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| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  32nd Meeting: Ljubljana, SI, 12–18 July 2018 | Document: JCTVC-AF0004-v1 |

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| --- | --- | --- | --- |
| *Title:* | **HEVC conformance test development (AHG4)** | | |
| *Status:* | Input document to JCT-VC | | |
| *Purpose:* | AHG Report | | |
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| *Source:* | AHG on HEVC conformance development | | |

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# Introduction

The mandates of this AHG are:

* Study the requirements of HEVC conformance testing to ensure interoperability.
* Produce and develop proposed improvements to the conformance testing draft JCTVC-AE1004 for SCC and non-intra HT profiles.
* Discuss work plans and testing methodology to develop and improve HEVC v.1, RExt, SHVC, and SCC conformance testing.
* Identify needs for HEVC conformance bitstreams with particular characteristics.
* Collect, distribute, and maintain the bitstream exchange database and draft HEVC conformance bitstream test set.

# Activities

## Reflector

The e-mail reflector is [jct-vc@lists.rwth-aachen.de].  To receive email, please subscribe to the e-mail reflector: <http://mailman.rwth-aachen.de/mailman/listinfo/jct-vc>. For e-mail exchange, it is recommended to put [AHG4] in the subject line for easy grouping.

## ftp site

The ftp site at ITU-T is used to exchange bitstreams. The ftp site for downloading bitstreams is

<http://wftp3.itu.int/av-arch/jctvc-site/bitstream_exchange/>

The spreadsheet to summarize the status of bitstream exchange, conformance bitstream generation is available at this directory. It includes the list of bitstreams, codec features and settings, and status of verification.

## Bitstream generation guideline

The guideline to generate the conformance bitstreams is summarized in JCTVC-O1010.

## HEVC v.1, MV/3D-HEVC, RExt and SHVC conformance

There was no updates from the last JCTVC meeting. The latest bitstreams are available at the following site.

<http://wftp3.itu.int/av-arch/jctvc-site/draft_conformance/>

## SCC conformance

### Bitstream generation instructions

The document JCTVC-O1010 contains the general guidelines for bit-stream generation, uploading and bit-stream naming conventions.

### Test plan

HEVC Screen Content Coding extensions conformance testing will test the following profiles:

Screen-Extended Main, Screen-Extended Main 10, Screen-Extended Main 4:4:4, Screen-Extended Main 4:4:4 10, Screen-Extended High Throughput 4:4:4, Screen-Extended High Throughput 4:4:4 10, and Screen-Extended High Throughput 4:4:4 14.

The following bitstreams were planned to be generated.

1. Palette size 0/1:
   1. Zero\_and\_One\_Palette\_Size\_A\_Canon (Screen-Extended Main)
2. Slice ACT QP offsets:
   1. Slice\_ACT\_QP\_Offsets\_A\_Qualcomm (Screen-Extended Main 4:4:4)
3. delta QP and chroma QP offsets signalled in the palette block:
   1. Delta\_QP\_Chroma\_QP\_Offsets\_A\_Qualcomm (Screen-Extended Main 4:4:4)
4. Motion vector resolution set to full pel or quarter pel:
   1. MVRESIDC\_A\_MS (Screen-Extended Main 4:4:4)
   2. MVRESIDC\_B\_MS (Screen-Extended Main 4:4:4)
   3. MVRESIDC\_C\_MS (Screen-Extended Main 4:4:4)
5. High Throughput SCC profiles:
   1. HT\_A\_SCC\_Apple (Screen-Extended High Throughput 4:4:4 10)
   2. HT\_B\_SCC\_Apple (Screen-Extended High Throughput 4:4:4 14)
   3. HT\_C\_SCC\_Apple (Screen-Extended High Throughput 4:4:4 14)

Table 1 lists the bitstream features to be tested. Some bitstream features may be represented using multiple bitstreams.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Chroma format | Bit depth | Category | Sub category | Bitstream feature | Volunteers | Candidates |
| 4:4:4 4:2:0 | 8/10 | Palette | Predictor palette initialization (PPS/SPS/initialized to zero) |  | InterDigital |  |
| Palette size 0/1 |  | Canon |  |
| 4:4:4 4:2:0 | 8/10 | Current picture reference (CPR) | bi-prediction restriction (conversion from bi to uni) |  | Qualcomm |  |
| DPB | in-loop filtering enabled/disabled | MediaTek |  |
| 4:4:4 4:2:0 | 8/10 | adaptive residual transform | slice ACT QP offsets |  | Qualcomm |  |
| 4:4:4 4:2:0 | 8/10 | adaptive motion vector resolution | motion\_vector\_resolution\_ control\_idc = 0/1/2 |  | Microsoft |  |
| 4:4:4 4:2:0 | 8/10 | Intra coding | Intra boundary filtering disable |  | MediaTek |  |
| 4:4:4 4:2:0 | 8/10 | delta QP / chroma QP offset signalling | delta QP and chroma QP offsets are signalled in the palette block |  | Qualcomm |  |
| 4:2:2 4:4:4 | 8/10/14 | Screen-extended high throughput profiles | Enable tiles and wavefronts in the same bitstream |  | Apple |  |

### Updates since the last meeting

All the SCC and non-intra High Throughput conformance bitstreams listed in document JCTVC-AD1004 are available to download from the draft\_SCC\_conformance directory:

<http://wftp3.itu.int/av-arch/jctvc-site/bitstream_exchange/draft_SCC_conformance/>

The non-intra High Throughput conformance bitstreams are decodable using the latest HM version (HM-16.18) as well as the latest SCM version (HM-16.18+SCM-8.7). All the SCC conformance bitstreams are decodable using the latest SCM version (HM-16.18+SCM-8.7).

There are three issues outstanding related to the SCC conformance bitstreams and SCM software:

1. The level for some bitstreams is set too high (6.2) when compared to the resolution of the underlying bistreams. This is probably due to the fact that the SCM software and per-sequence config files were used to generate many of the conformance bitstreams. For all the SCC test sequences, the per-sequence config files provided with the SCM software set the level to 6.2 irrespective of the resolution. It should be emphasized that these conformance bitstreams are valid, but a conformant decoder operating at a level lower than 6.2 may be capable of decoding such bitstreams.
2. JCTVC-AE0021 reported an error in the specification of the screen-extended high throughput profiles. If the fix suggested in JCTVC-AE0021 is adopted, the SCM software would have to be modified and the three high throughput SCC bitstreams (HT\_A\_SCC\_Apple, HT\_B\_SCC\_Apple, HT\_C\_SCC\_Apple) would need to be regenerated.
3. The value of the syntax element general\_max\_14bit\_constraint\_flag is not correct for all the SCC and high throughput non-intra bitstreams. These need to be corrected.

## Originally planned bitstream features (HEVC v.1)

The following bitstreams were originally planned to generate and the yellow highlighted bitstreams are not generated yet.

Table: Candidates of HEVC conformance test features

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Categories | Sub categories | Feature Code | Bitstream features | Volunteers |
|  | Intra coding | Intra prediction | IPRED | Functional stage: Decoding of intra PU.  Purpose: Check that the decoder can properly decode all values of intraPredMode for different Luma and Chroma transform block sizes. | C.S. Lim, F. Bossen, J. Lainema, K. Sugimoto |
|  | Constraint intra prediction | CIP | Functional stage: Decoding of intra PU in non-intra slice when constrained\_intra\_pred\_flag is set to one  Purpose: Check that the decoder can properly perform reference sample substitution process. | C.S. Lim, K. Chono |
| Inter frame coding | AMVP | AMVP | Check whether motion vector prediction candidate generation and signalling perform correctly.  Check the process when neighboring PUs have various partition mode, prediction mode, reference index, inter\_pred\_idc, etc..  Related syntax element: mvp\_l0\_flag, mvp\_l1\_flag | C. Kim, M. Zhou, Y. -W. Huang |
|  | MVs | MV | maximum number of motion vectors permitted per CTU |  |
|  |  | MV | vectors reference padded picture edges. | M. Coban |
|  |  | MV | clipping of motion vector range in MVP/Merge candidates | M. Coban |
|  |  | MV | motion vectors are random, maximum page DRAM misses / minimize cache hits   (according to memory bandwidth model... e.g.  JCTVC-H007) |  |
|  | Merge | MERGE | Merge candidate list index signaling:  Check that merge candidate list can deal with every merge index (0..4) | B. Bross |
|  |  | MERGE | Parallel merge: test all the possible combinations of log2\_parallel\_merge\_level\_minus2 and CTB sizes. | M. Zhou, Y. -W. Huang |
|  |  | MERGE | number of maximum merge candidates signalling: test all the values of five\_minus\_max\_merge\_cand, i.e. 0, 1, 2, 3, 4 for CTB size of 64x64 | M. Zhou, |
|  | WP | WP | weighted\_pred\_flag and/or weighted\_bipred\_flag are equal to 1. | T. Chujoh |
|  |  | WP | various weighted prediction parameter combinations | T. Chujoh |
|  | mvd\_l1\_zero\_flag | MVD | Test mvd\_l1\_zero\_flag | F. Bossen |
|  | temporal\_mvp | TMVP | Test slice\_temporal\_mvp\_enable\_flag | J. Xu |
|  | Collocated ref idx | RIDX | Test collocated\_ref\_idx (single slice or multiple slice/picture with different reference lists.) |  |
| HL syntax | slices, PSs | PS | bitstreams with stuffed extensions (vps\_extension\_data\_flag=1, sps\_extension\_data\_flag=1, pps\_extension\_flag=1, ..) | W. Jang, M. Coban |
|  | dependent slice | DSLICE | Check:  - dependent slices  - WPP with dependent slices  - tiles with dependent slices | B. Bross |
|  | POC | POC | POC increments > 1 | M. Coban |
|  | RPS | RPS |  | M. Coban |
|  |  | RPS |  | F. Bossen |
|  |  | RPS | Slice header RPS with short-term pictures | R. Sjöberg |
|  |  | RPS | Slice header RPS with short-term and long-term pictures | R. Sjöberg |
|  |  | RPS | PPS RPS with short-term pictures | R. Sjöberg |
|  |  | RPS | PPS RPS with short-term pictures and inter-RPS prediction | R. Sjöberg |
|  |  | RPS | Mix of PPS and slice header RPS with short-term pictures | R. Sjöberg |
|  |  | RPS | Mix of PPS and slice header RPS with short-and long-term pictures | R. Sjöberg |
|  | RPL | RPL |  | M. Coban |
|  | RAP | RAP | all 6 (currently identified) RAP types | F. Bossen |
|  | HRD | HRD | maximum number of pictures in DPB | TBD |
|  |  | HRD | bitstream with largest possible CPB delay (maximum number of coded bits per picture but within MinCR) | TBD |
|  |  | HRD | bumping DPB | R. Sjöberg |
|  |  | HRD | Low delay, Sub picture | K. Kazui |
| Transform | RQT | RQT | Check all depths of inter  & intra transform tree:  QuadtreeTUMaxDepthInter : 0..4  QuadtreeTUMaxDepthIntra : 0..4 | B. Bross |
| Quantization | dQP | DQP | all depths of CU and diff\_cu\_qp\_delta\_depth | W. Wan, T. Suzuki |
|  | Scaling list | SLIST | non-default scaling lists | T. Suzuki, M. Zhou |
| Other coding tools | AMP | AMP | Check all asymetric partition mode enable | X. Zheng, C. Kim |
|  | Transform skip | TSKIP |  | J. Xu |
|  | I\_PCM | IPCM | Functional stage: Parsing of I\_PCM size information at SPS and I\_PCM flag at CU.  Purpose: Check that the decoder can properly decode pcm\_flag for different intra CU sizes.  Related Syntax: log2\_min\_pcm\_luma\_coding\_block\_size\_minus3, log2\_diff\_max\_min\_pcm\_luma\_coding\_block\_size, pcm\_flag. | W. Wan, C.S. Lim, K. Chono |
|  |  | IPCM | Functional stage: Parsing and decoding of I\_PCM CUs.  Purpose: Check that the decoder can properly decode I\_PCM CUs with different PCM bit depth.  Related syntax: pcm\_sample\_bit\_depth\_luma\_minus1, pcm\_sample\_bit\_depth\_chroma\_minus1, pcm\_flag | W. Wan, C.S. Lim, K. Chono |
|  |  | IPCM | Functional stage: Decoding of I\_PCM CUs with loop filter skipping.  Purpose: Check that the decoder can properly decode I\_PCM CUs by skipping loop filter.  Related syntax: pcm\_loop\_filter\_disable\_flag, pcm\_flag.  Note: Combination with cu\_transquant\_bypass\_flag will be tested. | W. Wan, C.S. Lim, K. Chono |
|  | Lossless | LOSSLESS | transquant\_bypass\_enable\_flag on, cu\_transquant\_bypass\_flag is set to 0 and 1 randomly at CU level  Purpose: Check that the decoder handles lossless coding. | F. Henry |
| Parallel processing tools | Tile | TILE | Maximum number of tiles in a random, non-uniform arrangement that changes from picture to picture, with random chosen value for loop\_filter\_across\_tiles\_enabled\_flag, deblocking\_filter\_override\_flag, slice\_disable\_deblocking\_filter\_flag, slice\_loop\_filter\_across\_slices\_enabled\_flag | A. Fuldseth, M. Zhou |
|  | WPP | WPP | entropy\_coding\_sync\_enabled\_flag on.  Purpose: Check that the decoder handles wavefront parallel processing | F. Henry |
|  | WPP and slices | WPP | entropy\_coding\_sync\_enabled\_flag on, number of slice varies randomly between 2 and maximum number of slices permitted, each non-first slice is either regular or dependent in a random way.  Purpose: Check that the decoder handles wavefront parallel processing and slices | F. Henry |
|  | Tile & WPP | WPP | entry point of WPP | Hendry |
| Temporal scalability |  | TSCL |  | W. Jang |
|  |  | TSCL | range of nested temporal\_id's |  |
| Deblocking filter |  | DBLK | various cb, cr qp\_offsets | T. Suzuki, R. Sjöberg |
|  |  | DBLK | various beta\_offset\_div2, tc\_offset\_div2 | T. Suzuki, R. Sjöberg |
|  |  | DBLK | trigger all deblocking decisions | T.Suzuki, R. Sjöberg |
|  |  | DBLK | deblocking + tile, etc |  |
| SAO |  | SAO | Check all CTU sizes with max. SAO information rate. | E. Francois, Y. -W. Huang |
|  |  | SAO | Random and extreme SAO offsets values | E. Francois, Y. -W. Huang |
|  |  | SAO | Random SAO merge left/up flag values | E. Francois, Y. -W. Huang |
|  | Slice- and component-level control | SAO | Pictures divided into x slices / randomly enabling SAO Y and/or SAO UV per slice | E. Francois |
|  | Tile- and component-level control | SAO | Pictures divided into x tiles / randomly enabling SAO Y and/or SAO UV per tile | E. Francois |
| Entropy coding |  |  |  |  |
|  | Sign data hiding | SDH | sign\_data\_hiding\_flag on, transquant\_bypass\_enable\_flag on, cu\_transquant\_bypass\_flag is set to 0 and 1 randomly at CU level  Purpose: Check that the decoder handles sign data hiding with lossless coding. | H. Henry |
|  | High through put binalizaion | HTB |  | M. Coban |
|  | cabac\_init\_idc | CAINIT |  | A. Segall |
|  | Max number of bins | MAXBIN |  | V. Sze |
| Corner case bitstream |  |  |  | Maximum number of slices permitted for Profile & Level combination; Each slice has unique short\_term\_ref\_pic\_set(), ref\_pic\_list\_modification() and pred\_weight\_table() with maximum num\_long\_term\_pics | C. Fogg |
|  |  |  | CTU size is 64x64 with no cu splits, and only one coded transform unit in the lower right 4x4 pixel corner of the CTU with delaQp signalled (as raised by P. Kaspenberg on the JCT reflector 12-Sept-2012) | C. Fogg |
|  |  |  | A wide range of values for pic\_crop\_left\_offset, pic\_crop\_right\_offset, pic\_crop\_top\_offset, pic\_crop\_bottom\_offset | C. Fogg |
|  |  |  | inferred splits along non-CTU multiple picture borders |  |
|  |  |  | combinations of transform\_skip\_enabled\_flag, transquant\_bypass\_enable\_flag, cu\_transquant\_bypass\_flag |  |
|  |  |  | something to test the vast universe that is: POC signalling |  |
| Video resolution |  |  | pic\_width\_in\_luma\_samples = pic\_height\_in\_luma\_samples = (1 << Log2MinCbSize), with various CTU sizes. |  |

## Originally planned bitstream features (RExt)

Table: Candidate features of RExt conformance

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Chroma format | Bit depth | Category | Sub category | Bitstream | Volunteers | Candidates |
| 4:4:4 |  | Intra coding | Intra smoothing disable | This feature is covered by other bitstreams | Fujitsu | Fujitsu ? |
| 4:2:2 |  |  | Adjustment to intra chroma prediction angle | ADJUST\_IPRED\_ANGLE\_A\_RExt\_Mitsubishi\_1 | A.Minezawa | Mitsubishi |
| 4:2:0, 4:2:2, 4:4:4 | 12, 16 | Inter frame coding | WP (high\_precision\_offsets\_enabled\_flag) | ?? TBD |  | Toshiba ? |
| 4:4:4 |  |  | Cross component prediction | CCP\_8bit\_RExt\_QCOM  CCP\_10bit\_RExt\_QCOM  CCP\_12bit\_RExt\_QCOM | Qualcomm | HHI/Qualcomm |
| 4:4:4 | L/C  10/8  8/10 |  | Different bit depth for luma and chroma | Bitdepth\_A\_RExt\_Sony\_1  Bitdepth\_B\_RExt\_Sony\_1 | Sony |  |
|  |  | Transform |  | This feature is covered by other bitstreams | Sony |  |
|  |  | Quantization | Scaling list | QMATRIX\_A\_RExt\_Sony\_1 | Sony | Sony ? |
|  |  |  | Chroma\_qp\_adjustment | This feature is covered by other bitstreams | Black Berry | Black Berry ? Apple ? |
| 4:2:2 |  | Loop filter | Deblocking | This feature is covered by other bitstreams |  | ? |
|  |  |  | SAO | SAO\_A\_RExt\_MediaTek\_1 | Media Tek | Samsung ? Media Tek ? |
|  |  | Entropy coding | Rice parameter initialization | ?? | Qualcomm | Qualcomm, Sony ? |
|  |  |  | Persistent Rice parameter tool | PERSIST\_RPARAM\_A\_RExt\_Sony\_2 | Sony |  |
|  |  |  | CABAC bypass alignment | This feature is covered by other bitstreams | Sony | Qaulcomm ? Sony ? |
| 4:4:4 | 16 | Precision | Extended precision | EXTPREC\_HIGHTHROUGHPUT\_444\_16\_INTRA\_8BIT\_RExt\_Sony\_1  EXTPREC\_HIGHTHROUGHPUT\_444\_16\_INTRA\_10BIT\_RExt\_Sony\_1  EXTPREC\_HIGHTHROUGHPUT\_444\_16\_INTRA\_12BIT\_RExt\_Sony\_1  EXTPREC\_HIGHTHROUGHPUT\_444\_16\_INTRA\_16BIT\_RExt\_Sony\_1  EXTPREC\_MAIN\_444\_16\_INTRA\_8BIT\_RExt\_Sony\_1  EXTPREC\_MAIN\_444\_16\_INTRA\_10BIT\_RExt\_Sony\_1  EXTPREC\_MAIN\_444\_16\_INTRA\_12BIT\_RExt\_Sony\_1  EXTPREC\_MAIN\_444\_16\_INTRA\_16BIT\_RExt\_Sony\_1 | Sony |  |
|  |  | HL syntax |  |  |  |  |
| 4:2:2, 4:4:4 | 10, 12, 16 | Others | PCM | IPCM\_A\_RExt\_NEC  IPCM\_B\_RExt\_NEC | NEC | NEC |
| 4:4:4 | 8, 10, 12, 16 |  | Transform skip rotation | ?? TBD | ?? | Microsoft, Qualcomm (N0288) |
| 4:4:4 | 8, 10, 12, 16 |  | Transform skip context | TSCTX\_8bit\_I\_RExt\_SHARP\_1, TSCTX\_8bit\_RExt\_SHARP\_1, TSCTX\_10bit\_I\_RExt\_SHARP\_1, TSCTX\_10bit\_RExt\_SHARP\_1, TSCTX\_12bit\_I\_RExt\_SHARP\_1, TSCTX\_12bit\_RExt\_SHARP\_1 | Sharp | Qualcomm (N0044)  Sharp |
| 4:4:4 | 8, 10, 12, 16 |  | RDPCM (implicit & explicit) | ExplicitRdpcm\_A\_BBC\_1  ExplicitRdpcm\_B\_BBC\_1 | Samsung  BBC(explicit) | Media Tek (P0154) |
| 4:4:4 | 8, 10, 12, 16 |  | Max transform skip block size | ?? TBD | BBC | Many. Perhaps BBC? |
| 4:2:2 | 10 |  | Various combination of tools/parameters | Main\_422\_10\_A\_RExt\_Sony\_1  Main\_422\_10\_B\_RExt\_Sony\_1 | Sony |  |
| 4:4:4 | 8/16 |  | Various combination of tools/parameters | GENERAL\_8b\_400\_RExt\_Sony\_1  GENERAL\_8b\_420\_RExt\_Sony\_1  GENERAL\_8b\_444\_RExt\_Sony\_1  GENERAL\_10b\_420\_RExt\_Sony\_1  GENERAL\_10b\_422\_RExt\_Sony\_1  GENERAL\_10b\_424\_RExt\_Sony\_1  GENERAL\_12b\_400\_RExt\_Sony\_1  GENERAL\_12b\_420\_RExt\_Sony\_1  GENERAL\_12b\_422\_RExt\_Sony\_1  GENERAL\_12b\_444\_RExt\_Sony\_1  GENERAL\_16b\_400\_RExt\_Sony\_1  GENERAL\_16b\_444\_RExt\_Sony\_1  GENERAL\_16b\_444\_highThroughput\_RExt\_Sony\_1  WAVETILES\_RExt\_Sony\_1 | Sony |  |

## Originally planned bitstream features (SHVC)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | Replace  Needed | # | LAYER DEPENDENCIES |
| Nokia | Antti Hallapuro | LAYERID | Y | 1 | gaps in layer id |
| InterDigital | Yan Ye | MVD | N | 1 | no MV dependency |
| Nokia | Antti Hallapuro | MVD | N | 1 | varying sample, MV dependencies |
| ETRI | Hahyun Lee | MAXTID | N | 3 | max\_tid |
| Qualcomm | Adarsh Ramasubramonian | INACTIVE | N | 1 | inactive ref layers |
| Vidyo | Wonkap Jang | REFLAYER | Y | 4 | multiple active ref layers with various inter layer predictors and dependencies |
|  |  |  |  |  |  |
|  |  |  |  |  | VPS SYNTAX |
| HHI | Robert Skupin | SPLITFLAG | N | 1 | splitting\_flag |
| Qualcomm | Hendry | VUI | N | 3 | VUI present |
| Qualcomm | Hendry | NONVUI | N | 3 | non VUI extension |
|  |  |  |  |  |  |
|  |  |  |  |  | DPB |
| Vidyo | Won Kap Jang | DPB | Y | 2 | Sub layer dbp info |
|  |  |  |  |  |  |
|  |  |  |  |  | RESOLUTIONS |
| Samsung | Elena Alshina | SRATIOS | N | 2 | 2 spatial layers w/ unusual ratios |
| InterDigital | Yan Ye | SNR | N | 3 | 2, 3 SNR layers |
| Vidyo | Wonkap Jang | REPFMT | Y | 3 | VPS rep formats |
| Vidyo | Wonkap Jang | RESCHANGE | Y | 1 | resolution change in SPS |
| Ericsson | Rickard Sjoberg | ADAPTRES | N | 1 | adaptive resolution |
| Sony | Ohji Nakagami | SPSREPFMT | N | 1 | SPS rep format idx |
| Vidyo | Wonkap Jang | CONFCROP | Y | 3 | conformance cropping window in VPS |
|  |  |  |  |  |  |
|  |  |  |  |  | OFFSETS AND PHASE ADJUSTMENTS |
| Qualcomm | Adarsh Ramasubramonian | SCREFOFF | N | 1 | scaled ref layer offsets |
| Sharp | Tomoyuki Yamamoto | REFREGOFF | N | 1 | ref region offsets |
| Samsung | Elena Alshina | RESPHASE | N | 1 | resample phase |
|  |  |  |  |  |  |
|  |  |  |  |  | OUTPUT LAYERS, PICS |
| Nokia | Antti Hallapuro | OLS | N | 1 | add output layer sets, non-default target output layer sets, unnecessary layers |
| Qualcomm | Hendry | DISFLAG | N | 1 | discardable flag |
|  |  |  |  |  |  |
|  |  |  |  |  | SCALING LIST |
| Sony | Ohji Nakagami | PPSSLIST | N | 1 | SPS scaling list infer |
| Sony | Ohji Nakagami | SPSSLIST | N | 1 | PPS scaling list infer |
|  |  |  |  |  |  |
|  |  |  |  |  | COLOR GAMUT SCALABILITY |
| Technicolor | Franck Hiron | CGS | Y | 9 | Colour gamut scalability 8-to-10 bits, 10-to-10 bits, spatial ratio change with CGS |
|  |  |  |  |  |  |
|  |  |  |  |  | ADDITIONAL EXTENSIBILITY |
| Vidyo | Wonkap Jang | PSEXT | N | 1 | SPS, PPS additional extension |
| HHI | Karsten Suehring | LAYERID63 | N | 1 | NUHs with layer\_id of 63 |
|  |  |  |  |  |  |
|  |  |  |  |  | POC |
| Ericsson | Rickard Sjoberg | POC | N |  | unaligned POC |
|  |  |  |  |  |  |
|  |  |  |  |  | BASE LAYER TYPE |
| Qualcomm | Hendry | HYBRID | N | 1 | hybrid scalability |
| Nokia | Antti Hallapuro | INBLD | Y | 1 | base layer not available (INBLD) |
| InterDigital | Yan Ye | SIM | N | 2 | simulcast |
|  |  |  |  |  |  |
|  |  |  |  |  | LEVEL SIGNALING |
| Vidyo | Wonkap Jang | SLLEV | N | 1 | sub\_layer level signaling |
|  |  |  |  |  |  |
|  |  |  |  |  | AUX PICS |
| BBC | Matteo Naccari | ALPHA | N | 1 | Alpha |
| Nokia | Antti Hallapuro | DEPTH | N | 1 | Depth |
|  |  |  |  |  |  |
|  |  |  |  |  | LAYERS |
| Qualcomm | Vadim Seregin | LAYERS | N | 1 | 8 layers |
|  |  |  |  |  | PROFILE CONFORMANCE |
| Fujitsu | Guillaume Barroux | SREXT | N | 6 | Scalable Range extension profiles |

# Recommendations

The AHG recommends

* to issue DAM of ISO/IEC 23008-8:2018/Amd 1 (SCC conformance) by MPEG
* to consent new edition of H.265.1, including SCC conformance, by ITU-T SG16, at this meeting or the next SG16 meeting
* to continue to improve SCC conformance bitstreams, if necessary