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| **Joint Video Experts Team (JVET)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  19th Meeting, by teleconference, 22 June – 1 July 2020 | Document: JVET-S\_Notes\_d0 |

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| *Title:* | **Meeting Report of the 19th Meeting of the Joint Video Experts Team (JVET), by teleconference, 22 June – 1 July 2020** | | |
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| *Purpose:* | Report | | |
| *Author(s) or Contact(s):* | **Gary Sullivan** Microsoft Corp. 1 Microsoft Way Redmond, WA 98052 USA  **Jens-Rainer Ohm** Institute of Communication Engineering RWTH Aachen Melatener Straße 23 D-52074 Aachen | Tel: Email:  Tel: Email: | +1 425 703 5308 [garysull@microsoft.com](mailto:garysull@microsoft.com)  +49 241 80 27671 [ohm@ient.rwth-aachen.de](mailto:ohm@ient.rwth-aachen.de) |
| *Source:* | Chairs 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/ WG 11 held its nineteenth meeting during 22 June – 1 July 2020 as an online-only meeting. It had previously been planned to be held in Geneva, Switzerland, at the ITU premises. The conversion of the meeting to be conducted only online was necessitated due to issues associated with the COVID-19 pandemic. The JVET meeting was held under the chairmanship of Dr Gary Sullivan (Microsoft/USA) and Dr Jens-Rainer Ohm (RWTH Aachen/Germany). For rapid access to particular topics in this report, a subject categorization is found (with hyperlinks) in section 2.13 of this document. It is further noted that the unabbreviated name of JVET was formerly known as “Joint Video *Exploration* Team”, but the parent bodies modified it when entering the phase of formal development of a new standard. The name Versatile Video Coding (VVC) was chosen in April 2018 as the informal nickname for the new standard.

The JVET meeting began at approximately 1300 hours UTC on Monday 22 June 2020. Meeting sessions were held on all days (including weekend days) until the meeting was closed at approximately XXXX hours UTC on Wednesday 1 July 2020. Approximately XXX people attended the JVET meeting, and approximately XXX input documents (not counting crosschecks), and 17 AHG reports were discussed. The meeting took place in a collocated fashion with a meeting of SG16 – one of the two parent bodies of the JVET. The subject matter of the JVET meeting activities consisted of developing video coding technology with a compression capability that significantly exceeds that of the current HEVC standard, or otherwise gives better support regarding the requirements of future application domains of video coding. As a primary goal, the JVET meeting reviewed the work that was performed in the interim period since the eighteenth JVET meeting in producing an ninth draft of the VVC standard and the ninth version of the associated VVC test model (VTM). Further important goals were reviewing technical input on novel aspects of video coding technology, producing the next versions of the VVC draft text and VTM, and plan next steps for further investigation of candidate technology towards the formal standard development.

The JVET produced 8 output documents from the meeting (update):

* JVET-R2001 Versatile Video Coding specification text (Draft 9)
* JVET-R2002 Algorithm description for Versatile Video Coding and Test Model 9 (VTM 9)
* JVET-R2005 Methodology and reporting template for coding tool testing
* JVET-R2007 Supplemental enhancement information messages for coded video bitstreams (Draft 4)
* JVET-R2008 Conformance testing for versatile video coding (Draft 3)
* JVET-R2009 Draft plan for VVC verification testing (Draft 2)
* JVET-R2013 JVET common test conditions and software reference configurations for non-4:2:0 colour formats
* JVET-R2016 Summary information on BD-rate experiment evaluation practices.

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, no Core Experiments (CE) were defined. The next four JVET meetings were planned for 7–16 October 2020 under WG 11 auspices in Rennes, FR, during 6–15 January 2021 under WG 11 auspices in Capetown, ZA, during 20–28 April 2021 under ITU-T SG16 auspices in Geneva, CH, and during XX–XX July 2021 under WG 11 auspices in Prague, CZ.

The document distribution site <http://phenix.int-evry.fr/jvet/> was used for distribution of all documents.

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

# Administrative topics

## Organization

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

The Joint Video Experts Team (JVET) of ITU-T WP3/16 and ISO/IEC JTC 1/ SC 29/ WG 11 held its nineteenth meeting during 22 June – 1 July 2020 as an online-only meeting, using Zoom teleconferencing tools. The JVET meeting was held under the chairmanship of Dr Gary Sullivan (Microsoft/USA) and Dr Jens-Rainer Ohm (RWTH Aachen/Germany).

It is further noted that the unabbreviated name of JVET was formerly known as “Joint Video *Exploration* Team”, but the parent bodies modified it when entering the phase of formal development of a new standard. The name Versatile Video Coding (VVC) was chosen in April 2018 as the informal nickname for the new standard.

## 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/2020_06_S_Virtual/>.

## Primary goals

As a primary goal, the JVET meeting reviewed the work that was performed in the interim period since the eighteenth JVET meeting in producing a ninth draft of the VVC standard and the ninth version of the associated VVC test model (VTM). Further important goals were reviewing technical input on novel aspects of video coding technology, producing the next versions of draft text and VTM, and planning next steps for further investigation of candidate technology towards the formal standard development.

## Documents and document handling considerations

### General

The documents of the JVET meeting are listed in Annex A of this report. The documents can be found at <http://phenix.int-evry.fr/jvet/>.

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

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

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

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

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

### Late and incomplete document considerations

The formal deadline for registering and uploading non-administrative contributions had been announced as Wednesday, 10 June 2020. Any documents uploaded after 1159 hours Paris/Geneva time on Thursday 11 June 2020 were considered “officially late”, giving a grace period of 12 hours to accommodate those living in different time zones of the world. The deadline does not apply to AHG reports, and other such reports which can only be produced after the availability of other input documents.

In the interim period and prior to the regular JVET meeting, a series of AHG meetings were held during 27-28 May and during 19-21 June for HLS topics (AHG8/AHG9/AHG12). An earlier upload deadline of 22 May 2020 had been announced for documents to be discussed during the May 2020 AHG meeting days. Results of these meetings can be found in documents JVET-S0137 (27-28 May) and JVET-S0237 (19-21 June), which were later pasted into this main meeting report, being refined during further review, and AHG recommendations approved accordingly. AHG4 also conducted meetings for preparation of verification tests.

All contribution documents with registration numbers higher than JVET-S0238 were registered after the “officially late” deadline (and therefore were also uploaded late). Likewise, AHG 27-28 May meeting related proposal documents with registration numbers higher than JVET-S0136 were to be considered late, and due to lack of time, many of them could only be considered during the 19-21 June AHG meeting or durng the main meeting. However, some documents in the “late” range might include break-out activity reports that were generated during the meetings, and are therefore better considered as report documents rather than as late contributions. Also, all cross-check reports were uploaded late.

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

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

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

* JVET-S0XXX (a proposal on …), uploaded XX-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. For example, some of them were proposing combinations or simplifications of other proposals.

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

* JVET-S0XXX (a document on …), uploaded XX-XX.
* …

Almost all cross-verification reports at this meeting were registered late, and even those registered before the deadline were all 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 (X) contribution registrations were later cancelled, withdrawn, never provided, were cross-checks of a withdrawn contribution, or were registered in error: JVET-S0XXX, ...

“Placeholder” contribution documents that were basically empty of content, or lacking any results showing benefit for the proposed technology, and obviously uploaded with an intent to provide a more complete submission as a revision, had been agreed to be considered unacceptable and to be rejected in the document management system until a more complete version was available (which would then typically be counted as a late contribution). At the current meeting, this situation applied to the initial uploads of documents JVET-S0XXX, … .

Contributions that had significant problems with uploaded versions included the following:

* JVET-S0XXX (…)
* …

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

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

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

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

### Outputs of the preceding meeting

All output documents of the previous meeting, particularly the meeting report JVET-R2000, the Versatile Video Coding specification text (Draft 9) JVET-R2001, the Algorithm description for Versatile Video Coding and Test Model 9 (VTM 9) JVET-R2002, the Methodology and reporting template for coding tool testing JVET-R2005, the Supplemental enhancement information messages for coded video bitstreams (Draft 4) JVET-R2007, the Conformance testing for VVC (Draft 3) JVET-R2008, the Draft plan for VVC verification testing (Draft 2) JVET-R2009, the JVET common test conditions and software reference configurations for non-4:2:0 colour formats JVET-R2013, and the Summary information on BD-rate experiment evaluation practices JVET-R2016, had been completed and were approved. The software implementation of VTM (versions 9.0 and 9.1) was also approved.

The group was initially asked to review the meeting report of the previous meeting for finalization. The meeting report was later approved with a minor modification of including a missing output document in a list.

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

## Attendance

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

The meeting was open to those qualified to participate either in ITU-T WP3/16 or ISO/IEC JTC 1/‌SC 29/‌WG 11 (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 on the WG11 host’s website. Access to the teleconference sessions of the main JVET meeting was controlled with a password that is distributed to the registered participants; this should help overloading the teleconferencing tool.

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

o Use the “hand-raising” function to enter yourself in the queue to speak (unless otherwise instructed by the session chair). If you are dialed in by phone, request your queue position verbally.

o Stay muted unless you have something to say. (people were muted by default when they join and would need to unmute themselves to speak. The chair may mute anyone who is disrupting the proceedings (e.g. by forgetting they have a live microphone while chatting with their family or by causing bad noise or echo).

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

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

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

o Avoid overloading people’s internet connections, we do not plan to use video for the teleconferencing calls – only voice and screen sharing. Extensive use of screen sharing is encouraged.

## Agenda

The agenda for the meeting was as follows:

* Opening remarks and review of meeting logistics and communication practices
* ISO Code of Conduct, IPR policy reminder and declarations
* Contribution document allocation
* Review of results of the previous meeting
* Reports of ad hoc group (AHG) activities
* Consideration of contributions on high-level syntax
* Consideration of contributions and communications on project guidance
* Consideration of video coding technology contributions
* Consideration of information contributions
* Coordination activities
* Approval of output documents and associated editing periods
* Future planning: Determination of next steps, discussion of working methods, communication practices, establishment of coordinated experiments (if any), establishment of AHGs, meeting planning, other planning issues
* Other business as appropriate for consideration

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

* 1300-1500 1st “afternoon” session [break after 2 hours]
* 1520-1720 2nd “afternoon” session
* [“dinner” break – nearly 2 hours]
* 1900-2100 1st “evening” session [break after 2 hours]
* 2120-2320 2nd “evening” session

## IPR policy reminder

[+ISO Code of Conduct]

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)
* <http://www.itscj.ipsj.or.jp/sc29/29w7proc.htm> (JTC 1/‌SC 29 Procedures)

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

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

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

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

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

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

## Software copyright disclaimer header reminder

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

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

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

## Communication practices

The documents for the meeting can be found at <http://phenix.int-evry.fr/jvet/>.

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 was 1221.

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

## Terminology

Some terminology used in this report is explained below:

(check for completeness with JVET-N0013, and draft text)

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

## Opening remarks

Remarks during the opening session of the meeting Monday 22 June at 1300 UTC (chaired by GJS and JRO) were as follows.

* Timing and organization of online meetings, calendar
* Balloting and approval timelines:   
  "H.VVC" | ISO/IEC 23090-3 for VVC and H.SEI | ISO/IEC 23002-7
* The meeting logistics, agenda, working practices, policies, and document allocation were reviewed.
  + The meeting is conducted using Zoom
  + Having text and software available is crucial (and not just arriving at the end of the meeting).
  + There were no objections voiced in the opening plenary to the consideration of late contributions.
* The results of the previous meeting and the meeting report were reviewed.
* AHG pre-meetings
* There was somewhat less of a problem of late non-cross-check documents and no “placeholders” – (see section 2.4.2).
* The primary goals of the meeting were … .
* Due to the high number of input contributions, parallelization and breakout work were planned to be used at the meeting.
* Verification test planning
* Principles of standards development were discussed.
  + It was noted that now is the time for the filing of formal IPR declarations for those who have patent rights that would be necessary for implementation of VVC or the associated SEI standard.

## Scheduling of discussions

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

* 1300-1500 1st “afternoon” session [break after 2 hours]
* 1520-1720 2nd “afternoon” session
* [“dinner” break – nearly 2 hours]
* 1900-2100 1st “evening” session [break after 2 hours]
* 2120-2320 2nd “evening” session

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

* Mon. 22 June, 1st day
  + 1300–1330 Opening remarks, review of practices, agenda, IPR reminder
  + 1330–XXXX Reports of AHGs XX
  + …

## Contribution topic overview

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

* AHG reports (17) (section 3) (Plenary)
* Project development (section 4) (Plenary or Track B)
  + General (0)
  + Text and software development (1)
  + Test conditions (2)
  + Verification test planning (8)
  + Coding studies and tools on specific use cases (0)
  + Test Material (1)
  + Conformance (0)
  + Implementation studies (1)
  + Profile/level specification (2)
* Low-level tool technology proposals (13) (section 5) (Track B)
* High-level syntax (HLS) proposals (section 6) with subtopics (Track A)
  + AHG9: General high-level syntax (105+74) (section 6.1)
  + AHG12: High-level parallelism and coded picture regions (7+5) (section 6.2)
  + AHG8: Layered coding and resolution adaptation (8+5) (section 6.3)
* Complexity analysis (0) (section 7) (Track B)
* Encoder optimization (0) (section 8) (Track B)
* Metrics and evaluation criteria (0) (section 9) (Track B)
* Withdrawn (1) (section 10) (Track none)
* Joint meetings, plenary discussions, BoG reports, Summary of actions (section 11)
* Project planning (section 12)
* Establishment of AHGs (section 13)
* Output documents (section 14)
* Future meeting plans and concluding remarks (section 15)

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

Track A (XXX) was generally chaired by GJS and Track B (XXX) by JRO.

# AHG reports (17)

These reports were discussed Monday 22 June 2020 during 1300-1500 and … UTC (chaired by GJS & JRO), except as otherwise noted.

The general status of HLS AHGs (see S0137 and S0237) and AHG4 on verification test planning (see sec. 4.4) was also reviewed.

[JVET-S0001](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10368) JVET AHG report: Project management (AHG1) [J.-R. Ohm, G. J. Sullivan]

[JVET-S0002](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10369) JVET AHG report: Draft text and test model algorithm description editing (AHG2) [B. Bross, J. Chen, J. Boyce, S. Kim, S. Liu, Y.-K. Wang, Y. Ye]

[JVET-S0003](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10370) JVET AHG report: Test model software development (AHG3) [F. Bossen, X. Li, K. Sühring]

[JVET-S0004](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10371) JVET AHG report: Test material and visual assessment (AHG4) [V. Baroncini, T. Suzuki, M. Wien, A. Norkin, A. Segall, Y. Ye]

[JVET-S0005](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10372) JVET AHG report: Conformance testing (AHG5) [J. Boyce, W. Wan, E. Alshina, I. Moccagatta, K. Kawamura, S. McCarthy, K. Sühring, X. Xu]

[JVET-S0006](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10373) JVET AHG report: 360° video coding tools, software and test conditions (AHG6) [J. Boyce, Y. He, K. Choi, J.-L. Lin, Y. Ye]

[JVET-S0007](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10374) JVET AHG report: Coding of HDR/WCG material (AHG7) [A. Segall, E. François, W. Husak, S. Iwamura, D. Rusanovskyy]

[JVET-S0008](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10375) JVET AHG report: Layered coding and resolution adaptivity (AHG8) [S. Wenger, A. Segall, M. M. Hannuksela, Hendry, S. McCarthy, Y.-C. Sun, P. Topiwala, M. Zhou]

[JVET-S0009](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10376) JVET AHG report: High-level syntax (AHG9) [R. Sjöberg, J. Boyce, B. Choi, S. Deshpande, M. M. Hannuksela, R. Skupin, A. Tourapis, Y.-K. Wang, W. Wan, P. Wu]

[JVET-S0010](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10377) JVET AHG report: Encoding algorithm optimization (AHG10) [A. Duenas, A. Tourapis, S. Ikonin, A. Norkin, R. Sjöberg, J. Le Tanou, J.-M. Thiesse]

[JVET-S0011](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10378) JVET AHG report: Screen content coding (AHG11) [S. Liu, J. Boyce, A. Filippov, Y.-C. Sun, X. Xu]

[JVET-S0012](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10379) JVET AHG report: High-level parallelism and coded picture regions (AHG12) [S. Deshpande, B. Choi, M. M. Hannuksela, R. Sjöberg, R. Skupin, W. Wan, B. Wang, Y.-K. Wang]

[JVET-S0013](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10380) JVET AHG report: Tool reporting procedure and testing (AHG13) [W.-J. Chien, J. Boyce, Y.-W. Chen, R. Chernyak, K. Choi, R. Hashimoto, Y.-W. Huang, H. Jang, R.-L. Liao, S. Liu]

[JVET-S0014](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10381) JVET AHG report: Lossless and near-lossless coding (AHG14) [T. Nguyen, T.-C. Ma, M. Ikeda, H. Jang, X. Zhao]

[JVET-S0015](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10382) JVET AHG report: Quantization control (AHG15) [R. Chernyak, E. François, C. Helmrich, S. McCarthy, A. Segall]

[JVET-S0016](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10383) JVET AHG report: Implementation studies (AHG16) [M. Zhou, J. An, E. Chai, K. Choi, S. Sethuraman, T. Hsieh, X. Xiu]

[JVET-S0017](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10384) JVET AHG report: SEI message studies (AHG17) [S. McCarthy, J. Boyce, P. de Lagrange, A. Luthra, A. Tourapis, Y.-K. Wang, S. Wenger]Formularende

# Project development (12)

## General (0)

## Text and software development (1)

[JVET-S0152](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10274) AHG2: Editorial input of a text integration for the May 2020 HLS AHG meeting outcome [Y.-K. Wang (Bytedance)]

[JVET-S0249](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10388) AHG3: Bugfix to LMCS with multiple slices in VTM-9.0 encoder [J. Lee, Y. Ahn (Digital Insights)] [late]

## Test conditions (2)

[JVET-S0180](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10302) Addition of a GOP hierarchy of 32 for random access configuration for VTM [K. Andersson, J. Enhorn, R. Sjöberg, J. Ström, L. Litwic (Ericsson)]

[JVET-S0244](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10366) AHG13: On RGB Common Test Condition Regarding LMCS [J. Zhao, Hendry, S. Kim (LGE)] [late]

## Verification test planning (8)

[JVET-S0041](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10163) Status Report on SDR Verification Test Preparation [M. Wien (RWTH), V. Baroncini (VABTECH ltd)]

[JVET-S0043](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10165) Agenda and Report of the AHG4 Meeting on the SDR Verification Test on 2020-05-15 [M. Wien (RWTH), V. Baroncini (VABTECH), T. Suzuki (Sony)]

[JVET-S0146](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10268) Status Report on 360º video Verification Test Preparation [M. Wien (RWTH), V. Baroncini (VABTECH ltd), Y. Ye (Alibaba)]

[JVET-S0149](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10271) Agenda and Report of the AHG4 Meeting on the 360 Verification Test on 2020-05-27 [M. Wien (RWTH), Y. Ye (Alibaba), V. Baroncini (VABTECH ltd), T. Suzuki (Sony)]

[JVET-S0151](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10273) Status Report and Proposed Agenda for the AHG4 Meeting on HDR Verification Test Preparation [A. Segall (Sharp)]

[JVET-S0153](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10275) Agenda and Report of the AHG4 Meeting on the HDR Verification Test on 2020-05-29 [A. Segall, M. Wien, V. Baroncini, T. Suzuki]

[JVET-S0246](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10385) Results of dry run subjective assessment of SDR UHD verification test [V. Baroncini, M. Wien]

[JVET-S0253](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10392) Update on Verification Test Preparation [M. Wien, V. Baroncini, A. Segall, Y. Ye]

## Coding studies and tools on specific use cases (0)

## Test material (1)

[JVET-S0218](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10340) 4K HLG test sequences for HDR verification test [S. Iwamura, S. Nemoto, A. Ichigaya (NHK)] [miss]

## Conformance (0)

## Implementation studies (AHG16) (1)

[JVET-S0224](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10346) AHG16: Performance of a reasonably fast VVC software decoder [F. Bossen (Sharp)]

## Profile/level specification (2)

[JVET-S0187](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10309) Request for a Constrained Main 10 Profile in VVC Version 1 [W. Wan (Broadcom), R. Foray (Allegro DVT), D. LeGall, A. Wells (Ambarella), H. Edward, G. Sines (AMD), D. Singer, A. Tourapis (Apple), S. Pejhan, M. Raulet (ATEME), P. Pahalawatta, E. Petajan (ATT Inc.), S. Davis (Charter Communications), D. Grois, Y. Syed (Comcast Cable), D. Nicholson (Ektacom), X. Ducloux, P. Haskell (Harmonic Inc.), J. Le Tanou (MediaKind), C. Hau (NBCUniversal), A. Luthra (Picsel Labs), T. Suzuki (Sony), E. Chai (Ubilinx), J.-M. Thiesse (VITEC)]

[JVET-S0210](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10332) On definition of the VVC Still Picture profiles [M. Pettersson, R. Sjöberg, M. Damghanian, J. Enhorn, J. Ström, R. Yu, D. Liu (Ericsson)]

# Low-level tool technology proposals (13)

[JVET-S0170](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10292) Use of ACT with IBC [S. Keating, K. Kondo (Sony)]

[JVET-S0215](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10337) AHG2: On residual coding syntax [M. G. Sarwer, Y. Ye (Alibaba)]

[JVET-S0217](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10339) On deblocking filter for ACT [S. Iwamura, S. Nemoto, A. Ichigaya (NHK)]

[JVET-S0222](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10344) On CABAC parameters [F. Bossen (Sharp)]

[JVET-S0228](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10350) Transform coefficients range extension for high bit-depth [T. Zhou, T. Chujoh, E. Sasaki, T. Ikai (Sharp)]

[JVET-S0229](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10351) Bug fix of BDOF for high bit-depth [T. Chujoh, E. Sasaki, T. Ikai (Sharp)]

[JVET-S0251](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10390) Crosscheck of JVET-S0229 (Bug fix of BDOF for high bit-depth) [Adrian Browne, Karl Sharman, Steve Keating (Sony)] [late]

[JVET-S0231](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10353) On Signaling of TU Luma Coded Flag for CU with ACT [L.-F. Chen, X. Li, S. Liu (Tencent)]

[JVET-S0232](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10354) Removal of redundant clipping operations on inter prediction samples in forward luma mapping [X. Xiu, Y.-W. Chen, T.-C. Ma, H.-J. Jhu, X. Wang (Kwai), Tzu-Der Chuang, Ching-Yeh Chen, Chih-Wei Hsu, Yu-Wen Huang (MediaTek)]

[JVET-S0233](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10355) Suggested bug fixes for ACT text in VVC draft 9 [X. Xiu, Y.-W. Chen, T.-C. Ma, H.-J. Jhu, C.-W. Kuo, X. Wang (Kwai)]

[JVET-S0234](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10356) Mismatch between text specification and reference software on chroma residual scaling when ACT is enabled [X. Xiu, Y.-W. Chen, T.-C. Ma, H.-J. Jhu, C.-W. Kuo, X. Wang (Kwai)]

[JVET-S0240](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10362) Editorial Cleanup for BCW (Bi-prediction with CU-level Weights) [W. Lim, G. Bang (ETRI)] [late]

[JVET-S0242](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10364) Cleanup on merge\_idx [J. Y. Lee (Sejong University), W. Lim, G. Bang (ETRI)] [late]

[JVET-S0243](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10365) On operation beyond 10-bit [A. Browne, S. Keating, K. Sharman (Sony)] [late]

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

[JVET-S0137](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10259) Agenda and report of the 27-28 May 2020 HLS AHG meeting [G. J. Sullivan, Y.-K. Wang (AHG meeting coordinators)]

[JVET-S0237](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=10359) Agenda and report of the 19-21 June 2020 HLS AHG pre-meeting [G. J. Sullivan, Y.-K. Wang (AHG pre-meeting coordinators)]

By the end of Day 3 of the AHG pre-meeting, approximately ***157 (77%) of the 120+84 input documents*** had been reviewed, resulted in **76 recommendations** for normative action, **24** editorial action items, and ***23 revisits/deferred***:

1. (5) 3.1.1 High level tool control (24/(16+11)): 4 recommendations, 4 editorial action items, 2 revisits
2. (3) 3.1.2 General and misc. HLS topics (31/(16+15)): 12+9 recommendations, 1 editor action item, 3 deferred/revisits
3. (3) 3.1.3 General constraints information (GCI) (32/(25+7)): 11 recommendations, 6 editor action items, 3 revisits
4. (0) 3.1.4 SPS, PPS, and APS cleanups (17/(9+8)): 8 recommendations, 1 editor action item
5. (7) 3.1.5 PH and SH cleanups (10/(10+4)): 3 recommendations, 3 deferred/revisits
6. (1) 3.1.6 Reference picture lists cleanups (10/(8+2)): 7 recommendations, 2 editor action items, 1 revisit
7. (1) 3.1.7 Signalling of virtual boundaries (7/(2+5)): 4 recommendations, 2 editor action items, 1 revisit
8. (23) 3.1.8 Hypothetical reference decoder (HRD) (5/(12+14)): 10 recommendations, 1 editor action item, 2 deferred
9. (6) 3.1.9 DCI, VUI, and SEI (1/(3+3)): 1 recommendation, 1 revisit
10. (7) 3.1.10 HLS editorial inputs (0/(4+3))
11. (2) 3.2 Subpictures, slices, and tiles (12/(7+5)): 2 recommendations, 4 editor action items, 2 revisits
12. (7) 3.3 Scalability and RPR cleanups (8/(8+5)): 5 recommendations, 3 editor action items, 3 deferred

## AHG9: General high-level syntax (105+74)

### High level tool control (16+11)

[JVET-S0144](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10266) AHG9: A summary of proposals on high level tool control [L. Zhang, Y.-K. Wang (Bytedance)]

This contribution was discussed in the HLS AHG meeting at 0835 UTC on 27 May and in the HLS AHG pre-meeting at 1305 UTC on 19 June.

This contribution provides a summary of the 25 proposals on High level tool control (the agenda item 3.1.1 in JVET-S0137 and JVET-S0237).

It is suggested that this summary, in terms of a list of design questions, is used for the reviewing of these proposals, such that the discussions can be in a more structured and efficient manner. The following actions are proposed:

1. Removal of SPS BDOF/DMVR/PROF control present flag

Remove the syntax elements sps\_bdof\_control\_present\_in\_ph\_flag, sps\_dmvr\_control\_present\_in\_ph\_flag and sps\_prof\_control\_present\_in\_ph\_flag and instead condition the presence of ph\_bdof\_disabled\_flag, ph\_dmvr\_disabled\_flag and ph\_prof\_disabled\_flag on the existing syntax elements sps\_bdof\_enabled\_flag, sps\_dmvr\_enabled\_flag and sps\_affine\_prof\_enabled\_flag, respectively. (S0044)

Each of these flags was said to save at most one bit per picture. This would increase overhead in some common uses. No clear need for action was evident, so no action was recommended.

1. On TMVP derivation considering inter-layer reference picture
   1. Disable TMVP when either RefPic or ColRefPic is inter-layer reference picture (ILRP), but not both. (S0089 #1)
   2. Enable TMVP with combination of STRP and ILRP on RefPic or ColRefPic, and disable TMVP with combination of LTRP and ILRP. (S0089 #2)
   3. Enable TMVP when either RefPic or ColRefPic is ILRP. (S0089 #3)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| RefPic  (target reference picture) | ColRefPic  (reference picture of collocated block) | Current VVC | Solution #1 | Solution #2 | Solution #3 |
| STRP | ILRP | X | X | O | O |
| ILRP | STRP | X | X | O | O |
| LTRP | ILRP | O | X | X | O |
| ILRP | LTRP | O | X | X | O |

Much of the behaviour was originally from HEVC.

It was commented that this has a low-level impact and we should avoid any potentially unnecessary changes in this area. No clear need for action was evident, so no action was recommended.

1. On maximum number of subblock merge candidates

Change the range of the value of sps\_five\_minus\_max\_num\_subblock\_merge\_cand from 0..5 − sps\_sbtmvp\_enabled\_flag to 0..5 and change the derivation of maximum number of subblock merge candidates in PH as follows: (S0088)

if( sps\_affine\_enabled\_flag *&& sps\_five\_minus\_max\_num\_subblock\_merge\_cand < 5* )

MaxNumSubblockMergeCand = 5 − sps\_five\_minus\_max\_num\_subblock\_merge\_cand (88)

else

MaxNumSubblockMergeCand = sps\_sbtmvp\_enabled\_flag && ph\_temporal\_mvp\_enabled\_flag

Some participants said that it was intentional not to want to consider ph\_temporal\_mvp\_enabled\_flag.

There was no agreement that the proposal was needed, so no action was recommended.

1. On PDPC control
   1. Add an SPS flag to control PDPC on/off and check it in the intra prediction process. (S0072, S0136)
      1. For all color formats, add an SPS PDPC disabled flag (named sps\_pdpc\_disabled\_flag) (S0072 method 1), or an SPS PDPC enabled flag (named sps\_pdpc\_enabled\_flag). (S0136)
      2. Only for 4:4:4 and 4:2:2 cases, add an SPS PDPC disabled flag (named sps\_pdpc\_disabled\_flag). (S0072 method 3)
   2. Add a PDPC constraint flag in the general constraint information (GCI) syntax structure. (S0136, S0072 v2)

There is currently no high-level control syntax for PDPC, although there is some form of on-off switching for it. The proponent indicated that being able to disable it could provide a benefit in some cases (e.g., for SCC and 4:4:4 – verbally commented to be as much as 2% for an SCC sequence with some specialized configuration that had some tools disabled – ordinarily a much smaller impact on PSNR, but asserted to be a visual improvement for still pictures in some cases).

It was commented that adding this control would involve a low-level change.

It was noted that approach a.ii would not affect the Main 10 (4:2:0) profile.

It was commented that HMVP also doesn’t have a high-level flag.

See also the notes for the next item.

1. On intra reference sample filtering control
   1. Add an SPS flag to control intra reference sample filtering on/off and check it in intra prediction process. (S0072, S0150)
      1. For all color formats, add an SPS disabled flag (named sps\_intra\_reference\_filter\_disabled\_flag). (S0072 method 2, S0150)
         1. Furthermore, add sps\_intra\_smoothing\_disabled\_present\_in\_sh\_flag when sps\_intra\_reference\_filter\_disabled\_flag is equal to 0, and add sh\_intra\_smoothing\_disabled\_flag when sps\_intra\_smoothing\_disabled\_present\_in\_sh\_flag is equal to 1. (S0150)
      2. Only for 4:4:4 and 4:2:2 cases, add an SPS disabled flag (named sps\_intra\_reference\_filter\_disabled\_flag). (S0072 method 3)
   2. Add an intra reference filtering constraint flag in the GCI syntax structure to constrain the added SPS flag. (S0072 v2)

It was commented that adding this control would involve a low-level change.

This was further discussed in the HLS AHG pre-meeting on Friday 19 June at 1305 UTC, together with the previous item (note that S0150 is a submission submitted after the AHG meeting in May).

This item and the previous one raise similar issues and for similar reasons – trying to avoid using spatial neighbours for some sort of blending operation that may not be beneficial for SCC usage.

There was discussion of whether a benefit with still pictures for high QP is really important.

Mixed content was mentioned, in which camera captured regions would be better with the blending enabled and SCC regions perhaps being better without it.

There is some disabling of PDPC already in the design, but not for the same cases, so it was said that some low-level change would be involved.

No action was recommended due to the late stage of the process and some questioning of the degree of benefit.

AHG discussion stopped here at 0920 UTC on 27 May.

This topic was discussed in the HLS AHG at 0030 UTC on 28 May.

1. On TSRC
   1. Remove no\_tsrc\_constraint\_flag. (S0073, option 3 in section 3.3)
   2. Change the semantics of no\_tsrc\_constraint\_flag (removal: *italic*; addition: **bold**):
      1. Add "When no\_transform\_skip\_constraint\_flag is 1, the value of no\_tsrc\_constraint\_flag shall be one." (S0062, method 3)
      2. Change the semantics to be as follows (S0069, option 1):

**no\_tsrc\_constraint\_flag** equal to 1 specifies that sh\_ts\_residual\_coding\_disabled\_flag shall be equal to *0* **1 or sps\_transform\_skip\_enabled\_flag shall be equal to 0**. no\_tsrc\_constraint\_flag equal to 0 does not impose such a constraint. **When no\_transform\_skip\_constraint\_flag is equal to 1, the value of no\_tsrc\_constraint\_flag shall be equal to 1.**

* + 1. Change the semantics to be as follows (S0069, option 2):

**no\_tsrc\_constraint\_flag** equal to 1 specifies that sh\_ts\_residual\_coding\_disabled\_flag shall be equal to *0* **1 when sps\_transform\_skip\_enabled\_flag is equal to 1**. no\_tsrc\_constraint\_flag equal to 0 does not impose such a constraint. **When no\_transform\_skip\_constraint\_flag is equal to 1, the value of no\_tsrc\_constraint\_flag shall be equal to 1.**

* + 1. Change the semantics to be as follows (S0105):

**no\_tsrc\_constraint\_flag** equal to 1 specifies that sh\_ts\_residual\_coding\_disabled\_flag shall be equal to *0* **1**. no\_tsrc\_constraint\_flag equal to 0 does not impose such a constraint. **When no\_transform\_skip\_constraint\_flag is equal to 1, the value of no\_tsrc\_constraint\_flag shall be equal to 1.**

* + 1. Add a semantic constraint to no\_tsrc\_constraint\_flag to disable DQ and SDH in SPS level (S0073, option 1 in section 3.1)

**no\_tsrc\_constraint\_flag** equal to 1 specifies that sh\_ts\_residual\_coding\_disabled\_flag shall be equal to *0* **1 and sps\_dep\_quant\_enabled\_flag and sps\_sign\_data\_hiding\_enabled\_flag are both equal to 0**. no\_tsrc\_constraint\_flag equal to 0 does not impose such a constraint.

* + 1. Add a semantic constraint to no\_tsrc\_constraint\_flag to disable DQ and SDH in all slices (S0073, option 2 in section 3.2)
  1. Infer sh\_ts\_residual\_coding\_disable\_flag to be equal to !sps\_transform\_skip\_enabled\_flag instead of 0. (S0062, method 1)
  2. Add an SPS flag for TSRC, use it to control the presence of sps\_dep\_quant\_enabled\_flag and sps\_sign\_data\_hiding\_enabled\_flag, and change the semantics of no\_tsrc\_constraint\_flag to constrain the SPS flag instead of the SH flag. (S0062, method 2)
  3. Change both semantics of no\_tsrc\_constraint\_flag and sh\_ts\_residual\_coding\_disabled\_flag: (S0069, option 3) as follows (removal: *italic*; addition: **bold**)

**no\_tsrc\_constraint\_flag** equal to 1 specifies that sh\_ts\_residual\_coding\_disabled\_flag shall be equal to *0* **1**. no\_tsrc\_constraint\_flag equal to 0 does not impose such a constraint. **When no\_transform\_skip\_constraint\_flag is equal to 1, the value of no\_tsrc\_constraint\_flag shall be equal to 1.**

**sh\_ts\_residual\_coding\_disabled\_flag** equal to 1 specifies that the syntax structure residual\_coding( ) is used to parse the residual samples of a transform skip block for the current slice. slice\_ts\_residual\_coding\_disabled\_flag equal to 0 specifies that the syntax structure residual\_ts\_coding( ) is used to parse the residual samples of a transform skip block for the current slice. When slice\_ts\_residual\_coding\_disabled\_flag is not present, *it is infered to be equal to 0.***the following applies:**

* **If sps\_transform\_skip\_enabled\_flag is equal to 0, the value of sh\_ts\_residual\_coding\_disabled\_flag is inferred to be equal to 1.**
* **Otherwise, the value of sh\_ts\_residual\_coding\_disabled\_flag is inferred to be equal to 0.**

A suggested principle was to not have GCI constraint flags that constrain combinations.

The no\_tsrc\_constraint\_flag was suggested to be problem in this regard (as it disables three things: TSRC and SDH and DQ). Disabling SDH and DQ has a significant coding efficiency impact. It was thus suggested to remove this constraint flag (item “a” above).

The other aspects (some of which relate to bugs in the specification of the implications of that flag) would also be resolved by that action.

AHG Recommendation (cleanup/bug fix): Remove the no\_tsrc\_constraint\_flag.

Discussion in AHG sessions 1-8 stopped here.

Discussion in AHG pre-meeting session 9 began here on 19 June at 1330.

1. On residual coding

Add the following SPS and PH flags, and revise SH gating conditions and inferences: (S0093)

* 1. Addition of the SPS flag sps\_residual\_control\_present\_in\_sh\_flag.
  2. Addition of picture header flags for DQ and SDH.
  3. Modification of gating conditions for sh\_dep\_quant\_enabled\_flag, sh\_sign\_data\_hiding\_enabled\_flag, and sh\_ts\_residual\_coding\_disabled\_flag to ensure that at most one of these flags are signalled at the slice level.
  4. Modifications of inference rules for sh\_dep\_quant\_enabled\_flag, sh\_sign\_data\_hiding\_enabled\_flag, and sh\_ts\_residual\_coding\_disabled\_flag to match the desired behaviour.

It was commented that when SDH or DQ is enabled, it is now necessary to repeat the enabling indication in every SH. The proposal is to implicitly disable these when TSRC is disabled in the SH. It was commented that the interaction between these features is relevant only for very high quality coding, where saving something in the SH is not so relevant.

There had been extensive discussion of the SDH/DQ interaction with TSRC at the previous meeting. It was commented that we should not further tinker with this unless we find some aspect that is really a bug, and that is not the case here. Thus, no action was recommended on this.

1. On presence of explicit scaling list

Allow the aps\_chroma\_present\_flag of the scaling list APS NAL unit referenced by the PH to be equal to 0 when ChromaArrayType is greater than 0. (S0049, aspect 9)

This flag is already in the syntax, but is required to be 1 for colour formats that have chroma.

It was commented that ALF and LMCS act similarly to what is proposed, and that a previous problem with allowing this had gone away due to an action of the previous meeting.

In the current design, there is no provision to use a scaling list for chroma without using a scaling list for luma.

It was commented that the flag was only added to avoid sending scaling lists that are completely irrelevant, and sending flat chroma scaling lists does not cost many bits.

Although there may be some arguable inconsistency with ALF and LMCS, it was said that we should not change this since there is no real bug. Thus, no action was recommended on this.

1. On chroma QP table signalling
2. Change the range of sps\_num\_points\_in\_qp\_table\_minus1[ i ] from 0..63 + QpBdOffset to 0..62 + QpBdOffset. (S0130 aspect 1)

AHG Recommendation (spec bug fix/expression of existing intent): Adopt this aspect.

1. Add an SPS flag (named sps\_chroma\_qp\_identical\_to\_luma\_flag) to skip signalling of chroma QP information when chroma QPs are set equal to luma QPs. (S0130 aspect 2)

This would be a syntax shortcut for generating a chroma QP table that indicates chroma QP to be identical to the luma QP. Relative to what the VTM currently does, this would save 6 bits when the tables are identical and add one bit for when they are not, at the SPS level. The proponent noted that this is motivated as a shortcut for a reasonable case rather than really as a bit savings issue. It was commented that in the 4:2:0 case the QP table would typically not be identical. No clear need for action was identified, so no action was recommended on this.

1. On ALF APS constraints

Add an SPS flag (named sps\_one\_aps\_per\_slice\_one\_filter\_per\_aps\_flag) to support the following case and change the signalling of aps\_adaptation\_parameter\_set\_id, sh\_alf\_aps\_id\_luma, sh\_alf\_aps\_id\_chroma from u(5)/u(3) to u(v). (S0134):

1. Each ALF APS contains up to 1 luma filter, up to 1 chroma filter, and no cross-component filters, and each slice in the CLVS uses 0 or 1 ALF APSs for luma adaptive loop filtering, 0 or 1 ALF APSs for chroma adaptive loop filtering, and applies no cross-component adaptive loop filtering.
2. Allow maximum of 115 ALF APSs.

The use case is BEAMing with different encoders using different ALF parameters in different slices.

As far as the syntax is concerned, this would be only a high-level change.

However, the memory usage for the proposal would assume the decoder stores filters in a particular way to save memory. If the decoder does not do this, there would be a problem for the decoder memory. It was thus commented that this would actually have a low-level impact.

No action was recommended on this, as it would be a late change that has a low-level impact, and we do not have evidence that the current design has a problem for most use cases.

1. On deblocking filter parameters
2. Inference of chroma DB offsets
   * 1. If pps\_chroma\_tool\_offsets\_present\_flag is equal to 1, infer the values of the chroma DB offsets in the PH and SH, when not present, to be equal to the chroma DB offsets in the PPS and PH, respectively, instead of inferring the values from the luma DB offsets in the same header (as in the current VVC text). Otherwise, infer the values from the luma DB offsets in the same header (as in the current VVC text) (S0053, aspect 1)
     2. Infer the chroma DB offsets in the PH and SH to be equal to the values of the chroma DB offsets in the PPS and PH, respectively, when not present, regardless of the value of pps\_chroma\_tool\_offsets\_present\_flag. But this solution is not recommended. (S0053, aspect 1, alternative solution)

It was commented that aspect a.i is more sensible than the current design, as it makes use of information sent for chroma at a higher level.

AHG Recommendation (logical cleanup): Adopt S0053 as proposed (approach a.i).

1. Removal the condition check of pps\_deblocking\_filter\_override\_enabled\_flag for signalling the ph\_deblocking\_filter\_override\_flag. (S0121, aspect 2)

It was noted that this is a purely editorial change, to avoid checking an unnecessary condition in the syntax logic.

Editor action item: The editor is strongly suggested to remove this unnecessary condition check.

1. Semantics of pps\_chroma\_tool\_offsets\_present\_flag

Change the semantics such that the chroma deblocking tc and β offset syntax elements may be (instead of "are") present in the PHs or the SHs of pictures referring to the PPS when the flag is equal to 1. (S0053, aspect 2)

It was noted that this is an editorial bug fix, simply to make the semantics accurate.

AHG Recommendation (editorial bug fix): Adopt S0053 aspect 2 to fix the semantics error.

1. Change the inference rules of non-present syntax elements PH/SH SAO, ALF, CCALF flags. (S0121, aspect 1)
2. Infer ph\_sao\_luma\_enabled\_flag to be equal to sps\_sao\_enable\_flag instead of 0.
3. Infer ph\_alf\_enabled\_flag to be equal to sps\_alf\_enable\_flag instead of 0.
4. Infer ph\_sao\_chroma\_enabled\_flag to be as follows, instead of 0:

* If sps\_sao\_enable\_flag is equal to 1 and ChromaArrayType is not equal to 0, ph\_sao\_chroma\_enabled\_flag is inferred to be equal to 1.
* Otherwise, ph\_sao\_chroma\_enabled\_flag is inferred to be equal to 0.

1. Infer ph\_alf\_cb\_flag/ph\_alf\_cr\_flag to be 0 if one of the following two conditions are true, and to be 1 otherwise:

* ChromaArrayType is equal to 0.
* ph\_alf\_enabled\_flag is equal to 0.

1. Infer ph\_cc\_alf\_cb\_enabled\_flag/ph\_cc\_alf\_cr\_enabled\_flag to be 0 if one of the following two conditions are true, and to be 1 otherwise:

* sps\_ccalf\_enabled\_flag is equal to 0.
* ph\_alf\_enabled\_flag is equal to 0.

1. Infer sh\_alf\_cb(r)\_flag as follows:

* If sh\_alf\_enabled\_flag or ph\_alf\_cb(r)\_flag is equal to 0, sh\_alf\_cb(r)\_flag is inferred to be equal to 0.
* Otherwise (both sh\_alf\_enabled\_flag and ph\_alf\_cb(r)\_flag are equal to 1), sh\_alf\_cb(r)\_flag is inferred to be equal to 1.

1. Infer sh\_cc\_alf\_cb(r)\_enabled\_flag as follows:

* If sh\_alf\_enabled\_flag or ph\_cc\_alf\_cb(r)\_enabled\_flag is equal to 0, sh\_cc\_alf\_cb(r)\_enabled\_flag is inferred to be equal to 0.
* Otherwise (both sh\_alf\_enabled\_flag and ph\_cc\_alf\_cb(r)\_enabled\_flag are equal to 1), sh\_cc\_alf\_cb(r)\_enabled\_flag is inferred to be equal to 1.

In the discussion, it was said that these changes are just to better express the existing design intent.

It was agreed that there is a problem in the existing semantics.

However, it was said that the proposed semantics should be carefully studied and there may be a simpler way to address the problem.

Revisit after offline study.

1. Change the semantics of some PH syntax elements related to ALF and SAO as follows, asserted to address the inconsistency in the semantics reported in JVET-S0121: (S0252 late)

(Convention for text changes proposed: “quoted text” is proposed to be removed and text inside delimiters < > is proposed to be added by proposals)

**ph\_alf\_enabled\_flag** equal to 1 specifies that adaptive loop filter is enabled and may be used for the current picture. ph\_alf\_enabled\_flag equal to 0 specifies that adaptive loop filter <may or may not be enabled> "is disabled and not used" for the current picture. When not present, ph\_alf\_enabled\_flag is inferred to be equal to 0.

**ph\_alf\_cb\_flag** "equal to 0 specifies that the adaptive loop filter is disabled and not applied to the Cb colour component for the current picture. ph\_alf\_cb\_flag" equal to 1 specifies that the adaptive loop filter is enabled and may be applied to the Cb colour component for the current picture. <ph\_alf\_cb\_flag equal to 0 specifies that the adaptive loop filter may or may not be enabled for the Cb colour component of the current picture.>When ph\_alf\_cb\_flag is not present, it is inferred to be equal to 0.

**ph\_alf\_cr\_flag** "equal to 0 specifies that the adaptive loop filter is disabled and not applied to the Cr colour component for the current picture. ph\_alf\_cr\_flag" equal to 1 specifies that the adaptive loop filter is enabled and may be applied to the Cr colour component for the current picture. <ph\_alf\_cr\_flag equal to 0 specifies that the adaptive loop filter may or may not be enabled for the Cr colour component of the current picture.> When ph\_alf\_cr\_flag is not present, it is inferred to be equal to 0.

**ph\_cc\_alf\_cb\_enabled\_flag** equal to 1 specifies that cross-component adaptive loop filter for the Cb colour component is enabled and may be used for the current picture. ph\_cc\_alf\_cb\_enabled\_flag equal to 0 specifies that cross-component adaptive loop filter for the Cb colour component <may or may not be enabled> "is disabled and not used" for the current picture. When not present, ph\_cc\_alf\_cb\_enabled\_flag is inferred to be equal to 0.

**ph\_cc\_alf\_cr\_enabled\_flag** equal to 1 specifies that cross-compoent adaptive loop filter for the Cr colour component is enabled and may be used for the current picture. ph\_cc\_alf\_cr\_enabled\_flag equal to 0 specifies that cross-component adaptive loop filter for the Cr colour component <may or may not be enabled> "is disabled and not used" for the current picture. When not present, ph\_cc\_alf\_cr\_enabled\_flag is inferred to be equal to 0.

**ph\_sao\_luma\_enabled\_flag** equal to 1 specifies that SAO is enabled and may be used for the luma component of the current picture. ph\_sao\_luma\_enabled\_flag equal to 0 specifies that SAO <may or may not be enabled> "is disabled and not used" for the luma component of the current picture. When ph\_sao\_luma\_enabled\_flag is not present, it is inferred to be equal to 0.

**ph\_sao\_chroma\_enabled\_flag** equal to 1 specifies that SAO is enabled and may be used for the chroma component of the current picture. ph\_sao\_chroma\_enabled\_flag equal to 0 specifies that SAO <may or may not be enabled> "is disabled and not used" for the chroma component of the current picture. When ph\_sao\_chroma\_enabled\_flag is not present, it is inferred to be equal to 0.

1. Change the semantics of PH syntax elements related to ALF and SAO as follows, asserted to address the inconsistency in the semantics reported in JVET-S0121: (S0255 late)

(Convention for text changes proposed: “quoted text” is proposed to be removed and text inside delimiters < > is proposed to be added by proposals)

<When pps\_alf\_info\_ph\_flag is equal to 1,> **ph\_alf\_enabled\_flag** equal to 1 specifies that adaptive loop filter is enabled and may be used for the current picture. ph\_alf\_enabled\_flag equal to 0 specifies that adaptive loop filter is disabled and not used for the current picture. When not present, ph\_alf\_enabled\_flag is inferred to be equal to 0."

<When pps\_alf\_info\_ph\_flag is equal to 1,> **ph\_alf\_cb\_flag** equal to 0 specifies that the adaptive loop filter is disabled and not applied to the Cb colour component for the current picture. ph\_alf\_cb\_flag equal to 1 specifies that the adaptive loop filter is enabled and may be applied to the Cb colour component for the current picture. When ph\_alf\_cb\_flag is not present, it is inferred to be equal to 0.

<When pps\_alf\_info\_ph\_flag is equal to 1,> **ph\_alf\_cr\_flag** equal to 0 specifies that the adaptive loop filter is disabled and not applied to the Cr colour component for the current picture. ph\_alf\_cr\_flag equal to 1 specifies that the adaptive loop filter is enabled and may be applied to the Cr colour component for the current picture. When ph\_alf\_cr\_flag is not present, it is inferred to be equal to 0.

<When pps\_alf\_info\_ph\_flag is equal to 1,> **ph\_cc\_alf\_cb\_enabled\_flag** equal to 1 specifies that cross-component adaptive loop filter for the Cb colour component is enabled and may be used for the current picture. ph\_cc\_alf\_cb\_enabled\_flag equal to 0 specifies that cross-component adaptive loop filter for the Cb colour component is disabled and not used for the current picture. When not present, ph\_cc\_alf\_cb\_enabled\_flag is inferred to be equal to 0.

<When pps\_alf\_info\_ph\_flag is equal to 1,> **ph\_cc\_alf\_cr\_enabled\_flag** equal to 1 specifies that cross-compoent adaptive loop filter for the Cr colour component is enabled and may be used for the current picture. ph\_cc\_alf\_cr\_enabled\_flag equal to 0 specifies that cross-component adaptive loop filter for the Cr colour component is disabled and not used for the current picture. When not present, ph\_cc\_alf\_cr\_enabled\_flag is inferred to be equal to 0.

<When pps\_alf\_info\_ph\_flag is equal to 1,> **ph\_sao\_luma\_enabled\_flag** equal to 1 specifies that SAO is enabled and may be used for the luma component of the current picture. ph\_sao\_luma\_enabled\_flag equal to 0 specifies that SAO is disabled and not used for the luma component of the current picture. When ph\_sao\_luma\_enabled\_flag is not present, it is inferred to be equal to 0.

<When pps\_alf\_info\_ph\_flag is equal to 1,> **ph\_sao\_chroma\_enabled\_flag** equal to 1 specifies that SAO is enabled and may be used for the chroma component of the current picture. ph\_sao\_chroma\_enabled\_flag equal to 0 specifies that SAO is disabled and not used for the chroma component of the current picture. When ph\_sao\_chroma\_enabled\_flag is not present, it is inferred to be equal to 0.

1. Invocation of the decoding process for symmetric motion vector difference reference indices specified in clause 8.3.5

In clause 8.1.2, add the following text as a step after the invocation of the decoding process for generating unavailable reference pictures specified in clause 8.3.4: "At the beginning of the decoding process for each B slice, the decoding process for symmetric motion vector difference reference indices specified in clause 8.3.5 is invoked for derivation of the variables RefIdxSymL0 and RefIdxSymL1.", and at the beginning of clause, add the following: "This process is invoked at the beginning of the decoding process for each B slice, after decoding of the slice header as well as the invocation of the decoding process for reference picture list construction for the slice as specified in clause 8.3.2, but prior to the parsing and decoding of any coding unit." (S0191)

It was commented that this is really an editorial bug fix proposal, and some correction is needed, but that it is editorially preferable to avoid having parsing specified in a way that is dependent on the decoding process specification (when feasible).

It was suggested that something also be done for 8.3.6.

Revisit after offline study.

1. Make either of the following changes regarding the inferences of sps\_scaling\_matrix\_for\_lfnst\_disabled\_flag and sps\_scaling\_matrix\_designated\_colour\_space\_flag: (S0196)
   1. Remove the inferences of both flags, as they are asserted not used when not present.
   2. Change the inferred value from 1 to 0 for both flags.

It was commented that these are simply editorial suggestions.

Editor action item: The editor is suggested to remove the unnecessary inferences.

1. Make one of the following changes to disallow the ACT and LFNST combination: (S0197)
   1. When sps\_lfnst\_enabled\_flag is equal to 1, sps\_act\_enabled\_flag is not signalled and is inferred to be 0.
   2. When sps\_act\_enabled\_flag is equal to 1, sps\_lfnst\_enabled\_flag is not signalled and inferred to be 0.
   3. Add a constraint: The values of sps\_act\_enabled\_flag and sps\_lfnst\_enabled\_flag shall not both be equal to 1.

The proponent indicated that this is the only case with three cascaded transforms in the decoding process, and that experiments with RGB content showed no benefit for the combination.

Another participant said that on the OldTownCross test sequence in the RA case, the combination of ACT and LFNST provides 2.8% gain, and that overall it also provides gain on some other content.

Test results were shown, with different test results for different test sequences. It was commented that an encoder could hypothetically make a smart decision about when to enable the combination.

It was commented that the cascading of ACT with LFNST is not really an implementation problem.

Some participants preferred to leave this to the encoder to be able to choose.

It was not clear that there is a real problem that needs to be solved by this change, so no action was recommended.

1. Signal an SPS flag to specify whether ph\_joint\_cbcr\_sign\_flag is present in PHs. When not present, the value of ph\_joint\_cbcr\_sign\_flag is inferred to be equal to 1. (S0201)

The proponent indicated that only 3 test sequences out of 26 in the CTC use the sign flag. One of these is SlideShow, which is screen content.

The argument, aside from 1 bit per picture bit savings, is consistency with how BDOF is handled. Another participant said there had been a proposal to change BDOF signalling, for a similar consistency reason, with no action recommended.

It was not clear that there is a real problem that needs to be solved by this change, so no action was recommended.

1. Make the following syntax and semantics changes to infer the values of ph\_dmvr\_disabled\_flag and ph\_bdof\_disabled\_flag to be equal to 1 (DMVR/BDOF disabled) when the picture is not qualified to use bi-prediction, to fix the asserted issue that currently they are inferred to be equal to 0 (DMVR/BDOF enabled) when the picture is not qualified to use bi-prediction: (S0205)

Change the picture header structure syntax and semantics as follows (additions in **bold fonts**, removals in *italic fonts*):

|  |  |
| --- | --- |
| **presenceFlag = 0** |  |
| if( ph\_inter\_slice\_allowed\_flag ) { |  |
| ... |  |
| if( sps\_mmvd\_fullpel\_only\_flag ) |  |
| **ph\_mmvd\_fullpel\_only\_flag** | u(1) |
| *presenceFlag = 0* |  |
| if( !pps\_rpl\_info\_in\_ph\_flag ) /\* This condition is intentionally not merged into the next,  to avoid possible interpretation of RplsIdx[ i ] being unspecified. \*/ |  |
| presenceFlag = 1 |  |
| else if( num\_ref\_entries[ 0 ][ RplsIdx[ 0 ] ] > 0 &&  num\_ref\_entries[ 1 ][ RplsIdx[ 1 ] ] > 0 ) |  |
| presenceFlag = 1 |  |
| if( presenceFlag ) { |  |
| **ph\_mvd\_l1\_zero\_flag** | u(1) |
| if( sps\_bdof\_control\_present\_in\_ph\_flag ) |  |
| **ph\_bdof\_disabled\_flag** | u(1) |
| if( sps\_dmvr\_control\_present\_in\_ph\_flag ) |  |
| **ph\_dmvr\_disabled\_flag** | u(1) |
| } |  |

Change the picture header structure syntax as follows:

**ph\_bdof\_disabled\_flag** equal to 1 specifies that bi-directional optical flow inter prediction based inter bi-prediction is disabled and not used in the slices associated with the PH. ph\_bdof\_disabled\_flag equal to 0 specifies that bi-directional optical flow inter prediction based inter bi-prediction is enabled and may be used in the slices associated with the PH.

When not present, the value of ph\_bdof\_disabled\_flag is inferred as follows:

* If **presenceFlag is equal to 1** *sps\_bdof\_control\_present\_in\_ph\_flag is equal to 0*, the value of ph\_bdof\_disabled\_flag is inferred to be equal to 1 − sps\_bdof\_enabled\_flag.
* Otherwise (**presenceFlag is equal to 0** *sps\_bdof\_control\_present\_in\_ph\_flag is equal to 1*), the value of ph\_bdof\_disabled\_flag is inferred to be equal to 1.

**ph\_dmvr\_disabled\_flag** equal to 1 specifies that decoder motion vector refinement based inter bi-prediction is disabled and not used in the slices associated with the PH. ph\_dmvr\_disabled\_flag equal to 0 specifies that decoder motion vector refinement based inter bi-prediction is enabled and may be used in the slices associated with the PH.

When not present, the value of ph\_dmvr\_disabled\_flag is inferred as follows:

* If **presenceFlag is equal to 1** *sps\_dmvr\_control\_present\_in\_ph\_flag is equal to 0*, the value of ph\_dmvr\_disabled\_flag is inferred to be equal to 1 − sps\_dmvr\_enabled\_flag.
* Otherwise (**presenceFlag is equal to 0** *sps\_dmvr\_control\_present\_in\_ph\_flag is equal to 1*), the value of ph\_dmvr\_disabled\_flag is inferred to be equal to 1.

This is only editorial. Currently there is an inference rule that sometimes infers values that are not used. The current expression is done this way just to make the inference rule simple.

It was suggested to change the expression of the inference rule so that values are not inferred when they are not used.

Editor action item: The editor may consider ways of improving the expression, although no clear bug has been identified.

1. Add sps\_ltdf\_enabled\_flag for controlling the on/off of long deblocking filters, and add a GCI flag (no\_ltdf\_constraint\_flag) to constrain the new sps\_ltdf\_enabled\_flag. (S0226)

R0300 had reported that there was sometimes an over-smoothing phenomenon and suggested to be able to control the long deblocking filter. It was commented that the long DBF is the main difference between VVC and HEVC deblocking.

It was commented that there is already a way to control overall DBF strength.

There had been a proposal at the previous meeting for separate control of the long filter at the slice level, but it had not been determined necessary at the time. There had also been analysis of the question at the meeting before that.

This would have a low-level impact, as it would be necessary to support the switching within the DBF process.

It was not clear that there is a real problem that needs to be solved by this change, so no action was recommended.

1. Make either of the following changes to resolve an asserted inconsistency between the semantics of sps\_mmvd\_fullpel\_only\_flag and the related syntax parsing process: (S0227)
   1. Change the syntax condition for ph\_mmvd\_fullpel\_only\_flag from "if( sps\_mmvd\_fullpel\_only\_flag )" to " if( !sps\_mmvd\_fullpel\_only\_flag )".
   2. Rename sps\_mmvd\_fullpel\_only\_flag to sps\_mmvd\_fullpel\_only\_enabled\_flag, and switch the phrases "uses" and "may use" for the value 1 and 0 in the semantics of this SPS flag.

It was commented that option a has a problem.

AHG recommendation (logical cleanup): Adopt option b. (The naming of the flag is an editorial matter left to the discretion of the editor – removing “\_only” was suggested.)

1. Change the LMCS data syntax and semantics as well as the related decoding process texts as in S0245 (S0245 aspect 1 late)

TBP: Proponent not present at the time of AHG discussion.

1. Change scaling list data semantics as well as the related decoding process texts as in S0245 (S0245 aspect 2 late)

TBP: Proponent not present at the time of AHG discussion.

[JVET-S0044](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10166) AHG9: Cleanup of high-level signalling of BDOF, DMVR and PROF [M. Pettersson, R. Sjöberg, M. Damghanian, J. Enhorn, Z. Zhang, J. Ström, R. Yu, D. Liu (Ericsson)]

[JVET-S0049](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10171) AHG9/AHG8/AHG12: On parameter sets and picture header [Y.-K. Wang, L. Zhang, Z. Deng, K. Zhang (Bytedance)]

Aspect 9 of this contribution belongs to this category.

[JVET-S0053](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10175) AHG9: Inference of chroma deblocking offset values in the PH and SH [Z. Zhang, M. Pettersson, M. Damghanian, J. Enhorn, K. Andersson, J. Ström, R. Sjöberg, R. Yu, D. Liu (Ericsson)]

[JVET-S0062](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10184) AHG9: On no\_tsrc\_constraint\_flag [K. Naser, F. Le Leannec, T. Poirier, P. de Lagrange (InterDigital)]

[JVET-S0072](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10194) AHG9: On PDPC and reference sample filtering of non-420 sequences [M. G. Sarwer, Y. Ye (Alibaba)]

[JVET-S0069](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10191) AHG9: General constraint information on features related to transform skip mode [S.-T. Hsiang, O. Chubach, L. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

Aspect 2 of this contribution belongs to this category.

[JVET-S0073](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10195) AHG9: Bug-fix of the constraint flag of VVC [M. G. Sarwer, Y. Ye (Alibaba)]

Aspect 2 of this contribution belongs to this category.

[JVET-S0088](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10210) AHG9: Clean-up on derivation of the MaxNumSubblockCand [N. Park, J. Nam, H. Jang, J. Lim, S. Kim(LGE)]

[JVET-S0089](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10211) AHG8: On TMVP derivation using inter-layer reference picture [N. Park, J. Nam, H. Jang, J. Lim, S. Kim(LGE)]

[JVET-S0093](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10215) On slice header flags related to residual coding [J. Samuelsson, S. Deshpande, F. Bossen, A. Segall (Sharp)]

[JVET-S0148](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10270) Crosscheck of JVET-S0093 (On slice header flags related to residual coding) [J. Gan (Canon)]

[JVET-S0105](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10227) AHG9: Modification of general constraint information [S. McCarthy, P. Yin, T. Lu, F. Pu, W. Husak, T. Chen (Dolby)]

The aspect on changing the semantics of no\_tsrc\_constraint\_flag belongs to this category.

[JVET-S0121](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10243) AHG9: On deblocking filter, ALF, and SAO enabling flags in PH and SH [N. Hu, V. Seregin, Y. He, M. Karczewicz (Qualcomm)]

[JVET-S0130](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10252) On chroma QP mapping [L. Li, X. Li, B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-S0134](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10256) AHG9/AHG12: Relaxing an ALF APS constraint [A. Aminlou, M. M. Hannuksela (Nokia)]

[JVET-S0136](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10258) AHG9: On signaling of PDPC enabling/disabling flag in SPS [X. Xiu, Y.-W. Chen, H.-J. Jhu, T.-C. Ma, X. Wang (Kwai)]

[JVET-S0150](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10272) AHG9: On high-level syntax for smoothing intra prediction tools [A. Filippov, V. Rufitskiy, E. Alshina (Huawei)]

[JVET-S0191](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10313) AHG9: On decoding process for symmetric motion vector difference reference indices [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-S0196](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10318) AHG9: On inference rules of the SPS scaling matrix related flags [M. G. Sarwer, Y. Ye (Alibaba)]

[JVET-S0197](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10319) AHG9: On ACT and LFNST [M. G. Sarwer, Y. Ye (Alibaba)]

[JVET-S0201](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10323) AHG9: On signaling the JCCR sign information in PH [C.-W. Kuo, X. Xiu, H.-J. Jhu, Y.-W. Chen, T.-C. Ma, X. Wang (Kwai Inc.)]

[JVET-S0205](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10327) AHG9: Inference value of DMVR/BDOF disabled flag in PH [K. Unno, K. Kawamura (KDDI)]

[JVET-S0226](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10348) AHG9: On high level syntax for longer tap deblocking filter [A. M. Kotra, N. Hu, M. Coban, V. Seregin, J. Chen, M. Karczewicz (Qualcomm)]

[JVET-S0227](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10349) AHG9: On MMVD flag in SPS and PH [Y. Kidani, K. Unno, K. Kawamura (KDDI)]

[JVET-S0245](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10367) AHG9: Editorial clarifications of APS ID for LMCS\_APS and SCALING\_APS [Y. Ahn, J. Lee, D. Sim (Digital Insights), S. Park (Hyundai Motors)] [late]

[JVET-S0252](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10391) PH semantics of ALF and SAO syntax elements [J. Samuelsson, S. Deshpande, A. Segall (Sharp), L. Li, X. Li, B. Choi (Tencent)] [late]

[JVET-S0255](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10394) AHG9: Semantics fix to ALF and SAO enabling flags in PH [N. Hu, V. Seregin, M. Karczewicz (Qualcomm), O. Chubach, C.-Y. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

### General and misc. HLS topics (16+16)

[JVET-S0139](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10261) AHG9: A summary of proposals on general and misc. HLS topics [Y.-K. Wang (Bytedance)]

This contribution was discussed in the HLS AHG meeting at 0515 UTC on 27 May and in the HLS AHG pre-meeting at 1630 UTC on 19 June and 1300 UTC on 21 June.

This contribution provides a summary of the 31 proposals on general and misc. HLS topics (the agenda item 3.1.2 in JVET-S0137 and JVET-S0237).

It is suggested that this summary, in terms of a list of proposed items, is used for the reviewing of these proposals, such that the discussions can be in a more structured and efficient manner. The following actions are proposed:

1. Remove the support of the separate colour plane coding from VVCv1, by removing the syntax elements sps\_separate\_colour\_plane\_flag and sh\_colour\_plane\_id and the related text. If such functionality is desired in the future, the SPS and SH extension mechanisms could be used. Another option is to rename these syntax elements to be reserved bits. (S0052)

AHG Recommendation (cleanup): Remove these syntax elements and the associated decoding process as proposed.

1. Add a constraint: The value of sps\_field\_seq\_flag shall be the same in all SPSs that are referred to by CLVSs in a CVS. (S0056 aspect 1)

No action seemed necessary on this, as the decoding process is not affected.

1. Add a constraint: When sps\_field\_seq\_flag is equal to 1, all fields that compose the same frame shall refer to the same PPS. (S0056 aspect 2)

The concept of fields belonging to the same frame did not seem adequately defined, and no action was recommended on this.

1. Add a constraint: When sps\_video\_parameter\_set\_id is equal to 0, parameter sets referred to by all VCL NAL units shall have the same value of nuh\_layer\_id as the VCL NAL units. (S0075 aspect 1 – also covered in another summary document S0141)

This was deferred for consideration in relation to S0141 regarding inference of an OLS when there is no VPS – adding a NOTE may be sufficient.

1. Do the following for setting of PictureOutputFlag after receiving the first slice of a picture and before receiving other slices of the picture: (S0077)
2. Add a constraint that when a picture contains a mix of RASL\_NUT with NAL unit type(s) other than RADL\_NUT or a mixed of RADL\_NUT with other NAL unit type(s) other than RASL\_NUT, then the following applies:
   * 1. If interlace coding is not used (i.e., sps\_field\_seq\_flag is equal to 0), there shall be at least one non-leading picture between the picture and its associated IRAP picture.
     2. Otherwise, if interlace coding is used (i.e., sps\_field\_seq\_flag is equal to 1), there shall be at least two non-leading pictures between the picture and its associated IRAP picture.
3. Add a NOTE to clarify the derivation of PictureOutputFlag that when decoder received the first slice of the current picture and the NAL unit type of the slice is either RASL\_NUT or RADL\_NUT and the value of pps\_mixed\_nalu\_types\_in\_pic\_flag is equal to 1, if decoder has not received any non-leading picture from the last IRAP picture, then decoder can determine that the current picture is a RASL picture.

It was noted that PictureOutputFlag is not really needed until all slices of the picture have been decoded, and thus suggested to move the derivation of this flag to the end of the decoding process of the picture.

AHG Recommendation (cleanup): Move the derivation of this flag to the end of the decoding process of the picture.

1. Invoke the derivation process for NoOutputOfPriorPicsFlag only once per AU, that is, before the decoding process of the first picture in the CVSS AU but after parsing the slice header of the first slice of the current picture. When NoOutputOfPriorPicsFlag is equal to 1, the process of removing pictures stored in the DPB without outputting them is invoked only once per access unit. (S0078)

AHG Recommendation (BF/expression of existing intent): Adopt.

1. Fix an asserted bug (the derivation of prevTid0Pic that is used in the POC decoding process does not consider the value of ph\_non\_ref\_pic\_flag), by adding the following constraint: (S0081)

Let picture picA and picB be two pictures with TemporalId equal to 0, it is a constraint of conformance bitstream that DiffPicOrderCnt( picB, picA ) shall not be greater than MaxPicOrderCntLsb / 2 when all of the following conditions are satisfied:

* The values of nuh\_layer\_id of picA and picB are the same.
* picA and picB are not RADL picture or RASL picture.
* The value of ph\_non\_reference\_picture\_flag of picA and picB are both equal to 0.
* picB is the first picture with TemporalId equal to 0 that follows picA in output order.

An alternative approach was suggested, to modify the derivation of prevTid0Pic to consider only pictures with ph\_non\_ref\_pic\_flag equal to 0. It was commented that this approach was taken in HEVC.

It was also commented that we should do the same with prevNonDiscardablePic and in C.4 and the semantics of delta\_poc\_msb\_cycle\_present\_flag.

AHG Recommendation (BF/expression of existing intent): Make the alternative suggested changes.

1. When the current picture is a RADL picture, allow RASL pictures with pps\_mixed\_nalu\_types\_in\_pic\_flag is equal to 1 in active entries in RefPicList[ 0 ] or RefPicList[ 1 ]. (S0084, spec text ticket #1035)

AHG Recommendation (BF/expression of existing intent): Adopt (the editor may also add a NOTE to explain that such RADL pictures would still be correctly decodable when random accessing from the CRA picture, due to the existence of subpicture-level constraints).

1. Do one of the following to the NOTE in the definition of RASL picture: (S0110 aspect 1)
2. Remove the sentence "RASL pictures are not used as reference pictures for the decoding process of non-RASL pictures."
3. Change the sentence to be: "RASL pictures with mixed\_nalu\_types\_in\_pic\_flag equal to 0 are not used as reference pictures for the decoding process of non-RASL pictures."

AHG Recommendation (BF/expression of existing intent): Adopt “b” in principle; editor to produce the precise wording.

1. When aud\_irap\_or\_gdr\_au\_flag is equal to 1, in the AUD syntax, *optionally* signal the OLS index of the OLS represented by the CVS (aud\_cvs\_ols\_idx) and the highest temporal sublayer present in the CVS (aud\_cvs\_htid\_plus1), each conditioned by its own presence flag, with the following additional details: (S0087)
2. aud\_cvs\_htid\_plus1 equal to 0 specifies that all the pictures in the CVS starting with the AUD NAL unit are IRAP pictures or GDR pictures with ph\_recovery\_poc\_cnt equal to 0. aud\_cvs\_htid\_plus1 greater than 0 specifies that all the pictures in the CVS starting with the AUD NAL unit have TemporalId less than aud\_cvs\_htid\_plus1.
3. aud\_cvs\_ols\_idx specifies that the CVS starting with the AUD NAL unit does not contain any other layers than those included in the OLS with OLS index equal to aud\_cvs\_ols\_idx.
4. When aud\_cvs\_htid\_plus1 is present, it is used to derive the value of Htid. Otherwise, Htid is set by external means (like in VVC Draft 9).
5. When aud\_cvs\_ols\_idx is present, it is used to derive the value of TargetOlsIdx. Otherwise, TargetOlsIdx is set by external means (like in VVC Draft 9).
6. The sub-bitstream extraction process is modified so that the highest temporal sublayer and the target OLS given as inputs to the process are used in modifying the AUD NAL units in the output sub-bitstream.

It was noted that this requires AUD syntax rewriting for extraction.

A participant suggested to consider using the AUD content only if such information is not provided by external means. Others said that any external means and the AUD content (if present) should be required to match each other. Another participant said this could have a similar concept as for parameter sets – it needs to be available – either in the bitstream or by external means.

Another participant commented that dropping of some NAL units may cause mismatch, although we would not need to specify a decoder response to accidental dropping that produces non-conforming bitstreams.

The spirit is to allow the information to be signalled “in band”. If not present, the current scheme would apply such that external means is needed.

Something similar had been proposed at the January 2020 (Brussels) meeting in JVET-Q0256, using a different NAL unit rather than the AUD. This proposal would make the AUD have variable length.

It was commented that having a different NAL unit might help deal with the rewriting issue.

This was initially deferred for further study until the main meeting to propose an approach with a distinct NAL unit and text such that the information needs to be available – either in the bitstream or by external means. See the notes for item 27 for the later resolution of this.

1. Add a rule to select among OLSs matching BitstreamToDecode: When TargetOlsIdx is not provided via external means, it is set equal to the OLS with the lowest index that contains all layers of AU 0 of BitstreamToDecode and the highest number of output layers. (S0103 aspect 1)

Currently, there is no default, and TargetOlsIdx needs to be provided.

This was initially deferred for further study until the main meeting in conjunction with the previous item above. See the notes for item 27 for the later resolution of this.

1. Do one of the following to enable setting of PictureOutputFlag equal to 0 for pictures in CVSS AUs (for correct picture output behavior when random accessing from a DRAP AU): (S0104)
2. Add sps\_pic\_in\_cvss\_au\_no\_output\_flag, which equal to 1 specifies that a picture in a CVSS AU referring to the SPS is not output (regardless of the ph\_pic\_output\_flag value in the PH).
3. Add an external-means-determined variable NoOutputBeforeDrapFlag for CVSS AUs. PictureOutputFlag is set equal to 0 for pictures in CVSS AUs with NoOutputBeforeDrapFlag equal to 1.

It was asked whether this proposed behaviour is consistent with DRAP being only an SEI message, since this is proposing a change in the main body. DRAP was also an SEI message in HEVC.

It was commented that the distinction between “output” and “display” might allow a system to not display an IRAP picture although the decoder would conceptually “output” it.

It was commented that DRAP could be used for various purposes – not just recovery but also for fast-forward.

Option “b” might be considered similar in spirit with some of these suggestions.

It was commented that it had been intended for DRAP to not affect the main spec, and it seemed too late to change that intent.

No action was recommended for this (within the scope of v1).

1. In order to enable signalling the picture rate information without requiring signalling a complete HRD model, allow general\_nal\_hrd\_params\_present\_flag and general\_vcl\_hrd\_params\_present\_flag to be both equal to 0, and when that condition is true, only signal the following HRD parameters syntax elements: num\_units\_in\_tick, time\_scale, general\_same\_pic\_timing\_in\_all\_ols\_flag, fixed\_pic\_rate\_general\_flag[ i ], fixed\_pic\_rate\_within\_cvs\_flag[ i ], and elemental\_duration\_in\_tc\_minus1[ i ]. (S0109)

It was asked whether these can be sent in AVC and HEVC without HRD parameters, and the proponent said this was possible. It was also asked what these would mean if fixed\_pic\_rate\_general\_flag[ i ] and fixed\_pic\_rate\_within\_cvs\_flag[ i ] are equal to 0.

HEVC has a specification of a correspondence between POC and timing in a special case.

It was commented that the semantics of some of these parameters depend on the HRD specification, so the parameters would not make sense without the HRD model (as currently specified).

This was deferred for further study to determine whether it is feasible and desirable to signal picture rate information in the bitstream without signalling HRD parameters in the bitstream. See S0175 aspect 6 in section 3.1.8.

1. Add a prediction constraint on the pictures following a recovery point picture in both decoding and output order, as follows: When the current picture follows a recovery point picture having the same value of nuh\_layer\_id in both decoding order and output order, there shall be no picture referred to by an active entry in RefPicList[ 0 ] or RefPicList[ 1 ] that precedes that recovery point picture in output order or decoding order of the associated GDR picture in the layer with the nuh\_layer\_id equal to the nuh\_layer\_id of the reference picture. (S0114)

It was commented that this would prohibit using “clean” areas of “partially dirty” pictures prior to the recovery point. This seems against the spirit of the intent of the GDR design, so no action was recommended on this.

1. Make the following changes: (S0124)
2. Add derivation of TemporalId, ph\_non\_ref\_pic\_flag, and parameter sets to the decoding process for generating unavailable reference pictures (in order to enable checking of some constraints for them).
3. Remove the constraint that each inter-layer reference picture entry in RefPicList[ 0 ] or RefPicList[ 1 ] of a slice shall be an active entry.
4. Invoke the decoding process for generating unavailable reference pictures for ILRPs or constrain that ILRPs shall not be equal to "no reference picture".

It was commented that aspects b and c are not necessary. Part of the motivation for item b is to enable more use of signalling the RPL in the PH or SPS rather than SH – e.g., for bit savings.

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

AHG Recommendation (BF/expression of existing intent): Adopt aspect a, modified as described.

(Note: This may also need to be an errata item for HEVC.)

1. Move the signalling of WPP enabling flag and the entry point offsets present flag from SPS to PPS, and enable the signalling of only the tile entry points when both tiles and WPP are enabled. (S0128)

Part of the motivation of the first proposed change is to enable the second proposed change.

No strong need for action was identified on this, so no action was recommended.

Discussion of this topic area stopped here at the mid-term AHG meeting and resumed at 1630 UTC on 19 June in the AHG pre-meeting.

1. Make the following changes on end of sequence (EOS) NAL units (S0155):
   1. In clause 3 (Definitions), the NOTE as part of the definition of CLVS picture, the phrase "the first PU in the layer of the bitstream that follows an EOS NAL unit in decoding order", change "EOS NAL unit" to "EOS NAL unit **in the layer**".
   2. In clause 7.4.2.2 (NAL unit header semantics), instead of requiring the nuh\_layer\_id of an EOS NAL unit to be equal to the nuh\_layer\_id of the associated VCL NAL unit, it is specified that the nuh\_layer\_id of an EOS NAL unit shall be equal to one of the nuh\_layer\_id values of the layers present in the CVS.
   3. In clause 7.4.2.4.3 (Order of PUs and their association to AUs), it is specified that, when present, the next PU of a particular layer after an EOS NAL unit that belongs to the same layer shall be an IRAP or GDR PU.
   4. In clause 7.4.2.4.4 (Order of NAL units and coded pictures and their association to PUs), it is specified that, when an EOS NAL unit is present in a PU, it shall be the last NAL unit among all NAL units within the PU other than other EOS NAL units (when present) or an EOB NAL unit (when present).
   5. In clause 7.4.3.10 (End of sequence RBSP semantics), it is specified that, when present, the EOS RBSP specifies that the next subsequent PU that belongs to the same layer as the EOS NAL unit in the bitstream in decoding order (if any) is an IRAP or GDR PU.

AHG Recommendation (cleanup/BF/expression of existing intent): Adopt.

1. Add either of the following constraints related to EOS NAL units in multi-layer bitstreams (S0174 aspect 2):
2. The picture referred to by each ILRP entry, when present, in RefPicList[ 0 ] or RefPicList[ 1 ] of a slice of the current picture shall not be a RASL picture when the associated CRA has NoOutputBeforeRecoveryFlag equal to 1 and the current picture is not a RASL picture.
3. It is a requirement of bitstream conformance that when a layer k that depends on a layer m and the layer m contains an EOS NAL unit in AU n, layer k shall also contain an EOS NAL in AU n or the next AU n + 1 must contain a CLVSS picture for layer k.

A wording clarification for this was suggested: When an AU auA contains an EOS NAL unit in a layer layerA, for each layer layerB that is present in the CVS and has layerA as a reference layer, the first picture in layerB in decoding order in an AU following auA in decoding order shall be a CLVSS picture.

It was commented that option “a” doesn’t cover some GDR cases and that option “b” seemed more aligned with practical use cases.

AHG Recommendation (cleanup/BF/expression of existing intent): Adopt option b, as clarified.

1. In clause A.4.2 (Profile-specific level limits), change the definitions of the two level limits on the relationship between the CPB removal times for AU 0 and for AU n ( n > 0 ) and the number of slices i.e., items c and d, from being based on MaxSlicesPerPicture and the maximum picture size to be based on MaxSlicesPerPicture \* ( the number of pictures in the AU ) and the maximum AU size. (S0156 aspect 1)
2. Alternatively, change the two level limits to be based on MaxSlicesPerAu, which is rename of the existing MaxSlicesPerPicture without changing its value, and change "the number of slices in each picture in AU" to "the number of slices in AU". (S0156 aspect 1 alt, late)

AHG Recommendation (cleanup/BF/expression of existing intent): Adopt alternative “a”.

1. In clause A.4.2 (Profile-specific level limits), change the definitions of the two level limits on the relationship between the CPB removal times for AU 0 and for AU n ( n > 0 ) and the number of tiles i.e., items i and j, from being based on MaxTileCols \* MaxTileRows and the maximum AU size to be based on MaxTileCols \* MaxTileRows \* ( the number of pictures in the AU ) and the maximum AU size. (S0156 aspect 2)
2. Alternatively, change the two level limits to be based on MaxTilesPerAu, which replaces the existing MaxTileRows, where the value of MaxTilesPerAu is set equal to MaxTileRows \* MaxTileCols, and change "the number of tiles in each picture in AU" to "the number of tiles in AU". (S0156 aspect 2 alt, late)

AHG Recommendation (cleanup/BF/expression of existing intent): Adopt alternative “a”.

It was noted that this implies that the minimum tile size can be as small as a single CTU in certain cases.

1. In clause C.4 (Bitstream conformance), the 6th constraint, change "DpbOutputTime[ n ] greater than DpbOutputTime[ currPic ]" to "DpbOutputTime[ n ] greater than CpbRemovalTime[ currPic ]". This is asserted to be a bug, because all decoded pictures in the DPB are always decoded earlier than decoding of the current picture, and thus CpbRemovalTime[ n ] in the context is always less than CpbRemovalTime[ currPic ]. This is also asserted to be a bug in the latest HEVC spec. (S0156 aspect 3)

AHG Recommendation (BF/expression of existing intent): Adopt. Also clarify that the number of decoded pictures in the DPB is the number that is computed in the sentence. This is noted to also affect HEVC.

Discussion in AHG session 10 stopped here in the HLS AHG pre-meeting at 1720 UTC on 19 June.

Discussion in AHG session 17 began here in the HLS AHG pre-meeting at 1300 UTC on 21 June.

1. Change "less than" in the following condition (that's part of the specification of the first picture of an AU) to "less than or equal to": The value of nuh\_layer\_id of the VCL NAL unit is less than the nuh\_layer\_id of the previous picture in decoding order. (S0160 aspect 5)

AHG Recommendation (editorial bug fix/expression of existing intent): Adopt.

1. Remove the following constraint from the definition of the two still picture profiles: The referenced SPS shall have max\_dec\_pic\_buffering\_minus1[ sps\_max\_sublayers\_minus1 ] equal to 0. (S0160 aspect 6)

It was commented that this affects the ability to extract a picture from a Main profile bitstream.

AHG Recommendation (editorial bug fix/expression of existing intent): Adopt. (Also affects HEVC)

1. Make sure that each VUI syntax element that describes a property of the bitstream has an inferred/default value when sps\_vui\_parameters\_present\_flag is equal to 0. (S0160 aspect 8)

Revisit after offline study to determine whether action is needed. Defaults should indicate unspecified and/or unconstrained indications.

1. Change an existing constraint such that the value of ph\_poc\_msb\_cycle\_present\_flag is required to be equal to 0 when vps\_independent\_layer\_flag[ GeneralLayerIdx[ nuh\_layer\_id ] ] is equal to 0 and there is an ILRP entry in RefPicList[ 0 ] or RefPicList[ 1 ] of a slice of the current picture (instead of "and there is a picture in the current AU in a reference layer of the current layer"). (S0160 aspect 9, late)

Several participants confirmed the need for this.

AHG Recommendation (editorial bug fix/expression of existing intent): Adopt.

1. Add the following constraints to resolve an asserted bug that may cause POC derivation process not working correctly for IRAP pictures in an independent non-output layer in which pictures other than IRAP pictures are not used for inter-layer prediction and hence would be removed during sub-bitstream extraction: (S0241 late)
   1. It is a requirement of bitstream conformance that the value of sps\_poc\_msb\_cycle\_flag shall be equal to 1 when both of the following conditions are true:

* The value of sps\_video\_parameter\_set\_id is not equal to 0.
* The SPS is referred to by at least a VCL NAL unit with layer id equal to nuh\_layer\_id and value of NumSubLayersInLayerInOLS[ i ][ GeneralLayerIdx[ nuh\_layer\_id ] ] is equal to 0 for any value of i in the range 0 TotalNumOlss − 1, inclusive, and vps\_independent\_layer\_flag[ GeneralLayerIdx[ nuh\_layer\_id ] ] is equal to 1.
  1. It is a requirement of bitstream conformance that the value of ph\_poc\_msb\_cycle\_present\_flag shall be equal to 1 when all the following conditions are true:
* The picture associated with the picture header is an IRAP picture or GDR picture with associated ph\_recovery\_poc\_cnt equal to 0 that is not a CLVSS picture.
* The POC difference between the current picture and the previous IRAP picture or GDR picture with ph\_recovery\_poc\_cnt equal to 0 in the same layer in decoding order is equal to or greater than MaxPicOrderCntLsb / 2.
* The value of sps\_video\_parameter\_set\_id is greater than 0 and the value of NumSubLayersInLayerInOLS[ i ][ GeneralLayerIdx[ nuh\_layer\_id ] ] is equal to 0 for i in the range 0 TotalNumOlss − 1, inclusive, and vps\_independent\_layer\_flag[ GeneralLayerIdx[ nuh\_layer\_id ] ] is equal to 1.

It was commented that the constraint that the output of the bitstream extraction process shall be a conforming bitstream imposes this requirement indirectly. It was also commented that the second bullet of aspect “b” is somewhat circular. Adding a NOTE was suggested.

Editor action item: The editor is strongly suggested to add a NOTE to explain this issue. This affects such scenarios as single-layer intra-picture-only trick play.

1. Enable signalling of TargetOlsIdx and Htid in the bitstream as follows: (S0163)
2. Add operation point information (OPI) NAL unit for carrying syntax elements indicating TargetOlsIdx and Htid.
3. Including an extension mechanism in OPI NAL unit similar to that in DCI and all parameter sets.
4. Allowing OPI NAL unit in all AUs with IRAP or GDR slices (and thus may become IRAP or GDR AUs as a result of layer and/or subpicture extraction), and requiring the content of the OPI NAL unit to be the same within a CVS.
5. TargetOlsIdx and Htid remain valid for one or more CVSs, until they are updated by another OPI NAL unit or through external means.
6. When both AUD and OPI NAL units are present in an AU, the OPI NAL unit shall be the next NAL unit after the AUD NAL unit. When no AUD NAL unit is present in an AU and the OPI NAL unit is present in the AU, the OPI NAL unit shall be the first NAL unit in the AU. No more than one instance of the OPI NAL unit shall be present in an AU.
7. Allowing to have neither external means nor the OPI NAL unit present for the first AU of the bitstream.
8. When no target OLS index is provided in the OPI NAL unit or through external means for the first AU of the bitstream, TargetOlsIdx is inferred to be equal to the lowest OLS index that contains the largest number of layers and the largest number of output layers among all OLSs.
9. When no highest temporal ID is provided in the OPI NAL unit or through external means for the first AU of the bitstream, Htid is inferred equal to vps\_ptl\_max\_tid[ vps\_ols\_ptl\_idx[ TargetOlsIdx ] ].
10. Assigning nal\_unit\_type equal to 12 (which was earlier used for RSV\_IRAP\_12) for the OPI NAL unit.
11. TemporalId of OPI NAL unit shall be equal to 0 and TemporalId of the containing AU shall also be 0.
12. Allowing any nuh\_layer\_id value for the OPI NAL unit. Consequently, in the sub-bitstream extraction process, the OPI NAL unit is added among the NAL units that are not removed based on nuh\_layer\_id values.

If item h above is adopted, the following items are also proposed:

1. In the current VVC draft, if no VPS is present, then vps\_ptl\_max\_tid[ vps\_ols\_ptl\_idx[ TargetOlsIdx ] ] is not inferred. This document proposes to infer it equal to sps\_max\_sublayers\_minus1 when no VPS is present.
2. It is proposed to consider changing the syntax element name of vps\_ptl\_max\_tid[ i ] and change its semantics to be more generic.

The proposed semantics are (the bolded italics text at the end of the sentence added): vps\_ptl\_max\_tid[ i ] specifies the TemporalId of the highest sublayer representation for which the level information is present in the i-th profile\_tier\_level( ) syntax structure in the VPS ***and present in the OLSs with index olsIdx such that vps\_ols\_ptl\_idx[ olsIdx ] is equal to i*.**

This contribution was the result of offline work after the May AHG meeting. The proposal is to add an “operation point information NAL unit”. The information could be in the bitstream or provided by external means. It would be at the beginning of an AU when present.

A default would be specified if this is not present – see aspect “g”.

It was commented that this is a substantial action, but appears to resolve a key open issue in the specification.

It was asked why it is necessary to be able to have the additional NAL unit in the bitstream; this is to provide some in-bitstream means of specifying non-default OLS behaviour.

After discussion, it was suggested that if external means is available, it would override the in-bitstream information.

AHG Recommendation (cleanup): Adopt, modified as suggested to specify the ability to override by external means (text with the modification to be provided in a revision).

1. Make the following changes to the constraints on RPLs for RADL pictures and subpictures, considering multi-layer coding as well as its combination with subpictures (S0167) (additions in **bold**, removals in *italic*):

* When the current picture is a RADL picture, there shall be no active entry in RefPicList[ 0 ] or RefPicList[ 1 ] that is any of the following:
  + A RASL picture with pps\_mixed\_nalu\_types\_in\_pic\_flag is equal to 0

NOTE 4 – This means that an active entry of the RPLs of a RADL picture can refer to a RASL picture with pps\_mixed\_nalu\_types\_in\_pic\_flag equal to 1 **and the referenced RASL picture may either belong to the same layer or a different layer than the layer containing the current RADL picture**. However, when decoding starts from the associated CRA picture, such a RADL picture can still be correctly decoded, because the RADL subpicture(s) in that referenced RASL picture **with sps\_subpic\_treated\_as\_pic\_flag equal to 1** would be correctly decoded, as the RADL picture would only refer to the RADL subpictures in the referenced RASL picture, as imposed by the next constraint that disallows RADL subpictures referring to a RASL subpicture.

* + A picture that precedes the associated IRAP picture in decoding order
* When the current subpicture, with nuh\_layer\_id equal to a particular value layerId and subpicture index equal to a particular value subpicIdx **and sps\_subpic\_treated\_as\_pic\_flag[ subPicIdx ] equal to 1**, is a RADL subpicture, there shall be no active entry in RefPicList[ 0 ] or RefPicList[ 1 ] that is any of the following:
  + A picture [Removing: *with nuh\_layer\_id equal to layerId*] **for which the value of nuh\_layer\_id may or may not be equal to layerId** containing a RASL subpicture with subpicture index equal to subpicIdx
  + **A RASL picture for which the value of nuh\_layer\_id is not equal to layerId and the value of sps\_num\_subpics\_minus1 is equal to 0**
  + A picture that precedes the picture containing the associated IRAP subpicture in decoding order

The first part of the proposal was supported as a clarification.

It was agreed that we should not insert “**with sps\_subpic\_treated\_as\_pic\_flag equal to 1**” and “**and sps\_subpic\_treated\_as\_pic\_flag[ subPicIdx ] equal to 1**” because if the RASL pictures discussed in the NOTE have all I slices, they can be correctly decoded, and the subpicture-level constraint would apply even if the sps\_subpic\_treated\_as\_pic\_flag[ subPicIdx ] is equal to 0.

AHG Recommendation (expression of existing intent): Adopt, modified to not insert two phrases as noted above.

1. Make the following changes, considering the combination of GDR, subpictures, and virtual boundaries (S0168):
2. (Option 1) Do nothing or rewrite virtual boundary information in the SPS in the subpicture sub-bitstream extraction process (without actual proposed changes).
3. (Option 2) Add a requirement of bitstream conformance that the extracted first subpicture for the sub-bitstream shall contain an intra-coded area and the following processing are required in sub-bitstream extraction:
   * 1. Locate the first subpicture with an intra-coded area in the GDR picture or the following recovering pictures. This located subpicture becomes the new GDR subpicture.
     2. Change the value of nal\_unit\_type of the new GDR subpicture to GDR\_NUT when the new GDR subpicture is not in the current GDR picture.
     3. Rewrite the virtual boundary information in the SPS in terms of the new GDR subpicture.
     4. Adjust the value of ph\_recovery\_poc\_cnt in the PH when the new GDR subpicture is not the current GDR picture.
4. (Option 3, which is on top of option 2) When sps\_gdr\_enabled\_flag is equal to 1, add sps\_gdr\_subpic\_intra\_starting\_present\_flag in the SPS. In the PH, when ph\_recovery\_poc\_cnt is greater than 0 and sps\_gdr\_subpic\_intra\_starting\_present\_flag is equal to 1, add ph\_subpic\_intra\_starting\_poc\_cnt[ i ] for each subpicture, which specifies "the intra-coded starting point of the i-th decoded subpicture in output order".

The question is whether we need some kind of subpicture-level information about GDR. We do not have area-specific information about what areas have been refreshed. It was commented that this concept had been discussed before. The contribution considers the implication of this for subpictures.

The proposed additional information is essentially metadata that would provide some extra information but would not be completely necessary and would not affect the decoding process. Such information – if determined helpful – could be developed as something to be considered for later specification, e.g., as an SEI message.

It was noted that we do not have any constraint that the picture must contain some intra-coded area in order to be identified as a GDR picture. How the refresh is done is a matter left up to the encoder.

It was asked whether it is really important to try to do something special for the combination of subpictures with GDR.

Further study of the need for a potential SEI approach (after version 1) is encouraged. No current action was recommended.

1. Add a constraint: The recovering pictures of a GDR picture shall precede the recovery point picture in decoding order. (S0188 aspect 1)

The draft standard says that all pictures that follow the recovery point picture in output order (and that picture itself) will be correct.

A “recovering picture” is defined as a picture (that follows the GDR picture in decoding order) that precedes the recovery point picture in output order.

An example is a CRA. A CRA is basically a GDR picture with a zero recovery period, but it may be followed in decoding order by RASL pictures, which are pictures that follow the GDR picture in decoding order and precede it in output order. RASL pictures would violate the proposed constraint.

Otherwise, a GDR picture could be used as a CRA replacement.

It was not clear that there is a need to establish the proposed constraint, so no action was recommended.

1. Add a constraint: When pps\_mixed\_nalu\_types\_in\_pic\_flag is equal to 1 for a picture, the picture shall not be a recovering picture or the recovery point picture associated with a GDR picture. (S0188 aspect 2)

It was noted that GDR NAL unit types cannot be mixed with other types.

It was commented that the proposed constraint would probably be ordinarily applied by encoders, but it was said that the constraint may not really be necessary.

An example that would violate the constraint was expressed as a GDR followed by a picture that mixes the “dirty area” with something else and then has a later recovery picture.

It was noted that we allow mixing of trailing and STSA pictures and it was said that this could be OK in a recovering picture.

It was not clear that there is a need to establish the proposed constraint, so no action was recommended.

1. Add a constraint: The value of recoveryPointPocVal of a layer shall be equal to or greater than the recoveryPointPocVal of a reference layer of the layer. (S0188 aspect 3)

It was commented that R0274 had also proposed this and it was determined not to be necessary.

It was not clear that there is a need to establish the proposed constraint, so no action was recommended.

1. Move the syntax element ph\_recovery\_poc\_cnt to be signalled after ph\_poc\_msb\_cycle\_val. (S0188 aspect 4)

This is proposed due to resolve a semantics dependency issue, to order the syntax so that the variables computed from a syntax element do not depend on a later syntax element.

This change would require parsing the SPS before using the ph\_recovery\_poc\_cnt to identify the distance to a recovery point. A system could scan through the data for recovery point identification without parsing the SPS.

Because of this consideration, no action was recommended on this.

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

AHG Recommendation (editorial BF/expression of existing intent): Fix the description to consider the case with a recovery POC distance of 0. (Possibly also affecting HEVC and AVC.)

1. Modify the decoding process for generating unavailable reference pictures to set the values of nuh\_layer\_id and PicOrderCntVal of unavailable inter-layer reference pictures and mark those pictures as “used for long-term reference”. (S0192 aspect 1)

It was commented that this aspect had been discussed at the May AHG meeting, and that inter-layer reference pictures cannot be unavailable.

It was said that the reason for this existing constraint is for picture loss detection.

There was an editorial issue discussed – in the RPL derivation there is a process that considers the forbidden possibility of an ILRP that is not present in the DPB. This is not an error, but is not strictly necessary. There is a NOTE below that describes the potential inference of an unintentional loss.

1. Change the definition of still picture profiles to contain one AU only instead of one picture only. (S0091 aspect 1, S0202 aspect 2)
2. If yes, add the following two constraints: (S0202 aspect 2)
   * 1. When sps\_video\_parameter\_set\_id is not equal to 0, there shall be one OLS specified in the VPS that contains all the layer present in the bitstream and the OLS has only one output layer.
     2. The value of max\_dec\_pic\_buffering\_minus1[ sps\_max\_sublayers\_minus1 ] in the DPB parameters shall not be less than the maximum of direct reference layers of any layer in the bitstream.

This would include inter-layer prediction, motion vectors, etc.

See also item 46 of S0138, discussion whether to either change general\_one\_picture\_only\_constraint\_flag to general\_one\_au\_only\_constraint\_flag. (S0091 #1) or remove general\_one\_picture\_only\_constraint\_flag (S0160 #7).

The AHG recommended to revisit this in the main meeting, together with the parent bodies.

1. Add either of the following constraint for a bitstream conforming to the Main 10 Still Picture profile or Main 4:4:4 10 Still Picture profile (S0202 aspect 1):
2. When sps\_video\_parameter\_set\_id is greater than 0, there shall be an OLS specified in the VPS that contains only the layer that is present in the bitstream.
3. The value of sps\_video\_parameter\_set\_id shall be equal to 0.

It was asked whether the picture output flag would also need to be 1 for a picture in the Main 10 Still Picture profile. It was commented that perhaps we should have a constraint that applies to all bitstreams that requires that the bitstream must have at least one picture that is in an output layer that has pic\_output\_flag equal to 1.

AHG Recommendation (sensibility constraint): Require that the bitstream shall contain at least one picture with pic\_output\_flag equal to 1 that is in an output layer.

1. In the PTL syntax structure, change the signalling of sublayer\_level\_idc[ i ] to be in descending order of i, i.e., from the maxNumSubLayersMinus1 − 1 to 0, inclusive. (S0203 aspect 1, S0207)

This is for semantics purposes, so that the syntax order would be the same order as the inference dependency order.

AHG Recommendation (cleanup): Adopt, together with the next item.

1. In the PTL syntax structure, change the signalling of ptl\_sublayer\_level\_present\_flag[ i ] to be in descending order of i. (S0203 aspect 2)

This would match the order for item 37 and was agreed; see the notes for that item.

1. In the PTL syntax structure, move the sub-profile fields to be immediately before general\_level\_idc, which saves two lines of syntax, "if( profileTierPresentFlag ) {" and "}". (S0216)

It was commented that the general PTL info is the most important to systems and decoders and should be kept together, so no action was recommended on this.

1. Add an inference rule: When not present, ph\_poc\_msb\_cycle\_present\_flag is inferred to be equal to 0. (S0239 late, bug ticket #1118)

It was commented that we could either do this inference or avoid using the flag when it is not present.

AHG Recommendation (editorial bug fix/expression of existing intent): either infer ph\_poc\_msb\_cycle\_present\_flag to be equal to 0 when it is not present or avoid referring to the flag when it is not present.

[JVET-S0052](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10174) AHG9: Removing separate colour plane coding from VVCv1 [Y.-K. Wang, Z. Deng (Bytedance), J. Boyce (Intel)]

[JVET-S0056](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10178) AHG9: On field coding [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-S0075](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10197) AHG9: On constraints and inference values when VPS is not present [Hendry, S. Paluri, S. Kim (LGE)]

Aspect 1 of this contribution belongs to this category.

[JVET-S0077](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10199) AHG9: On derivation of PictureOutputFlag for RASL [Hendry, H. Jang, J. Nam, S. Paluri, S. Kim, J. Lim (LGE)]

[JVET-S0078](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10200) AHG9: On derivation of NoOutputOfPriorPicsFlag [Hendry, S. Paluri, S. Kim (LGE)]

[JVET-S0081](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10203) AHG9: On non-referenced picture and POC derivation [Hendry, H. Jang, J. Nam, S. Kim, J. Lim (LGE)]

[JVET-S0084](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10206) AHG9: On RPL constraint of RADL picture [Hendry (LGE)]

[JVET-S0110](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10232) AHG9: On HLS Editorial cleanup [Y. He, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

Aspect 1 of this contribution belongs to this category.

[JVET-S0087](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10209) AHG9: On target OLS and sublayers for decoding [M. M. Hannuksela (Nokia)]

[JVET-S0103](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10225) AHG9: On OLS identification [R. Skupin, Y. Sanchez, K. Suehring, T. Schierl (HHI)]

Aspect 1 of this contribution belongs to this category.

[JVET-S0104](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10226) AHG9: On DRAP output [Y. Sanchez, R. Skupin, K. Suehring, T. Schierl (HHI)]

[JVET-S0109](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10231) AHG9: Signalling of picture rate [B. Heng, W. Wan (Broadcom)]

[JVET-S0114](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10236) AHG9: On GDR RPL constraint [Y. He, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-S0124](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10246) AHG9: On unavailable reference pictures [V. Seregin, Y. He, M. Coban, A. K. Ramasubramonian, M. Karczewicz (Qualcomm)]

[JVET-S0128](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10250) AHG12: On entry point signalling [M. Coban, V. Seregin, Y. He, Y.-J. Chang, M. Karczewicz (Qualcomm)]

[JVET-S0155](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10277) AHG9: On EOS NAL units [Y.-K. Wang, Z. Deng (Bytedance)]

[JVET-S0174](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10296) AHG9: Miscellaneous cleanups [R. Skupin, Y. Sanchez, K. Suehring, T. Schierl (HHI)]

Aspect 2 of this contribution belongs to this category.

[JVET-S0156](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10278) AHG9: On level definitions and bitstream conformance [Y.-K. Wang, Z. Deng (Bytedance)]

[**JVET-S0160**](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10282) **AHG9/AHG12/AHG8: Miscellaneous HLS cleanups [Y.-K. Wang, Z. Deng, L. Zhang, K. Zhang (Bytedance)]**

Aspects 5, 6, 8, and 9 of this contribution belong to this category.

[JVET-S0163](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10285) AHG9: On target OLS and sublayers for decoding [M. M. Hannuksela (Nokia), R. Skupin (HHI), Hendry (LG Electronics), B. Choi (Tencent)]

[JVET-S0167](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10289) AHG9: Constraints on reference picture lists of a RADL picture [L. Chen, S.-T. Hsiang, C.-W. Hsu, O. Chubach, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-S0168](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10290) AHG9: On GDR subpictures for sub-bitstream extraction [L. Chen, C.-Y. Chen, C.-W. Hsu, O. Chubach, S.-T. Hsiang, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-S0188](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10310) AHG9: On gradual decoding refresh [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-S0192](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10314) AHG9: On reference picture list with generating unavailable reference picture [B. Choi, S. Wenger, S. Liu (Tencent)]

Aspect 1 of this contribution belongs to this category.

[JVET-S0091](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10213) AHG8/AHG9: On constraints of still picture [K. Abe, T. Nishi, T. Toma, V. Drugeon (Panasonic)]

Aspect 1 of this contribution belongs to this category.

[JVET-S0202](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10324) AHG9: On Still Picture Profile and multi layers aspect [H. Jang, Hendry, J. Nam, N. Park, S. Paluri, S. Kim, J. Lim (LGE)]

[JVET-S0203](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10325) AHG9: On signalling of sublayer level idc [Hendry (LGE)]

[JVET-S0207](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10329) AHG9: Order of the sublayer\_level\_idc[ i ] syntax elements [Z. Zhang, R. Sjöberg, M. Pettersson, M. Damghanian, J. Ström (Ericsson)]

[JVET-S0216](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10338) AHG9: Parsing order of profile\_tier\_level( ) [K. Naser, F. Le Leannec, T. Poirier, M. Kerdranvat (InterDigital)]

[JVET-S0239](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10361) AHG9: Clean-up on derivation of POC [N. Park, Hendry, J. Nam, H. Jang, J. Lim, S. Kim(LGE)] [late]

[JVET-S0241](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10363) AHG9: On signalling of POC MSB information in picture header [Hendry, H. Jang, N. Park, S. Kim, J. Lim (LGE) [late]]

### General constraints information (GCI) (25+7)

[JVET-S0138](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10260) AHG9: A summary of proposals on general constraints information [Y. He (Qualcomm), Y.-K. Wang, Z. Deng (Bytedance)]

This contribution was discussed in the HLS AHG meeting at 2110 UTC on 27 May and in the HLS AHG pre-meeting at 1900 UTC on 19 June.

This contribution provides a summary of the 31 proposals on general constraints information (GCI) (the agenda item 3.1.3 in JVET-S0137 and JVET-S0237).

It is suggested that this summary, in terms of a list of design questions, is used for the reviewing of these proposals, such that the discussions can be in a more structured and efficient manner. The following actions are proposed:

On the GCI syntax structure

1. Approaches to enable skipping all GCI syntax elements
   1. Add a presence flag for general\_constraint\_info( ) syntax structure. (S0050 #1, S0127)
      1. Infer the values of the GCI flags to 0. (S0050 #1a, S0127)
      2. Infer the values of max\_bitdepth\_constraint\_idc to 8 and the value of max\_chroma\_format\_constraint\_idc value to 3. (S0050 #1). Or infer the value of max\_bitdepth\_constraint\_idc to 2 and max\_chroma\_format\_constraint\_idc to 1. (S0127)

Editor action item: Consider the name of max\_bitdepth\_constraint\_idc to clarify its semantics.

* + 1. Move the alignment bits outside the GCI syntax structure and change the GCI reserved bytes to bits (S0050 #1b).
  1. Move the extension length indicator (gci\_num\_reserved\_bytes) from last to first (gci\_num\_constraint\_bytes) in the GCI syntax structure to enable skip all GCI SE signaling when all GCI SEs values are 0. The value of gci\_num\_reserved\_bytes shall be equal to either 0 or 9. (S0092)

It was commented, and agreed, that inference rules should not really be needed; the flags would just have semantics when they are present (just an editorial matter).

It was questioned whether people would really use the flags if they can be skipped.

It was noted that the number of flags is substantial, so having some ability to skip them is desirable.

AHG Recommendation: Agree in spirit to allow some form of skipping the GCI syntax. The exact method was agreed to be for further study to be determined later.

This was further discussed in the HLS AHG pre-meeting at 1900 UTC on 19 June after offline discussion.

A side activity had been conducted for the above. The result from that side activity was a design proposed in S0179: Signal the GCI syntax structure between the general PTL fields and sub-profile fields in the PTL syntax structure. Signal the gci\_present\_flag at the beginning of the GCI syntax structure and use it to condition the GCI fields, move the byte alignment to the end of the GCI syntax structure, and change the reserved bytes to reserved bits.

The semantics were reviewed and refined (essentially editorially) in group discussion, to be uploaded in a v2 of S0179.

AHG Recommendation (cleanup): Adopt S0179-v2.

Editor action item: The editor is requested to review the clarity of semantics for reserved syntax elements and reserved values of syntax elements, to not only prohibit use in bitstreams conforming to this version of the Specification, but also to clarify that decoders shall allow presence of reserved syntax elements and ignore values of reserved syntax elements when they are present. Where relevant, decoders shall also allow reserved values of existing syntax elements that do not affect the decoding process and picture output (e.g., transfer function and matrix coefficients) and interpret those as having an unspecified meaning, and encoders for the current version shall not use such values.

1. Categorize GCI SEs into substructures
2. Into 11 sub-structures (format, functionality, NALU, partition, pred, intra, inter, transform/quantization/residual, loop filter, layer, SEI) and add inference value in the semantics (S0105), each substructure is gated by a present flag and, when not present, the value of the corresponding constraint flag is inferred to be 0 (S0105 alt)
3. Into 3 sub-structures (capability, coding tool, NALU) (S0111)
4. Rearrange GCI SEs to put intra-related GCI flags together, and inter-related GCI flags together (S0129 #3)

Approach c was said to be essentially a subset of approach a.

AHG Recommendation: Adopt approach “a”.

It was later recommended that the order of GCI syntax elements should be aligned with the SPS syntax elements. This was included into the side activity for items 4 to 22, and the report of that side activity is in S0161 (see notes under item 4) below).

It was commented that we should not have category-wise skipping. Although some interest was expressed by a proponent, no action was recommended on that aspect.

New GCI SEs

1. Weighted prediction
2. Two GCI flag, one for each of sps\_weighted\_pred\_flag and sps\_weighted\_bipred\_flag (S0050 #2, S0105, S0131)
3. One GCI flag for both sps\_weighted\_pred\_flag and sps\_weighted\_bipred\_flag (S0058)

There are currently no weighted prediction constraint flags.

AHG Recommendation: Adopt approach “b”.

1. no\_virtual\_boundaries\_constraint\_flag to constrain sps\_virtual\_boundaries\_enabled\_flag (S0050 #2, S0105, S0131)

AHG Recommendation: J. Boyce was asked to coordinate further study offline and make a recommendation for items 4-22.

The side activity also included an effort trying to align the order of GCI syntax elements with the SPS syntax elements, related to item 2) above.

The outcome of the side activity was included in S0161.

This was further discussed in the HLS AHG pre-meeting at 1930 UTC on 19 June after offline discussion.

Additional recommendations in S0161 included the following:

* 1. Remove any constraints that existing constraint flags impose on other constraint flags (as previously agreed)
  2. Rename max\_bitdepth\_constraint\_idc to max\_bitdepth\_minus8\_constraint\_idc (a matter of editorial clarity)
  3. Remove no\_aps\_constraint\_flag (since there are already constraint flags for each tool that uses an APS and since the flag only controlled presence within the bitstream without controlling presence by external means, which is hard to control).

An alternative is proposed in S0073-v2 aspect 1 option 1, which disables presence in the bitstream and also disables the use of any APS references. It was commented that S0050 item 5 proposes the same modification.

AHG Recommendation (cleanup): Adopt S0161 except additional recommendation “c”, for which we instead adopt S0073-v2 aspect 1 option 1 and editorial recommendation “b”.

There was further discussion of general\_non\_packed\_constraint\_flag and general\_non\_‌projected\_‌constraint\_‌flag. It was suggested to either move them to VUI or move them outside the GCI structure.

AHG Recommendation (cleanup): Move general\_non\_packed\_constraint\_flag and general\_non\_‌projected\_‌constraint\_‌flag to the VUI. After the general\_interlaced\_source\_flag.

There was further discussion of single\_layer\_constraint\_flag. It was suggested to just remove the flag. Another suggestion was to move it outside the GCI structure into the PTL structure.

It was noted that the value of the VPS ID being 0 is another clear indication of a lack of layering usage, and those are observable in the bitstream earlier than the PTL information. Another suggestion was to have a no\_vps\_nal\_unit\_constraint\_flag.

Revisit.

1. no\_explicit\_scaling\_list\_constraint\_flag/no\_scaling\_list\_constraint\_flag to constrain
2. sps\_explicit\_scaling\_list\_enabled\_flag shall be equal to 0 (S0050 #2, S0058 S0066, S0067, S0105)
3. and aps\_params\_type shall not be equal to 2 (S0066)
4. no\_mtt\_constraint\_flag to constrain SPS MTT SEs sps\_max\_mtt\_hierarchy\_depth\_intra\_slice\_luma, sps\_max\_mtt\_hierarchy\_depth\_inter\_slice and sps\_max\_mtt\_hierarchy\_depth\_intra\_slice\_chroma (S0058)
5. max\_luma\_transform\_size\_32\_constraint\_flag or no\_luma\_transform\_size\_64\_constraint\_flag to constrain sps\_max\_luma\_transform\_size\_64\_flag (S0058, S0066)
6. no\_long\_term\_ref\_pic\_constraint\_flag to constrain sps\_long\_term\_ref\_pics\_flag (S0058)
7. max\_log2\_ctu\_size\_constraint\_idc (u(2)) to constrain sps\_log2\_ctu\_size\_minus5 (S0066)
8. max\_layers\_constraint\_idc to constrain vps\_max\_layers\_minus1 (S0113)
9. max\_sublayers\_constraint\_idc to constrain vps\_max\_sublayers\_minus1 (S0113)
10. max\_subpics\_constraint\_idc to constrain sps\_num\_subpics\_minus1 (S0113)
11. no\_pic\_partition\_constraint\_flag to constrain pps\_no\_pic\_partition\_flag (S0113)
12. no\_rectangular\_slice\_constraint\_flag to constrain pps\_rect\_slice\_flag (S0113)
13. one\_slice\_per\_subpicture\_constraint\_flag to constrain pps\_single\_slice\_per\_subpic\_flag (S0113)
14. no\_conformance\_window\_constraint\_flag to contrain sps\_conformance\_window\_flag (S0131)
15. general\_single\_ols\_per\_layer\_set\_constraint\_flag to constraint no two OLSs contain the same layer set (S0103#2)
16. no\_scalability\_constraint\_flag to constraint scalable and layered coding (S0105)
17. no\_360\_video\_constraint\_flag to constrain sps\_ref\_wraparound\_enabled\_flag, and equirectangular projection SEI messages or generalized cubemap projection SEI messages (S0105)
18. lossless\_coding\_constraint\_flag to constrain all picture are losslessly coded (S0054 #8)
19. no\_scc\_constraint\_flag to constrain sps\_ibc\_enabled\_flag, sps\_bdpcm\_enabled\_flag and sps\_palette\_enabled\_flag (S0105)
20. no\_VUI\_constraint\_flag to constrain sps\_vui\_parameters\_present\_flag (S0113)
21. SEI related new GCI flags
22. no\_scalable\_nesting\_SEI\_constraint\_flag to constrain scalable nesting SEI (S0105)
23. no\_subpic\_level\_SEI\_constraint\_flag to constrain subpicture level SEI (S0105)
24. no\_filler\_payload\_SEI\_constraint\_flag to constrain filler payload SEI (S0105)
25. no\_user\_data\_reg\_SEI\_constraint\_flag to constrain user data registered by Recommendation ITU T.35 SEI (S0105)
26. no\_user\_data\_unreg\_SEI\_constraint\_flag to constrain data unregistered SEI (S0105)
27. no\_film\_grain\_SEI\_constraint\_flag to constrain film grain characteristics SEI (S0105)
28. no\_parameter\_set\_incl\_SEI\_constraint\_flag to constrain parameter sets inclusion indication SEI (S0105)
29. no\_decoded\_picture\_hash\_SEI\_constraint\_flag to constrain decoded picture hash SEI (S0105)
30. no\_mcdv\_SEI\_constraint\_flag to constrain mastering display colour volume SEI (S0105)
31. no\_cll\_SEI\_constraint\_flag to constrain content light level SEI (S0105)
32. no\_drap\_sei\_constraint\_flag to constrain DRAP indication SEI (S0105, S0113)
33. no\_alt\_transfer\_char\_SEI\_constraint\_flag to constrain alternative transfer characteristics SEI (S0105)
34. no\_ambient\_view\_envir\_SEI\_constraint\_flag to constrain ambient viewing environment SEI (S0105)
35. no\_ccv\_SEI\_constraint\_flag to constrain content colour volume SEI (S0105)
36. no\_omni\_video\_SEI\_constraint\_flag to constrain ERP, GCMP, sphere rotation, region-wise packing and omnidirectional viewport SEI (S0105, S0113)
37. no\_field\_frame\_SEI\_constraint\_flag to constrain frame-field information SEI (S0105)
38. no\_sar\_SEI\_constraint\_flag to constrain sample aspect ratio SEI (S0105)
39. general\_non\_HRD\_constraint\_flag to constrain BP, PT and DU SEI (S0113)

No action was recommended on these SEI-message-related constraints.

GCI SEs syntax/semantics changes and constraining GCI and non-GCI SE values based on values of GCI SEs: Subpicture, slices, and tiles related

1. When one\_tile\_per\_pic\_constraint\_flag is equal to 1, NumTilesInPic shall be equal to 1. (S0050 #3b)

This proposal seemed editorial.

Editor action item: Check/clarify as appropriate.

1. When one\_subpic\_per\_pic\_constraint\_flag is equal to 1,
2. sps\_num\_subpics\_minus1 shall be equal to 0. (S0050 #3c, S0112)

Aspect “a” seemed editorial.

Editor action item: Check/clarify aspect “a” as appropriate.

1. sps\_subpic\_info\_present\_flag shall be equal to 0. (S0105)

It was commented that aspect “b” would interfere with some BEAM usage involving the sh\_subpic\_id, so no action was recommended on that.

1. no\_mixed\_nalu\_types\_in\_pic\_constraint\_flag shall be equal to 1 (S0054 #3, S0106 #5, S0112, S0131)

Some reluctance was expressed for aspect “c” in regard to BEAM. We often allow tools to be not used without requiring associated constraint flags to be equal to 1, so no action was recommended on that.

It was noted that the software has some configuration issues for the constraint flags, such that it tends to set the constraint flags whenever some feature is not being used. This could cause splicing/concatenation problems. The software coordinator suggested to have configuration support for multiple modes for these flags in the software – e.g. a) set the flag if the feature is disabled, b) explicitly control the value of the flag. Volunteers for this software work were solicited.

1. When one\_slice\_per\_pic\_constraint\_flag is equal to 1, pps\_rect\_slice\_flag shall be equal to 1. (S0050#5c, S0106 #6)

Such a change did not seem necessary, so no action was recommended on this.

1. When one\_slice\_per\_pic\_constraint\_flag is equal to 1, pps\_num\_slices\_in\_pic\_minus1 shall be equal to 0. (S0050#5c)

Such a change did not seem necessary, so no action was recommended on this.

Editor action item: Consider clarifying semantics – e.g., when pps\_rect\_slice\_flag is 1, then pps\_num\_slices\_in\_pic\_minus1 needs to be equal to 0 (which is already required).

1. When one\_tile\_per\_pic\_constraint\_flag and one\_slice\_per\_pic\_constraint flag are both equal to 1, the value of pps\_no\_pic\_partition\_flag shall be equal to 1. (S0050 #5, S0112)

Such a change did not seem necessary, so no action was recommended on this.

GCI SEs syntax/semantics changes and constraining GCI and non-GCI SE values based on values of GCI SEs: Single-layer, single-picture related

1. Change the semantics of single\_layer\_constraint\_flag equal to 1 from "single\_layer\_constraint\_flag equal to 1 specifies that sps\_video\_parameter\_set\_id shall be equal to 0" to one of the following: (S0090)
2. Option 1: single\_layer\_constraint\_flag equal to 1 specifies that one of the following conditions shall be fulfilled (1) sps\_video\_parameter\_set\_id is equal to 0; (2) The value of vps\_max\_layers\_minus1 in the referred VPS is equal to 0 and all VCL NAL units in the CVS have the same value of nuh\_layer\_id.
3. Option 2: single\_layer\_constraint\_flag equal to 1 specifies that all VCL NAL units in the CVS shall have the same value of nuh\_layer\_id.

Currently this flag can only be set to 1 if there is no VPS. These proposals allow it to be set to 1 under additional circumstances. Option 2 fits the name of the flag, but there was the question of what is the intent for the use of the flag. Is it for not using the VPS or is it for just indicating having one layer? Some participants said the intent for adoption of the flag was consistent with option 2.

AHG Recommendation: Adopt option 2.

1. When single\_layer\_constraint\_flag is equal to 1, all\_layers\_independent\_constraint\_flag shall be equal to 1. (S0050 #4, S0054 #6)

Such a change did not seem necessary, so no action was recommended on this.

1. When general\_one\_picture\_only\_constraint\_flag is equal to 1,
2. no\_mixed\_nalu\_types\_in\_pic\_constraint\_flag shall be equal to 1 (S0050 #4)
3. no\_trail\_constraint\_flag shall be equal to 1 (S0050 #4, S0054 #5)
4. no\_stsa\_constraint\_flag shall be equal to 1 (S0050 #4, S0054 #5)
5. no\_rasl\_constraint\_flag shall be equal to 1 (S0050 #4, S0054#5)
6. no\_radl\_constraint\_flag shall be equal to 1 (S0050 #4, S0054 #5)

The first picture in the bitstream needs to be IRAP or GDR.

In the current draft, we cannot indicate conformance to the Main 10 Still Picture profile without sending the constraint flag. There is also a max dec pic buffering issue.

In HEVC, the Main Still Picture profile has its own value of profile\_idc, and there were profile compatibility flags, which are not present in VVC.

AHG Recommendation: Use a different profile\_idc for Main 10 Still Picture (we already require Main 10 profile decoders to decode such bitstreams). Do not require the constraint flag to be 1 as part of the profile definition.

It was asked whether we need the general\_one\_picture\_only\_constraint\_flag.

Further study was recommended to study the final signalling relationship for the still picture profile(s).

It was noted that there is also a proposal S0129 to have a one-picture-only indication in the SPS.

It was commented that all expressed constraints on the values of GCI flags should be removed, as these should just be specified with one-way meaning.

AHG Recommendation: Remove all constraints that require GCI flags to be equal to a value that imposes a constraint.

AHG discussion for Sessions 1-8 stopped here 2315 UTC Wednesday 27 May.

AHG discussion for Sessions 11-12 started here 20:40 UTC Friday 19 June.

GCI SEs syntax/semantics changes and constraining GCI and non-GCI SE values based on values of GCI SEs: Intra only related

1. When intra\_only\_constraint\_flag is equal to 1,
2. all\_layers\_independent\_constraint\_flag shall be equal to 1 (S0050 #4, S0106 #4. S0112)
3. no\_ref\_pic\_resampling\_constraint\_flag shall be equal to 1 (S0050 #4, S0112, S0131)
4. no\_res\_change\_in\_clvs\_constraint\_flag shall be equal to 1 (S0050 #4)
5. no\_sbt\_constraint\_flag shall be equal to 1 (S0050 #4, S0060, S0106 #1, S0112, S0129 #3, S0131)
6. no\_trail\_constraint\_flag shall be equal to 1 (S0106 #2, S0112)
7. no\_stsa\_constraint\_flag shall be equal to 1 (S0106 #2, S0112)
8. no\_rasl\_constraint\_flag shall be equal to 1 (S0106 #2, S0112)
9. no\_radl\_constraint\_flag shall be equal to 1 (S0106 #2, S0112)
10. no\_cra\_constraint\_flag shall be equal to 1 (S0106 #3)
11. no\_gdr\_constraint\_flag shall be equal to 1 (S0106 #3)
12. no\_idr\_constraint\_flag shall be equal to 0 (S0106 #3)
13. no\_mixed\_nalu\_types\_in\_pic\_constraint\_flag shall be equal to 1 (S0112)
14. sps\_weighted\_pred\_flag shall be equal to 0. (S0061)
15. sps\_weighted\_bipred\_flag shall be equal to 0. (S0061)
16. sps\_long\_term\_ref\_pics\_flag shall be equal to 0. (S0061)
17. sps\_inter\_layer\_ref\_pics\_present\_flag shall be equal to 0. (S0061)
18. sps\_idr\_rpl\_present\_flag shall be equal to 0. (S0061)
19. sps\_rpl1\_same\_as\_rpl0\_flag shall be equal to 0. (S0061)
20. sps\_num\_ref\_pic\_lists[ i ] shall be equal to 0. (S0061)
21. sps\_sbtmvp\_enabled\_flag shall be equal to 0. (S0061)
22. sps\_six\_minus\_max\_num\_merge\_cand shall be equal to 0. (S0061)
23. sps\_log2\_parallel\_merge\_level\_minus2 shall be equal to 0. (S0061)
24. sps\_explicit\_mts\_inter\_enabled\_flag shall be equal to 0. (S0061)
25. pps\_rpl1\_idx\_present\_flag shall be equal to 0 (S0061)
26. pps\_rpl\_info\_in\_ph\_flag shall be equal to 0 (S0061)
27. pps\_ref\_wraparound\_enabled\_flag shall be equal to 0 (S0061)
28. pps\_output\_flag\_present\_flag shall be equal to 0 (S0112)
29. ph\_pic\_output\_flag shall be equal to 1 (S0112)
30. ph\_inter\_slice\_allowed\_flag shall be equal to 0 (S0061, S0112)
31. ph\_non\_ref\_pic\_flag shall be equal to 1 (S0112)

No action on a-l, per previous discussions about constraining constraint flags. For the others, it was commented that it is desirable to be able to extract all the I pictures from a bitstream and set the intra\_only\_constraint\_flag to 1 without needing to rewrite headers. No action was recommended for this, to avoid the need for header rewriting just to avoid constraint violations.

GCI SEs syntax/semantics changes and constraining GCI and non-GCI SE values based on values of GCI SEs: Random access related

1. When no\_cra\_constraint\_flag is equal to 1, no\_rasl\_constraint\_flag shall be equal to 1. (S0054 #4, S0112)

No action, per previous discussions about constraining constraint flags.

1. When no\_idr\_constraint\_flag is equal to 1 and no\_cra\_constraint\_flag is equal to 1, no\_radl\_constraint\_flag shall be equal to 1. (S0054 #4)

No action, per previous discussions about constraining constraint flags.

1. At least one of the no\_gdr\_constraint\_flag, no\_idr\_constraint\_flag, and no\_cra\_constraint\_flag shall be equal to 0. (S0050 #5, S0112)

No action, per a general desire to avoid constraining constraint flags.

GCI SEs syntax/semantics changes and constraining GCI and non-GCI SE values based on values of GCI SEs: APS related

1. When no\_alf\_constraint\_flag is equal to 1, aps\_params\_type shall not be equal to 0. (S0066)

No action was recommended on this, as it would prohibit presence of non-referenced APSs (which could, e.g., be referenced in a later CVS).

1. When no\_lmcs\_constraint\_flag equal to 1, aps\_params\_type shall not be equal to 1. (S0066)

No action was recommended on this, as it would prohibit presence of non-referenced APSs (which could, e.g., be referenced in a later CVS).

1. When no\_aps\_constraint\_flag is equal to 1,
2. no\_lmcs\_constraint\_flag shall be equal to 1. (S0050 #4, S0067#1, S0105)
3. no\_ccalf\_constraint\_flag shall be equal to 1. (S0050 #4)
4. no\_explicit\_scaling\_list\_constraint\_flag shall be equal to 1. (S0050 #4, S0067 #2, S0105)
5. sps\_ccalf\_enabled\_flag, ph\_num\_alf\_aps\_ids\_luma, ph\_alf\_cb\_flag, ph\_alf\_cr\_flag, sh\_num\_alf\_aps\_ids\_luma, sh\_alf\_cb\_flag, and sh\_alf\_cr\_flag all be equal to 0. (S0050 #5, S0073 #1.1)
6. (alternative to 38.d and 38.f) sps\_chroma\_alf\_enabled\_flag (newly added as part of this item), sps\_chroma\_alf\_enabled\_flag and sh\_num\_alf\_aps\_ids\_luma shall be equal to 0 (S0073 #1.2)
7. (alternative to 38.d and 38.e) sps\_alf\_enabled\_flag and sps\_ccalf\_enabled\_flag shall both be equal to 0 (S0073 #1.3)

No additional action was needed on this, per previous discussions about constraining constraint flags and per action recommended earlier for sub-item d as noted elsewhere in the notes.

GCI SEs syntax/semantics changes and constraining GCI and non-GCI SE values based on values of GCI SEs: Video format related

1. The value of the u(4)-coded max\_bitdepth\_minus8\_constraint\_idc shall be in the range of 0 to 8, inclusive. (S0046 #1, S0050 #3a).

AHG Recommendation (sensibility constraint): Adopt.

1. When max\_chroma\_format\_constraint\_idc is equal to 0, no\_chroma\_qp\_offset\_constraint\_flag shall be equal to 1. (S0046 #3, S0060, S0112, S0131).

No action, per previous discussions about constraining constraint flags.

1. When max\_chroma\_format\_constraint\_idc is equal to 0, no\_act\_constraint\_flag shall be equal to 1. (S0131)

No action, per previous discussions about constraining constraint flags.

GCI SEs syntax/semantics changes and constraining GCI and non-GCI SE values based on values of GCI SEs: Others

1. When no\_ref\_pic\_resampling\_constraint\_flag to 1, no\_res\_change\_in\_clvs\_constraint\_flag shall be equal to 1. (S0054 #7, S0105, S0112, S0131)

No action, per previous discussions about constraining constraint flags.

1. When no\_transform\_skip\_constraint\_flag is equal to 1, no\_bdpcm\_constraint\_flag shall be equal to 1. (S0050 #4, S0059, S0069#1, S0105, S0112, S0131)

No action, per previous discussions about constraining constraint flags.

1. When no\_affine\_motion\_constraint\_flag is equal to 1, no\_prof\_constraint\_flag shall be equal to 1. (S0046 #2, S0112, S0131)

No action, per previous discussions about constraining constraint flags.

1. When all\_layers\_independent\_constraint\_flag is equal to 1, the value of sps\_inter\_layer\_ref\_pics\_present\_flag shall be equal to 0. (S0050 #5)

It was noted that this constraint already expressed (indirectly), so no action was needed on this.

GCI and profiles

1. Either change general\_one\_picture\_only\_constraint\_flag to general\_one\_au\_only\_constraint\_flag. (S0091 #1) or remove general\_one\_picture\_only\_constraint\_flag (S0160 #7)

It was noted that a profile\_idc value already indicates one picture only.

It was commented that extraction from a Main profile bitstream might be a potential use of the flag.

Revisit after consideration of proposals to change the Still Picture profile.

1. Constrain the values of max\_chroma\_format\_constraint\_idc and max\_bitdepth\_constraint\_idc in main 10 profile. (S0094)

It was noted that these syntax elements are defined in a backwards way from the way other constraints are expressed.

AHG Recommendation (consistency cleanup): Make the maximum bit depth to be 16 − max\_bitdepth\_‌constraint\_idc and the maximum chroma format be 3 − max\_chroma\_format\_constraint\_idc.

No other action on this.

GCI editorial changes

Editor action item: The editor is asked to consider the below suggestions.

1. Rename "max\_bitdepth\_constraint\_idc" to "max\_bitdepth\_minus8\_constraint\_idc". (S0105)

No action on this per the decision on the previous item.

1. Rename "general\_non\_packed\_constraint\_flag" to "general\_non\_packed\_SEI\_constraint\_flag", and "general\_non\_projected\_constraint\_flag" to "general\_non\_projected\_SEI\_constraint\_flag". (S0105)

No action (capital letters, not very necessary, being moved anyway).

1. Move the constraint "When general\_frame\_only\_constraint\_flag is equal to 1, the value of sps\_field\_seq\_flag shall be equal to 0" from SPS semantics to GCI semantics (S0054 #1, S0105, S0209 #2) and/or rename general\_frame\_only\_constraint\_flag" to "no\_field\_seq\_constraint\_flag" and change the semantics to constrain sps\_field\_seq\_flag (S0195 #2).
2. Move the constraint "When no\_mixed\_nalu\_types\_in\_pic\_constraint\_flag is equal to 1, the value of pps\_mixed\_nalu\_types\_in\_pic\_flag shall be equal to 0" from PPS semantics to GCI semantics. (S0054 #2, S0209 #2)
3. Replace the while-loop for GCI byte alignment with 6 zero-valued bits. (S0209 #3)
4. Prefix all syntax elements in the general constraint information with 'gci\_'. (S0209 #4)

New submissions (for the June 10th submission deadline) on adding new GCI fields, or removing or changing existing GCI fields

1. Add a "no\_ts\_rrc\_constraint\_flag" (S0238 late)

This was not just an editorial proposal. The prior related flag had been agreed to be removed in earlier discussion. The proposal suggested to add a flag to require sh\_tsrc\_disabled\_flag to be equal to 0. The CTC use would match this flag being 1.

It was commented that this does not constrain a tool but rather a combination. The regular residual coding would still be present in the decoder.

No action was recommended on this.

1. Remove general\_non\_packed\_constraint\_flag and general\_non\_projected\_constraint\_flag (S0195 #1)

See notes elsewhere, agreeing to move these flags.

1. Add new GCI flags
   1. no\_subpic\_info\_constraint\_flag to constrain sps\_subpic\_info\_present\_flag (S0195 #3)
   2. no\_idr\_rpl\_constraint\_flag to constrain sps\_idr\_rpl\_present\_flag (S0195 #3)
   3. no\_hrd\_constraint\_flag to constrain vps\_general\_hrd\_params\_present\_flag and sps\_general\_hrd\_params\_present\_flag (S0195 #3)
   4. no\_bidirectional\_prediction\_constraint\_flag to constrain pps\_rpl1\_idx\_present\_flag and num\_ref\_entries[ 1 ][ rplsIdx ] (S0209 #1)
   5. no\_parallel\_merge\_constraint\_flag to constrain sps\_log2\_parallel\_merge\_level\_minus2 (S0209 #1)
   6. no\_switchable\_cabac\_init\_constraint\_flag to constrain pps\_cabac\_init\_present\_flag (S0209 #1)
   7. no\_entropy\_coding\_sync\_constraint\_flag to constrain sps\_entropy\_‌coding\_sync\_enabled\_flag (S0230)

J. Boyce was asked to coordinate offline study of these proposals for revisit during the main meeting.

[JVET-S0046](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10168) AHG9: General constraint information semantics constraints [R. Yu, M. Pettersson, R. Sjöberg, M. Damghanian, J. Enhorn, Z. Zhang, J. Ström, D. Liu (Ericsson)]

[JVET-S0050](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10172) AHG9: On general constraints information [Z. Deng, Y.-K. Wang, L. Zhang, K. Zhang, K. Fan (Bytedance)]

[JVET-S0054](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10176) AHG9: Clean-ups on general constraint flags [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-S0058](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10180) AHG9: Additional General Constraint Flags [K. Naser, F. Le Leannec, T. Poirier, P. de Lagrange (InterDigital)]

[JVET-S0059](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10181) AHG9: Fixing the Semantics of no\_bdpcm\_constraint\_flag [K. Naser, F. Le Leannec, T. Poirier, P. de Lagrange (InterDigital)]

[JVET-S0060](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10182) AHG9: Fixing the Semantics of no\_chroma\_qp\_offset\_constraint\_flag and no\_sbt\_constraint\_flag [K. Naser, F. Le Leannec, T. Poirier, P. de Lagrange (InterDigital)]

[JVET-S0061](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10183) AHG9: HLS Cleanup of All-Intra Profile [K. Naser, F. Le Leannec, T. Poirier, P. de Lagrange (InterDigital)]

[JVET-S0066](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10188) AHG9: On constraint flags [C. Rosewarne, J. Gan (Canon)]

[JVET-S0067](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10189) AHG9: General constraint information on features using APS [S.-T. Hsiang, O. Chubach, L. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-S0069](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10191) AHG9: General constraint information on features related to transform skip mode [S.-T. Hsiang, O. Chubach, L. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

Aspect 1 of this contribution belongs to this category.

[JVET-S0073](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10195) AHG9: Bug-fix of the constraint flag of VVC [M. G. Sarwer, Y. Ye (Alibaba)]

Aspect 1 of this contribution belongs to this category.

[JVET-S0090](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10212) AHG8/AHG9: On single\_layer\_constraint\_flag [K. Abe, T. Nishi, T. Toma, V. Drugeon (Panasonic)]

[JVET-S0091](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10213) AHG8/AHG9: On constraints of still picture [K. Abe, T. Nishi, T. Toma, V. Drugeon (Panasonic)]

Aspect 2 of this contribution belongs to this category.

[JVET-S0092](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10214) On constraint info signalling [J. Samuelsson, S. Deshpande, A. Segall (Sharp)]

[JVET-S0094](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10216) AHG9: Profile-level constraints on chroma format and bit depth constraint flags [K. Sharman, S. Keating, A. Browne (Sony)]

[JVET-S0103](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10225) AHG9: On OLS identification [R. Skupin, Y. Sanchez, K. Suehring, T. Schierl (HHI)]

Aspect 2 of this contribution belongs to this category.

[JVET-S0105](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10227) AHG9: Modification of general constraint information [S. McCarthy, P. Yin, T. Lu, F. Pu, W. Husak, T. Chen (Dolby)]

All aspects other than the aspect on changing the semantics of no\_tsrc\_constraint\_flag belong to this category.

[JVET-S0106](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10228) AHG9: Some cleanups on general constraint flags [G. Laroche, N. Ouedraogo, P. Onno (Canon)]

[JVET-S0111](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10233) AHG9: On GCI syntax structure [Y. He, Y.-J. Chang, N. Hu, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-S0112](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10234) AHG9: On GCI semantic constraints [Y. He, N. Hu, Y.-J. Chang, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-S0113](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10235) AHG9: On new GCI flags [Y. He, Y.-J. Chang, N. Hu, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-S0127](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10249) AHG9: On general constraint info signalling [M. Coban, V. Seregin, Y. He, Y.-J. Chang, M. Karczewicz (Qualcomm)]

[**JVET-S0129**](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10251) **AHG9: cleanup on parameter sets and GCI [L. Li, X. Li, B. Choi, S. Wenger, S. Liu (Tencent)]**

Aspect 3 of this contribution belongs to this category.

[JVET-S0131](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10253) AHG9: On general constraint information syntax [H.-J. Jhu, X. Xiu, Y.-W. Chen, T.-C. Ma, X. Wang (Kwai Inc.)]

[**JVET-S0160**](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10282) **AHG9/AHG12/AHG8: Miscellaneous HLS cleanups [Y.-K. Wang, Z. Deng, L. Zhang, K. Zhang (Bytedance)]**

Aspect 7 of this contribution belongs to this category.

[JVET-S0161](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10283) AHG9: Report of side activity on GCI syntax elements [J. Boyce]

[JVET-S0179](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10301) AHG9: On conditional signalling of GCI fields [Y.-K. Wang, L. Zhang, Z. Deng, K. Zhang, K. Fan (Bytedance), J. Samuelsson, S. Deshpande, A. Segall (Sharp), M. Coban, V. Seregin, Y. He, Y.-J. Chang, M. Karczewicz (Qualcomm), Hendry, J. Nam (LGE), S. Wenger, B. Choi (Tencent), M. Zhou (Broadcom)]

[JVET-S0195](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10317) AHG9: On GCI cleanups [Y. He, Y.-J. Chang, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-S0209](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10331) AHG9: On General Constraint Information [M. Pettersson, R. Yu, R. Sjöberg, M. Damghanian, J. Enhorn, J. Ström, D. Liu (Ericsson)]

[JVET-S0230](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10352) AHG9: New GCI flag [T. Ikai (Sharp)]

[JVET-S0238](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10360) AHG9: GCI for RRC [K. Naser, F. Le Leannec, T. Poirier, P. de Lagrange (InterDigital)] [late]

### SPS, PPS, and APS cleanups (9+8)

[JVET-S0142](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10264) AHG9: A summary of proposals on SPS, PPS, and APS cleanups [Hendry (LGE)]

This contribution was discussed in the HLS AHG meeting at 2330 UTC on Wednesday 27 May and in the HLS AHG pre-meeting at 2225 UTC on 19 June.

This contribution provides a summary of the 16 proposals on SPS, PPS, and APS cleanups (the agenda item 3.1.4 in JVET-S0137 and JVET-S0237).

It is suggested that this summary, in terms of a list of design questions, is used for the reviewing of these proposals, such that the discussions can be in a more structured and efficient manner. The following changes are proposed:

1. It is asserted that when extension\_flag in DCI, VPS, SPS, PPS, or APS is equal to 1, it is allowed that no extension\_data\_flag syntax elements be present. The following options for change are proposed (JVET-S0042)
   1. Option 1: When an extension\_flag in DCI, VPS, SPS, PPS, or APS is equal to 1, enforce the presence of at least one extension\_data\_flag syntax element in the syntax.

From the following design in the current spec:

|  |  |
| --- | --- |
| **dci\_extension\_flag** | u(1) |
| if( dci\_extension\_flag ) |  |
| while( more\_rbsp\_data( ) ) |  |
| **dci\_extension\_data\_flag** | u(1) |

To the following:

|  |  |
| --- | --- |
| **dci\_extension\_flag** | u(1) |
| if( dci\_extension\_flag ) { |  |
| do |  |
| **dci\_extension\_data\_flag** | u(1) |
| while( more\_rbsp\_data( ) ) |  |
| } |  |

* 1. Option 2: Relax the semantics so that an extension\_flag in DCI, VPS, SPS, PPS, or APS equal to 1 specifies that specifies extension\_data\_flag syntax elements *may be* present. (Currently, it says these flags *are* present.)
  2. Option 3: Do nothing

It was commented that option 2 seems like just a better editorial expression of the what the current syntax already specifies.

AHG Recommendation (editorial clarification): Option 2.

Note: This should be also considered as an errata report for HEVC semantics clarification.

1. Rearrange some syntax elements in SPS so that the syntax elements of similar coding tools are grouped together.
   1. All of the transform related SPS syntax are placed together (JVET-S0074 aspect 1)
   2. sps\_lmcs\_enabled\_flag is signalled right after signalling of sps\_ccalf\_enabled\_flag (JVET-S0074 aspect 1)
   3. Group the dual tree related syntax elements together in the SPS (JVET-S0132 aspect 1)
   4. Rearrange the partition constraint related syntax elements in the SPS to be consistent with the ordering of the corresponding syntax elements in the picture header (PH). More specifically, group such syntax in the SPS based on whether they are intra or inter related (JVET-S0132 aspect 2)

AHG Recommendation (minor cleanup of logical syntax order): Adopt. It is also desirable to have the constraint flag order match SPS order (to be considered by J. Boyce in further study).

1. Not signalling sps\_max\_sublayers\_minus1 when sps\_ptl\_dpb\_hrd\_params\_present\_flag is equal to 0 (JVET-S0079)
   1. Move the signalling of sps\_max\_sublayers\_minus1 and sps\_reserved\_zero\_4bits immediately before the signalling of profile\_tier\_level( 1, sps\_max\_sublayers\_minus1 )
   2. Condition the presence of the two syntax elements such that they are present only when sps\_ptl\_dpb\_hrd\_params\_present\_flag is equal to 1.

The proponent reported that the sps\_max\_sublayers\_minus1 value is not actually used when sps\_ptl\_dpb\_hrd\_params\_present\_flag is equal to 0.

It was commented that there may be some interaction with other proposals or the extraction process.

It was commented that sps\_max\_sublayers\_minus1 could be useful to know even if not necessary for parsing and the decoding process.

No clear need for action was evident, so no action was recommended.

1. Add a constraint such that when sps\_video\_parameter\_set\_id is greater than 0 and vps\_all\_layers\_same\_num\_sublayers\_flag is equal to 1, the value of sps\_max\_sublayers\_minus1 shall be equal to the value of vps\_max\_sublayers\_minus1 (JVET-S0115 aspect 2).

It was commented that this had been proposed in JVET-R0125 item 2. At that time a concern had been expressed about what would happen if some sublayers are removed and the SPS is rewritten.

It has been intended that it should be allowed to removed sublayers without rewriting the VPS.

AHG Recommendation (bug fix/expression of existing intent): Change the name and semantics of vps\_all\_layers\_same\_num\_sublayers\_flag to only control VPS syntax without requiring the number of sublayers to be the same for all layers.

No action on the proposed change, due to the agreement recorded above.

1. Add new flag sps\_one\_picture\_only\_constraint\_flag and use the flag to skip signalling of some syntax elements in SPS. The skipped syntax elements include inter prediction, RPL, and POC related syntax elements in both SPS and PH (JVET-S0129 aspect 2).

It was commented that this would require PH rewriting when extracting a single picture from the bitstream (e.g., to remove RPL and POC).

Concern was expressed about POC, as we allow sending POC for IDR pictures.

A similar proposal was considered at the previous meeting, for intra-only rather than for single-picture-only. The basic issues seemed similar.

It was commented that it is an encoder choice how to set the values of non-relevant syntax elements if the bitstream will contain only intra pictures or only one picture.

No clear need for action was identified, so no action was recommended.

1. Constrain the value of pps\_alf\_info\_in\_ph\_flag to be equal to 0 when the PH is in the SH (JVET-S0049 aspect 4)

It was asked why we hadn’t already done something like this, since we did something like this for five other similar syntax elements (see the next item for a list). There had been some argument of wanting the ALF info to be early in the header. However, it was commented that the ALF info can be in the SH already.

It was noted that another proposal has this as one of two options for action (see item 9a in the S0143 summary for S0120).

AHG Recommendation (consistency/cleanup): Adopt.

1. When pps\_rect\_slice\_flag is equal to 1 and pps\_num\_slices\_in\_pic\_minus1 is equal to 0, constrain the values of the 6 PPS flags (i.e., pps\_alf\_info\_in\_ph\_flag, pps\_rpl\_info\_in\_ph\_flag, pps\_dbf\_info\_in\_ph\_flag, pps\_sao\_info\_in\_ph\_flag, pps\_wp\_info\_in\_ph\_flag, and pps\_qp\_delta\_info\_in\_ph\_flag) to be all equal to 0 (JVET-S0049 aspect 5).

The motivation / justification of the proposed changes is as follows:

* + To be better aligned with the inference of the value to 0 when pps\_no\_pic\_partition\_flag is equal to 1.
  + For more optimal syntax in the case of pps\_rpl\_info\_in\_ph\_flag or pps\_wp\_info\_in\_ph\_flag.
  + For the case of pps\_alf\_info\_in\_ph\_flag, to enable the use of ALF for the same use case that applies independent parallel encoding of different subpictures as above.

It was commented that this could require SH rewriting if there is an original bitstream and one subpicture is extracted as one picture with one slice. These flags could be in the PPS and would need to be moved to the SH.

It was commented that there is a similar issue for when pps\_no\_pic\_partition\_flag is equal to 1. However, it was commented that this flag could be set to 0.

After offline further study, the proposal was withdrawn in HLS AHG pre-meeting at 2225 UTC on 19 June.

1. Rearrange the syntax elements related to inter slices in the picture parameter set (PPS) in a similar manner as the grouping of the inter-slice related syntax elements in the PH. More specifically, group syntax elements in PPS based on whether they are intra or inter related (JVET-S0132 aspect 3).

It was commented that this change is pretty minor and logical, and this had been tested with software. See also item 2 above.

AHG Recommendation (consistency/cleanup): Adopt.

1. Currently due to existing constraints, only 3 bits out of 5 bits of APS Id are needed in current profiles. The following is proposed: split the u(5)-coded aps\_adaptation\_parameter\_set\_id into u(2)-coded aps\_reserved\_zero\_2bits followed by u(3)-coded aps\_adaptation\_parameter\_set\_id (JVET-S0049 aspect 6).

Currently we signal the APS ID first, followed by the APS type, but the value spaces for different APS types are distinct.

It was commented that in some future profile we might want a larger range of values.

It was concluded that, as proposed, this would really be only an editorial change.

No clear need for action was evident, so no action was recommended.

1. If aps\_chroma\_present\_flag is equal to 0, due to an existing constraint, alf\_luma\_filter\_signal\_flag must be equal to 1. Based on that, it is proposed that when aps\_chroma\_present\_flag is equal to 0, alf\_luma\_filter\_signal\_flag is skipped and inferred to be equal to 1. Otherwise, when alf\_chroma\_filter\_signal\_flag and alf\_cc\_cb\_filter\_signal\_flag are both equal to 0, alf\_cc\_cr\_filter\_signal\_flag is skipped and inferred to be equal to 1 (JVET-S0049 aspect 7).

No clear need for action was evident, so no action was recommended.

1. It is asserted that the memory to store APSs may exceed the max memory used to store the max number of APSs in a PU due to the fact that in a PU, prefix and suffix APS NAL units with particular APS identifier and type can have different contents. The following two constraints are proposed (JVET-S0122)
   1. In a PU, for an APS type, a signalled suffix APS shall not have the same identifier as a referenced APS.

It was commented that this topic had been raised the previous meeting.

It was commented that this depends on whether the decoding process is applied after receiving the VCL NAL units or after also receiving the suffix APS NAL units. If the picture is decoded before parsing the suffix APS NAL units, the memory of the prior APS content can be re-used in the on-chip memory.

No clear need for action was evident, so no action was recommended.

* 1. Any two suffix (prefix resp.) APS NAL units with particular APS identifier and type signalled in a PU cannot have the same APS identifier

This would disallow repetition. It was commented that such repetition is not really a problem.

No clear need for action was evident, so no action was recommended.

Review of the above items in this category completed ~0120 UTC 28 May.

Discussion resumed here in the HLS AHG pre-meeting at 2225 UTC on 19 June.

1. Allow inferring some SPS syntax elements from SPS in the reference layer. It is asserted that in HEVC such mechanism is allowed (i.e., for scaling list data structure). If we allow this mechanism, the following syntax elements are proposed to be inferred from SPS in direct reference layer (JVET-S0166):
   1. RPLs of the current SPS from the SPS referred to by the direct reference layer.
   2. Subpicture information of the current SPS from the SPS referred to by the direct reference layer

Mechanism detail: for each category of syntax elements that can be inferred, add a new flag to specify whether the syntax elements are inferred or not. If inferred, signal additional syntax element to specify the index of the direct reference layer.

Concern was expressed about introducing such a prediction across layers at this late stage.

A benefit of coding efficiency could be argued, but did not seem like an important consideration.

The proponent said the proposal might help encoders avoid conformance problems.

It was noted that SPS sharing is allowed. This would be a form of partial SPS sharing.

No action was recommended on this, to be conservative about considering late changes.

1. It is asserted that the current semantics of sps\_sublayer\_dpb\_params\_flag and vps\_sublayer\_dpb\_params\_present\_flag are inaccurate. It currently says that it control the presence of max\_dec\_pic\_buffering\_minus1[ i ], max\_num\_reorder\_pics[ i ], and max\_latency\_increase\_plus1[ i ] syntax elements. However, it actually controls the presence of those syntax elements for temporal sub-layers that are not the highest. It is proposed to change the semantics to be more accurate (JVET-S0169 aspect 1). (added or changed in **bold**)

sps\_sublayer\_dpb\_params\_flag is used to control the presence of max\_dec\_pic\_buffering\_minus1[ i ], max\_num\_reorder\_pics[ i ], and max\_latency\_increase\_plus1[ i ] syntax elements in the dpb\_parameters( ) syntax strucure in the SPS **for i in range from 0 to sps\_max\_sublayers\_minus1 − 1, inclusive, when sps\_max\_sublayers\_minus1 is larger than 0.** When not present, the value of sps\_sublayer\_dpb\_params\_flag is inferred to be equal to 0.

vps\_sublayer\_dpb\_params\_present\_flagis used to control the presence of max\_dec\_pic\_buffering\_minus1[ **j** ], max\_num\_reorder\_pics[ **j** ], and max\_latency\_increase\_plus1[ **j** ] syntax elements in the dpb\_parameters( ) syntax strucure in the VPS **for j in range from 0 to vps\_dpb\_max\_tid[ i ] − 1, inclusive, when vps\_dpb\_max\_tid[ i ] in VPS is larger than 0**. When not present, vps\_sub\_dpb\_params\_info\_present\_flag is inferred to be equal to 0.

*It is noted that j instead of i is used for specifying the range of syntax element array max\_dec\_pic\_buffering\_minus1[ ], max\_num\_reorder\_pics[ ], and max\_latency\_increase\_plus1[ ] in order to avoid confusion of the i in vps\_dpb\_max\_tid[ i ].*

It was commented that this is just editorial and should be considered by the editor.

Editor action item: The editor is asked to consider this potential clarification.

1. Move the two syntax elements (sps\_chroma\_format\_idc and sps\_log2\_ctu\_size\_minus5) to take the place of sps\_reserved\_zero\_4bits. (JVET-S0186 aspect 1)

The reserved bits were said to have been there only for byte alignment.

AHG Recommendation (cleanup): Adopt.

1. Reserve sps\_seq\_parameter\_set\_id value equal to 15 for future extensibility. Additionally, do the same for value 63 of pps\_pic\_parameter\_set\_id. (JVET-S0186 aspect 2)

No clear need for action on this seemed evident.

1. Move the location of decoded picture buffer (DPB) parameters syntax structure and hypothetical reference decoder (HRD) parameters syntax structure to directly follow sps\_ptl\_dpb\_hrd\_params\_present\_flag. (JVET-S0199).

Currently only the signalling of PTL syntax structure directly follows sps\_ptl\_dpb\_hrd\_params\_present\_flag (i.e., early in SPS), the signalling of DPB syntax structure is in the middle of SPS, and HRD syntax structure is near the end of SPS. The proposal would move DPB and HRD syntax structures to early position in the SPS.

It was commented that moving DBP and HRD syntax earlier could put it ahead of other syntax that may be more important to access from the system perspective and that saving some condition checks in the parsing is not so important, so no action was recommended on this.

1. Change the coding of syntax element sps\_log2\_transform\_skip\_max\_size\_minus2 from ue(v) to u(2). (JVET-S0204).

It was asked whether some future profile might want to allow a value greater than 3, and this seemed possible, although it was commented that such a future profile would probably have other, much more significant, changes in it.

In HEVC, RExt added larger TS block sizes without a syntax change for that, and used the same type of coding, although in the PPS rather than SPS.

It was noted that this would increase the number of bits used for coding the value 0.

Since no clear need for action was identified, no action was recommended on this.

1. Add additional conditions for the presence of the six PPS flags pps\_alf\_info\_in\_ph\_flag, pps\_rpl\_info\_in\_ph\_flag, pps\_dbf\_info\_in\_ph\_flag, pps\_sao\_info\_in\_ph\_flag, pps\_wp\_info\_in\_ph\_flag, and pps\_qp\_delta\_info\_in\_ph\_flag, as follows (S0164) (additions in *italic*):

|  |  |
| --- | --- |
| **...** |  |
| if( !pps\_no\_pic\_partition\_flag *&& ( !pps\_rect\_slice\_flag | |  pps\_single\_slice\_per\_subpic\_flag | | pps\_num\_slices\_in\_pic\_minus1 > 0 )* &&  pps\_deblocking\_filter\_override\_enabled\_flag ) |  |
| **pps\_dbf\_info\_in\_ph\_flag** | u(1) |
| if( !pps\_deblocking\_filter\_disabled\_flag ) { |  |

|  |  |
| --- | --- |
| ... |  |
| if( !pps\_no\_pic\_partition\_flag *&& ( !pps\_rect\_slice\_flag | |* *pps\_single\_slice\_per\_subpic\_flag | | pps\_num\_slices\_in\_pic\_minus1 > 0 )* ) { |  |
| **pps\_rpl\_info\_in\_ph\_flag** | u(1) |
| **pps\_sao\_info\_in\_ph\_flag** | u(1) |
| **pps\_alf\_info\_in\_ph\_flag** | u(1) |
| if( ( pps\_weighted\_pred\_flag | | pps\_weighted\_bipred\_flag ) &&  pps\_rpl\_info\_in\_ph\_flag ) |  |
| **pps\_wp\_info\_in\_ph\_flag** | u(1) |
| **pps\_qp\_delta\_info\_in\_ph\_flag** | u(1) |
| } |  |
| … |  |

The contribution was said to be similar in spirit to item 7 above (S0049).

The desire is that when there is only one slice in the picture, to avoid signalling some information in the PPS.

It was commented that if an original bitstream has multiple slices and has this signalling in the PH, then extraction of a single slice could cause a rewriting requirement. The proponent indicated that there is a provision to avoid the rewriting based on the single slice per subpicture flag equal to 1 (at some expense of bits).

No clear need for action was identified, and thus no action was recommended.

1. Enable removal of parameter sets (i.e., PPS and APS) in non-output layer that is not used as reference for decoding of pictures in output layers during extraction process, as follows: (JVET-S0219 aspect 1)

* Modify the semantics of vps\_max\_tid\_il\_ref\_pics\_plus1[ i ][ j ] such that when it is greater than 0 it means for decoding pictures of the i-th layer, no parameter set and picture from the j-th layer with TemporalId greater than vps\_max\_tid\_il\_ref\_pics\_plus1[ i ][ j ] − 1 is used as reference.
* In extraction process, in addition to removing VCL NAL unit, also remove PPS and APS with TemporalId that is greater than or equal to NumSubLayersInLayerInOLS[ targetOlsIdx ][ GeneralLayerIdx[ nuh\_layer\_id ] ].

It was commented that this makes more sense for the APS than the PPS and that APSs are a bigger problem. This would treat APS more similar to PH for the extraction.

“Smart” extractors were discussed, and whether the extraction process model is sufficient.

Several participants saw value in being able to identify and remove useless APS from the bitstream based on this proposal. The change is also small.

AHG Recommendation (cleanup): Adopt APS aspect only.

1. Move the signalling of aps\_params\_type to an earlier position and change the signalling of aps\_adaptation\_parameter\_set\_id from u(5) to u(v). The length of the syntax element depends on the type of the APS. (JVET-S0219 aspect 2)

A participant said this (or swapping the order of the ID and type) may be useful for extensibility, as some future APS type might need more ID values. The fact that the type is before the ID seemed to just be for historical reasons – it was originally proposed that way and never modified.

It was commented that we took no action on something similar previously.

AHG Recommendation (cleanup): Just change the order to put the type before the ID.

1. Move the flag indicating the presence of sh\_cabac\_init\_flag from PPS to SPS. (JVET-S0235)

The location is a carry-over from HEVC.

No action seemed clearly necessary, so no action was recommended on this.

[JVET-S0042](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10164) JVET-S0042 AHG9: On the parameter set extension mechanism [M. M. Hannuksela, K. Kammachi-Sreedhar (Nokia)]

[JVET-S0049](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10171) AHG9/AHG8/AHG12: On parameter sets and picture header [Y.-K. Wang, L. Zhang, Z. Deng, K. Zhang (Bytedance)]

Aspects 4 to 7 of this contribution belong to this category.

[JVET-S0074](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10196) AHG9: On SPS, PH, SH syntax order [M. G. Sarwer, Y. Ye (Alibaba)]

Aspect 1 of this contribution belongs to this category.

[JVET-S0079](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10201) AHG9: On signalling of sps\_max\_sublayers\_minus1 [Hendry (LGE)]

[JVET-S0115](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10237) AHG9: On SPS cleanups [Y. He, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

Aspect 2 of this contribution belongs to this category.

[**JVET-S0129**](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10251) **AHG9: cleanup on parameter sets and GCI [L. Li, X. Li, B. Choi, S. Wenger, S. Liu (Tencent)]**

Aspect 2 of this contribution belongs to this category.

[JVET-S0132](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10254) AHG9: On syntax signaling order in SPS and PPS [H.-J. Jhu, Y.-W. Chen, X. Xiu, T.-C. Ma, X. Wang (Kwai Inc.)]

[JVET-S0122](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10244) AHG9: On APS memory constraint [N. Hu, V. Seregin, M. Karczewicz (Qualcomm)

[JVET-S0164](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10286) AHG9: On signalling six PPS flags for indicating the presence of syntax in PH/SH [S.-T. Hsiang, L. Chen, O. Chubach, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-S0166](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10288) AHG9: Inferring information of the SPS from the reference layer [S.-T. Hsiang, L. Chen, O. Chubach, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-S0169](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10291) AHG9: Miscellaneous Cleanups for HLS [B. Wang, S. Esenlik, H. Gao, E. Alshina (Huawei)]

Aspect 1 of this contribution belongs to this category.

[JVET-S0186](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10308) AHG9: On SPS Cleanup [S. Deshpande, J. Samuelsson, A. Segall, P. Cowan (Sharp)]

[JVET-S0199](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10321) AHG9: On syntax grouping in SPS [H.-J. Jhu, Y.-W. Chen, X. Xiu, T.-C. Ma, C.-W. Kuo, X. Wang (Kwai Inc.)]

[JVET-S0204](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10326) AHG9: On signalling of the maximum transform skip size [K. Unno, K. Kawamura (KDDI)]

[JVET-S0219](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10341) AHG8/AHG9: On APS NAL unit clean-up [H. Jang, J. Nam, J. Lim, S. Paluri, Hendry, S. Kim (LGE)]

[JVET-S0235](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10357) AHG9: On pps\_cabac\_init\_flag signalling [M. Coban, V. Seregin, Y. He, Y.-J. Chang, M. Karczewicz (Qualcomm)]

### PH and SH cleanups (10+4)

[JVET-S0143](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10265) AHG9: A summary of proposals on picture header and slice header cleanups [Hendry (LGE)]

This topic was discussed in the HLS AHG at 2330 on 28 May and in the HLS AHG pre-meeting at 1900 on 21 June.

This contribution provides a summary of the 13 proposals on picture header and slice header cleanups (the agenda item 3.1.5 in JVET-S0137 and JVET-S0237).

It is suggested that this summary, in terms of a list of design questions, is used for the reviewing of these proposals, such that the discussions can be in a more structured and efficient manner. The following changes are proposed:

1. Add a constraint such that the value of ph\_inter\_slice\_allowed\_flag is required to be equal to 1 when vps\_independent\_layer\_flag[ GeneralLayerIdx[ nuh\_layer\_id ] ] is equal to 0 (JVET-S0049 aspect 8).

This proposal seemed undesirable, as it would enforce undesirable behaviour on the picture header based on layer-level characteristics.

1. It is asserted there may be issue with the signalling of ph\_no\_output\_of\_prior\_pics\_flag. When ph\_gdr\_or\_irap\_pic\_flag is equal to 0, but the associated picture the associated picture may or may not be an IRAP picture but the ph\_no\_output\_of\_prior\_pics\_flag is not present but there is no inference value for it. The following options are proposed to fix this asserted issue (JVET-S0055 proposal 1, JVET-S0070 proposal 1)
   1. Option 1: Change the current semantics of ph\_gdr\_or\_irap\_pic\_flag to be a two-way (i.e., if ph\_gdr\_or\_irap\_pic\_flag is equal 1 the associated picture is a GDR or an IRAP picture, otherwise, if ph\_gdr\_or\_irap\_pic\_flag is equal to 0, the associated picture is not a GDR nor an IRAP picture) (JVET-S0055 proposal 1 option 1).
   2. Option 2: Apply the following (JVET-S0070 proposal 1):
      1. Replace the current flag ph\_gdr\_or\_irap\_pic\_flag with two new flags: ph\_irap\_pic\_flag and ph\_gdr\_pic\_flag
      2. Semantics of ph\_irap\_pic\_flag and ph\_gdr\_pic\_flag are two-way.
      3. ph\_no\_output\_of\_prior\_pics\_flag is present when at least ph\_irap\_pic\_flag or ph\_gdr\_pic\_flag is equal to 1
   3. Option 3: Add the following inference: when not present, the value of ph\_no\_output\_of\_prior\_pics\_flag is inferred to be equal to 0. (JVET-S0055 proposal 1 option 1)

It was agreed that there is a problem. It was commented that the idea of using one-way semantics was to avoid PH rewriting for BEAM usage. It was commented that a two-flag approach had also been previously discussed.

Moving the no\_output\_of\_prior\_pics\_flag to the slice header was suggested. It had previously been there.

See item 13 for later developments on this issue.

1. Add a constraint such that when aud\_irap\_or\_gdr\_au\_flag is present and the value of aud\_irap\_or\_gdr\_au\_flag is equal to 1, the value of ph\_gdr\_or\_irap\_pic\_flag shall be equal to 1. (JVET-S0055 proposal 2)

It was commented that this interacts with BEAM usage. This is related to item 2 above.

The AHG deferred this topic for further study.

1. Regarding the signalling of ph\_gdr\_or\_irap\_pic\_flag when pps\_mixed\_nalu\_types\_in\_pic\_flag is equal to 1 (JVET-S0135):
   1. Option 1: add a constraint such that the value of ph\_gdr\_or\_irap\_pic\_flag shall be equal to 0 when pps\_mixed\_nalu\_types\_in\_pic\_flag is equal to 1
   2. Option 2: condition the presence of ph\_gdr\_or\_irap\_pic\_flag on pps\_mixed\_nalu\_types\_in\_pic\_flag being equal to 0.
   3. Option 3: add a constraint to the definition of GDR picture that pps\_mixed\_nalu\_types\_in\_pic\_flag is equal to 0.

For option 3, the proponent provided the text as a NOTE, instead of a constraint.

This is related to items 2 and 3 above.

The AHG deferred this topic for further study.

1. Change coding of ph\_pic\_parameter\_set\_id from ue(v) to u(6) (JVET-S0076 item b), JVET-S0110 aspect 3)

This would add 5 bits to every picture when only 1 PPS is being used.

No strong need for action was identified, so no action was recommended for this.

1. Rearrange the position of syntax elements in PH and SH.
   1. Move syntax elements related to SAO and de-blocking process to earlier position in PH and in SH (i.e., signal them right after ALF and LMCS related syntax) JVET-S0074 aspect 2)

This suggestion had been discussed at the previous meeting. This would move the APS ID for the scaling list APS to later in the syntax, which is undesirable. No strong need for action was identified, so no action was recommended for this.

* 1. Move ph\_non\_ref\_pic\_flag to earlier position, i.e., before any syntax element whose presence is conditioned on the value of other syntax element(s). Immediately after ph\_gdr\_or\_irap\_pic\_flag (JVET-S0076 item a) )

AHG Recommendation (cleanup): Adopt.

* 1. Move ph\_pic\_parameter\_set\_id to earlier position (i.e., after ph\_non\_ref\_pic\_flag) (JVET-S0076 item c) )

This was withdrawn due to lack of action on item 5.

* 1. Move down the location of syntax elements ph\_inter\_slice\_allowed\_flag and ph\_intra\_slice\_allowed\_flag and condition the presence of ph\_inter\_slice\_allowed\_flag only for picture with no inter-layer prediction and non-irap picture and non-gdr picture when ph\_recovery\_poc\_cnt is equal to 0 (JVET-S0070 proposal 2)

It was commented that this would require some SPS parsing for interpretation. There was discussion over whether this would be of interest to the system level.

It could save one or two bits per picture under some circumstances.

There seemed to be no clear need for action on this, so no action was recommended.

Discussion in the HLS AHG stopped here at 0020 UTC on 29 May.

Discussion in the HLS AHG pre-meeting resumed here at 1900 on 21 June.

1. Condition the presence of ph\_gdr\_pic\_flag such that it may be present only when sps\_gdr\_enabled\_flag is equal to 1 (JVET-S0076 item d)

This proposal is somewhat based on the idea that ph\_gdr\_pic\_flag is not needed/used by the system level, which was not considered necessarily true, so no action was recommended on this item.

1. Change the constraint on the value of sh\_picture\_header\_in\_slice\_header\_flag as follows: the value of sh\_picture\_header\_in\_slice\_header\_flag shall be equal to 0 when sps\_subpic\_info\_present\_flag is equal to 1 *and pps\_no\_pic\_partition\_flag is equal to 0* (JVET-S0120 aspect 1)

The idea is that if there is only one slice in the picture, it should be OK to put the PH in the SH.

This would not be friendly to parallel encoding with merging.

In the discussion, it was said that the only purpose of having sps\_subpic\_info\_present\_flag equal to 1 is to support BEAM usage, and putting the PH in the SH would not be consistent with that purpose. No action was thus recommended on this.

1. Change the constraint on the value of sh\_picture\_header\_in\_slice\_header\_flag as follows: (JVET-S0120 aspect 2 and 3)
   1. Option 1: the value of sh\_picture\_header\_in\_slice\_header\_flag shall be equal to 0 when the value of pps\_rpl\_info\_in\_ph\_flag, pps\_dbf\_info\_in\_ph\_flag, pps\_sao\_info\_in\_ph\_flag, pps\_wp\_info\_in\_ph\_flag, *pps\_alf\_info\_in\_ph\_flag*, or pps\_qp\_delta\_info\_in\_ph\_flag is equal to 1.
   2. Option 2: remove the following constraint: “*the value of sh\_picture\_header\_in\_slice\_header\_flag shall be equal to 0 when The value of pps\_rpl\_info\_in\_ph\_flag, pps\_dbf\_info\_in\_ph\_flag, pps\_sao\_info\_in\_ph\_flag, pps\_wp\_info\_in\_ph\_flag, or pps\_qp\_delta\_info\_in\_ph\_flag is equal to 1”*

This topic was closed; see notes for S0142.

1. Change VTM encoder to signal the override flag (i.e., ph\_partition\_constraints\_override\_flag) as zero when the derived partition constraints for a PH are identical to the ones in the SPS (JVET-S0133 aspect 1)

This aspect is a non-normative software-only encoder modification proposal. The software was attached to the proposal.

Some coding gain was reported under CTC conditions (overall 0.14% in LB, with 0.46% in Class E).

It was commented that this could have just been fixed in response to a bug track report.

AHG Recommendation (non-normative encoder software improvement): Adopt.

1. Change the semantics of the signalled values of partition constraints in PH from values for overriding the corresponding values signalled in SPS to delta values relative to the corresponding values signalled in the SPS (JVET-S0133)

The results reportedly show that the encoder-only change to remove the redundant signalling introduces -0.10% (RA) and -0.06% (LD) BD-rate reduction for class D. On top of the encoder-only change, the proposed syntax modifications introduce -0.18% (RA), -0.19% (LD) BD-rate reduction for class D. In average, the encoder-only change introduces 0.00 (AI), -0.03% (RA) and -0.14% (LDB) BD-rate changes, and when combined with the encoder-only change, the proposed syntax modification introduces 0.00 (AI), -0.03% (RA) and -0.15% (LDB) BD-rate changes under CTC.

The additional average gain from the syntax change across all classes is negligible, although there is a little gain for class D.

It is noted that the results show no impact on AI because the current VTM always disables the override of the partition constraints for intra pictures.

The proposal assumes the SPS-level information is an upper bound or lower bound. The proposal use the upper bound convention for some SEs and the lower bound convention for others, based on which would be more efficient than the CTC.

It was commented that this seems to complicate the design for basically negligible benefit, so no action was recommended.

1. It is asserted that reference rule for the value of ph\_collocated\_from\_l0\_flag when L0 empty and L1 non-empty is missing. Update the current inference rule for ph\_collocated\_from\_l0\_flag as follows: (JVET-S0174 aspect 3) (added/changed in **bold**)

ph\_collocated\_from\_l0\_flag equal to 1 specifies that the collocated picture used for temporal motion vector prediction is derived from reference picture list 0. ph\_collocated\_from\_l0\_flag equal to 0 specifies that the collocated picture used for temporal motion vector prediction is derived from reference picture list 1. When **not present and** ph\_temporal\_mvp\_enabled\_flag and pps\_rpl\_info\_in\_ph\_flag are both equal to 1, **the value of ph\_collocated\_from\_l0\_flag is inferred to be equal to ( num\_ref\_entries[ 1 ][ RplsIdx[ 1 ] ]  = =  0 ? 1 : 0 ).**

This is proposed as a bug fix.

It was commented that either of the lists can be empty. However, per the notes for S0140 item 11 in 3.1.6 that discuss S0096, List 0 could only be empty for an I slice.

Revisit with S0096.

1. Further study result for the item 2 above (i.e., harmonization of JVET-S0055 proposal 1 and JVET-S0070 proposal 1). Change IRAP or GDR flag in PH with the following options (JVET-S0193 aspect 1):
   1. Option 1: Change the semantics of ph\_gdr\_or\_irap\_pic\_flag to be two-way.
   2. Option 2: Replace the flag ph\_gdr\_or\_irap\_pic\_flag with two new flags: ph\_irap\_pic\_flag and ph\_gdr\_pic\_flag with two-way semantics.
   3. Option 3: Add the following inference: when not present, the value of ph\_no\_output\_of\_prior\_pics\_flag is inferred to be equal to 1.
   4. Option 4: Move no\_output\_of\_prior\_pics\_flag to the slice header of IRAP and GDR slices (but require it to have the same in all IRAP and GDR slices of the AU).

It was commented that option 1 would be harmful to merging bitstreams that have different IRAP periods. Option 2 has the same issue.

Option 3 would lose the ability to set the flag to 0 in some cases and might require some rewriting to put the flag in.

Option 4 was thus suggested. It was noted that the flag in HEVC is at the slice level.

Putting the no\_output\_of\_prior\_pics\_flag in the AUD was mentioned as a possible option 5.

An option 6 was mentioned of putting the flag in all PHs.

AHG Recommendation (bug fix): Adopt option 4. (It was noted that no inference rule is needed for this case and the text should reflect that.)

1. If option 3 or option 4 from the above item is agreed, change the syntax element ph\_gdr\_or\_irap\_pic\_flag to ph\_irap\_pic\_flag and send a GDR flag in more cases. (JVET-S0193 aspect 1)

It was commented that the detecting a random-access point would be easier without the change. However, detecting an IRAP would be easier with the change, and this is anticipated to be the more common use – e.g. for trick play. Another participant said that the current semantics is difficult to understand.

Since the technical merits seem relatively unimportant, no action was recommended on this aspect.

Discussion in the HLS pre-meeting stopped here at 2100 UTC on 21 June.

1. Do one of the following (JVET-S0200):
   1. Option 1: Add a constraint such that ph\_inter\_slice\_allowed\_flag shall be equal to 1 when ph\_gdr\_pic\_flag is equal to 1.
   2. Option 2: Condition the presence of ph\_inter\_slice\_allowed\_flag on ph\_gdr\_pic\_flag being equal to 0.
2. Add a constraint such that when vps\_max\_layers\_minus1 is equal to 0, an AUD is present for the current AU, and aud\_irap\_or\_gdr\_au\_flag is equal to 0, the value of ph\_gdr\_or\_irap\_pic\_flag shall be equal to 0 (JVET-S0160 aspect 4).
3. Add a constraint such that when an AUD is present for the current AU and aud\_pic\_type is equal to 0, the value of sh\_slice\_type shall be equal to 2 (JVET-S0160 aspect 2).
4. Add a constraint such that when an AUD is present for the current AU and aud\_pic\_type is equal to 1, the value of sh\_slice\_type shall be equal to 1 or 2 (JVET-S0160 aspect 3).
5. Add the following constraint for CTU size when using ILRP as collocated reference picture as follows (JVET-S0174 aspect 1) (addition in **bold**):

sh\_collocated\_ref\_idx specifies the reference index of the collocated picture used for temporal motion vector prediction.

[…]

Let colPicList be set equal to sh\_collocated\_from\_l0\_flag ? 0 : 1. It is a requirement of bitstream conformance that the picture referred to by sh\_collocated\_ref\_idx shall be the same for all non-I slices of a coded picture and the value of RprConstraintsActiveFlag[ colPicList ][ sh\_collocated\_ref\_idx ] shall be equal to 0 **and the value of sps\_log2\_ctu\_size\_minus5 in the SPS referred to by the picture referred to by sh\_collocated\_ref\_idx shall be equal to or greater than the value of sps\_log2\_ctu\_size\_minus5 in the SPS referred to by the current picture**.

NOTE – The above constraint requires the collocated picture to have the same spatial resolution. the same scaling window offsets **and same or larger CTU size** as the current picture.

[JVET-S0049](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10171) AHG9/AHG8/AHG12: On parameter sets and picture header [Y.-K. Wang, L. Zhang, Z. Deng, K. Zhang (Bytedance)]

Aspect 8 of this contribution belongs to this category.

[JVET-S0055](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10177) AHG9: On signaling IRAP and GDR pictures [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-S0070](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10192) AHG9: On flag ph\_gdr\_or\_irap\_pic\_flag [L. Chen, C.-W. Hsu, S.-T. Hsiang, O. Chubach, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-S0074](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10196) AHG9: On SPS, PH, SH syntax order [M. G. Sarwer, Y. Ye (Alibaba)]

Aspect 2 of this contribution belongs to this category.

[JVET-S0076](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10198) AHG9: On syntax elements in the beginning of picture header [Hendry (LGE)]

[JVET-S0110](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10232) AHG9: On HLS Editorial cleanup [Y. He, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

Aspect 3 of this contribution belongs to this category.

[JVET-S0120](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10242) AHG9: Constraints on sh\_picture\_header\_in\_slice\_header\_flag [N. Hu, V. Seregin, Y. He, M. Karczewicz (Qualcomm)]

[JVET-S0133](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10255) AHG9: On partition constraints override in picture header [Y.-W. Chen, X. Xiu, H.-J. Jhu, T.-C. Ma, X. Wang (Kwai Inc.)]

[JVET-S0135](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10257) AHG9: On IRAP and GDR picture signaling in picture header [X. Xiu, Y.-W. Chen, H.-J. Jhu, T.-C. Ma, X. Wang (Kwai)]

[**JVET-S0160**](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10282) **AHG9/AHG12/AHG8: Miscellaneous HLS cleanups [Y.-K. Wang, Z. Deng, L. Zhang, K. Zhang (Bytedance)]**

Aspects 2 to 4 of this contribution belong to this category.

[JVET-S0174](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10296) AHG9: Miscellaneous cleanups [R. Skupin, Y. Sanchez, K. Suehring, T. Schierl (HHI)]

Aspects 1 and 3 of this contribution belong to this category.

[JVET-S0193](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10315) AHG9: Bugfix and Cleanup on ph\_no\_output\_of\_prior\_pics\_flag and ph\_gdr\_or\_irap\_pic\_flag [B. Choi, S. Wenger, S. Liu (Tencent), L. Chen, C.-W. Hsu, S.-T. Hsiang, O. Chubach, Y.-W. Huang, S.-M. Lei(MediaTek)]

[JVET-S0200](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10322) AHG9: On ph\_inter\_slice\_allowed\_flag in GDR picture [H.-J. Jhu, X. Xiu, Y.-W. Chen, T.-C. Ma, C.-W. Kuo, X. Wang (Kwai Inc.)]

### Reference picture lists cleanups (8+2)

[JVET-S0140](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10262) AHG9: A summary of proposals on reference picture lists [Y.-K. Wang (Bytedance)]

This contribution was discussed in the HLS AHG meeting at 0500 UTC on Thursday 28 May and in the HLS AHG pre-meeting at 1300 UTC on 20 June.

This contribution provides a summary of the 9 proposals on reference picture lists cleanups (the agenda item 3.1.6 in JVET-S0137 and JVET-S0237).

It is suggested that this summary, in terms of a list of proposed items, is used for the reviewing of these proposals, such that the discussions can be in a more structured and efficient manner. The following changes were proposed:

1. Modify the semantics of strp\_entry\_sign\_flag[ listIdx ][ rplsIdx ][ i ], such that it (S0045)
2. swaps the meaning of positive and negative (consequently swaps the sign assignment of DeltaPocValSt[ listIdx ][ rplsIdx ][ i ] in Equation 155, and change the subtraction to addition when assigning RefPicPocList[ i ][ j ] using DeltaPocValSt[ i ][ RplsIdx[ i ] ][ j ] in Equation 205.

The concept is that in other place in the spec, a sign flag value ‘1’ is associated with a negative value and ‘0’ is associated with a positive value.

1. associates strp\_entry\_sign\_flag[ listIdx ][ rplsIdx ][ i ] with DeltaPocValSt[ listIdx ][ rplsIdx ][ i ] instead of with an "i-th entry in the syntax structure ref\_pic\_list\_struct( listIdx, rplsIdx )".

Both aspects are only editorial. The “bits on the wire” do not change.

Editor action item: The editor is strongly suggested to make the proposed changes as a more precise and natural expression of the intent.

1. When sps\_inter\_layer\_ref\_pics\_present\_flag is equal to 1, sps\_idr\_rpl\_present\_flag is skipped and inferred to be equal to 1. (S0049 aspect 2)

The motivation is to eliminate a combination that is asserted to not make sense.

This is closely related to items 4 and 5.

It was suggested to remove the sps\_idr\_rpl\_present\_flag, as a simplification of the RPL design for IDR pictures. This would require RPL to be present even for all-intra usage, costing about one or two bits per picture to signal an empty RPL.

Another participant said there is not really a problem in the current syntax.

No clear need for action was evident, so no action was recommended.

1. Add a constraint: When vps\_independent\_layer\_flag[ GeneralLayerIdx[ nuh\_layer\_id ] ] is equal to 0, the value of sps\_idr\_rpl\_present\_flag shall be equal to 1. (S0049 aspect 2)

The motivation is to eliminate a combination that is asserted to not make sense.

It was commented that it might be desirable to be able to detect the self-contained nature of such an IDR picture.

No clear need for action was evident, so no action was recommended.

1. Remove sps\_idr\_rpl\_present\_flag (i.e., always signal RPLs for IDR slices, like for non-IDR I slices), and invoke generating unavailable reference picture for IDR pictures: (S0123 approach 1)

See also items 2 and 5. No clear need for action was evident, so no action was recommended.

1. As an alternative to 4), do the following and invoke generating unavailable reference picture for IDR pictures: (S0123 approach 2)
   1. Do one of the following:
2. Change the SH syntax to signal RPL for each IDR slice in a non-independent layer.
3. Require sps\_idr\_rpl\_present\_flag or pps\_rpl\_info\_in\_ph\_flag to be equal to 1 for an IDR slice when the current layer is a non-independent layer.
4. Require sh\_slice\_type to be equal to 2 for IDR slice when sps\_idr\_rpl\_present\_flag and pps\_rpl\_info\_in\_ph\_flag are both equal to 0.
   1. Change the process for deriving empty RPLs when sps\_idr\_rpl\_present\_flag is equal to 0 and nal\_unit\_type is equal to IDR\_W\_RADL or IDR\_N\_LP to involve pps\_rpl\_info\_in\_ph\_flag.

See also items 2 and 4. For the aspect “a”, no clear need for action was evident, so no action was recommended.

However, for the basic concept of needing to generate unavailable reference picture for IDR pictures, it was agreed there is an issue.

It was commented that this may only be relevant/necessary for a merge/extract scenario.

It was noted that some validity checks for entries of the RPL apply even if the picture is not an active entry.

AHG Recommendation (bug fix/expression of existing intent): Invoke the generation of unavailable reference picture for an IDR picture that has RPLs, and change the RPL constraints in clause 8.3.2 accordingly.

For aspect “b” it was agreed that there is a spec bug relating to when the RPL is in the PH.

AHG Recommendation (bug fix/expression of existing intent): Adopt aspect “b”. Editor may consider the exact expression.

1. Add sps\_ref\_layer\_idx\_plus1 under the condition "if( sps\_inter\_layer\_ref\_pics\_present\_flag )" to enable skipping ilrp\_idx[ listIdx ][ rplsIdx ][ i ] in the RPL syntax structures when the layer has only one direct reference layer, as follows: (S0082)
   1. The value of ps\_ref\_layer\_idx\_plus1 shall be equal to

( NumDirectRefLayers[ GeneralLayerIdx[ nuh\_layer\_id ] ] > 1 ) ? 0:  
 DirectRefLayerIdx[ GeneralLayerIdx[ nuh\_layer\_id ] ][ 0 ] + 1

* 1. Consequently, when sps\_ref\_layer\_idx\_plus1 is greater than 0, ilrp\_idx[ listIdx ][ rplsIdx ][ i ] is skipped and inferred to be equal to sps\_ref\_layer\_idx\_plus1 − 1.

It is common for there to be only one direct reference layer. In this case it would be possible to skip the ILRP index signalled in the PH/SH (whichever has the RPL structure, if one of them does).

It was noted that something similar is done in HEVC.

It was commented that this seemed like something we would do if it was proposed a couple of meetings earlier. It would be basically a shortcut for a common use case.

The bit savings for this was not so clear, and software had not been tested.

No clear need for action was evident, so no action was recommended.

1. Change ilrp\_idx[ listIdx ][ rplsIdx ][ i ] to delta\_ilrp\_idx\_minus1[ i ][ RplsIdx ][ i ] as well as the semantics such that the following part of Equation 205 (S0083):

layerIdx = DirectRefLayerIdx[ GeneralLayerIdx[ nuh\_layer\_id ] ][ ilrp\_idx[ i ][ RplsIdx ][ j ] ]  
refPicLayerId = vps\_layer\_id[ layerIdx ]

is proposed to be changed to be as follows:

ilrpIdx = GeneralLayerIdx[ nuh\_layer\_id ] − ( delta\_ilrp\_idx\_minus1[ i ][ RplsIdx ][ j ] + 1 )  
layerIdx = DirectRefLayerIdx[ GeneralLayerIdx[ nuh\_layer\_id ] ][ ilrpIdx ]  
refPicLayerId = vps\_layer\_id[ layerIdx ]

The motivation is partly to make it more possible to be able to share SPSs.

It was commented that some sharing is already enabled since the index is an index into a list of direct reference layers.

Again it was commented that this seemed like something we would do if it was proposed a couple of meetings earlier.

There was a bug noted in the proposed equations, that they should instead be more like this:

ilrpIdx = GeneralLayerIdx[ nuh\_layer\_id ] − ( delta\_ilrp\_idx\_minus1[ i ][ RplsIdx ][ j ] + 1 )  
refPicLayerId = vps\_layer\_id[ ilrpIdx ]

No clear need for action was evident, so no action was recommended.

1. Fix an asserted bug (when sps\_num\_ref\_pic\_lists[ 0 ] is greater than sps\_num\_ref\_pic\_lists[ 1 ], pps\_rpl1\_idx\_present\_flag is equal to 0, and rpl\_idx[ 1 ] is less than sps\_num\_ref\_pic\_lists[ 0 ], the value of rpl\_idx[ 1 ] may be out of range), with either of the following two options: (S0085 aspect 1)
   1. Add a constraint: When sps\_num\_ref\_pic\_lists[ 0 ] is greater than sps\_num\_ref\_pic\_lists[ 1 ], pps\_rpl1\_idx\_present\_flag shall be equal to 1.
   2. Add the following to the semantics of rpl\_idx[ i ]: When pps\_rpl1\_idx\_present\_flag is equal to 0, the syntax element rpl\_idx[ 0 ] shall be in the range of 0 to min(sps\_num\_ref\_pic\_lists[ 0 ], sps\_num\_ref\_pic\_lists[ 1 ]) − 1 and the syntax element rpl\_idx[ 0 ] is represented by Ceil( Log2(min( sps\_num\_ref\_pic\_lists[ 0 ], sps\_num\_ref\_pic\_lists[ 1 ] ) ) ) bits, otherwise (pps\_rpl1\_idx\_present\_flag is equal to 1) the syntax element rpl\_idx[ i ] is represented by Ceil( Log2( sps\_num\_ref\_pic\_lists[ i ] ) ) bits.

It was commented that there is a constraint, on the value range of rpl\_idx[ 1 ], that would be violated by the example for describing of the asserted but. Therefore, the asserted bug is not valid.

It was noted that a value range for a syntax element, unless explicitly said to apply only when the syntax element is present, it applies also to inferred values.

No need for an action was identified. Thus no action was recommended on this.

1. Fix an asserted bug in the syntax condition "if( !pps\_rpl\_info\_in\_ph\_flag | | num\_ref\_entries[ 1 ][ RplsIdx[ 1 ] ] > 0 )" in the PH syntax (when pps\_rpl\_info\_in\_ph\_flag is equal to 0 the variable RplsIdx[ 1 ] in the context is used undefined), with the following changes: (S0085 aspect 2)
   1. Add ", otherwise rpl\_sps\_flag[ i ] is inferred to be equal to 0" to the end of inference of rpl\_sps\_flag[ i ].
   2. Add "num\_ref\_entries[ listIdx ][ sps\_num\_ref\_pic\_lists[ listIdx ] ] is infered to be equal to 0." to end of the semantics of num\_ref\_entries[ listIdx ][ rplsIdx ].

It was commented that " if( !pps\_rpl\_info\_in\_ph\_flag | | num\_ref\_entries[ 1 ][ RplsIdx[ 1 ] ] > 0 )" is equivalent to "if( !pps\_rpl\_info\_in\_ph\_flag | | ( pps\_rpl\_info\_in\_ph\_flag && num\_ref\_entries[ 1 ][ RplsIdx[ 1 ] ] > 0 ) )". Therefore, the asserted bug is not valid.

Generally, a value of a syntax element or variable, when not present, is not inferred/derived when not needed, unless it is referred in a syntax condition or other condition.

It was commented that the text has some issue.

It was initially agreed to add the derivation of the value of RplsIdx[ 1 ] in the PH semantics when pps\_rpl\_info\_in\_ph\_flag is equal to 0. In later discussion, adding an “if” condition was suggested as an alternative.

Editor action item: The editor is asked to rephrase the text to avoid the problem. The suggested method is to add an extra “if” condition with a comment to explain why it is there.

1. Fix an asserted bug that the inference of RplsIdx[ 0 ] is missing, by adding the following inference rule (in addition to the existing inference of RplsIdx[ 1 ]): The value of rpl\_idx[ 0 ] is inferred to be equal to 0 when sps\_num\_ref\_pic\_lists[ 0 ] is equal to 1 and rpl\_sps\_flag[ 0 ] is equal to 1. (S0085 aspect 3, S0096 aspect 3)

AHG Recommendation (bug fix/expression of existing intent): Adopt in spirit; infer a value only when needed. Exact expression to be determined offline by the editor.

1. Additionally check num\_ref\_entries[ 1 ][ RplsIdx[ 1 ] ] for conditional signalling of ph\_collocated\_from\_l0\_flag and ph\_mvd\_l1\_zero\_flag to reduce the unnecessary signalling, by changing "num\_ref\_entries[ 1 ][ RplsIdx[ 1 ] ] > 0" in the syntax condition to "num\_ref\_entries[ 0 ][ RplsIdx[ 0 ] ] > 0 && num\_ref\_entries[ 1 ][ RplsIdx[ 1 ] ] > 0". (S0096 aspect 1)

If list 0 is empty, we should not be able to indicate that we are getting the collocated picture from that list.

List 0 could only be empty for an I slice. Usually, for an I slice, if we have a non-empty list, we would make that list 0, but we do not have a constraint that requires that. It was remarked that we might not want to establish such a constraint.

The existing syntax condition seems to have a built-in assumption that list 0 will always be non-empty. This is not a valid assumption.

The initial AHG discussion thought that, as a bug fix/expression of existing intent, this should be adopted.

This was further discussed in the context of discussion of S0174 on 21 June at 1940. The prior understanding seemed to be incorrect. If the RPL is sent in the PH, it is used for all slices, and therefore list 0 can only be empty if the whole picture contains only I slices.

It was suggested to require that ph\_inter\_slice\_allowed\_flag be 0 when the RPL is sent in the PH and list 0 is empty, but this could be unfriendly to merging.

See also the notes for related contribution S0174 in 3.1.5 for S0143 item 12.

Offline study and revisit was suggested to determine the appropriate course of action.

1. Consider the number of active entries in the reference picture list when inferring the value of sh\_collocated\_ref\_idx so that encoder can have more flexibility to change the number of active entries in slice headers, by changing "sh\_collocated\_ref\_idx is inferred to be equal to ph\_collocated\_ref\_idx" to "sh\_collocated\_ref\_idx is inferred to be equal to min( ph\_collocated\_ref\_idx, NumRefIdxActive[ !sh\_collocated\_from\_l0\_flag ] − 1 )". (S0096 aspect 2)

The issue is not actually a bug, because the problem case is prohibited.

The usefulness of the extra flexibility would be to avoid needing to signal the RPL in the SH by allowing it to be sent in the PH in such a case. However, it was remarked that it is not clear that this would be a common case. No clear need for action was evident, so no action was recommended.

1. Change the constraint that the collocated picture "shall be the same for all slices of a picture" to "shall be the same for all non-I slices of a picture". (S0096 aspect 4).

It was remarked that this seems necessary to resolve the lack of a collocated picture definition for an I slice, and that this is the same way it was done in HEVC.

AHG Recommendation (bug fix/expression of existing intent): Adopt.

The discussion of the above items of this section in the HLS AHG meeting was completed at 0830 UTC on 28 May.

Discussion of the below items in the HLS pre-meeting began at 1300 UTC on 20 June.

1. Add a constraint such that when sps\_idr\_rpl\_present\_flag is equal to 0, pps\_mixed\_nalus\_in\_pic\_flag is equal to 1, and pps\_rpl\_info\_in\_ph\_flag is equal to 0, the value of nal\_unit\_type shall not be equal to IDR\_W\_RADL or IDR\_N\_LP. (S0159 aspect 1)

There was discussion of whether this would be purely editorial (due to existing indirect constraints) and whether it is necessary to specify. A possible violation would be an IDR slice without RPL information mixed with an I slice with a trail NAL unit type in which the RPL is empty, which would not seem to cause a problem in principle (although it would be strange).

No action was recommended on this.

1. Add a constraint such that when vps\_independent\_layer\_flag[ GeneralLayerIdx[ nuh\_layer\_id ] ] is equal to 0, the value of sps\_inter\_layer\_ref\_pics\_present\_flag shall be equal to 1. (S0159 aspect 2)

It was asked whether this constraint would really be needed. It did not seem to really be needed. It was mentioned that since some semantics are “one-way”, an encoder could set flags to indicate that something may happen that would not actually occur in the bitstream, and there seemed to be no clear need to prohibit this. Thus, no action was recommended on this.

1. Add GDR picture with ph\_recovery\_poc\_cnt equal to 0 (in addition to IRAP picture) to the constraint in clause 8.3.2 on RPLs based on the value of vps\_max\_tid\_il\_ref\_pics\_plus1[ ][ ]. (S0159 aspect 3)

The idea of this is to treat GDR picture with ph\_recovery\_poc\_cnt equal to 0 consistently the same as an IRAP picture. This seemed to be just a forgotten, essentially editorial, issue.

AHG Recommendation (editorial BF/expression of existing intent): Adopt as proposed.

1. Mark each ILRP entry, when present, in RefPicList[ 0 ] or RefPicList[ 1 ], of a CLVSS picture as "used for long-term reference". (S0159 aspect 4)

The proponent said that this is an essentially editorial bug fix of the existing intent of the spec.

It was noted that the proposal would put the same text in both an “if” and “otherwise”, so it could just be applied unconditionally.

AHG Recommendation (editorial BF/expression of existing intent): Adopt (with suggested editorial refinement).

1. When num\_ref\_entries[ listIdx ][ rplsIdx ] in the ref\_pic\_list\_struct( listIdx, rplsIdx ) syntax structure is equal to 0, ltrp\_in\_header\_flag[ listIdx ][ rplsIdx ] is skipped and inferred to be equal to 0. (S0182)

In this case, the ltrp\_in\_header\_flag[ listIdx ][ rplsIdx ] has no purpose or meaning.

The inference aspect is not proposing a change, since there is an existing inference specification that would naturally include this case.

AHG Recommendation (cleanup): Adopt.

[JVET-S0045](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10167) AHG9: On the sign of DeltaPocValSt [D. Liu, R. Sjöberg, Z. Zhang, M. Pettersson, M. Damghanian, J. Enhorn, J. Ström, R. Yu(Ericsson)]

[JVET-S0049](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10171) AHG9/AHG8/AHG12: On parameter sets and picture header [Y.-K. Wang, L. Zhang, Z. Deng, K. Zhang (Bytedance)]

Aspect 2 of this contribution belongs to this category.

[JVET-S0082](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10204) AHG8/AHG9: On signaling of inter-layer reference picture layer index [H. Jang, Hendry, S. Paluri, J. Nam, S. Kim, J. Lim (LGE)]

[JVET-S0083](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10205) AHG8/AHG9: On signaling of ILRP layer index using delta value [Hendry, H. Jang, J. Nam, S. Kim, J. Lim (LGE)]

[JVET-S0085](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10207) AHG9: On semantics related to reference picture lists [T. Chujoh, E. Sasaki, T. Ikai (Sharp)]

[JVET-S0096](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10218) AHG9: On RPL syntax and semantics [J. Chen, Y. Ye, R.-L. Liao (Alibaba)]

Aspects 1 to 4 of this contribution belong to this category.

[JVET-S0123](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10245) AHG9: On reference picture list constraints [V. Seregin, Y. He, M. Coban, A. K. Ramasubramonian, M. Karczewicz (Qualcomm)]

[JVET-S0159](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10281) AHG9: Reference picture list (RPL) cleanups [Y.-K. Wang, L. Zhang, Z. Deng (Bytedance)]

[JVET-S0182](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10304) AHG9: On Reference Picture List Sgnalling [S. Deshpande, J. Samuelsson, A. Segall, P. Cowan (Sharp)]

### Signalling of virtual boundaries (2+5)

[JVET-S0047](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10169) AHG9: Signalling of Virtual Boundary Positions [M. Damghanian, R. Sjöberg, M. Pettersson, Z. Zhang, J. Enhorn, J. Ström, R. Yu, D. Liu]

This contribution was discussed in the HLS AHG meeting at 0837 UTC on Thursday 28 May.

At the 18th JVET meeting, it was decided (in JVET-R0266 item 6) to code virtual boundary positions using ue(v) for the sps\_virtual\_boundary\_pos\_x, sps\_virtual\_boundary\_pos\_y, ph\_virtual\_boundary\_pos\_x and ph\_virtual\_boundary\_pos\_y syntax elements instead of fixed length coding using u(13). It is observed that the value of 0 is not allowed for these four syntax elements so this contribution proposes to align the semantics of these four syntax elements with other syntax elements in the specification and use the minus1 mechanism. The following changes to the syntax and semantics are proposed:

* Add “\_minus1” to each of the four syntax elements sps\_virtual\_boundary\_pos\_x, sps\_virtual\_boundary\_pos\_y, ph\_virtual\_boundary\_pos\_x and ph\_virtual\_boundary\_pos\_y.
* Update the corresponding ranges and derivations in the semantics of the four syntax elements accordingly.

AHG Recommendation (cleanup): Adopt.

[JVET-S0065](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10187) AHG9: On Virtual Boundary [S. Deshpande, J. Samuelsson, A. Segall, P. Cowan (Sharp)]

This contribution was discussed in the HLS AHG meeting at 0840 UTC on Thursday 28 May.

Modifications are proposed related to virtual boundary.

The following changes were proposed:

* Proposal 1: An assertedly missing inference rule is specified for sps\_virtual\_boundaries\_present\_flag to be inferred to be equal to 0 when not present.

AHG Recommendation (bug fix/expression of existing intent): Adopt.

* Proposal 2: An asserted simplification of text is proposed for virtual boundary derivation.

This aspect is only editorial.

Editor action item: The editor is requested to consider improving the expression. It was remarked that there may be some issues with the text that was proposed.

The following topics were discussed in the HLS pre-meeting at 1340 UTC on 20 June.

[JVET-S0165](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10287) AHG9: Cleanup on signalling virtual boundaries [S.-T. Hsiang, L. Chen, O. Chubach, Y.-W. Huang, S.-M. Lei (MediaTek)]

In this contribution following high-level syntax cleanups are proposed, related to signalling information on virtual boundaries:

1. Proposal 1: The presence of sps\_virtual\_boundaries\_present\_flag is conditioned on sps\_res\_change\_in\_clvs\_allowed\_flag.
2. Proposal 2: The presence of virtual boundaries is further conditioned on sps\_subpic\_info\_present\_flag.
   1. Proposal 2a: The presence of ph\_virtual\_boundaries\_present\_flag is further conditioned on sps\_subpic\_info\_present\_flag
   2. Proposal 2b: The presence of sps\_virtual\_boundaries\_present\_flag is further conditioned on sps\_subpic\_info\_present\_flag

This is a proposal for syntax conditioning to enforce existing constraints that disable the combination of virtual boundaries with resolution changes and subpictures.

It was commented that it would be hypothetically possible to make these tools work together (e.g. in some future revision), although that is prohibited, and that we ordinarily do not use syntax conditioning in such cases. In some prior contributions (see JVET-Q0417), these features were proposed to work together. Thus, no action was recommended on this.

[JVET-S0171](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10293) AHG9: Cleanup on virtual boundaries for SAO [S.-Y. Lin, Y.-H. Lee, J.-L. Lin, Y.-J. Chen, C.-C. Ju (MediaTek)]

This contribution proposes editorial changes for disabling SAO filtering operations across virtual boundaries by moving the specification text to the condition of edge offset mode to make it clearer.

This does not propose technical modifications.

Editor action item: The editor is requested to consider the proposed improvements.

[JVET-S0184](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10306) AHG9: On Virtual Boundary Signalling [S. Deshpande, J. Samuelsson, A. Segall, P. Cowan (Sharp)]

Modification is proposed related to a virtual boundary constraint.

It is proposed to specify a conformance constraint regarding virtual boundary signalling when subpictures are present, directly on related SPS syntax elements.

Revisit after offline study.

[JVET-S0211](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10333) AHG9: Extensibility for the number of virtual boundaries [M. Damghanian, M. Pettersson, R. Sjöberg, J. Enhorn, J. Ström, R. Yu, D. Liu (Ericsson)]

This contribution proposes to signal the number of virtual boundaries using ue(v) instead of the current signalling using u(2) for the four syntax elements sps\_num\_ver\_virtual\_boundaries, sps\_num\_hor\_virtual\_boundaries, ph\_num\_ver\_virtual\_boundaries and ph\_num\_hor\_virtual\_boundaries. The motivation for the proposed change was reported to be future extensibility. The value range of the four syntax elements are proposed to be kept as 0 to 3, inclusive, for version 1 of VVC.

The current “hard coding” of the constraint seemed only to try to prohibit violation, but forecloses future uses. It was commented that we generally do not use syntax solely to enforce constraints that could be violated in a reasonable future use.

AHG Recommendation (extensibility cleanup): Adopt (while retaining the current value range).

[JVET-S0221](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10343) AHG9: On virtual boundaries [Y.-J. Chang, M. Coban, V. Seregin, N. Hu, M. Karczewicz (Qualcomm)]

The current specification allows a virtual boundary to be located at the picture boundary when the picture resolution is 8xH or Wx8, but it is disallowed for other picture resolutions. This contribution proposes to disallow virtual boundaries located at picture boundary for all picture resolutions. Two approaches, signalling constraint or semantics restriction, are proposed as follows:

1. Add explicit checking on the signalling of syntax elements as follows:
   1. Condition sps\_virtual\_boundaries\_enabled\_flag on (sps\_pic\_width\_max\_in\_luma\_samples > 8 | | sps\_pic\_height\_max\_in\_luma\_samples > 8), and infer sps\_virtual\_boundaries\_enabled\_flag to be equal to 0 when not present.
   2. Condition sps\_num\_ver\_virtual\_boundaries on (sps\_pic\_width\_max\_in\_luma\_samples > 8).
   3. Condition sps\_num\_hor\_virtual\_boundaries on (sps\_pic\_height\_max\_in\_luma\_samples > 8).
   4. Condition ph\_num\_ver\_virtual\_boundaries on (pps\_pic\_width\_in\_luma\_samples > 8).
   5. Condition ph\_num\_hor\_virtual\_boundaries on (pps\_pic\_height\_in\_luma\_samples > 8).
2. Or add bitstream conformance constraints as follows:
   1. It is a requirement of bitstream conformance that when the value of sps\_pic\_width\_max\_in\_luma\_samples is equal to or smaller than 8, the value of sps\_num\_ver\_virtual\_boundaries shall be equal to 0.
   2. It is a requirement of bitstream conformance that when the value of sps\_pic\_height\_max\_in\_luma\_samples is equal to or smaller than 8, the value of sps\_num\_hor\_virtual\_boundaries shall be equal to 0.
   3. It is a requirement of bitstream conformance that when the value of pps\_pic\_width\_in\_luma\_samples is equal to or smaller than 8, the value of ph\_num\_ver\_virtual\_boundaries shall be equal to 0.
   4. It is a requirement of bitstream conformance that when the value of pps\_pic\_height\_in\_luma\_samples is equal to or smaller than 8, the value of ph\_num\_hor\_virtual\_boundaries shall be equal to 0.

In the current draft spec, there is a case where a syntax element has a specified range from 0 to −1 under certain conditions.

The proponent said that subpicture layout has a similar syntax treatment as approach #1.

AHG Recommendation (spec bug fix/expression of existing intent): Adopt approach 2 (or editorial equivalent). It also seems desirable to make sure the range constraint never specifies a non-valid range even in disallowed cases.

### Hypothetical reference decoder (HRD) (12+15)

See also JVET-S0098 aspects c and d in section 3.3.

[JVET-S0141](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10263) AHG9: A Summary of Proposals Related to HRD [S. Deshpande (Sharp)]

This contribution was discussed in the HLS AHG meeting at 0850 UTC on Thursday 28 May and in the HLS AHG pre-meeting at 1530 on 20 June.

This contribution intends to provide a summary of proposals on core aspects of HRD (including HRD operation, related SEI message signalling and sub-bitstream extraction).

Following proposals listed in JVET-S0137-v2 section 3.1.8 are covered in this summary: JVET-S0064, JVET-S0075 (aspect 2), JVET-S0097, JVET-S0080, JVET-S0086, JVET-S0099, JVET-S0101, JVET-S0102, JVET-S0117, JVET-S0118. Additionally JVET-S0049 Item 1 is covered.

Additionally the 14 new proposals listed below in this Section starting from JVET-S0154 are also covered in this summary.

It is suggested that this summary be used for the reviewing of these proposals, such that the discussions may be done in a more structured and efficient manner. The following changes were proposed:

**Related to HRD signalling and operation:**

1. Conditionally signal bp\_sublayer\_dpb\_output\_offsets\_present\_flag (and bp\_dpb\_output\_tid\_offset[ i ]) only when bp\_max\_sublayers\_minus1 is greater than 0 and infer it as 0 otherwise?
   1. Alternatively, add following constraint: when bp\_max\_sublayers\_minus1 is equal to 0, bp\_sublayer\_dpb\_output\_offsets\_present\_flag shall be equal to 0. (JVET-S0064)

AHG Recommendation (bug fix/expression of existing intent): Adopt the conditional signalling.

1. When sps\_video\_paramater\_set\_id is equal to 0:

AHG Recommendation (bug fix/expression of existing intent): Adopt inferences a, b, c, e, f, and g.i.

* 1. Infer TotalNumOlss to be equal to 1 (JVET-S0075, JVET-S0097)
  2. Infer NumLayersInOls[ 0 ] to be equal to 1 (JVET-S0075, JVET-S0097)
  3. Infer vps\_layer\_id[ 0 ] to be equal to the single value of nuh\_layer\_id of all the VCL NAL units. (JVET-S0097)
  4. Require that parameter sets referred to shall have same nuh\_layer\_id value (JVET-S0075)

It was commented that this aspect is not necessary since the extraction process indirectly requires this.

Also, sharing of PSs is only allowed only if all layers are present in the OLS, which would be violated unless the requirement is true.

Editor action item: The editor is asked to consider adding some explanation to point out that this is the case. Item e below may help to make this clear.

* 1. Infer LayerIdInOls[ 0 ][ 0 ] to be equal to the single value of nuh\_layer\_id of all the VCL NAL units. (JVET-S0097)
  2. Infer NumSubLayersInLayerInOLS[ 0 ][ 0 ] to be equal to sps\_max\_sublayers\_minus1 + 1. (JVET-S0097)
  3. Modify the inference rule for vps\_max\_sub\_layers\_minus1 and range of values for sps\_max\_sublayers\_minus1 by adding quoted text and not inferring vps\_max\_layers\_minus1 to be equal to 6? (JVET-S0097)
     1. “When sps\_video\_parameter\_set\_id is greater than 0,” the value of sps\_max\_sublayers\_minus1 shall be in the range of 0 to vps\_max\_sublayers\_minus1, inclusive. “When sps\_video\_parameter\_set\_id is equal to 0, the value of sps\_max\_sublayers\_minus1 shall be in the range of 0 to 6, inclusive, and vps\_max\_sublayers\_minus1 is inferred to be equal to sps\_max\_sublayers\_minus1.”

or

* + 1. Modify only the inference for vps\_max\_sub\_layers\_minus1 (JVET-S0049 Item 1, JVET-S0097) as: When sps\_video\_parameter\_set\_id is equal to 0, the value of vps\_max\_sublayers\_minus1 is inferred to be equal to“sps\_max\_sublayers\_minus1” (instead of 6).

It was commented that option ii has a circularity issue in the semantics of sps\_max\_sublayers\_minus1, so option i is preferred.

1. Modify the semantics of bp\_max\_sublayers\_minus1 to change the range of values from 0 to vps\_max\_sublayers\_minus1 to instead require it to be equal to maxSubLayers (given as input to the ols\_hrd\_parameters() syntax structure)? (JVET-S0097)

It was commented that this has a relationship to S0100.

See the notes for S0100 in section 3.3.

1. Modify the additional bumping process for DPB by doing following? (JVET-S0080)
   1. Move the process for setting the value of PicLatencyCount from within additional bumping process to within the output and removal of pictures from the DPB (i.e., sub clause C.5.2.2) after the invocation of bumping process.

It was commented that no action is needed on this due to the recommended action for PictureOutputFlag for S0077.

* 1. Remove the additional bumping process or removal of the output of pictures in the additional bumping process.

Defer this for further study.

Discussion in the HLS AHG meeting stopped here at ~0220 on 28 May.

Discussion continued here in the HLS AHG pre-meeting at 1530 on 20 June.

1. Fix an asserted bug in Equation C.10 (also applicable to HEVC)? (JVET-S0101)

AHG Recommendation (bug fix/expression of existing intent): Adopt (also applicable to HEVC).

1. Add a constraint on the sum of InitialCpbRemovalDelay and InitialCpbRemovalOffset as follows? (JVET-S0101)

When bp\_concatenation\_flag is equal to 0, the sum of InitCpbRemovalDelay[ Htid ][ ScIdx ] and InitCpbRemovalDelayOffset[ Htid ][ ScIdx ] shall be the same as in the previous buffering period.

In the discussion, it was commented that we need to consider the possibility of splicing without the use of bp\_concatenation\_flag equal to 1. It was commented that this constraint could be a very serious imposition for such a splicing operation, and would be unlikely to be fulfilled in practice.

No action was recommended on this.

1. Include PH and AUD NAL units into the bitstream subject to HRD conformance checking using either of the following alternative options? (JVET-S0118)
   1. Include PH NAL unit and AUD in Type I bitstream
   2. Include PH NAL unit and AUD in Type II bitstream

Currently, Type I includes VCL (i.e., slices) and filler data NAL units only. Everything goes in Type II (possibly needing editorial clarification, but this is clearly what is specified).

Since PH is sometimes in the SH, it will be in Type I when it is not in a separate NAL unit.

When rewriting / BEAMing, we do not ordinarily expect PH content to be rewritten.

AHG Recommendation (consistency cleanup): Include PH NAL unit in Type I (but keep AUD in Type II as it was).

**Related to general and subpicture sub-bitstream extraction processes:**

Review of this group of contributions was deferred TBP, and the next topic discussed was item 12.

1. Perform the asserted bug-fixes for the general sub-bitstream extraction process for determining which AUD NAL units of the input bitstream are kept in the output sub-bitstream as follows? (JVET-S0086)
   1. Add AUD\_NUT among the NAL unit types that are kept in the output sub-bitstream regardless of its nuh\_layer\_id value.
   2. Add removal of an AUD NAL unit for which all VCL NAL units of an AU are removed by the sub-bitstream extraction.
2. Make the following changes related to the general sub-bitstream extraction process? (JVET-S0102)
   1. Add a constraint that the BP/PT/DUI SEI messages for any two OLSs with the same layer set are the same.
   2. Modification regarding AUs that become IRAP or GDR AU after extraction by doing one of the two options:
      1. Option 1: Add AUD writing to the extraction process for AUs that become IRAP AUs or GDR AUs.
      2. Option 2: Mandate AUDs to be placed in all AUs that contain IRAP or GDR pictures and add rewriting of aud\_irap\_or\_gdr\_au\_flag to extraction process.

Item 46) is related.

* 1. Place PT SEI messages in individual SEI NAL units when general\_same\_pic\_timing\_in\_all\_ols\_flag is equal to 1.
  2. Require that the scalable-nested and non-scalable-nested BP SEI messages in a CVS have the same values for the five syntax elements which specify lengths of various u(v) syntax elements.

1. Modify the subpicture sub-bitstream extraction process regarding handling of scalable-nested SEI messages by performing following? (JVET-S0099)
   1. Removal of scalable-nested SEI messages for non-target subpictures

Item 66) is related.

* 1. Removal before replacing non-scalable-nested SEI messages

Item 72) is related.

1. Modify the subpicture sub-bitstream extraction process by performing following? (JVET-S0117)
   1. Remove rewriting of PPS conformance window syntax elements since pps\_conformance\_window\_flag is asserted to be equal to 0.
   2. Remove subpicture ID mapping in SPS and PPS as follows:
      1. Remove the syntax elements sps\_subpic\_id[ j ] in all the referenced SPS NAL units and for each j that is not equal to subpicIdx.
      2. Remove the syntax elements pps\_subpic\_id[ j ] in all the referenced PPS NAL units and for each j that is not equal to subpicIdx.
   3. Rewrite virtual boundary syntax elements in SPS.

**New submissions (for the June 10th submission deadline)**

Discussion in the AHG pre-meeting began here at 1635 on 20 June.

(Convention for text changes proposed: “quoted text” is proposed to be removed and text inside delimiters < > is proposed to be added by proposals)

**Related to HRD signalling and operation:**

1. Change HRD operation description from being picture-specific to be AU-specific as follows? (JVET-S0157 item 1)
   1. In clauses C.2.3, D.3.2, and D.4.2, rename prevNonDiscardablePic to prevNonDiscardableAu, firstPicInPrevBuffPeriod to firstAuInPrevBuffPeriod, notDiscardablePic to notDiscardableAu, and change their descriptions from being picture-specific to AU-specific.
   2. In clause D.3.2, change the description of the semantics of bp\_concatenation\_flag and bp\_cpb\_removal\_delay\_delta\_minus1 from being picture-specific to be AU-specific.
   3. In clause D.3.2, change the description of the condition for the constraint requiring bp\_alt\_cpb\_params\_present\_flag to be equal to 0 from being picture-specific to be AU-specific.
   4. In clause D.4.2, change the descriptions of BpResetFlag, CpbRemovalDelayMsb[ i ], CpbRemovalDelayVal[ i ] and the constraint requiring pt\_cpb\_alt\_timing\_info\_present\_flag to be equal to 0 from being picture-specific to be AU-specific.
   5. In clause D.4.2, change the description of the semantics of pt\_dpb\_output\_delay, pt\_dpb\_output\_du\_delay, and pt\_display\_elemental\_periods\_minus1 from being picture-specific to be AU-specific.
   6. In clause D.5.2 (DU information SEI message semantics), change the description of the semantics of dui\_dpb\_output\_du\_delay from being picture-specific to be AU-specific.

It was commented that the design intent should already be clear that the HRD is intended to operate on an AU basis. These changes are intended just as editorial expression of this existing design intent.

AHG Recommendation (editorial BF/expression of existing intent): Adopt.

1. In clause D.3.2, modify the constraint related to bp\_alt\_cpb\_params\_present\_flag as follows: (JVET-S0157 item 2):

When <the associated AU is not an IRAP or GDR AU> “the associated picture is neither a CRA picture nor an IDR picture”, the value of bp\_alt\_cpb\_params\_present\_flag shall be equal to 0.

The idea of this is to treat GDR picture with ph\_recovery\_poc\_cnt equal to 0 consistently the same as an IRAP picture. This seemed to be just a forgotten, essentially editorial, issue.

AHG Recommendation (editorial BF/expression of existing intent): Adopt as proposed.

1. In clause D.4.2, in the constraint related to requiring pt\_cpb\_alt\_timing\_info\_present\_flag to be equal to 0, add that the RASL pictures in the constraint are RASL pictures that do not have mixed NAL unit types as follows? (JVET-S0157 item 4).

When <all pictures in the associated AU are RASL pictures with pps\_mixed\_nalu\_types\_in\_pic\_flag equal to 0> “the associated picture is a RASL picture”, the value of pt\_cpb\_alt\_timing\_info\_present\_flag shall be equal to 0.

AHG Recommendation (editorial BF/expression of existing intent): Adopt as proposed.

1. In clause D.5.2, in the semantics of pt\_display\_elemental\_periods\_minus1, change fixed\_pic\_rate\_within\_cvs\_flag[ TemporalId ] (3 instances) to fixed\_pic\_rate\_within\_cvs\_flag[ Htid ]? (JVET-S0153 item 5)

AHG Recommendation (editorial BF/expression of existing intent): Adopt as proposed.

1. Modify constraints as follows: (JVET-S0175 aspect 3)?

When “fixed\_pic\_rate\_within\_cvs\_flag[ TemporalId ] is equal to 0 or sps\_field\_seq\_flag is equal to 1, the value of” <any of the following applies> pt\_display\_elemental\_periods\_minus1 shall be equal to 0.<:

– sps\_field\_seq\_flag is equal to 1 for the output layers in the OLS.

– <sps\_field\_seq\_flag is equal to 0 for all output layers of the bitstream and there is not frame-field information SEI message present or display\_fields\_from\_frame\_flag is equal to 0 if a frame-field SEI message is associated with the AU and fixed\_pic\_rate\_within\_cvs\_flag[ TemporalId ] is equal to 0.>

It was noted that the frame-field SEI message is in the SEI message specification, and it contains the display\_fields\_from\_frame\_flag. It was said that the expressed constraint on pt\_display\_elemental\_periods\_minus1 is wrong in both specs.

AHG Recommendation (editorial bug fix/expression of existing intent): Replace the constraint above with “When sps\_field\_seq\_flag is equal to 1, the value of pt\_display\_elemental\_periods\_minus1 shall be equal to 0” and to say this (or equivalent) in both specs.

1. Change the condition for fixed picture rate across CVSs, by removing the max\_dec\_pic\_buffering\_minus1 (asserted not to be needed) and adding BP SEI message syntax related to concatenation\_flag. (JVET-S0175 aspect 1, 2)

AHG Recommendation (bug fix/expression of existing intent): Adopt first aspect. (This also affects HEVC in one place.)

The second aspect would impose an extra burden that is not currently imposed when the general flag is set equal to 0. It was also commented that it may not consider picture decoding time appropriately.

No action was recommended on the second aspect.

Discussion in the HLS AHG pre-meeting stopped here with the remaining items TBP.

1. Make either of the following changes (JVET-S0175 aspects 4 and 5)?
   1. Add a gating flag for pt\_display\_elemental\_periods\_minus1, so that its presence can be controlled and change the derivation of elementalOutputPeriod as follows and change D.9.6 accordingly?

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

–< Otherwise, if external means are provided to set the value of elementalOutputPeriods, elementalOutputPeriods is set equal to the value provided via external means.

– Otherwise , if frame-field information SEI messages are present for at least one of the output pictures in the AU of picture n, the value of elementalOutputPeriods is set to the lowest value of display\_elemental\_periods\_minus1 + 1 among all present frame-field information SEI messages.>

– Otherwise, elementalOutputPeriods is equal to 1.

* 1. An alternative option to a), with the key difference being that herein the main VVC specification does not depend on the frame-field information SEI message that is specified in the SEI specification.

1. Enable decoder operation without HRD timing SEI messages when fixed picture rate is signalled? (JVET-S0175 aspect 6). This is related to S0109 in section 3.1.2.
2. Conditionally signal bp\_sublayer\_initial\_cpb\_removal\_delay\_present\_flag, only when bp\_max\_sublayers\_minus1 is greater than 0 and infer it to 0 otherwise? (JVET-S0181 proposal 1, JVET S0157 item 3)
3. Move the signalling of bp\_max\_sublayers\_minus1 to be before the signalling of bp\_cpb\_removal\_delay\_deltas\_present\_flag and conditionally signal bp\_cpb\_removal\_delay\_deltas\_present\_flag and bp\_num\_cpb\_removal\_delay\_deltas\_minus1 and bp\_cpb\_removal\_delay\_delta\_val[ i ] syntax elements, only when bp\_max\_sublayers\_minus1 is greater than 0 and infer bp\_cpb\_removal\_delay\_deltas\_present\_flag equal to 0 otherwise? (JVET-S0181 proposal 2)?
4. Move the syntax element pt\_cpb\_removal\_delay\_minus1[ bp\_max\_sublayers\_minus1 ]  to locate it near the other CPB removal delay syntax elements, in particular other pt\_cpb\_removal\_delay\_minus1[ i ] syntax elements (and pt\_cpb\_removal\_delay\_delta\_idx[ i ] syntax elements) for i in the range of TemporalId to bp\_max\_sub\_layers\_minus1 − 1, inclusive? (JVET-S0185 proposal 1)
5. Move the signalling of syntax element bp\_alt\_cpb\_params\_present\_flag to locate it near the syntax element bp\_use\_alt\_cpb\_params\_flag where it is used? (JVET-S0185 proposal 2)
6. Modify the output and removal of picture from DPB as follows? (JVET-S0198)

C.5.2.2 Output and removal of pictures from the DPB

…

– Otherwise (the current AU is not a CVSS AU or the current AU is a CVSS AU that is not AU 0 but the current picture is not the first picture of the current AU), all picture storage buffers containing a picture which are marked as "not needed for output" and "unused for reference" are emptied (without output). For each picture storage buffer that is emptied, the DPB fullness is decremented by one. “When one or more of the following conditions are true, t”<T>he "bumping" process specified in clause C.5.2.4 is invoked repeatedly “while further decrementing the DPB fullness by one for each additional picture storage buffer that is emptied,” until <the number of pictures in the DPB is less than max\_dec\_pic\_buffering\_minus1[ Htid ] + 1>. “none of the following conditions are true:

* The number of pictures in the DPB that are marked as "needed for output" is greater than max\_num\_reorder\_pics[ Htid ].
* max\_latency\_increase\_plus1[ Htid ] is not equal to 0 and there is at least one picture in the DPB that is marked as "needed for output" for which the associated variable PicLatencyCount is greater than or equal to MaxLatencyPictures[ Htid ].
* The number of pictures in the DPB is greater than or equal to max\_dec\_pic\_buffering\_minus1[ Htid ] + 1.”

…

1. In clause 8.1.1, add the derivation of the variables DuHrdPreferredFlag and DecodingUnitHrdFlag, simialrly as in HEVC. (S0248 aspect 2 late)
2. In clauses C.2.2 and C.2.3, change the local variable decodingUnitParamsFlag to be a global variable DecodingUnitParamsFlag, to address the issue that decodingUnitParamsFlag was used in clause C.2.2 without being defied/initialized. (S0248 aspect 3 late)
3. In clause C.3.2, change the condition on when to remove decoded pictures neither needed for referecne nor needed for output such that it is applied to all pictures except for the first picture of AU 0. (S0248 aspect 4 late)
4. In clause C.5.2.2, change "Otherwise (the current AU is not a CVSS AU or the current AU is a CVSS AU that is not AU 0 but the current picture is not the first picture of the current AU)" to either of the following, as the condition in the parentheses is assertedly incorrect.
   1. "Otherwise (the current AU is not a CVSS AU, <the current AU is CVSS AU 0,> or the current AU is a CVSS AU that is not AU 0 but the current picture is not the first picture of the current AU)" (S0223)
   2. "Otherwise" (S0248 aspect 5 late)
5. In clause C.5.2.3, remove "AU n containing " from the first sentence, i.e., "The processes specified in this clause happen instantaneously when the last DU of AU n containing the current picture is removed from the CPB." (S0223, S0248 aspect 6 late)
6. In clause D.3.2, add the following constraint to disallow the combination of alternative timing for the CRA/DRAP case and the decoding unit HRD mode: When bp\_alt\_cpb\_params\_present\_flag is equal to 1, the value of bp\_du\_hrd\_params\_present\_flag shall be equal to 0. (S0248 aspect 7 late)

**Related to sub-bitstream extraction**

**General SEI semantics and constraints:**

1. Fix an asserted missing integration of an agreement (from JVET-Q0394) that specifies that non-scalable-nested HRD-related SEI messages apply to the OLSs that include the same set of layers as the entire bitstream (instead of only to the 0th OLS)? (JVET-S0178 aspect 1)
   1. Consequently, add a constraint such that when there is no OLS that includes the set of layers same as the entire bitstream, there shall be no non-scalable-nested SEI message with payloadType equal to 0 (BP), 1 (PT), 130 (DUI), or 203 (SLI)? (JVET-S0178 aspect 1.a)
   2. And remove the constraint requiring the value of nuh\_layer\_id for an SEI NAL unit containing non-scalable-nested HRD-related SEI messages to be equal to vps\_layer\_id[ 0 ], such that the value of nuh\_layer\_id for such SEI NAL units is unconstrained, same as for the nuh\_layer\_id for DCI, VPS, AUD, and EOS NAL units? (JVET-S0178 aspect 1.b)
2. Remove the payloadType value 203 (SLI) from the VclAssociatedSeiList? (JVET-S0178 aspect 3)
3. Add the clarification (that was recently added to the HEVC specification as an corrigendum item) on the value ranges of tone\_map\_id, frame\_packing\_arrangement\_id, knee\_function\_id, and colour\_remap\_id, including potential collisions of the interpretation for values of these syntax elements? (JVET-S0178 aspect 4)
4. Add a constraint such that when general\_same\_pic\_timing\_in\_all\_ols\_flag is equal to 1, there shall be no SEI NAL units that contain a scalable-nested SEI message with payloadType equal to 1 (PT) ? (JVET-S0178 aspect 5)
5. Modify an existing constraint, to add the SLI SEI message, such that when an SEI NAL unit contains a non-scalable-nested SEI message with payloadType equal to 0 (BP), 1 (PT), 130 (DUI), or 203 (SLI), the SEI NAL unit shall not contain any other SEI message with payloadType not equal to 0, 1, 130, or 203? (JVET-S0178 aspect 6)
6. Modify an existing constraint, to add the SLI SEI message, that when an SEI NAL unit contains a scalable-nested SEI message with payloadType equal to 0 (BP), 1 (PT), 130 (DUI), or 203 (SLI), the SEI NAL unit shall not contain any other SEI message with payloadType not equal to 0, 1, 130, 203, or 133 (scalable nesting) ? (JVET-S0178 aspect 7)
7. Add a constraint such that when an SEI NAL unit contains an SEI message with payloadType equal to 3 (filler payload), the SEI NAL unit shall not contain any other SEI message with payloadType not equal to 3? (JVET-S0178 aspect 8)
8. Add a constraint such that when an SLI SEI message and a BP SEI message that apply to a particular OLS are present within an AU, the SLI SEI messages shall precede the BP SEI message in decoding order? (JVET-S0178 aspect 9)

**Scalable nesting SEI message:**

1. Modify semantics of sn\_num\_subpics\_minus1 (based on following options)?
   1. Clarify the association of scalable-nested SEI messages for subpictures to either layers or OLS as follows? (JVET-S0173 item 2)

**sn\_num\_subpics\_minus1** plus 1 specifies the number of subpictures to which the scalable-nested SEI messages apply. <When sn\_ols\_flag is equal to 0,> the value of sn\_num\_subpics\_minus1 shall be less than or equal to the value of sps\_num\_subpics\_minus1 in the SPS referred to by the pictures <of the indicated layer. Otherwise, when sn\_ols\_flag is equal to 1, the value of sn\_num\_subpics\_minus1 shall be less than or equal to the value of sps\_num\_subpics\_minus1 in the SPS referred to by the pictures of the highest layer in the OLS with sps\_num\_subpics\_minus1 greater than 0.>

* 1. Specify the semantics of sn\_num\_subpics\_minus1 and sn\_subpic\_idx[ i ] in a way such that the syntax elements are about the subpictures of the layers with multiple subpictures per picture? (JVET-S0177 aspect 7)

<Among the layers in the OLSs (when sn\_ols\_flag is equal to 1) to which the scalable-nested SEI messages apply, or among the layers (when sn\_ols\_flag is equal to 0) to which the scalable-nested SEI messages apply, those for which the referenced SPSs have sps\_num\_subpics\_minus1 greater than 0 are referred to as the multiSubpicLayers.>

**sn\_num\_subpics\_minus1** plus 1 specifies the number of subpictures <in each picture in the multiSubpicLayers> “to which the scalable-nested SEI messages apply”. The value of sn\_num\_subpics\_minus1 shall be less than or equal to the value of sps\_num\_subpics\_minus1 in the SPS<s> referred to by the pictures in the <multiSubpicLayers> “CLVS**”**.

1. Change sn\_subpic\_id[ i ] to sn\_subpic\_idx[ i ] and remove sn\_subpic\_id\_len\_minus1 as follows? (JVET-S0177 aspect 1)

**sn\_subpic\_id<x>**[ i ] “indicates” <specifies the subpicture index of> the i-th subpicture “ID associated with the scalable-nested SEI messages” <in each picture in the multiSubpicLayers. The value of sn\_subpic\_idx[ i ] shall be less than or equal to the value of sps\_num\_subpics\_minus1 in the SPSs referred to by the pictures in the multiSubpicLayers.> “The length of the sn\_subpic\_id[ i ] syntax element is sn\_subpic\_id\_len\_minus1 + 1 bits.” <The scalable-nested SEI messages also apply to the single subpicure in each picture in the layers that are not in the multiSubpicLayers but are among the layers in the OLSs (when sn\_ols\_flag is equal to 1) to which the scalable-nested SEI messages apply or among the layers (when sn\_ols\_flag is equal to 0) to which the scalable-nested SEI messages apply.>

**“sn\_subpic\_id\_len\_minus1** plus 1 specifies the number of bits used to represent the syntax element sn\_subpic\_id[ i ]. The value of sn\_subpic\_id\_len\_minus1 shall be in the range of 0 to 15, inclusive.

It is a requirement of bitstream conformance that the value of sn\_subpic\_id\_len\_minus1 shall be the same for all scalable nesting SEI messages that are present in a CLVS.”

Or change semantics of sn\_subpic\_id\_len\_minus1 by changing CLVS to CVS (JVET-S0173 item 2):

**sn\_subpic\_id\_len\_minus1** plus 1 specifies the number of bits used to represent the syntax element sn\_subpic\_id[ i ]. The value of sn\_subpic\_id\_len\_minus1 shall be in the range of 0 to 15, inclusive.

It is a requirement of bitstream conformance that the value of sn\_subpic\_id\_len\_minus1 shall be the same for all scalable nesting SEI messages that are present in a C“L”VS.

1. Disallow containing of filler payload SEI messages in a scalable nesting SEI message? (JVET-S0177 aspect 2)
2. Constrain that, when a scalable nesting SEI message contains one or more subpicture level information (SLI) SEI messages, the value of sn\_ols\_flag shall be equal to 1, and the value of sn\_subpic\_flag shall be equal to 0? (JVET-S0177 aspect 3)
3. Modify an existing constraint, to include the SLI message, such that when a scalable nesting SEI message contains a BP, PT, DUI, or SLI SEI message, the scalable nesting SEI message shall not contain any other SEI message with payloadType not equal to 0 (BP), 1 (PT), 130 (DUI), or 203 (SLI)? (JVET-S0177 aspect 4)
4. Modify an existing constraint, to include recently added SEI messages, such that when a scalable nesting SEI message contains an SEI message that has payloadType not equal to 132 (decoded picture hash), the SEI NAL unit containing the scalable nesting SEI message shall have nal\_unit\_type equal to PREFIX\_SEI\_NUT? (JVET-S0177 aspect 5)
5. Add a constraint such that when a scalable nesting SEI message contains an SEI message that has payloadType equal to 132 (decoded picture hash), the SEI NAL unit containing the scalable nesting SEI message shall have nal\_unit\_type equal to SUFFIX\_SEI\_NUT? (JVET-S0177 aspect 6)

**General sub-bitstream extraction:**

1. Handling of AUD in sub-bitstream extraction process (JVET-S0102 item 5, JVET-S0225)
   1. Restrict aud\_irap\_or\_gdr\_au\_flag to a one-way constraint in single-layer bitstreams as follows? (JVET-S0102 item 5).

aud\_irap\_or\_gdr\_au\_flag equal to 1 specifies that the AU containing the AU delimiter is an IRAP or GDR AU. aud\_irap\_or\_gdr\_au\_flag equal to 0 specifies that the AU containing the AU delimiter is not an IRAP or GDR AU <when NumLayersInOls[ TargetOlsIdx ] is greater than 1>.

* 1. And/or modify sub-bitstream extraction process using either one of the following two options: (JVET-S0225)
     1. Option 1: Add AUD or rewrite aud\_irap\_or\_gdr\_au\_flag of the existing AUD when the associated extracted AU is an IRAP AU or GDR AU as follows:

<When an AU is an IRAP AU or GDR AU and no associated AUD, add an AUD NAL unit of type AUD\_NUT before the first VCL NAL unit of the AU with aud\_irap\_or\_gdr\_au\_flag equal to 1. Otherwise for any existing AUD, set aud\_irap\_or\_gdr\_au\_flag equal to 1 for  an IRAP AU or GDR AU.>

* + 1. Option 2: Add AUD or rewrite aud\_irap\_or\_gdr\_au\_flag of the existing AUD when the associated AU is an IRAP AU or GDR AU and the target OLS has multi-layers; and either remove the existing AUD or rewrite aud\_irap\_or\_gdr\_au\_flag of the existing AUD when the associated AU is an IRAP AU or GDR AU and the target OLS contains only single layer as follows:

– <When the targte OLS contains more than one layer,

* For each AU that is an IRAP AU or GDR AU with no associated AUD, add a NAL unit of type AUD\_NUT before the first VCL NAL unit of the AU with aud\_irap\_or\_gdr\_au\_flag equal to 1.
* Otherwise for any existing AUD, set aud\_irap\_or\_gdr\_au\_flag equal to 1 for an IRAP AU or GDR AU.

– Otherwise (the target OLS contains only one layer), remove the associated AUD from outBitstream for each AU, or for any existing AUD, set aud\_irap\_or\_gdr\_au\_flag equal to 1 for an IRAP AU or GDR AU.>

Item 9).b) is related.

1. In the general sub-bitstream extraction process, specify the conditions under which an output sub-bitstream is required to be a conforming bitstream such that the value of tIdTarget is specified to be in the range of 0 to vps\_ptl\_max\_tid[ vps\_ols\_ptl\_idx[ targetOlsIdx ] ], inclusive (instead of 0 to 6 inclusive)? (JVET-S0158 aspect 1)
2. Specify the general sub-bitstream extraction process such that it would remove, from the output bitstream outBitstream, SEI NAL units that contain a scalable nesting SEI message with sn\_ols\_flag equal to 0 while the applicable layers as indicted in the scalable nesting SEI message does not include any layer in the target OLS? (JVET-S0158 aspect 2)
3. Make the following changes to the 4th step in the general sub-bitstream extraction process? (JVET-S0158 aspect 3)
   1. Remove the redundant condition "nuh\_layer\_id is equal to LayerIdInOls[ targetOlsIdx ][ j ] for a value of j in the range of 0 to NumLayersInOls[ targetOlsIdx ] − 1 inclusive". (This is asserted to be editorial.)?
   2. When removing from the output bitstream the VCL NAL units, instead of removing the associated SEI NAL units containing SEI messages other than the BP, PT, or DUI SEI messages, remove all SEI NAL units that contain SEI messages that become not applicable to any picture or subpicture remaining in the final output bitstream? (Since this is not easy to do, another option is not to remove SEI NAL units in this step.)
4. Make the following changes to the last step in the general sub-bitstream extraction process? (JVET-S0158 aspect 4)
   1. Change the condition as follows?

When the list LayerIdInOls[ targetOlsIdx ] does not include all values of nuh\_layer\_id in all <VCL> NAL units in the bitstream <inBitstream>.

* 1. When at least one layer is removed by the extraction process, also remove all SEI NAL units that contain a non-scalable-nested SLI SEI message (same as for BP, PT, and DUI SEI messsages)?
  2. Insert SEI NAL units to directly contain those SEI messages that were scalable-nested HRD-related SEI messages that apply to the output bitstream, and remove their original container SEI NAL units from the output bitstream. When the target OLS includes only one layer, apply the same for scalable-nested non-HRD-related SEI messages?

**Subpicture level information (SLI) SEI message:**

1. Clarify the scope of Subpicture Level Information (SLI) SEI to be CVS instead of CLVS? (JVET-S0173 item 1)
2. Include all layers of the OLS in MinCr related constraint for subpictures by making the following changes? (JVET-S0173 item 3):

* The sum of the NumBytesInNalUnit variables for AU 0 corresponding to the j-th subpicture shall be less than or equal to FormatCapabilityFactor \* ( Max(“SubpicSizeY[ j ]”<AuSizeMaxInSamplesY[ 0 ]>, fR \* MaxLumaSr <) >\* OlsRefLevelFraction[ i ][ j ] ÷ 256 “)” + MaxLumaSr \* ( AuCpbRemovalTime[ 0 ] − AuNominalRemovalTime[ 0 ] ) \* OlsRefLevelFraction[ i ][ j ] ) ÷ ( 256 \* MinCr ), where MaxLumaSr and FormatCapabilityFactor are the values specified in Table A.2 and Table A.3, respectively, that apply to AU 0, at level sli\_ref\_level\_idc[ i ], and MinCr and AuSizeMaxInSamplesY[ 0 ] are derived as indicated in A.4.2.

1. Modify the inference rule for sli\_ref\_level\_fraction\_minus1[ i ][ j ]? (JVET-S0173 item 5):

When not present, the value of sli\_ref\_level\_fraction\_minus1[ i ][ j ] is inferred to be equal to <Max( 256,> Ceil( 256 \* SubpicSizeY[ j ] ÷ PicSizeInSamplesY \* MaxLumaPs( general\_level\_idc ) ÷ MaxLumaPs( sli\_ref\_level\_idc[ i ] ) <)>− 1.

1. Resolve editorial notes related to subpictures as follows? (JVET-S0173 item 6):
   1. Refer to minCR and fR derivation in A.4.2.
   2. Replace PicSizeInSamplesY with PicSizeMaxInSamplesY and clarify that the picture size of the highest layer with subpictures in the OLS is taken.
2. Replace sps\_num\_subpics\_minus1 with sli\_num\_subpics\_minus1 in semantics of sli\_num\_ref\_levels\_minus1? (JVET-S0173 item 7)
3. Modify alignment constraint of intendent subpictures by adding sps\_subpic\_treated\_as\_pic\_flag[ i ] syntax element to the clause as follows? (JVET-S0173 item 4):

– All the SPSs referred to by the layers in targetLayerSet shall have the same value of sps\_num\_subpics\_minus1 and <sps\_log2\_ctu\_size\_minus5 and> shall have the same values of sps\_subpic\_ctu\_top\_left\_x[ j ], sps\_subpic\_ctu\_top\_left\_y[ j ], sps\_subpic\_width\_minus1[ j ], sps\_subpic\_height\_minus1[ j ], and sps\_subpic\_treated\_as\_pic\_flag[ j ], respectively, for each value of j in the range of 0 to sps\_num\_subpics\_minus1, inclusive.

1. Add sli\_max\_sublayers\_minus1, sli\_sublayer\_info\_present\_flag, and a loop for sublayers for the signalled fractions and reference level indicators, to support sublayers? (JVET-S0176 item 1)
2. Allow SLI SEI messages to be available either in the bitstream or provided through an external means not specified in this Specification? (JVET-S0176 item 2)
3. Change the persistency scope for SLI SEI from one CVS to one or more CVSs, to be consistent with VPSs and SPSs wherein level information are or may be signalled? (JVET-S0176 item 3)
4. Change the definition of subpicture sequence to cover the case when there is one or more layers with single subpicture per picture? (JVET-S0176 item 4)
5. Require that, when an SLI SEI message is present for a CVS, the value of sps\_num\_subpics\_minus1 shall be the same for all the SPSs referenced by the pictures in the layers with multiple subpictures per picture. (JVET-S0176 item 5)?
6. Specify the semantics of sli\_num\_subpics\_minus1 in a way such that the syntax element is about the subpictures of the layers with multiple subpictures per picture? (JVET-S0176 item 6)
7. Make variable derivations subpicture sequence specific as follows: Add an array index, which identifies a subpicture sequence, to both the variables SubpicLevelIdc and SubpicLevelIdx, as well as to the arrays SubpicCpbSizeVcl, SubpicCpbSizeNal, SubpicBitRateVcl, and SubpicBitRateNal in the last set of constraints in the semantics of the SLI SEI message? (JVET-S0176 item 7)

**Subpicture sub-bitstream extraction:**

1. Modify the specification of subpicture sequences, which when extracted, are required to be a conforming bitstream? (JVET-S0154 aspect 1)?
2. Remove VCL NAL units and their associated filler data NAL units and associated filler payload SEI messages etc. regardless of whether there is an external means for replacing of the parameter sets? (JVET-S0154 aspect 2)
3. Remove SEI NAL units containing scalable-nested SEI messages that do not apply to the output bitstream from the output bitstream? (JVET-S0154 aspect 3)
4. Specify the subpicture index for identifying the subpicture sequence as the subpicture index of the to-be-extracted subpictures in the layers with multiple subpictures per picture, not the layers with only one subpicture per picture? (JVET-S0154 aspect 4)
5. Rewrite both general\_level\_idc and sublayer\_level\_idc[ k ] for k in the range of 0 to tIdTarget − 1, inclusive, in the referenced VPSs, when present, and in the referenced SPSs, when NumLayersInOls[ targetOLsIdx ] is equal to 0? (JVET-S0154 aspect 5)
6. Rewrite cpb\_size\_value\_minus1[ k ][ j ] and bit\_rate\_value\_minus1[ k ][ j ] for all values of k in the range of 0 to tIdTarget, inclusive, in the referenced VPSs, when present, and in the referenced SPSs, when NumLayersInOls[ targetOLsIdx ] is equal to 0? (JVET-S0154 aspect 6)
7. Specify the calculation and rewriting of the scaling window offset parameters as part of the subpicture sub-bitstream extraction process?
   1. As per JVET-S0154 aspect 7?
   2. As per JVET-S0189?
8. Rewrite cbr\_flag[ tIdTarget ][ j ] in the referenced VPSs, when present, and in the referenced SPSs, when NumLayersInOls[ targetOLsIdx ] is equal to 0? (JVET-S0154 aspect 8)
9. Insert SEI NAL units to directly contain those SEI messages that were scalable-nested HRD-related SEI messages that apply to the output bitstream, and remove their original container SEI NAL units from the output bitstream. When the target OLS includes only one layer, apply the same for scalable-nested non-HRD-related SEI messages? (JVET-S0154 aspect 9)

[JVET-S0049](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10171) AHG9/AHG8/AHG12: On parameter sets and picture header [Y.-K. Wang, L. Zhang, Z. Deng, K. Zhang (Bytedance)]

Aspect 1 of this contribution belongs to this category.

[JVET-S0064](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10186) AHG9: On Buffering Period Message Signalling [S. Deshpande, J. Samuelsson, A. Segall, P. Cowan (Sharp)]

[JVET-S0075](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10197) AHG9: On constraints and inference values when VPS is not present [Hendry, S. Paluri, S. Kim (LGE)]

Aspect 2 of this contribution belongs to this category.

[JVET-S0097](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10219) AHG8/AHG9: Clarifications to HRD specification for single-layer and multi-layers bitstreams [V. Drugeon, T. Nishi, K. Abe, T. Toma (Panasonic)]

[JVET-S0080](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10202) AHG9: On additional bumping process in the DPB [S. Paluri, Hendry, S. Kim (LGE)]

[JVET-S0086](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10208) AHG9: On AUD NAL units in the sub-bitstream extraction process [M. M. Hannuksela (Nokia)

[JVET-S0099](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10221) AHG12: SEI message handling in subpicture extraction [R. Skupin, Y. Sanchez, K. Suehring (HHI), V. Drugeon (Panasonic)]

[JVET-S0101](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10223) AHG9: On HRD [Y. Sanchez, R. Skupin, K. Suehring, T. Schierl (HHI)]

[JVET-S0102](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10224) AHG9: On OLS extraction [R. Skupin, Y. Sanchez, K. Suehring, T. Schierl (HHI)]

[JVET-S0117](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10239) AHG12: On Subpicture sub-bitstream exaction [Y. He, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-S0118](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10240) AHG9: On HRD bitstream [Y. He, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-S0154](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10276) AHG9/AHG8/AHG12: On the subpicture sub-bitstream extraction process [Y.-K. Wang, Z. Deng, K. Zhang, L. Zhang (Bytedance)]

[JVET-S0157](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10279) AHG9: HRD and related cleanups [Y.-K. Wang, Z. Deng (Bytedance)]

[JVET-S0158](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10280) AHG9/AHG8: On the general sub-bitstream extraction process [Y.-K. Wang, Z. Deng (Bytedance)]

[JVET-S0173](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10295) AHG9/AHG12: Subpicture related cleanups [R. Skupin, Y. Sanchez, K. Suehring, T. Schierl (HHI)]

[JVET-S0175](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10297) AHG9: Cleanup of picture rate info and HRD operation without timing SEI messages [Y. Sanchez, R. Skupin, K. Suehring, T. Schierl (HHI)]

[JVET-S0176](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10298) AHG9: On the subpicture level information SEI message [Y.-K. Wang, Z. Deng (Bytedance)]

[JVET-S0177](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10299) AHG9: On the scalable nesting SEI message [Y.-K. Wang, Z. Deng (Bytedance)]

[JVET-S0178](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10300) AHG9: General SEI semantics and constraints [Y.-K. Wang, Z. Deng (Bytedance)]

[JVET-S0181](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10303) AHG9: On Buffering Period [S. Deshpande, J. Samuelsson, A. Segall, P. Cowan (Sharp)]

[JVET-S0185](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10307) AHG9: On HRD Cleanups [S. Deshpande, J. Samuelsson, A. Segall, P. Cowan (Sharp)]

[JVET-S0189](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10311) AHG9/AHG8/AHG12: On subpicture bitstream extraction process [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-S0198](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10320) AHG9: On removal of picture from DPB process [S. Paluri, Hendry, S. Kim (LGE)]

[JVET-S0223](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10345) AHG9: On picture bumping process [V. Seregin, Y. He, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-S0225](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10347) AHG 9: On AUD for sub-bitstream extraction [Y. He, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

S0102-v2 item 5 is related.

[JVET-S0248](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10387) AHG9: HRD text cleanups [Y.-K. Wang (Bytedance), Y. Sanchez, R. Skupin (HHI), S. Deshpande (Sharp), V. Seregin (Qualcomm), Hendry (LGE), J. Chen (Alibaba)] [late]

Aspects 2 to 7 this contribution belong to this category.

### DCI, VUI, and SEI (3+3)

[JVET-S0172](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10294) AHG9: On generalized cubemap projection SEI message [Y.-H. Lee, J.-L. Lin, Y.-J. Chen, C.-C. Ju (MediaTek)]

This contribution was discussed in the HLS AHG pre-meeting at 1900 on 20 June. It proposes the following modifications and constraints related to the generalized cubemap projection SEI message:

1. Add a condition check of gcmp\_guard\_band\_flag when deriving gcmpGuardBandSamples to prevent from accessing an uninitialized variable.
2. Add constraints on gcmp\_face\_index[ i ] and gcmp\_face\_rotation[ i ] for the hemisphere cubemap projection to guarantee that the four half faces are the ones connecting to the full face and can represent 180°×180° omnidirectional image/video. (The “if” part of the “otherwise” should be removed.)
3. Include an offset the remapping of sample locations on the half faces of the hemisphere cubemap projection.

AHG Recommendation (bug fix and sensibility constraints): Adopt.

It was asked whether each half-height / half-width is required to be an integer multiple of 2 in the 4:2:0 / 4:2:2 cases, to avoid half-chroma samples.

Revisit after offline work by the proponent was requested to establish this constraint.

The remaining items in this category are TBP.

[JVET-S0051](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10173) AHG9: Digital signature SEI message [J. Xu, Y.-K. Wang, L. Zhang, K. Zhang (Bytedance)]

[JVET-S0107](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10229) AHG9/AHG12: Recommended multi-layer composite picture SEI messages [J. Boyce (Intel)]

[JVET-S0108](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10230) AHG8/AHG9: Refinement of proposed positioning information SEI message of output independent layers [E. Thomas (TNO)]

[JVET-S0213](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10335) AHG8/AHG9: Refinement of proposed positioning information SEI message of output independent layers with example bitstreams [E. Thomas (TNO)]

[JVET-S0214](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10336) AHG8/AHG9: Updates on the implementation of multi-layer decoding and output independent layer arrangement in VTM [E. Thomas (TNO)]

### HLS editorial inputs (4+3)

TBP.

[JVET-S0068](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10190) AHG9: Editorial improvements on high-level syntax [S.-T. Hsiang, O. Chubach, L. Chen, Y.-W. Huang, S.-M. Lei (MediaTek)]

[JVET-S0096](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10218) AHG9: On RPL syntax and semantics [J. Chen, Y. Ye, R.-L. Liao (Alibaba)]

Aspect 5 of this contribution belongs to this category.

[JVET-S0110](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10232) AHG9: On HLS Editorial cleanup [Y. He, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

Aspect 2 of this contribution belongs to this category.

[JVET-S0119](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10241) AHG9: Expression of existing intent for VPS/SPS/PPS syntax elements [N. Hu, V. Seregin, Y. He, M. Karczewicz (Qualcomm)]

[JVET-S0192](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10314) AHG9: On reference picture list with generating unavailable reference picture [B. Choi, S. Wenger, S. Liu (Tencent)]

Aspects 2 and 3 of this contribution belong to this category.

[JVET-S0194](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10316) AHG9: On editorial cleanups [Y. He, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-S0208](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10330) AHG9: Proposed fixes to HLS [M. Pettersson, R. Yu, R. Sjöberg, M. Damghanian, J. Enhorn, J. Ström, D. Liu (Ericsson)]

## AHG12: High-level parallelism and coded picture regions (7+5)

[JVET-S0145](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10267) AHG12: A summary of proposals on tile, slices, and subpictures [Y.-K. Wang (Bytedance)]

This contribution was discussed in the HLS AHG meeting at 0050 UTC on Friday 29 May and in the HLS AHG pre-meeting at 1945 on 20 June.

This contribution provides a summary of the 11 proposals on subpictures, slices, and tiles (the agenda item 3.2 in JVET-S0137 and JVET-S0237).

It is suggested that this summary, in terms of a list of proposed items, is used for the reviewing of these proposals, such that the discussions can be in a more structured and efficient manner.

**On tiles and slices**

1. Allow the value of pps\_no\_pic\_partition\_flag to be different for different PPSs that are referred to by coded pictures within a CLVS. (S0049 aspect 3, S0095 aspect 4)
   1. Alternatively, move pps\_no\_pic\_partition\_flag from the PPS to the SPS (and rename it to sps\_no\_pic\_partition\_flag). (S0095 aspect 4)

It was said that it is not clear why this constraint is in the draft and that the constraint does not seem logical. We have different flags regarding slices and tiles.

AHG Recommendation (cleanup): Remove the constraint.

1. Do either of the following to reduce the current two options for signalling of a tile containing exactly one rectangular slice to one option only: (S0095 aspect 1)
   1. Replace pps\_num\_exp\_slices\_in\_tile[ i ] with pps\_num\_exp\_slices\_in\_tile\_minus1[ i ].
   2. Change the upper limit of pps\_exp\_slice\_height\_in\_ctus\_minus1[ i ][ j ] from RowHeight[ SliceTopLeftTileIdx[ i ] / NumTileColumns ] − 1 to RowHeight[ SliceTopLeftTileIdx[ i ] / NumTileColumns ] − 2.

There isn’t really a bug or problem, but there are two ways to signal the same thing.

Approach “a” would have a bit cost penalty.

No clear need for action was evident, so no action was recommended on this.

1. For a more precise value range, change the upper limit of pps\_exp\_slice\_height\_in\_ctus\_minus1[ i ][ j ] from RowHeight[ SliceTopLeftTileIdx[ i ] / NumTileColumns ] − 1 to RowHeight[ SliceTopLeftTileIdx[ i ] / NumTileColumns ] − pps\_num\_exp\_slices\_in\_tile[ i ]. (S0095 aspect 2)

This is purely editorial.

Editor action item: The editor may wish to consider whether this would improve clarity.

1. Change the syntax condition for pps\_rect\_slice\_flag from "if( NumTilesInPic > 1 )" to "if( NumTilesInPic > 3 )", because when the number of tiles in a picture is less than 4, the shape of each slice has to be rectangular. (S0095 aspect 3)

It was commented that this seems somewhat similar in spirit to item 2. This would force the encoder to decide the slice layout at the PPS level in advance when there are fewer than 4 tiles per picture. It was commented that this imposition would be undesirable, so no action was recommended on this.

1. Change the semantics of pps\_rect\_slice\_flag to cover the case that rectangular slice is smaller than the tile. (S0095 aspect 5)

This is a correction of an error in the current semantics expression.

AHG Recommendation (editorial bug fix): Adopt.

1. The inference condition of pps\_single\_slice\_per\_subpic\_flag is changed from "When not present" to "When the value of pps\_no\_pic\_partition\_flag is equal to 1" so that pps\_single\_slice\_per\_subpic\_flag is inferred only when it is needed. (S0095 aspect 6)

This is purely editorial. (It makes no technical difference whether we make this change or not.)

Editor action item: The editor may wish to consider whether this would be an editorial improvement.

Discussion in the HLS AHG meeting stopped here at 0120 UTC on 29 May.

Discussion in the HLS AHG pre-meeting began here at 1945 on 20 June.

1. When pps\_pic\_width\_in\_luma\_samples is less than or equal to CtbSizeY, pps\_num\_exp\_tile\_columns\_minus1 and pps\_tile\_column\_width\_minus1[ i ] are skipped and inferred. (S0116 aspect 1)
   1. Alternatively, when the condition is true, the values of pps\_num\_exp\_tile\_columns\_minus1 and pps\_tile\_column\_width\_minus1[ i ] are both constrained to be equal to 0. (S0116 aspect 1)

It was commented that for subpicture position and width / height, there is a syntax condition check to optimize for the single-CTU case. In that case it was necessary to prevent a syntax problem.

It was commented that we generally avoid optimizing syntax for such corner cases.

It was asked whether the constraint is already indirectly required, and the answer was yes, so no action was recommended for this.

1. When pps\_pic\_height\_in\_luma\_samples is less than or equal to CtbSizeY, pps\_num\_exp\_tile\_row\_minus1 and pps\_tile\_row\_height\_minus1[ i ] are skipped and inferred. (S0116 aspect 1)
   1. Alternatively, when the condition is true, the values pps\_num\_exp\_tile\_row\_minus1 and pps\_tile\_row\_height\_minus1[ i ] are both constrained to be equal to 0. (S0116 aspect 1)

See item 7; this is basically the same issue.

1. When NumTilesInPic is equal to 1 and either pps\_pic\_width\_in\_luma\_samples or pps\_pic\_height\_in\_luma\_samples is less than or equal to CtbSizeY, pps\_tile\_idx\_delta\_present\_flag is skipped and inferred to be equal to 0. (S0116 aspect 2)

This raises similar issues as items 7 and 8. It was commented that a sufficient indirect constraint is already expressed.

**On subpictures**

1. Add a shortcut for signalling of subpictures layout, as follows: (S0071)
   1. Add sps\_subpic\_same\_res\_flag, equal to 1 specifies that all subpictures have the same width and height, respectively.
   2. When sps\_subpic\_same\_res\_flag is equal to 1, sps\_subpic\_width\_minus1[ i ] and sps\_subpic\_height\_minus1[ i ] are only signalled when i is equal to 0, and sps\_subpic\_ctu\_top\_left\_x[ i ] and sps\_subpic\_ctu\_top\_left\_y[ i ] are skipped for all i values.

Item 17) is related.

The proponent indicated that a uniform grid would be a typical use case.

A cross-check is in S0247. It was reported that in one OMAF example, 1500 bits could be saved in the SPS. Two other participants said they had closely checked the text and software.

A concern was expressed about adding a special case at this late stage, potentially introducing some problem.

It was asked how this handles the case where the width/height is not divisible by the expressed uniform subpicture width/height. Such a case is disallowed in the proposed shortcut mode. It was noted that in the uniform tile width/height syntax shortcut case, that issue is handled differently, by creating “leftover” areas.

It was commented that various other shortcuts had been proposed before and was suggested that it is too late to introduce a new one.

A participant commented that the use case would be common and said there is not really a need for “leftover” consideration, as this would not be expected in the use of the scheme.

It was commented that the need for repetition in the syntax is rather annoying from the encoder perspective to need to repeat the same data over and over, and that the use case would actually be common.

It was commented that at this meeting we have resisted other temptations to introduce new shortcuts.

Revisit was suggested.

1. When sps\_pic\_width\_max\_in\_luma\_samples and sps\_pic\_height\_max\_in\_luma\_samples are both less than or equal to CtbSizeY, sps\_num\_subpics\_minus1 is skipped and inferred to be equal to 0. (S0115 aspect 1)

This raises similar issues as items 7 and 8. It was commented that a sufficient constraint is already expressed and special handling in the syntax is not necessary.

1. Merge the three sets of constraints on the combination of subpictures and scalability, in the semantics of sps\_subpic\_treated\_as\_pic\_flag[ i ], the semantics of pps\_subpic\_id[ i ], and in the end of clause 8.3.2, respectively, to be placed in the end of clause 8.3.2, as follows (removal of those constraints from the semantics of sps\_subpic\_treated\_as\_pic\_flag[ i ] and the semantics of pps\_subpic\_id[ i ] not shown below): (S0125)

* When sps\_num\_subpics\_minus1 is greater than 0 and the current subpicture with subpicture index subpicIdx has sps\_subpic\_treated\_as\_pic\_flag[ subpicIdx ] equal to 1, it is a requirement of bitstream conformance that exactly one and not both of the following two conditions shall be true:
* The picture referred to by each active entry in RefPicList[ 0 ] or RefPicList[ 1 ] and the current picture have the same value for each of the following:
  + pps\_pic\_width\_in\_luma\_samples
  + pps\_pic\_height\_in\_luma\_samples
  + sps\_num\_subpics\_minus1
  + sps\_subpic\_ctu\_top\_left\_x[ i ], sps\_subpic\_ctu\_top\_left\_y[ i ], sps\_subpic\_width\_minus1[ i ], sps\_subpic\_height\_minus1[ i ], sps\_subpic\_treated\_as\_pic\_flag[ i ], respectively, for each value of i in the range of 0 to sps\_num\_subpics\_minus1, inclusive
  + SubpicIdVal[ subpicIdx ]
* The picture referred to by each active entry in RefPicList[ 0 ] or RefPicList[ 1 ] is an ILRP for which the value of sps\_num\_subpics\_minus1 is equal to 0.

Some constraints in the current text are expressed the same regardless of whether the subpictures are treated as pictures or not. The proponent said it was not clear that this was intentional.

It was commented that there is an important bug fix in the proposal, when the dependent layer has independent subpictures and the reference layer has non-independent subpictures. This should be disallowed and was not in the current text.

However, a different issue is having non-independent subpictures in an enhancement layer with independent subpictures in the reference layer. This is currently disallowed (intended but not fully expressed in the Brussels output), and would be allowed in the proposal, although it is not supported by the specified extraction process. It was said that this characteristic of the proposal is undesirable, so it was agreed to disallow this case.

Revisit for modified text.

**New submissions (for the June 10th submission deadline)**

1. Add the following constraint to the semantics of sps\_subpic\_treated\_as\_pic\_flag[ ] (S0190 aspect 1):

When sps\_num\_subpics\_minus1 is equal to 0, for each CLVS of a current layer referring to the SPS, let targetAuSet be all the AUs starting from the AU containing the first picture of the CLVS in decoding order, to the AU containing the last picture of the CLVS in decoding order, inclusive, it is a requirement of bitstream conformance that all of the following conditions are true for the targetLayerSet that consists of all the layers that have the current layer as a reference layer:

– All the SPSs referred to by the layers in targetLayerSet shall have the same value of sps\_num\_subpics\_minus1 and shall have the same values of sps\_subpic\_ctu\_top\_left\_x[ j ], sps\_subpic\_ctu\_top\_left\_y[ j ], sps\_subpic\_width\_minus1[ j ], sps\_subpic\_height\_minus1[ j ], and sps\_subpic\_treated\_as\_pic\_flag[ j ], respectively, for each value of j in the range of 0 to sps\_num\_subpics\_minus1, inclusive.

– For each AU in targetAuSet, all pictures of the layers in targetLayerSet shall have the same value of SubpicIdVal[ j ] for each value of j in the range of 0 to sps\_num\_subpics\_minus1, inclusive.

It is proposed that all reference layers need to have the same subpicture layout. There seemed to be a problem with the proposed expression of this concept, so the proposed text was edited above to reflect this intent. It was commented that it is not clear that such a constraint needs to be imposed. No action was recommended unless offline study determines otherwise.

1. Add a constraint: When the value of sps\_subpic\_info\_present\_flag of the current layer is equal to 1, the value of sps\_res\_change\_in\_clvs\_allowed\_flag of the reference layers of the current layer shall be equal to 0. (S0190 aspect 2).

In the discussed case, the size of the pictures in the reference layer could change from AU to AU. It was commented that this is not necessarily a problem, as we already have resampling invoked between the base layer and enhancement layer, and changing the resampling ratio from AU to AU should not be a problem. No action was recommended unless offline study determines otherwise.

1. Infer the value of pps\_loop\_filter\_across\_tiles\_enabled\_flag to be equal to 0 (instead of 1) when not present, for consistency with the inferences of sps\_loop\_filter\_across\_subpic\_enabled\_flag[ i ] and pps\_loop\_filter\_across\_slices\_enabled\_flag. (S0160 aspect 1)

It was commented that this is purely editorial, since the flag is only inferred when there is only one tile in the picture. And since the tile boundary is also a picture boundary in that case, no loop filtering is applied for that boundary anyway.

Editor action item: The editor is asked to consider this suggested consistency improvement.

1. Add a subpicture merging software, which includes the following setup, into the VTM source code package: (S0162)

* Encoding several bitstreams, each with one subpicture per picture, using the VTM encoder.
* Merging selected encoded bitstreams into a bitstream with multiple subpictures, using provided subpicture merging software.
* Decoding a bitstream having multiple subpictures, using the VTM decoder.

The contribution was greatly appreciated for demonstration and experimentation with merging functionality. Software was provided with the contribution, but the understanding was that the merging part was the only change – the encoder and decoder were merely a copy of the existing VTM software. It was agreed to add the merging software into the VTM software package.

It was commented that the type of encoding that is done in this experiment does not show the full potential of VVC for an application, as it disables several tools that are useful.

Having more functionality added in future work is highly desirable.

It was commented that this software will need to be tested and maintained as the rest of the VTM package evolves.

1. Add a flag, sps\_raster\_scan\_order\_subpics\_flag, to the SPS, the value equal to 1 specifies that subpictures are ordered in raster scan order in each picture in the CLVS, and when this flag is equal to 1, derive the top-left CTU positions of the subpictures instead of signalling them. (S0206)

Item 10) is related.

We have a similar scheme for rectangular slices. Software was provided, and it had been cross-checked, as reported in S0250.

Relative to item 10, this would save roughly half of the bits in that special case.

It was noted that this is only an SPS-level issue, where bits are not so precious.

It was commented that other schemes for SPS-level savings were not adopted.

It was commented that the derivation process seems nontrivial.

Due to the expressed concerns and late stage of the project, no action was recommended on this.

1. Specify that the value of sps\_num\_subpics\_minus1 shall be less than MaxSlicesPerPicture. (S0236 aspect 1)

It was noted that this is purely editorial.

Editor action item: The editor is strongly suggested to consider this change (MaxSlicesPerAu rather than MaxSlicesPerPicture).

1. When pps\_subpic\_id\_mapping\_present\_flag is equal to 1, skip pps\_rect\_slice\_flag and infer it to be equal to 1. (S0236 aspect 2)

It was asked whether it would be possible to define subpicture mapping to be compatible with rectangular slices. Yes, this would be possible. However, it was reported that we already have an assumption of this constraint that is built into other parts of the syntax.

It was commented that this is too trivial a refinement to consider at this stage, so no action was recommended for this.

[JVET-S0049](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10171) AHG9/AHG8/AHG12: On parameter sets and picture header [Y.-K. Wang, L. Zhang, Z. Deng, K. Zhang (Bytedance)]

Aspect 3 of this contribution belongs to this category.

[JVET-S0071](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10193) AHG12: Cleanup of subpicture layout signalling [M. Katsumata, M. Hirabayashi, T. Suzuki (Sony)]

[JVET-S0247](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10386) Crosscheck of JVET-S0071 (AHG12: Cleanup of subpicture layout signalling) [R. Sjöberg, D. Liu, M. Damghanian (Ericsson)] [late]

[JVET-S0095](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10217) AHG12: On tile and slice partitioning related syntax and semantics [J. Chen, Y. Ye, R.-L. Liao (Alibaba)]

[JVET-S0115](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10237) AHG9: On SPS cleanups [Y. He, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

Aspect 1 of this contribution belongs to this category.

[JVET-S0116](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10238) AHG9: On PPS cleanups [Y. He, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

[**JVET-S0125**](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10247) **AHG9: On sub-picture constraints [V. Seregin, Y. He, Y.-J. Chang, M. Coban, M. Karczewicz (Qualcomm)]**

[JVET-S0190](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10312) AHG8/AHG9/AHG12: On reference picture resampling with scalability [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-S0160](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10282) AHG9/AHG12/AHG8: Miscellaneous HLS cleanups [Y.-K. Wang, Z. Deng, L. Zhang, K. Zhang (Bytedance)]

Aspect 1 of this contribution belongs to this category.

[JVET-S0162](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10284) AHG3/AHG12: Subpicture merging software [A. Hallapuro, M. M. Hannuksela (Nokia)]

[JVET-S0206](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10328) AHG12: Raster scan order subpictures [M. Damghanian, D. Liu, R. Sjöberg, M. Pettersson, J. Enhorn, J. Ström, R. Yu (Ericsson)]

[JVET-S0250](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10389) Crosscheck of JVET-S0206 (Raster scan order subpictures) [S. Paluri, Hendry(LGE)] [late]

[JVET-S0236](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10358) AHG9/AHG12: High-level syntax cleanups on subpictures [S.-T. Hsiang, L. Chen, O. Chubach, Y.-W. Huang, S.-M. Lei (MediaTek)]

## AHG8: Layered coding and resolution adaptivity (8+5)

### General (1+0)

[JVET-S0147](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10269) AHG8: A summary of proposals on scalability and RPR [Y.-K. Wang (Bytedance)]

This contribution provides a summary of the 12 proposals on scalability and RPR (the agenda item 3.3 in JVET-S0137 and JVET-S0237).

It is suggested that this summary, in terms of a list of proposed items, is used for the reviewing of these proposals, such that the discussions can be in a more structured and efficient manner.

The following changes were proposed:

**On scalability**

1. When vps\_max\_layers\_minus1 is equal to 0, vps\_num\_ptls\_minus1 is skipped and inferred to be equal to 0. (S0063)

It was commented that this may not be strictly necessary but seems like a very small nice little cleanup and that since we are skipping nearby syntax elements under this condition.

AHG Recommendation (cleanup/consistency): Adopt.

1. Fix an asserted bug, that the specification allows to extract sublayers with TemporalId higher than the vps\_ptl\_max\_temporal\_id[ 0 ] + 1 for an OLS, by setting NumSubLayersInLayerInOLS[ i ][ k ] to be equal to vps\_ptl\_max\_temporal\_id[ i ] + 1, instead of vps\_max\_sublayers\_minus1 + 1, for output layers in Equation 40. (S0100 aspect 1)

AHG Recommendation (bug fix/expression of existing intent): Adopt.

1. Add the following constraint to disallow certain indirect reference layers when the value of vps\_max\_tid\_il\_ref\_pics\_plus1[ i ][ j ] is 0 for all the direct reference layers: (S0100 aspect 2)

For any two layers k and j within an OLS i, with k > j, when both NumSubLayersInLayerInOLS[ i ][ j ] and NumSubLayersInLayerInOLS[ i ][ k ] are equal to 0, j is a (direct or indirect) reference layer of k and there is a picture in layer k that is an IRAP picture or a GDR picture with ph\_recovery\_poc\_cnt equal to 0 in an AU, the picture in layer j shall also be an IRAP picture or a GDR picture with ph\_recovery\_poc\_cnt equal to 0, respectively.

It was commented that a similar constraint is already enforced by the requirement that the extracted bitstream shall be a conforming bitstream. The proposed constraint is a bit tighter than the indirect existing constraint.

Editor action item: The editor is requested to consider adding some NOTE/explanation for this aspect.

1. Do one of the following, with option b being preferred: (S0100 aspect 3)
   1. The values of vps\_ptl\_max\_temporal\_id[ i ], vps\_dpb\_max\_temporal\_id[ i ] and vps\_hrd\_max\_tid[ i ] shall be the same.
   2. The values of vps\_ols\_dpb\_max\_temporal\_id[ vps\_ols\_dpb\_params\_idx[ i ] ] and vps\_hrd\_max\_tid[ vps\_ols\_hrd\_idx[ i ] ] shall be greater than or equal to vps\_ptl\_max\_temporal\_id[ vps\_ols\_ptl\_idx[ i ] ].
   3. Infer the DPB and HRD parameters for sublayers from vps\_ols\_dpb\_max\_temporal\_id[ dpbIdx ] and vps\_hrd\_max\_tid[ hrdIdx ] up to vps\_ptl\_max\_temporal\_id[ ptlIdx ].

The idea is to have a relationship of these three values for any particular OLS. (The index variables above may not express this concept quite correctly.)

It was noted that S0097 aspect 3 is related (see section 3.1.8).

A participant commented that approach “a” is too restrictive, and indeed that approach “b” is preferred. Another participant considered approach “a” to be better.

Approach “b” would allow to send less unnecessary syntax for HRD and DPB parameters for the various OLSs than approach “a”.

It was asked whether S0097 aspect 3 would take care of the issue by itself.

The AHG agreed to defer this issue and S0097 aspect 3 for further study.

1. When not present, the value of vps\_max\_tid\_ref\_present\_flag[ i ] is inferred to be equal to 0. (S0129 aspect 1)

The contributor said this is not needed after review of the text and withdrew this aspect.

1. When vps\_all\_independent\_layers\_flag is equal to 1 and vps\_each\_layer\_is\_an\_ols\_flag is equal to 1, the value of vps\_ols\_mode\_idc is inferred to be equal to 0. (also in S0129 aspect 1)

It was noted that this is purely editorial, as the value that is inferred has no effect; this is just a matter of editorial completeness – wanting to always have some value if something is checked in a condition.

It was commented that inferring the value 0 might be confusing or incorrect, since 0 ordinarily has a semantic interpretation that is not intended here. Inferring the value 3 was suggested. Alternatively, adding an extra “if” with a comment seemed better.

Editor action item: The editor is asked to rephrase the text to avoid the problem. The suggested method is to add an extra “if” condition with a comment to explain why it is there.

**On RPR**

1. Change the value ranges of the scaling window offsets such that the scaling window width and height can be up to 16 times the picture width and height, respectively. (S0048 aspect 1)

It was asked whether this might have a memory bandwidth impact and concluded that it does not.

However, it was commented that there could be a bit width impact on some variables.

This is closely related to item 8 below.

The HLS AHG deferred this topic for further study.

1. Change the conformance specification for subpicture sequences for the case where higher layers of an OLS contain multiple subpictures while lower layers of OLS do not use subpicture partitioning, as follows: (JVET-S0098)
   1. Support extraction of subpictures that have reference layers with only one subpicture.

This is closely related to item 7 above.

The HLS AHG deferred this topic for further study.

* 1. Change the derivation of RprConstraintsActive[ i ][ j ] to incorporate the number of subpictures in reference picture and current picture, and set RprConstraintsActive[ i ][ j ] to 1 if the two values differ.

This is to fix a clear problem in the text.

AHG Recommendation (bug fix/expression of existing intent): Adopt this aspect.

* 1. Signal a new syntax element non\_subpic\_layers\_fraction[ i ] that specifies the fraction of the bitstream level limits associated with layers in the bitstream that have sps\_num\_subpics\_minus1 equal to 0, for each i.

The current derivation is asserted to not be sensible for cases where different layers have different subpicture layouts.

AHG Recommendation (bug fix): Adopt this aspect.

* 1. Handle accumulated levels for subpicture sets by using one of the following options:
     1. Option 1: Remove the accumulation and adjust equation D.11 to use a single subpicture.
     2. Option 2: Modify equation D.10 (and D.11).

AHG Recommendation (bug fix): Adopt option 1.

1. Change the semantics of the sps\_ref\_pic\_resampling\_enabled\_flag
2. to be aligned with the derivation of the RprConstraintsActive variable, which would be set equal to 1 when one or more of the following 6 parameters differ between the current picture and the reference picture: 1) picture width, 2) picture height, 3) scaling window left offset, 4) scaling window right offset, 5) scaling window top offset, and 6) scaling window bottom offset. (S0048 aspect 2)
3. such that when sps\_ref\_pic\_resampling\_enabled\_flag equal to 1, a slice may refer to a reference picture with a different spatial resolution or a different scaling window. (S0057 aspect 1)

This is editorial – a matter of accurately describing the semantics.

Approach “a” refers to PPS content in SPS semantics, which was suggested to not be appropriate. However, it is more explicit regarding what is involved, and this was suggested to be helpful.

The phrase “spatial resolution” in approach “b” was questioned.

Editor action item: The editor is requested to clarify the semantics as appropriate.

1. Add pps\_res\_change\_in\_clvs\_allowed\_flag, and when pps\_res\_change\_in\_clvs\_allowed\_flag is equal to 0, skip pps\_pic\_width\_in\_luma\_samples and pps\_pic\_height\_in\_luma\_samples and infer their values to be equal to sps\_pic\_width\_max\_in\_luma\_samples and sps\_pic\_height\_max\_in\_luma\_samples, respectively. (S0057 aspect 2)

It was commented that this could introduce a parsing dependency problem for the tile configuration in the PPS. The proposal had not been tested with an implementation. Thus, no action was recommended for this.

1. Add either of the following constraints (S0126):
2. When sps\_res\_change\_in\_clvs\_allowed\_flag is equal to 0, all pictures in the CLVS shall have the same values of pps\_scaling\_win\_left\_offset, pps\_scaling\_win\_right\_offset, pps\_scaling\_win\_top\_offset, and pps\_scaling\_win\_bottom\_offset, respectively.
3. When sps\_res\_change\_in\_clvs\_allowed\_flag is equal to 0, a current picture in the CLVS and a reference picture having the same nuh\_layer\_id shall have the same values of pps\_scaling\_win\_left\_offset, pps\_scaling\_win\_right\_offset, pps\_scaling\_win\_top\_offset, and pps\_scaling\_win\_bottom\_offset, respectively.

It was commented that this constraint would limit some use cases and that a similar constraint had previously been considered and agreed to be undesirable (see JVET-R0058 versions 1-3 aspect 2.c).

No clear problem was agreed to exist, so no action was recommended on this.

**New submissions (for the June 10th submission deadline)**

TBP here onwards.

1. Change Equation 37 as follows, considering that a reference layer can only be a lower layer: (S0169 aspect 2) (additions in **bold and bigger fonts**, removals in *italic and smaller fonts*)

for( i = 0; i <= vps\_max\_layers\_minus1; i++ ) {  
 for( j = 0; j **< i**  *<= vps\_max\_layers\_minus1*; j++ ) {  
 dependencyFlag[ i ][ j ] = vps\_direct\_ref\_layer\_flag[ i ][ j ]  
 for( k = **j+1** *0* ; k < i; k++ )  
 if( vps\_direct\_ref\_layer\_flag[ i ][ k ] && dependencyFlag[ k ][ j ] )  
 dependencyFlag[ i ][ j ] = 1  
 }  
 LayerUsedAsRefLayerFlag[ i ] = 0  
}  
for( i = 0; i <= vps\_max\_layers\_minus1; i++ ) {  
 for( j = 0, d = 0, r = 0; j **< i**  *<= vps\_max\_layers\_minus1*; j++ ) { (37)  
 if( vps\_direct\_ref\_layer\_flag[ i ][ j ] ) {  
 DirectRefLayerIdx[ i ][ d++ ] = j  
 LayerUsedAsRefLayerFlag[ j ] = 1  
 }  
 if( dependencyFlag[ i ][ j ] )  
 RefLayerIdx[ i ][ r++ ] = j  
 }  
 NumDirectRefLayers[ i ] = d  
 NumRefLayers[ i ] = r  
}

1. Do either of the following, considering that assertedly vps\_num\_output\_layer\_sets\_minus1 is signalled when vps\_max\_layers\_minus1 is greater than 0 (and when vps\_ols\_mode\_idc is equal to 2) and in this case there are at least two OLSs: (S0183 aspect 1)
   1. Change vps\_num\_output\_layer\_sets\_minus1 to vps\_num\_output\_layer\_sets\_minus2.
   2. Add a constraint: The value of vps\_num\_output\_layer\_sets\_minus1 shall be greater than 0.
2. Add a flag for each multi-layer OLS (except the first one) to indicate whether the OLS DPB picture width, height, chroma format, and bit depth values are the same as the values for the previous multi-layer OLS, and if the flag is equal to 1, these fields are skipped and inferred. (S0183 aspect 2)
3. Change to code the vps\_ols\_dpb\_pic\_width[ i ] and vps\_ols\_dpb\_pic\_height[ i ] in units of 8 luma samples, considering that assertedly the decoded picture width and height in a CLVS are constrained to be an integer multiple of Max( 8, MinCbSizeY ). (S0212 aspect 1)
4. Instead of signalling a set of width, height, chroma format, and bit depth of a DPB picture storage buffer for each multi-layer OLS in the VPS, signal these DPB parameters in the dpb\_parameters( ) syntax strucures, each of which (per the existing VVC text) can be shared by two or more OLSs. (S0160 aspect 10 late)
5. Specify that the ue(v)-coded vps\_ols\_dpb\_bitdepth\_minus8[ i ] shall be in the range of 0 to 8, inclusive, considering that the value range is currently missing. (S0212 aspect 2)
6. In Equation 41, replace vps\_ptl\_max\_tid[ 0 ] with vps\_ptl\_max\_tid[ vps\_ols\_ptl\_idx[ 0 ] ] and vps\_ptl\_max\_tid[ i ] with vps\_ptl\_max\_tid[ vps\_ols\_ptl\_idx[ i ] ] (for all the instances). (S0248 aspect 1 late)

### Scalability cleanups (3+5)

[JVET-S0063](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10185) AHG9: On VPS Signalling [S. Deshpande, J. Samuelsson, A. Segall, P. Cowan (Sharp)]

[JVET-S0100](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10222) AHG9: On OLS and sublayers [Y. Sanchez, R. Skupin, K. Suehring, T. Schierl (HHI), Y. He, V. Seregin, M. Coban, M. Karczewicz (Qualcomm)]

[JVET-S0129](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10251) AHG9: cleanup on parameter sets and GCI [L. Li, X. Li, B. Choi, S. Wenger, S. Liu (Tencent)]

Aspect 1 of this contribution belongs to this category.

[**JVET-S0160**](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10282) **AHG9/AHG12/AHG8: Miscellaneous HLS cleanups [Y.-K. Wang, Z. Deng, L. Zhang, K. Zhang (Bytedance)]**

Aspect 10 of this contribution belongs to this category.

[JVET-S0169](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10291) AHG9: Miscellaneous Cleanups for HLS [B. Wang, S. Esenlik, H. Gao, E. Alshina (Huawei)]

Aspect 2 of this contribution belongs to this category.

[JVET-S0183](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10305) AHG9: On VPS Information Signalling [S. Deshpande, J. Samuelsson, A. Segall, P. Cowan (Sharp)]

[JVET-S0212](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10334) AHG9: Modifications on VPS OLS DPB related parameters [R. Yu, M. Pettersson, R. Sjöberg, M. Damghanian, J. Enhorn, J. Ström, D. Liu (Ericsson)]

[JVET-S0248](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10387) AHG9: HRD text cleanups [Y.-K. Wang (Bytedance), Y. Sanchez, R. Skupin (HHI), S. Deshpande (Sharp), V. Seregin (Qualcomm), Hendry (LGE), J. Chen (Alibaba)] [late]

Aspect 1 of this contribution belongs to this category.

### Reference picture resampling (RPR) cleanups (4+0)

[JVET-S0048](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10170) AHG9/AHG8: On reference picture resampling [Y.-K. Wang, Z. Deng, K. Zhang, L. Zhang (Bytedance)]

[JVET-S0098](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10220) AHG9/12: On subpicture conformance [R. Skupin, Y. Sanchez, K. Suehring, T. Schierl (HHI)]

[JVET-S0057](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10179) AHG8/AHG9: On signaling reference picture resampling [B. Choi, S. Wenger, S. Liu (Tencent)]

[JVET-S0126](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=10248) AHG8: On scaling window constraint [Y.-J. Chang, V. Seregin, Y. He, A. K. Ramasubramonian, M. Coban, M. Karczewicz (Qualcomm)]

# Complexity analysis (0)

# Encoder optimization (0)

# Metrics and evaluation criteria (0)

# Withdrawn (1)

Section kept for future use.

JVET-S0220 Withdrawn

# Plenary meetings, joint meetings, BoG reports, and summary of actions taken

## High-level syntax / systems relation meeting

This planned session was cancelled due to a lack of identified need.

## Plenary meeting XXday XX June XXXX-XXXX

Reports of the tracks were presented as follows:

The status of Tracks A and B was presented and discussed, which particularly included the following aspects:

Track A:

Track B:

## Joint meeting XXday XX June XXXX-XXXX

Profiles and tools in profiles were discussed (see section 4.9).

NB ballot comments were also noted. [add detail]

## Closing plenary meeting Wednesday XX June xxxx-xxxx

Reports of the tracks were presented as follows:

The status of Tracks A and B was presented and discussed, which particularly included the following aspects:

The status of work was discussed

* CTC on chroma QP offsets 4.x – further study was requested
  + …
* Open input reviews and revisits
  + …
* Project development discussion (section 4.1)
  + …
* Output docs & dates
* AHG plans
* Mtg plans
* Discussion of the verification test plan and procedure (future planning for scalability was noted)
* List of actions taken
* Doc deadline

## BoGs (X)

## List of actions taken affecting the draft text of VVC, the VTM, and 360Lib

The following is a summary, in the form of a brief list, of the actions taken at the meeting that affect the text of the VVC draft text, VTM or 360Lib description. Both technical and editorial issues are included. This list is provided only as a summary – details of specific actions are noted elsewhere in this report and the list provided here may not be complete and correct. The listing of a document number only indicates that the document is related, not that it was adopted in whole or in part. The description given in the “Tool” column is a best effort for the sake of understanding but may not precisely reflect the functionality of the tool. It is also noted that in cases where several contributions proposed the same method, usually only one of the is listed as adoption below; refer to the meeting notes about the adoption to see which other contributions are related.

[Add actions of Friday 24 April.]

[This is just a reflection of what has already been recorded.]

# Project planning

## Core experiment planning

No CEs planned at this meeting.

## 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 encoder algorithm descriptions – relative to the existing drafts. Proposal contributions should also provide a software implementation (or at least such software should be made available for study and testing by other participants at the meeting, and software must be made available to cross-checkers in EEs).

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

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

The document upload deadline for the next meeting was planned to be XXday XX Apr 2020.

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 during the opening plenary on January 9 that those rules which had been set up or refined during the 12th meeting should be observed. In particular, for some CEs, results were available late, and some changes in the experimental setup (particularly in CE4) were not 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 the draft standard by the next meeting.
* 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 tha 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; the method for members to obtain the credentials is TBA on the reflector).
* During the experiment, revisions of the experiment plans can be made, but not substantial changes to the proposed technology.
* The CE description must match the CE testing that is done. The CE description needs to be revised if there has been some change of plans.
* The CE summary report must describe any changes that were made in the process of finalizing the CE.
* By the next meeting it is expected that at least one independent cross-checker will report a detailed analysis of each proposed feature that has been tested and confirm that the implementation is correct. Commentary on the potential benefits and disadvantages of the proposed technology in cross-checking reports is highly encouraged. Having multiple cross-checking reports is also highly encouraged (especially if the cross-checking involves more than confirmation of correct test results). The reports of cross-checking activities may (and generally should) be integrated into the CE report rather than submitted as separate documents.

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

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

The general agreed common conditions for single-layer coding efficiency experiments are described in the output document JVET-N1010.

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

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

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

[Add info on software access.]

Some agreements relating to CE activities were established as follows:

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

General timeline for CEs

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

T2 = Test model software release + 2 weeks or X XX, whichever is earlier: 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 – 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 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 straightforwared combinations of the identified technologies. Such supplemental testing needs to be clearly identified in the report if it was not part of the CE plan.

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

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

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

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

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

## Software development and anchor generation (update)

The planned timeline for software releases was established as follows:

* VTM8.0 will be released by 2020-02-17 including all adoptions necessary for CTC. VTM8.1 with non-CTC adoptions will be released 2020-03-16. Further versions of VTM may be released for additional bug fixing, as appropriate.
* Preparation of the VTM software will include immediate removal of macros that were added in the previous meeting cycle. The software coordinator has the discretion to retain some such macros.
* 360lib software is to be revised for the modified generalized cubemap, which was requested by 2019-02-28
* No change of HDRTools software was noted in response to meeting.

# Establishment of ad hoc groups

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

+Meeting plans for ad hocs

|  |  |  |
| --- | --- | --- |
| **Title and Email Reflector** | **Chairs** | **Mtg** |
| **Project Management (AHG1)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Coordinate overall JVET interim efforts. * Supervise AHG studies. * Report on project status to JVET reflector. * Provide a report to the next meeting on project coordination status. | J.-R. Ohm, G. J. Sullivan (co-chairs) | N |
| **Draft text and test model algorithm description editing (AHG2)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Produce and finalize JVET-R2001 VVC text specification draft 9 and JVET-R2007 SEI text draft 4. * Produce and finalize JVET-R2002 VVC Test Model 9 (VTM 9) Algorithm and Encoder Description. * Gather and address comments for refinement of these documents. * Coordinate with test model software development AhG to address issues relating to mismatches between software and text. | B. Bross, J. Chen (co-chairs), J. Boyce, S. Kim, S. Liu, 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 model (VTM) software and associated configuration files. * Produce documentation of software usage for distribution with the software. * Discuss and make recommendations on the software development process. * Propose improvements to the guideline document for developments of the test model software. * Perform tests of VTM behaviour relative to HEVC and the previous VTM using the VTM common test conditions. * Coordinate with AHG on Draft text and test model algorithm description editing (AHG2) to identify any mismatches between software and text, and make further updates and cleanups to the software as appropriate. * Coordinate with AHG6 for integration with 360lib software. | F. Bossen, X. Li, K. Sühring (co-chairs) | N |
| **Test material and visual assessment (AHG4)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Produce the draft verification test plan JVET-R2009 and develop proposed improvements for verification testing of VVC capability. * Maintain the video sequence test material database for development of the VVC standard. * Identify and recommend appropriate test materials for use in the development of the VVC standard. * Identify missing types of video material, solicit contributions, collect, and make available a variety of video sequence test material. * Evaluate new test sequences. * Maintain and update the directory structure for the test sequence repository as necessary. * Prepare availability of viewing equipment and facilities arrangements for the next meeting, and prepare testing upon consultation with CE coordinators. * Coordinate with AHG11 on test material for screen content coding. | V. Baroncini, T. Suzuki, M. Wien (co-chairs), A. Norkin, A. Segall, Y. Ye (vice-chairs) | Tel.  2020-05-14/15 on SDR  2020-05-27 on 360°  TBD on HDR  2 weeks notice |
| **Conformance testing (AHG5)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Produce the JVET-R2008 draft conformance testing specification and develop proposed improvements. * Study the requirements of VVC conformance testing to ensure interoperability. * Propose a work plan, including timeline, for preparation of a conformance testing specification and conformance bitstream database. * Study potential testing methodology to fulfil the requirements of VVC conformance testing. | J. Boyce and W. Wan (co-chairs), E. Alshina, I. Moccagatta, K. Kawamura, S. McCarthy, K. Sühring, X. Xu (vice-chairs) | N |
| **360° video coding tools, software and test conditions (AHG6)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the effect on compression and subjective quality of different projections formats, resolutions, and packing layouts. * Discuss refinements of common test conditions, test sequences, and evaluation criteria. * Solicit additional test sequences, and evaluate suitability of test sequences on head-mounted displays and normal 2D displays. * Study coding tools dedicated to 360° video, their impact on compression, and implications to the core codec design, including consideration of subpicture segmentations and adaptive viewport usage. * Study the effect of viewport resolution, field of view, and viewport speed/direction on visual comfort. * Study complexity of GPU rendering of projection formats. * Study syntax for signalling of projection formats, cubeface layouts, spherical rotations. * Prepare and deliver the 360Lib-10 software version and common test condition configuration files according to JVET-Q1012. * Generate CTC anchors and PERP results for the VTM according to JVET-Q1012 within two weeks of availability of SDR CTC anchors. * Coordinate with AHG4 in preparation for verification testing for 360° video content. * Produce documentation of software usage for distribution with the software. | J. Boyce and Y. He (co-chairs), K. Choi, J.-L. Lin, Y. Ye (vice-chairs) | N |
| **Coding of HDR/WCG material (AHG7)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study and evaluate available HDR/WCG test content. * Study objective metrics for quality assessment of HDR/WCG material, including investigation of the correlation between subjective and objective results. * Compare the performance of the VTM and HM for HDR/WCG content. * Generate CTC anchors for the VTM according to JVET-P2011 within two weeks of availability of SDR CTC anchors. * Prepare for expert viewing of HDR content at the next JVET meeting if feasible. * Coordinate implementation of HDR anchor aspects in the test model software with AHG3. * Coordinate with AHG4 in preparation for verification testing for HDR video content. * Study additional aspects of coding HDR/WCG content. | A. Segall (chair), E. François, W. Husak, S. Iwamura, D. Rusanovskyy (vice-chairs) | N |
| **Layered coding and resolution adaptivity (AHG8)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study adaptive-resolution coding approaches for real-time communication, adaptive streaming, and 360-degree viewport-dependent streaming, including subpicture-based resampling, reference picture management and related scope and signalling. * Study approaches for temporal scalability to avoid temporal judder when temporal scalability sub-bitstream extraction is used for achieving lower frame rate, and consider whether this should have a normative impact. * Coordinate with AHG2 and AHG3 for text drafting and software development for the layered coding and resolution adaptivity aspects of the VVC design. * Study and develop improvements of the JVET-Q2015 functionality testing condition description. * Propose common test conditions for layered coding and resolution adaptivity. * Study approaches for support of layered coding scalability including spatial, temporal, quality, view, and region-of-interest scalability; and analyse their coding efficiency and complexity characteristics | S. Wenger and A. Segall (co-chairs), M. M. Hannuksela, Hendry, S. McCarthy, Y.-C. Sun, P. Topiwala, M. Zhou (vice-chairs) | Tel. (Cat.1) 3 weeks notice |
| **High-level syntax (AHG9)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study NAL unit header, decoding parameter set, video parameter set, sequence parameter set, picture parameter set, adaptation parameter set, picture header, and slice header syntax designs. * Study reference picture buffering and list construction. * Study random access signalling and random access approaches. * Study detection of AU and picture boundaries and properties. * Study the appropriate syntax level and signalling approaches for high-level signalling of control information for lower-level coding tools. * Coordinate with AHG2 and AHG3 for text drafting and software development for the high-level syntax in the VVC design. * Study syntax approaches for interoperability point signalling. * Study selection of constraint flags and their impact on syntax, semantics, and decoding process. | R. Sjöberg, J. Boyce (co-chairs), B. Choi, S. Deshpande, M. M. Hannuksela, R. Skupin, A. Tourapis, Y.-K. Wang, W. Wan P. Wu (vice-chairs) | Tel. (Cat.1) 3 weeks notice |
| **Encoding algorithm optimization (AHG10)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the impact of using techniques such as GOP structures and perceptually optimized adaptive quantization for encoder optimization. * Study quality metrics for measuring subjective quality using e.g. the CfP response MOS scores. * Study the impact of adaptive quantization on individual tools in the test model. * Investigate other methods of improving objective and/or subjective quality, including adaptive coding structures and multi-pass encoding. * Study methods of rate control and their impact on performance, subjective and objective quality. | A. Duenas, A. Tourapis (co-chairs), S. Ikonin, A. Norkin, R. Sjöberg, J. Le Tanou, J.-M. Thiesse (vice-chairs) | N |
| **Screen content coding (AHG11)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Investigate coding tools targeted at screen content in terms of compression benefit and implementation complexity. * Identify test materials, discuss testing conditions for screen content coding, and propose associated updated common test conditions. * Study the impact of loop filters on screen content coding. | S. Liu (chair), J. Boyce, A. Filippov, Y.-C. Sun, J. Xu (vice-chairs) | N |
| **High-level parallelism and coded picture regions (AHG12)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study wavefront processing including the relationship with tiles and low delay characteristics. * Study flexible loop filter control and tile size restrictions, including identifying implications on coding tools and implementation. * Study support of independently coded picture regions, including easy extraction and merging of such regions into conforming bitstreams. * Coordinate with AHG2 and AHG3 for text drafting and software development for the high-level parallelism and coded picture regions aspects of the VVC design. * Study the coding efficiency impact of parallel processing and coded picture regions. | S. Deshpande (chair), B. Choi, M. M. Hannuksela, R. Sjöberg, R. Skupin, W. Wan, B. Wang, Y.-K. Wang (vice-chairs) | Tel. (Cat.1) 3 weeks notice |
| **Tool reporting procedure and testing (AHG13)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Prepare output document JVET-R2005, which describes the methodology of tool-off testing and a list of tools to be tested by identified testers, including non-CTC configurations as appropriate. * Produce, study and develop improvements of the JVET-R2013 testing condition description for non-4:2:0 colour format coding. * Provide configurations files, bitstreams, and results of tool-on/tool-off testing. * Develop and collect test results for additional testing of VVC capabilities. * Maintain VTM software aspects for memory bandwidth analysis in coordination with AHG3. * Use the tool usage counts and memory bandwidth usage to study the decoder complexity of features in on/off testing. * Prepare a report with results of the tests. | W.-J. Chien, J. Boyce (co-chairs), Y.-W. Chen, R. Chernyak, K. Choi, R. Hashimoto, Y.**-**W. Huang, H. Jang, R.-L. Liao, S. Liu (vice-chairs) | N |
| **Lossless and near-lossless coding (AHG14)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Produce, study and develop improvements of the JVET-Q2014 testing condition description. * Study lossless and near-lossless coding, including transform skip, BDPCM, and other potential technologies. * Consider the interaction between coding tools and other processing such as loop filtering and LMCS for lossless and near-lossless coding. * Consider throughput bottlenecks for lossless and near-lossless coding at high resolutions and frame rates. | T. Nguyen and T.-C. Ma (co-chairs), M. Ikeda, H. Jang, X. Zhao (vice-chairs) | N |
| **Quantization control (AHG15)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Identify methods for quantization step size control for luma and chroma, including spatially-adaptive and frequency-adaptive approaches. * Develop methods for evaluating quantization step size control operation. * Study the association between transforms and quantization scaling matrices. * Develop testing conditions for evaluating QP signalling improvements including rate control and perceptual optimization strategies as appropriate. * Evaluate the performance of the current VVC QP design using the adaptive quantization control techniques currently available in the VTM. | R. Chernyak (chair), E. François, C. Helmrich, S. McCarthy, A. Segall (vice-chairs) | N |
| **Implementation studies (AHG16)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study current and proposed coding tools to identify implementation issues relating to decoder pipelines, decoder throughput, and other aspects of implementation difficulty. * Solicit hardware analysis of complex tools. * Provide feedback on potential solutions to address identified issues. | M. Zhou (chair), J. An, E. Chai, K. Choi, S. Sethuraman, T. Hsieh, X. Xiu (vice-chairs) | N |
| **SEI message studies (AHG17)**  ([jvet@lists.rwth-aachen.de](mailto:jvet@lists.rwth-aachen.de))   * Study the SEI messages in current draft texts. * Collect software and SEI showcase information for SEI messages, including encoder and decoder implementations and bitstreams for demonstration and testing. * Identify potential needs for addition SEI message. * Study SEI messages defined in HEVC and AVC for potential use in the VVC context. | S. McCarthy (chair), J. Boyce, P. de Lagrange, A. Luthra, A. Tourapis, Y.-K. Wang, S. Wenger (vice-chairs) | N |

# Output documents

The following documents were agreed to be produced or endorsed as outputs of the meeting. Names recorded below indicate the editors responsible for the document production. 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 MPEG output document, a separate version under the MPEG document header should be generated. This version should be sent to GJS and JRO for upload.

[Replace 12 June with 5 June]

[JVET-R2000](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9674) Meeting Report of the 18th JVET Meeting [G. J. Sullivan, J.-R. Ohm] (2020-06-12, near next meeting)

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

[JVET-R2001](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9675) Versatile Video Coding (Draft 9) [B. Bross, J. Chen, S. Liu, Y.-K. Wang] [WG 11 N 19194] (2020-06-12)

(Initial version planned to be made available by 2020-05-01.)

Draft DoCR N 19203.

See the list of elements under section 11.7, [revisit to check].

[JVET-R2002](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9676) Algorithm description for Versatile Video Coding and Test Model 9 (VTM 9) [J. Chen, Y. Ye, S. Kim] [WG 11 N 19195] (2019-06-12)

(Initial version planned to be made available by 2020-05-22.)

Request for ISO/IEC 23090-16 reference software specification in WG 11 N 19202.

Software release of the 9.0 version was expected by 2020-05-15.

Remains valid – not updated: [JVET-N1003](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=6638) Guidelines for VVC reference software development [K. Sühring] (2019-04-01)

Remains valid – not updated: [JVET-Q2004](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9677) Algorithm descriptions of projection format conversion and video quality metrics in 360Lib (Version 10) [Y. Ye, J. Boyce] (2020-02-28)

[JVET-R2005](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9678) Methodology and reporting template for coding tool testing [W.-J. Chien and J. Boyce] (2020-05-15)

Remains valid – not updated: [JVET-M1006](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=5758) Methodology and reporting template for neural network coding tool testing [Y. Li, S. Liu, K. Kawamura] (2019-02-01)

This output was produced to capture aspects specific to enable study of neural network techniques.

[JVET-R2007](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9679) Supplemental enhancement information messages for coded video bitstreams (Draft 4) [J. Boyce, V. Drugeon, G. J. Sullivan, Y.-K. Wang] [WG 11 N 19196] (2020-05-29)

DoCR WG 11 N 19204.

See the list of elements under section 11.8 [revisit to check].

[JVET-R2008](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9680) Conformance testing for versatile video coding (Draft 3) [J. Boyce, E. Alshina, F. Bossen, K. Kawamura, I. Moccagatta, W. Wan] [WG 11 N 19199] (2020-05-29)

Request for ISO/IEC 23090-15 in WG 11 N 19201.

Bitstream were requested to be provided by two weeks after the release of the VTM 9.0 software.

[JVET-R2009](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9681) Draft plan for VVC verification testing (Draft 2) [M. Wien, V. Baroncini, A. Segall, Y. Ye] [WG 11 N 19200] (2020-05-01)

See notes in section 4.4.

Remains valid – not updated: [JVET-N1010](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=6643) JVET common test conditions and software reference configurations for SDR video [F. Bossen, J. Boyce, X. Li, V. Seregin, K. Sühring] (2019-04-12)

Remains valid – not updated: [JVET-P2011](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=8862) JVET common test conditions and evaluation procedures for HDR/WCG video [A. Segall, E. François, W. Husak, S. Iwamura, D. Rusanovskyy] (2019-07-31)

Remains valid – not updated: [JVET-L1012](http://phenix.int-evry.fr/jvet/doc_end_user/current_document.php?id=4840) JVET common test conditions and evaluation procedures for 360° video [P. Hanhart, J. Boyce, K. Choi, J.-L. Lin] (2018-10-26)

[JVET-R2013](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9682) JVET common test conditions and software reference configurations for non-4:2:0 colour formats [Y.-H. Chao, Y.-C. Sun, J. Xu, X. Xu] (2020-05-15)

Issuing an update was confirmed to be needed to reflect the disabling of dual tree for RGB content. (See the notes for R0468: “Change the conf setting for RGB coding of camera-captured content, single tree in I slices as suggested in JVET-R0468.” – single tree has already been used for computer-generated content) It was also agreed to avoid including the config files in the document.

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] (2020-03-02)

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] (2020-03-02)

[JVET-R2016](http://phenix.it-sudparis.eu/jvet/doc_end_user/current_document.php?id=9673) Summary information on BD-rate experiment evaluation practices [K. Andersson, F. Bossen, J.-R. Ohm, A. Segall, R. Sjöberg, J. Ström, G. J. Sullivan, A. Tourapis] (2020-05-15)

Minor refinements of the description.

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

Future meeting plans were established according to the following guidelines (update with expectation of lower work load?):

* Meeting under ITU-T SG 16 auspices when it meets (ordinarily starting meetings on the Tuesday of the first week and closing it on the Wednesday of the second week of the SG 16 meeting – a total of 9 meeting days), and
* Otherwise meeting under ISO/IEC JTC 1/SC 29/WG 11 auspices when it meets (ordinarily starting meetings on the Wednesday (better Fri/Sat?) prior to such meetings and closing it at lunchtime on the last day of the WG 11 meeting – a total of 9.5 meeting days).

In cases where an exceptionally high workload is expected for a meeting, an earlier starting date may be defined.

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

* Wed. 7 – Fri. 16 October 2020, 20th meeting under WG 11 auspices in Rennes, FR.
* Wed. 6 – Fri. 15 January 2021, 21st meeting under WG 11 auspices in Capetown, ZA.
* Tue. 20 – Wed. 28 April 2021, 22nd meeting under ITU-T auspices in Geneva, CH.
* Wed. 7 – Fri. 16 July 2021, 23rd meeting under WG 11 auspices in Prague, CZ.

The agreed document deadline for the 20th JVET meeting was planned to be XXday XX Oct. 2020.

Vittorio Baroncini, Andrew Segall, Mathias Wien, and Yan Ye were thanked for their efforts in further developing the VVC verification test plan and procedure, and the experts who encoded bitstreams for this purpose were also thanked.

Kenzler Conference Management was thanked for its advance arrangements and management of the unfortunate interruption of these arrangements under the exceptional circumstances of the current meeting.

The 19h JVET meeting was closed at approximately XXXX hours UTC on Wednesday 1 July 2020.

# Annex A to JVET report: List of documents

# Annex B to JVET report: List of meeting participants

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