, VSEI, HEVC, AVC, and Video CICP [Y.-K. Wang, B. Bross, I. Moccagatta, C. Rosewarne, G. J. Sullivan] (2024-07-05, near next meeting)

Primary editor: Y.-K. Wang.

This includes changes from JVET-AH0169 and JVET-AH0175.

[JVET-AH1005](https://jvet-experts.org/doc_end_user/current_document.php?id=14261) Technology under consideration for future editions of CICP [E. Thomas, A. Tourapis] [WG 5 N 289)] (2024-06-28)

From JVET-AH0154 and JVET-AH0217.

[JVET-AH1006](https://jvet-experts.org/doc_end_user/current_document.php?id=14262) HEVC with extensions and corrections (draft 3) [Y.-K. Wang, B. Bross, T. Ikai, G. J. Sullivan, A. Tourapis] (2024-06-28)

This includes changes from JVET-AH0046.

A corresponding text was submitted for ITU consent of ITU-T H.265 V10, and the changes were also used as the basis for ISO/IEC FDIS 23008-2:202x (Ed. 6), submitted as WG 5 N 281.

A DoCR on ISO/IEC 23008-2/DAM1 was issued as WG 5 N 280 (reviewed on Sun 21 April 1100-1230).

Primary editor: Y.-K. Wang.

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]

[JVET-AH1008](https://jvet-experts.org/doc_end_user/current_document.php?id=14263) Conformance testing for HEVC multiview extended and monochrome profiles [I. Moccagatta, S. Paluri, A. Tourapis, Y.-K. Wang] (2024-07-05)

Remains valid – not updated: [JCTVC-AC1009](https://jvet-experts.org/doc_end_user/current_document.php?id=12569) Common test conditions for SHVC [K. Sühring]

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-Axx1011

Remains valid – not updated: JVET-[AD1012](https://jvet-experts.org/doc_end_user/current_document.php?id=12973) Overview of IT systems used in JVET [J.-R. Ohm, I. Moccagatta, K. Sühring, M. Wien]

Remains valid – not updated: [JCT3V-G1003](http://phenix.int-evry.fr/jct3v/doc_end_user/current_document.php?id=1884) 3D-AVC Test Model 9 [D. Rusanovskyy, F. C. Chen, L. Zhang, T. Suzuki] [WG 11 N 14239]

Remains valid – not updated: [JCT3V-K1003](http://phenix.int-evry.fr/jct3v/doc_end_user/current_document.php?id=2499) Test Model 11 of 3D-HEVC and MV-HEVC [Y. Chen, G. Tech, K. Wegner, S. Yea] [WG 11 N 15141]

Remains valid – not updated: [JVET-AE1013](https://jvet-experts.org/doc_end_user/current_document.php?id=13268) Common test conditions of 3DV experiments [K. Sühring, M. Wien]

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 – not updated: [JVET-AC1015](https://jvet-experts.org/doc_end_user/current_document.php?id=12571) Common test conditions for SCM-based screen content coding [K. Sühring]

[JVET-AH1016](https://jvet-experts.org/doc_end_user/current_document.php?id=14264) AVC with extensions and corrections (draft 3) [B. Bross, T. Ikai, G. J. Sullivan, A. Tourapis, Y.-K. Wang] (2024-06-28)

A corresponding text was submitted for ITU consent of ITU-T H.264 V15, and the changes were also used as the basis for ISO/IEC FDIS 14496-10:202x (Ed. 11), submitted as WG 5 N 276.

A DoCR on ISO/IEC DIS 14496-10 was issued as WG 5 N 275 (reviewed on Sun 21 April 1100-1230).

Primary editor: B. Bross.

No output: JVET-Axx1017 through JVET-Axx1099

Remains valid – not updated [JVET-AA1100](https://jvet-experts.org/doc_end_user/current_document.php?id=11944) Common Test Conditions for HM Video Coding Experiments [K. Sühring, K. Sharman]

This specifies only the CTC for non-4:2:0 colour formats. The corresponding document for VVC is JVET-T2013, with no unification yet.

No output: JVET-Axx2001

[JVET-AH2002](https://jvet-experts.org/doc_end_user/current_document.php?id=14265) Algorithm description for Versatile Video Coding and Test Model 22 (VTM 22) [Y. Ye, A. Browne, S. Kim] [WG 5 N 284] (2024-07-05)

Primary editor: Y. Ye.

New elements from notes elsewhere in this report:

* …

It is noted that the list above may not be complete; if some adoption is missing that is recorded somewhere else in the meeting notes it shall also be considered included.

It was suggested that editorial improvements submitted as input to the next meeting would be welcome.

Remains valid – not updated: [JVET-AC2003](https://jvet-experts.org/doc_end_user/current_document.php?id=12573) Guidelines for VTM-based software development [F. Bossen, X. Li, 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-AH2005](https://jvet-experts.org/doc_end_user/current_document.php?id=14266) Additions and corrections for VVC version 4 (Draft 8) [G. J. Sullivan, B. Bross, M. M. Hannuksela, Y.-K. Wang] [WG 5 CDAM N 283)] (2024-05-10)

New elements from notes elsewhere in this report:

* …

It is noted that the list above may not be complete; if some adoption is missing that is recorded somewhere else in the meeting notes it shall also be considered included.

Primary editor: G. J. Sullivan.

[JVET-AH2006](https://jvet-experts.org/doc_end_user/current_document.php?id=14267) Additional SEI messages for VSEI version 4 (Draft 2) [J. Boyce, J. Chen, S. Deshpande, M. M. Hannuksela, Hendry, S. McCarthy, G. J. Sullivan, Y.-K. Wang] [WG 5 CDAM N 278)] (2024-05-10)

New elements from notes elsewhere in this report:

* …

It is noted that the list above may not be complete; if some adoption is missing that is recorded somewhere else in the meeting notes it shall also be considered included.

Primary editor: J. Boyce.

Remains valid – not updated: [JVET-AD2007](https://jvet-experts.org/doc_end_user/current_document.php?id=12977) Guidelines for NNVC software development [F. Galpin, S. Eadie, L. Wang, Z. Xie, Y. Li]

Remains valid – not updated: [JVET-X2008](https://jvet-experts.org/doc_end_user/current_document.php?id=11228) Conformance testing for versatile video coding (Draft 7) [J. Boyce, F. Bossen, K. Kawamura, I. Moccagatta, W. Wan]

[JVET-AH2009](https://jvet-experts.org/doc_end_user/current_document.php?id=14268) Reference software for versatile video coding 2nd edition (Draft 1) [F. Bossen, K. Sühring, X. Li] [WG 5 CD N 286)] (2024-05-10)

This was developed from VTM23.3 SW (see further notes under 8.1).

It was also submitted for ITU consent of ITU-T H.266.2 V2.

A request for ISO/IEC 23090-16 2nd ed. was issued as WG 5 N 285.

Primary editor: F. Bossen.

Remains valid – not updated [JVET-AB2010](https://jvet-experts.org/doc_end_user/current_document.php?id=12216) VTM and HM common test conditions and software reference configurations for SDR 4:2:0 10 bit video [F. Bossen, X. Li, V. Seregin, K. Sharman, K. Sühring]

Remains valid – not updated: [JVET-AC2011](https://jvet-experts.org/doc_end_user/current_document.php?id=12575) VTM and HM 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]

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]

Remains valid – not updated: [JVET-AF2016](https://jvet-experts.org/doc_end_user/current_document.php?id=13587) Common test conditions and evaluation procedures for neural network-based video coding technology [E. Alshina, R.-L. Liao, S. Liu, A. Segall]

Remains valid – not updated: [JVET-AF2017](https://jvet-experts.org/doc_end_user/current_document.php?id=13588) Common test conditions and evaluation procedures for enhanced compression tool testing [M. Karczewicz, Y. Ye]

Remains valid – not updated: [JVET-AA2018](https://jvet-experts.org/doc_end_user/current_document.php?id=11949) Common test conditions for high bit depth and high bit rate video coding [A. Browne, T. Ikai, D. Rusanovskyy, X. Xiu, Y. Yu]

[JVET-AH2019](https://jvet-experts.org/doc_end_user/current_document.php?id=14269) Description of algorithms and software in neural network-based video coding (NNVC) version 7 [F. Galpin, Y. Li, D. Rusanovskyy, J. Ström, L. Wang] [WG 5 N 292] (2024-05-31)

New elements from notes elsewhere in this report:

* …

It is noted that the list above may not be complete; if some adoption is missing that is recorded somewhere else in the meeting notes it shall also be considered included.

Remains valid – not updated: [JVET-AG2020](https://jvet-experts.org/doc_end_user/current_document.php?id=13275) Film grain synthesis technology for video applications (Draft 6) [D. Grois, Y. He, W. Husak, P. de Lagrange, A. Norkin, M. Radosavljević, A. Tourapis, W. Wan] [WG 5 DTR N 260] (2024-02-02)

[JVET-AH2021](https://jvet-experts.org/doc_end_user/current_document.php?id=14270) Verification test plan for VVC multilayer coding (update 3) [O. Chubach, P. de Lagrange, M. Wien] (2024-07-05)

This adds an annex to describe settings as used in JVET-AH0074 section 2.

[JVET-AH2022](https://jvet-experts.org/doc_end_user/current_document.php?id=14271) Draft plan for subjective quality testing of the FGC SEI message (update 2) [P. de Lagrange, W. Husak, M. Radosavljević, M. Wien] (2024-07-05)

This includes updates from JVET-AH0301.

[JVET-AH2023](https://jvet-experts.org/doc_end_user/current_document.php?id=14256) Exploration experiment on neural network-based video coding (EE1) [E. Alshina, F. Galpin, Y. Li, D. Rusanovskyy, M. Santamaria, J. Ström, R. Chang, Z. Xie] [WG 5 N 291] (2024-05-10)

An initial draft of this document was reviewed and approved at XXXX-XXXX on XXday 19 July.

This round of EE2 tests will include:

* …

[JVET-AH2024](https://jvet-experts.org/doc_end_user/current_document.php?id=14255) Exploration experiment on enhanced compression beyond VVC capability (EE2) [V. Seregin, J. Chen, R. Chernyak, K. Naser, J. Ström, F. Wang, M. Winken, X. Xiu, K. Zhang] [WG 5 N 293] (2024-05-24)

An initial draft of this document was reviewed and approved at XXXX-XXXX on XXday 19 July.

This round of EE2 tests will include:

…

[JVET-AH2025](https://jvet-experts.org/doc_end_user/current_document.php?id=14272) Algorithm description of Enhanced Compression Model 13 (ECM 13) [M. Coban, R.-L. Liao, K. Naser, J. Ström, L. Zhang] [WG 5 N 294] (2024-06-28)

New elements from notes elsewhere in this report:

* ….

It is noted that the list above may not be complete; if some adoption is missing that is recorded somewhere else in the meeting notes it shall also be considered included.

Remains valid – not updated: [JVET-AC2026](https://jvet-experts.org/doc_end_user/current_document.php?id=12581) Conformance testing for VVC operation range extensions (Draft 4) [D. Rusanovskyy, T. Hashimoto, H.-J. Jhu, I. Moccagatta, Y. Yu]

This can be removed after publication of VVC conformance v2.

[JVET-AH2027](https://jvet-experts.org/doc_end_user/current_document.php?id=14273) Draft CTC for gaming applications [J. Sauer, R. Chernyak, S. Puri, S. Thiebaud] (2024-05-17)

Remains valid – not updated: [JVET-AE2028](https://jvet-experts.org/doc_end_user/current_document.php?id=13279) Additional conformance bitstreams for VVC multilayer configurations [S. Iwamura, P. de Lagrange, I. Moccagatta]

[JVET-AH2029](https://jvet-experts.org/doc_end_user/current_document.php?id=14274) Visual quality comparison of ECM/VTM encoding [V. Baroncini, J.-R. Ohm, M. Wien] [AG 5 N 118] (2024-07-05)

[JVET-AH2030](https://jvet-experts.org/doc_end_user/current_document.php?id=14275) Optimization of encoders and receiving systems for machine analysis of coded video content (draft 5) [C. Hollmann, J. Chen, S. Liu] [WG 5 CDTR 23888-3, N 290)] (2024-06-28)

Primary editor: C. Hollmann.

This is based on JVET-AH0143, plus elements from JVET-AH0153.

[JVET-AH2031](https://jvet-experts.org/doc_end_user/current_document.php?id=14276) Common test conditions for optimization of encoders and receiving systems for machine analysis of coded video content [S. Liu, C. Hollmann] (2024-05-24)

See notes from the joint meeting discussed in section 7.3.

[JVET-AH2032](https://jvet-experts.org/doc_end_user/current_document.php?id=14277) Technologies under consideration for future extensions of VSEI (version 4) [S. McCarthy, J. Boyce, J. Chen, S. Deshpande, M. M. Hannuksela, Hendry] [WG 5 N 279)] (2024-05-31)

New elements from notes elsewhere in this report:

* …

It is noted that the list above may not be complete; if some adoption is missing that is recorded somewhere else in the meeting notes it shall also be considered included.

Remains valid – not updated: [JVET-AF2033](https://jvet-experts.org/doc_end_user/current_document.php?id=13593) Report of verification test on VVC multi-layer coding: Content layering [S. Iwamura, P. de Lagrange, M. Wien] [AG 5 N 105)] (2023-12-22)

No output: JVET-Axx2034

Remains valid – not updated: [JVET-AG2035](https://jvet-experts.org/doc_end_user/current_document.php?id=13920) Test conditions and evaluation procedures for generative face video coding [S. McCarthy, B. Chen] (2024-02-23)

Remains valid – not updated: [JVET-AG2036](https://jvet-experts.org/doc_end_user/current_document.php?id=13921) Call for training materials for neural network-based video coding tool development [E. Alshina, F. Galpin, S. Liu, M. Wien] [WG 5 N 266)] (2024-02-09)

The draft of WG 5 recommendations was reviewed and approved in JVET at 1210-1235 on Wednesday 24 April.

# Future meeting plans, expressions of thanks, a.o.b., and closing of the meeting

Future meeting plans were established according to the following guidelines (assuming face-to-face meetings):

* Meeting under ITU-T SG16 auspices when it meets (ordinarily starting meetings on the Tuesday or Wednesday of the first week and closing it on the Wednesday of the second week of the SG16 meeting – a total of 8-9 meeting days), and
* Otherwise meeting under ISO/IEC JTC 1/‌SC 29 auspices when its MPEG WGs meet (ordinarily starting meetings on the Thursday or Friday prior to the main week of such meetings and closing it on the same day as other MPEG WGs – a total of 8–9 meeting days).

In cases where an exceptionally high workload is expected for a meeting, an earlier starting date may be defined. In cases of online meetings, no sessions should be held on weekend days, such that meetings would typically start two days earlier.

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

* During Fri. 1 – Fri. 8 November 2024, 36th meeting under ISO/IEC JTC 1/‌SC 29 auspices in Antalya, TR (confirmed by host one week after the closing of the JVET meeting),
* During Mon. 13 – Wed. 22 January 2025, 37th meeting under ITU-T SG16/X auspices in Geneva, CH,
* During Wed. 26 March – Fri. 4 April 2025, 38th meeting under ISO/IEC JTC 1/‌SC 29 auspices, to be conducted as teleconference meeting,
* During Thu. 26 June – Fri. 4 July 2025, 39th meeting under ISO/IEC JTC 1/‌SC 29 auspices in Daejeon, – KR,
* During 2 – 10 October 2025, 40th meeting under ITU-T SG16/X auspices in Geneva, CH,
* During 14 – 23 January 2026, 41st meeting under ISO/IEC JTC 1/‌SC 29 auspices, to be conducted as teleconference meeting,
* During April 2026, 42nd meeting under ISO/IEC JTC 1/‌SC 29 auspices, date and location t.b.d.
* During July 2026, 43rd meeting under ITU-T SG16/X auspices, date and location t.b.d.

The agreed document deadline for the 36th JVET meeting was planned to be Wednesday 23 October 2024.

Update thanks

Huawei and InterDigital were thanked for providing updated test materials for gaming applications. InterDigital was thanked for submitting training materials that can be used in the NNVC exploration. Giacomo Baroncini, Vittorio Baroncini, and Mathias Wien were thanked for conducting subjective quality tests related to the ECM. Christian Lehmann and Fabrice Urban were thanked for technical assistance. GBTech and VABTech were thanked for providing resources to run tests with non-expert viewers. Couvent des Jacobins, FhG-HHI, RWTH, and VABTech were thanked for providing equipment used in the experts viewing in Rennes. The following companies were thanked for preparing encoded bitstreams: Alibaba, Bytedance, Ericsson, FhG-HHI, Google, Huawei, InterDigital, Kwai, MediaTek, Oppo, Qualcomm, Vivo. Experts who volunteered to participate in the viewing were also thanked. Marius Preda was thanked for maintaining the document site jvet-experts.org, as well as the document sites of JCT-VC and JCT-3V. Institut Mines-Télécom was thanked for hosting the sites.

Kenzler Conference Management and the entire team of AFNOR were thanked for the excellent hosting and organization of the 34th meeting of the JVET. Ateme, Canon, Dolby, Ektacom, IMT, InterDigital, Ofinno, and Orange were thanked for financially supporting the social event.

It was suggested that having a mechanism for a better overview of the different progression stages of the standards currently produced by JVET (both for ISO/IEC and ITU-T) would be desirable. Section 2.13 is giving that in text form, a tabular might be better to understand.

The 35th JVET meeting was closed at approximately XXXX hours JST on Friday 19 July 2024.

# Annex A to JVET report: List of documents

(Dates and times in the table below are in Paris/Geneva time.)

# Annex B1 to JVET report: List of meeting participants attending in person

The participants who were personally present at the meeting site of the thirty-fifth meeting of the JVET, according to a sign-in sheet circulated in the JVET meeting rooms (approximately XXX people in total), were as follows:

1. (XXXX)

# Annex B2 to JVET report: List of meeting participants attending remotely

The remote participants of the thirty-fifth meeting of the JVET, according to the participation records from the Zoom teleconferencing tool used for the meeting sessions (approximately XXX people in total, not including those who had attended the meeting in person at least part-time (see annex B1), and not including those who attended only the joint sessions with other groups), were as follows:

1. (XXXX)

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

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