Title:	BoG report: Extended chroma formats	
Status:	Input Document to JCT-VC	
Purpose:	BoG report	
Author(s):	David Flynn	*davidf@rd.bbc.co.uk*
Source:	BoG	

Abstract

A break out group on extended chroma formats was held on Tuesday 17th and Wednesday 18th July, covering topics on test material selection, test conditions and a more in-depth presentation of proposals JCTVC-J0191 [**?**] and JCTVC-J0357 [**?**] that provide software models for 4:2:2 and 4:4:4 chroma formats.

Test material selection for 4:2:2 and 4:4:4

The BoG reviewed the currently available test material with a view to select material for testing during the next meeting cycle for use by a possible AHG. A viewing session was arranged to examine the JCTVC-0197 [**?**] sequences.

Each sequence should be 10s (with the exception of Traffic).
4:4:4 shall be in $R'G'B'$ and $Y'CbCr$? (or $Y'CoCg$?) (or constant-luminance $Y'CbCr$)
4:2:2 shall be in $Y'CbCr$.

Suggestion: pick material from different productions, rather than different material from within a single production to reduce systematic biases.

Suggestion: concern about lack of diversity if converting from 4:4:4 to 4:2:2.

Suggestion: take two 4:4:4 sequences and reuse as 4:2:2

Sequences should be provided on uni-hannover ftp site in the appropriate format.

Comment: All processing and conversions must be documented.

Comment: Traffic gives 4k content

Suggestion: For any 4k sequence, crop to 2560×1600 as per current Class-A.

How many sequences? Suggestion: 5 – 8

Should the test material exercise something?

Review of new material currently available (4:4:4) for JCT-VC use

- J0152 [**?**] has used material that should be generally available.
  Three sequences, $R'G'B'$ 4:4:4 10-bit: kimono/parkscene/tennis.
  Preference: kimono, parkscene
  Availability: TBD.
  (Discounted ITE material, due to fees, not appropriate for short term test).

- J0197a (reported as 4:4:4 10-bit 60p), nine sequences.
  Note: question as to the 4:4:4 ($R'G'B'$)/4:2:2 ($Y'CbCr$) pedigree (captured via HDCAM-SR).
  Preference: sequence 16 ("birds in cage", second half), sequence 22 ("ducks and legs", second half).
  Availability: Within one week of meeting

- J0197b can provide traffic as 4:4:4 10-bit (class-A) $R'G'B'$.
  Availability: Within one week of meeting

- SVT sequences. Six sequences, Scanned film at 16bit RGB (linear) 4:4:4, Well documented processing although noisy.
  Preference: crowd-run, old town/seeking(part of fary tale).
  Availability: Immediate (TODO: upload to common ftp site)

: Use the following sequences (Table **??**): kimono, parkscene, birds-in-cage, ducks-and-legs, traffic, crowd-run, old-town, seeking.

Review of new material currently available (4:2:2) for JCT-VC use

- J0152 proposes EBU sequences [13], two are film, rest F-35
  Comment: crowdrun not interesting (we can generate it at higher precision)
  (Discounted ITE material, due to fees, not appropriate for short term test)
  Preference: KidsSoccer (Film), Graphics, Horse, Water Rocks Close
  <mark>Recommendation</mark>: Request a liaison statement to the EBU for access to the material, possibly include request for 4k material too.

- If J0197a is actually 4:2:2 (Y′CbCr)
  Preference: sequence 16 "birds in cage", second half, sequence 22 "ducks and legs", second half.
  Availability: Within one week of meeting

- The BBC has previously proposed 4:2:2 1080p50 (Y′CbCr) 10-bit sequences Themepark, Wind-vines, Wisley.

- Take 4:4:4 sequences and convert to 4:2:2
  Allows full control of the conversion process, potentially more than 10-bit images.
  Preference: Kimono, Traffic
  Availability: Within two weeks of the meeting

<mark>Recommendation</mark>: Use the following sequences (Table **??**): Kids Soccer, graphics, horse, water rocks close, birds-in-cage, ducks-and-legs, kimono, traffic.

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Table 1: Recommended 4:4:4 sequences (before any required conversions)

Sequence	Duration	Resolution	Frame rate	Color space	Bit-depth	Acquisition	Owner	Availability	Contribution
Kimono	10s	1920x1080	24	$R'G'B'$	10	Sony HDC-F950	CoSME	TBD	J0152
Parkscene	10s	1920x1080	24	$R'G'B'$	10	Sony HDC-F950	CoSME	TBD	J0152
Birds-in-cage	10s	1920x1080	60	$R'G'B'$	10	HDCAM-SR	Plannet inc	1 week	J0197
Ducks-and-legs	10s	1920x1080	60	$R'G'B'$	10	HDCAM-SR	Plannet inc	1 week	J0197
Traffic	5s	2560x1600	30	$R'G'B'$	10	?	?	1 week	J0197
Crowd-run	10s	1920x1080	50	RGB	16		SVT/EBU	1 week	I0108
Old-town	10s	1920x1080	50	RGB	16		SVT/EBU	1 week	I0108
Seeking	10s	1920x1080	50	RGB	16		SVT/EBU	1 week	I0108

Table 2: Recommended 4:2:2 sequences (before any required conversions)

Sequence	Duration	Resolution	Frame rate	Color space	Bit-depth	Acquisition	Owner	Availability	Contribution
Kids soccer	10s	1920x1080	50	$Y'CbCr$	10	ArriFlex	EBU	[1]	J0152
Graphics	10s	1920x1080	50	$Y'CbCr$	10	Sony F35	EBU	[1]	J0152
Horse	10s	1920x1080	50	$Y'CbCr$	10	Sony F35	EBU	[1]	J0152
Water rocks close	10s	1920x1080	50	$Y'CbCr$	10	Sony F35	EBU	[1]	J0152
Birds-in-cage	10s	1920x1080	60	$Y'CbCr$	10	HDCAM-SR	Plannet inc	1 week	J0197
Ducks-and-legs	10s	1920x1080	60	$Y'CbCr$	10	HDCAM-SR	Plannet inc	1 week	J0197
Kimono	10s	1920x1080	24	$Y'CbCr$	10	Sony HDC-F950	CoSME	TBD	J0152
Traffic	5s	2560x1600	30	$Y'CbCr$	10	?	?	2weeks	J0197

[1]Liaison statement required

Test conditions for a possible AhG

4:4:4

Suggestion: UHDTV defines constant luminance, we should have some constant-luminance sequences with the new chromaticity coordinates.

Suggestion: we should look at 10 bit parameters only for now.

Suggestion: can also try 8 bit (for comparison with main/he10) Recommend (initially) to keep current configurations (modified only for chroma format)

QPs: comment: introduce extra QPs

Suggestion: examine bitrate/quality of 10-bit standard QPs with a view to reviewing the test conditions.

Comment: different QPs for 8 and 10bit?

Comment: keeping some overlap between 8 and 10bit will allow for some comparison.

Suggestion: keep 8-bit same, examine 10bit.

Format considerations

$R'G'B'$, $Y'CbCr$, $Y'CoCg$, $Y'_C Cb_C Cr_C$

Suggestion: work on 4:4:4 at greater than 8-bit would be appropriate for still image compression, for lossless compression of still pictures $R'G'B'$ and $Y'CoCg$ might be used.

Suggestion: Take $Y'CbCr$ as a starting point, make $R'G'B'$/RGB available for people to investigate and recommend.

Question: if alternative formats are used, will sequences be made available?

Suggestion: Yes, or (ideally, and) provide the software. MD5 sums shall also be provided.

Comment: it would be useful to compare the evaluation method used for 4:4:4, see JVT document.

Common conditions

All intra

Comment about bitrates: Beware when lowering QP, that bitrate doesn't become insane.

Comment: application areas operate at different bitrates: Very high (low compression ratio) (currently for AVC up to 500Mbps–1Gbps 1080p30 4:4:4), High (currently for AVC 100Mbps)

Comment: benefit of HEVC might be to enable currently "difficult" applications eg 1080p60/120 to use current bitrates.

Comment: be aware that there have been issues with low QPs in the HM

Something else: random access? low delay (B)?

Suggestion: pick only one.

Suggestion: pick low-delay, it allows us to see the performance of inter.

Recommendation: pick low-delay (B)

Comment: Examining re-ordered sequence is not discouraged.

Anchors

Suggestion: test against JM 18.3, as that is the current state of the art

Comment: JM configuration files are required

Comment: there are some problems with JM 18.3 configuration. (with low delay, at 14bit)

Comment: some other proposals may have JM configurations we can reuse

Suggestion for the next meeting

Suggestion: review (and show) all test material that has been used at the next meeting

Problem: critical viewing environment.

Problem: viewing equipment. Consult with Vittorio on facilities.

Comment: reviewing material can be done in 8-bit, which isn't so critical.

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Future test material

Suggestion: Some form of screen content / animated content

Suggestion: sharper material / More vivid (ie, greater chroma excursion)

Suggestion: greater than 10-bit.

Suggestion: linear would be lovely, allows us to do what we want.

Comment: EBU 4k sequences might be available for IBC (September)

Suggestion: Review common test conditions.

Review of JCTVC-J0191 and JCTVC-J0357

Note: A subsequent revision (v3) of JCTVC-J0191 provides software using HM-7.1 as a base. This revision also integrates a number of features in JCTVC-J0357.

Table 3: Comparison of JCTVC-J0191 and JCTVC-J0357

Tool / Feature	J0357	J0191
Text supplied	No	No
Compatibility with HM-7.0	Untested	Standard and non-standard configurations tested (7.0) Standard configurations tested (7.1)
Chroma formats supported	4:2:2, 4:4:4	4:0:0, 4:2:2, 4:4:4
Input and output file formats	Yes	Yes plus sample repeat/drop
PU	4:4:4, Introduces NxN split for co-located chroma PU.	4:4:4, Introduces NxN split for co-located chroma PU. Also allowed in 4:2:2, subject to minimum size limits
Slices/CU	Slices, CU structures are chroma-format independent.	Slices, CU structures are chroma-format independent.
TU	TU may be 4x4 for chroma 4:4:4	TU may be 4x4 for chroma 4:4:4. Option to permit 4:2:0 style rules (eg force min chroma size as 8x8)
TU structures	Non-square TU (4:2:2)	Non-square TU (4:2:2)
Quantizer (4:2:2)	introduces scaling factor to compensate for non-square transform	Configurable options: • QP+3 • QP-3 • QStep Table mod to QP$\pm$3
NSQT	Extended to 4:2:2 case (might be same as 191)	Configurable options: • 4:2:2 maintains 4:2:0 splitting rules (16×4 luma $\Rightarrow$ 4×8 chroma). • 4:2:2 allow 8×4 chroma when 16×4 luma. Extended to 4:4:4
Transform skip	<mark>TBC</mark>	4:4:4 Option for J357 method (single transform skip for all channels)
Intra-prediction angular prediction	Uses same angle, but pads reference samples 4:4:4 = 2 modes (DM, LM)	The 4:2:2 algorithm has been modified to account for the change in sample aspect ratio for the chroma channels. • Option to force DM chroma only • Option to import J357 method (v3)
Intra reference sample filtering	No change	4:4:4 = on/off (chroma) 4:2:2 = off/on(v)/on(h,v)

Continued...

Table 3: Comparison of JCTVC-J0191 and JCTVC-J0357 (Continued)

Tool / Feature	J0357	J0191
TU edge filtering for H, V and DC modes	No change	4:4:4 = on/off (chroma) 4:2:2 = off/on(v)/on(h,v)
LM_Chroma	4:4:4 uses adjacent col	Options: • 4:4:4 uses adjacent col • 4:4:4 uses non-adjacent col (as per 4:2:0 method)
MDDT	No change	Option for MDDT to be applied to chroma 4x4 TUs for 4:4:4.
Motion interpolation filters	4:2:2 use luma (v) 4:4:4 use luma (h+v)	4:2:2 Options: • use luma (v) • no change 4:4:4 Options: • 4:4:4 use luma (h+v) • 4:4:4 no change
Scaling lists	==TBC==	For 4:2:2, a larger scaling list is used and sub-sampled. Options: • Use 32x32 chroma scaling list (imported J357 method in v3) • Use 32x32 luma scaling list for chroma as luma.
Chroma QP clipping table	No change	Unchanged from HM7.0, but there is the option to use a different clipping table for 4:2:2 and 4:4:4.
Chroma CBF Context Variable (CV) derivation	No change	Unchanged from HM7.0, but the CBF derivation for chroma may configured to use a non-depth based selection criteria.
Chroma CV sets and rules	No change	Option: • Rules for chroma CV derivation may be forced to be same as luma • The CVs for Cb and Cr may be separated • A single set of CVs for Y, Cb and Cr
MDCS	No change	MDCS is only used for luma in HM7.0, but it may be optionally applied to chroma. Plus flexibility on direction mapping
Significance map coding	Doubled height of map (replicating rows) Doubled group size	Options: • The significance map given in JCTVC-I0521 may be used, instead of the default neighbour-based algorithm, for the 4x8, 8x4, 8x16 and 16x8 4:2:2 chroma TUs. • Maintain group size 16, using 2x8 coefficient groups for vertical scan in 4:2:2 • J357 method (in v3)
Deblocking filter	No change	No change
ALF	No change	No change

Continued...

Table 3: Comparison of JCTVC-J0191 and JCTVC-J0357 (Continued)

Tool / Feature	J0357	J0191
SAO	No change	No change
RDO mods	Modified RDO to handle RGB. (applies to all 4:4:4)	Option for J357 method (v3)

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