



JCTVC-K0188

On the derivation of chroma QPs

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Proposal overview

■ Goals

- slight modification of the chroma QP derivation in order to simplify the design and to give more flexibility for controlling the chroma QP

■ Proposal 1

- replace the table to derive QPC from QPI by a generic equation
- remove one table from the specification

■ Proposal 2

- make this equation more generic using 2 new control parameters
- accurate control of the link between luma and chroma QPs
- No redundancy with existing parameters `cb/cr_qp_offset`
- finer chroma QP control usefull for fine local QP adaptation

Chroma QP derivation in HM8

■ QPC derived from QPY as follows

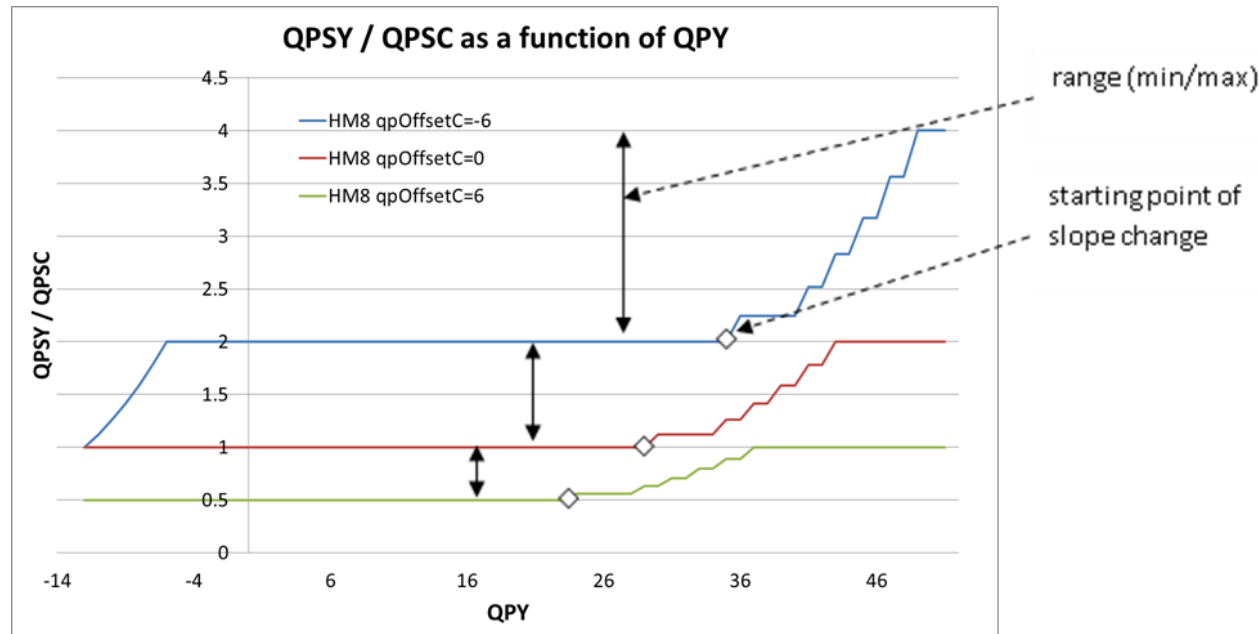
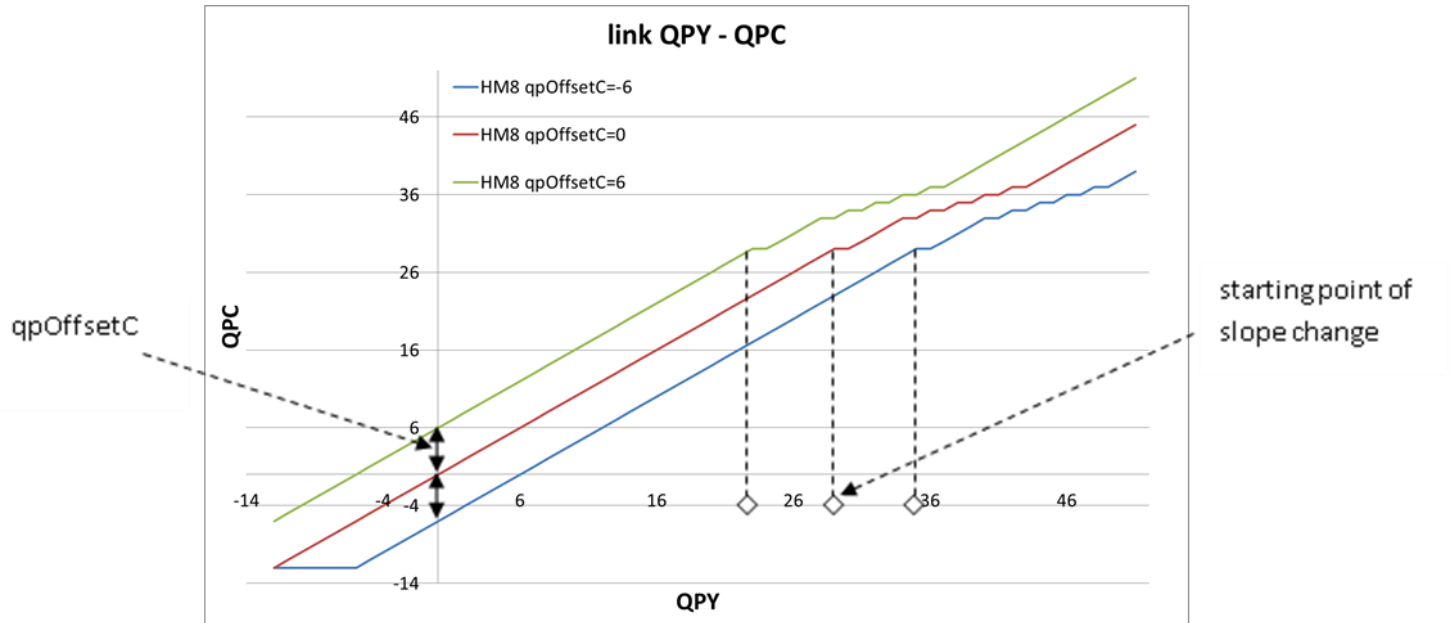
- Computes intermediate qPi from QPY

- $qPiCb = \text{Clip3}(-QpBdOffsetC, 57, QPY + pic_cb_qp_offset + slice_cb_qp_offset)$
- $qPiCr = \text{Clip3}(-QpBdOffsetC, 57, QPY + pic_cr_qp_offset + slice_cr_qp_offset)$

- Derive QPC from qPi using the following table

qPi	<30	30	31	32	33	34	35	36	37	38	39	40	41	42	43	>43
QP _C	= qPi	29	30	31	32	33	33	34	34	35	35	36	36	37	37	= qPi - 6

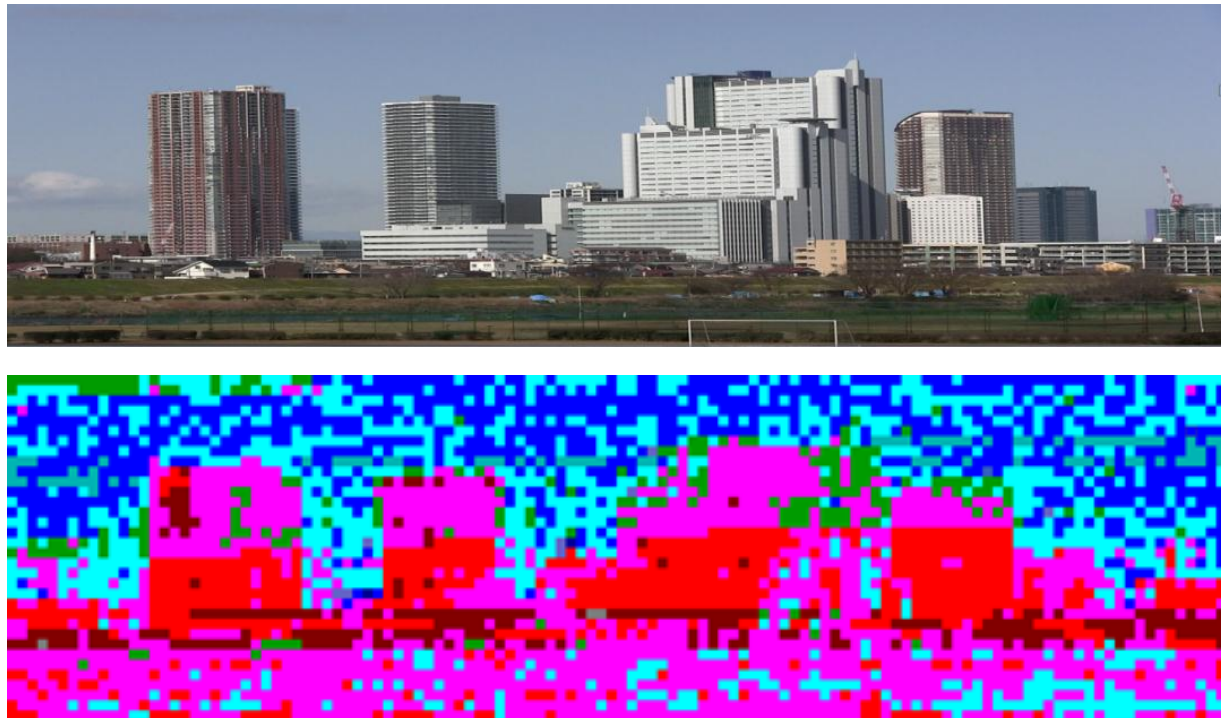
Chroma QP derivation in HM8



qpOffsetC does not independently control the slope change position and amplitude

Chroma QP derivation in HM8

- A fine control of QPC–QPY is important for local QP adaptation
 - QP can significantly vary inside a picture
 - It is important to finely control QPY and QPC



Proposal 1

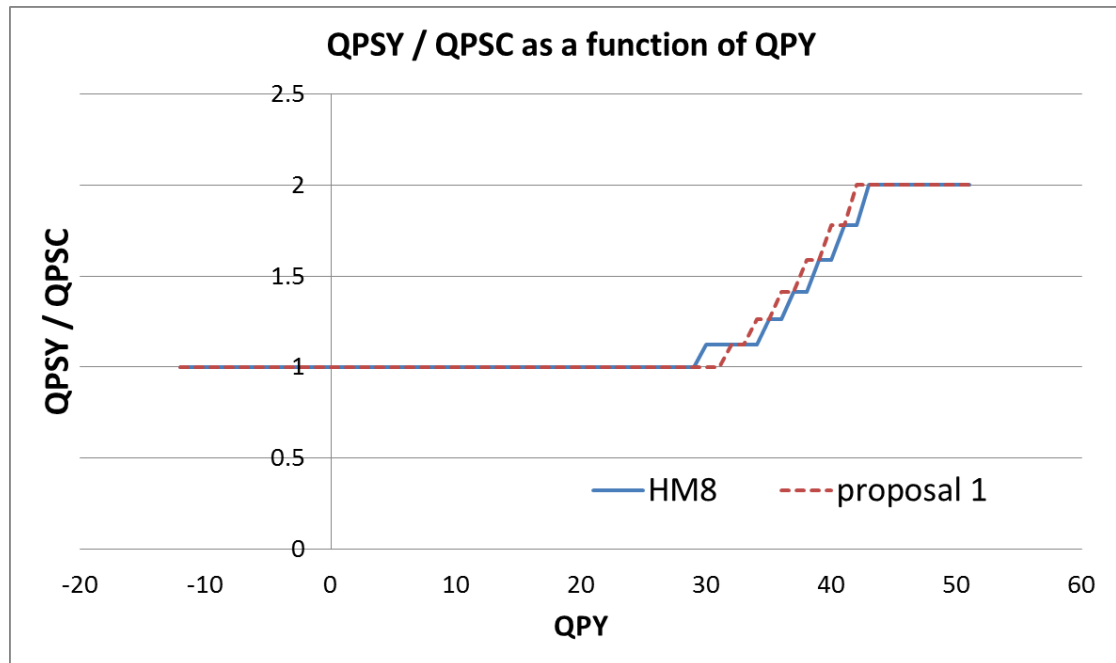
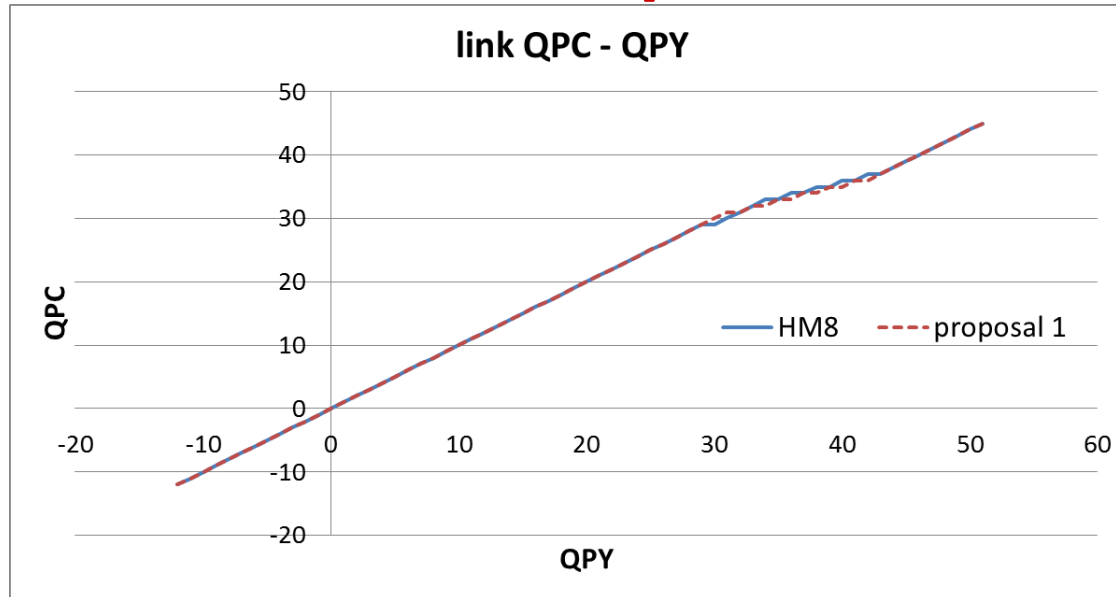
■ Replace table by straightforward equation

- $QPC = QPI - \text{Clip3}(0, 6, (qPI - 30) \gg 1)$

■ Results in slightly different values compared to the HM8 table

QP_I	<30	30	31	32	33	34	35	36	37	38	39	40	41	42	43	>43
QP_C HM8	= qPi	29	30	31	32	33	33	34	34	35	35	36	36	37	37	= qPi - 6
Proposed QP_C	= qPi	30	31	31	32	32	33	33	34	34	35	35	36	36	37	= qPi - 6

Proposal 1



Proposal 1

joint YUV BDR measure proposed in JCTVC-G401:

$$\text{PSNR}_{\text{YUV}} = (6 \cdot \text{PSNR}_Y + \text{PSNR}_U + \text{PSNR}_V) / 8$$

■ Minor BDR impact

	Random Access Main				Random Access HE10			
	Y	U	V	YUV	Y	U	V	YUV
Class A	0.0%	-0.9%	-1.0%	-0.1%	0.0%	-1.0%	-1.2%	-0.1%
Class B	0.1%	-0.5%	-0.3%	0.0%	0.1%	-0.6%	-0.3%	0.0%
Class C	0.1%	-0.4%	-0.5%	0.0%	0.1%	-0.4%	-0.5%	-0.1%
Class D	0.1%	-0.7%	-0.6%	-0.1%	0.0%	-0.7%	-0.6%	-0.1%
Class E								
Overall	0.1%	-0.6%	-0.6%	-0.1%	0.1%	-0.7%	-0.6%	-0.1%
	0.1%	-0.9%	-1.0%		0.1%	-1.0%	-1.0%	
Class F	0.1%	-0.2%	0.0%	0.0%	0.1%	-0.2%	-0.1%	0.1%

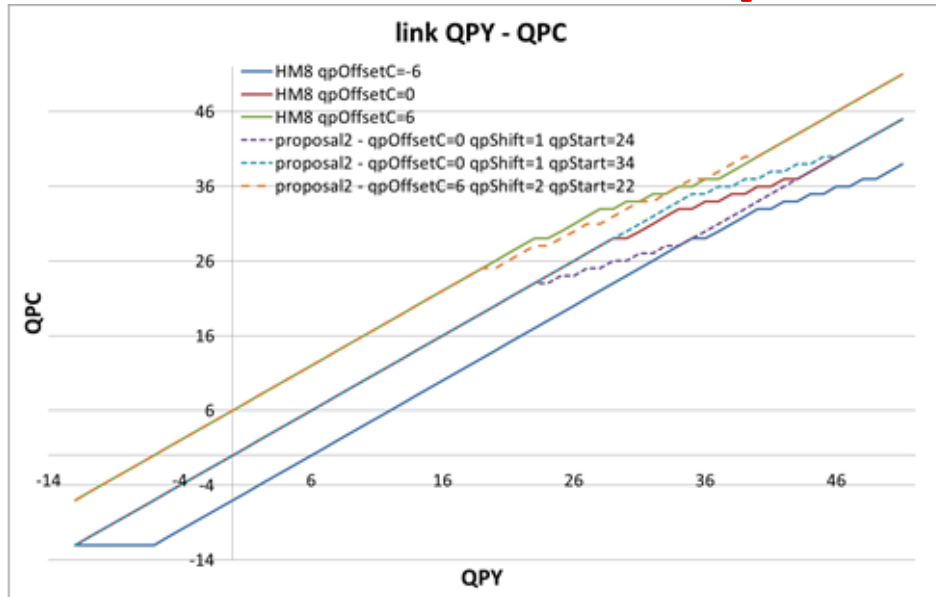
	Low delay B Main				Low delay B HE10			
	Y	U	V	YUV	Y	U	V	YUV
Class A								
Class B	0.1%	-0.7%	-0.9%	-0.1%	0.1%	-0.8%	-0.6%	-0.1%
Class C	0.1%	-0.8%	-0.8%	-0.1%	0.1%	-0.6%	-0.6%	-0.1%
Class D	0.1%	-0.4%	-1.2%	-0.2%	0.1%	-1.3%	-0.9%	-0.2%
Class E	0.2%	-0.7%	-0.5%	0.0%	0.0%	-0.7%	-0.8%	-0.1%
Overall	0.1%	-0.6%	-0.8%	-0.1%	0.1%	-0.8%	-0.7%	-0.2%
	0.1%	-1.9%	-2.3%		0.1%	-2.3%	-2.6%	
Class F	0.2%	0.0%	-0.6%	0.1%	0.0%	-0.3%	-1.4%	-0.3%

Proposal 2

- Generic equation controled by 1–2 new parameters to get a finer control of link QPC–QPY
 - $QPC = QPI - \text{Clip3}(0, 6, (qPI - \text{cbr_qp_start}) \gg \text{cbr_qp_shift})$
 - **cbr_qp_start** controls the position (starting point) where the slope in the curves linking luma and chroma QPs changes
 - **cbr_qp_shift** controls the inclination degree of the slope change
 - Signaled in PPS (possibly also in SPS)

pic_parameter_set_rbsp() {	Descriptor
...	
pic_cb_qp_offset	se(v)
pic_cr_qp_offset	se(v)
pic_cbr_qp_start	se(v)
pic_cbr_qp_shift	se(v)
pic_slice_level_chroma_qp_offsets_present_flag	u(1)
...	
}	

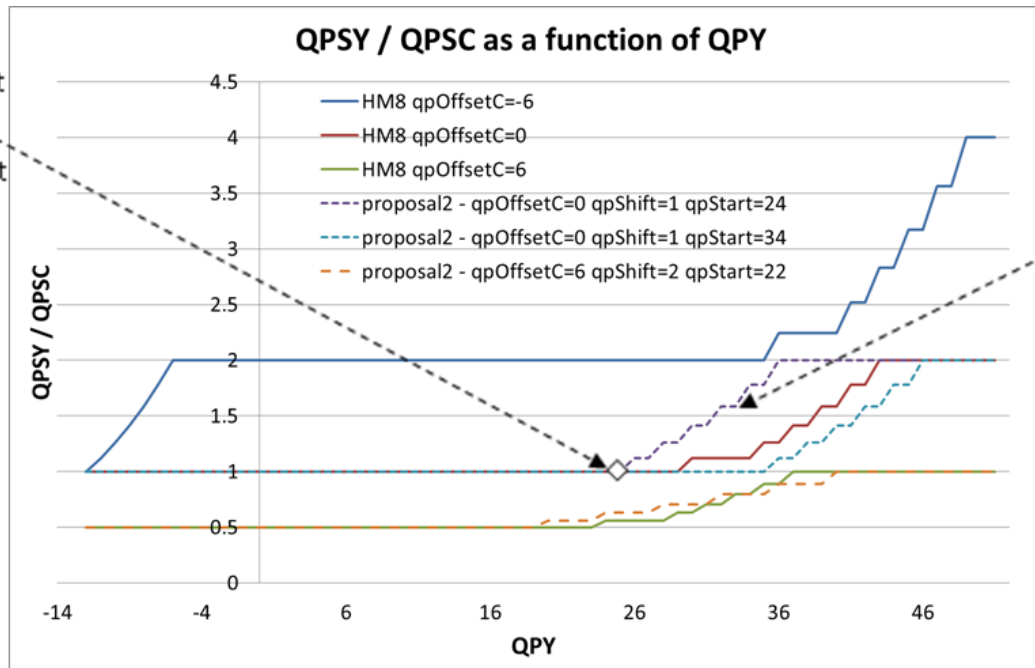
Proposal 2



Independent control of

- slope change position
- slope amplitude

control of
startingpoint
with
cbr_qp_start



control of
inclination
with
cbr_qp_shift

Proposal 2

Test 1 : cbr_qp_start = 29 – cbr_qp_shift = 1

	Random Access Main				Random Access HE10			
	Y	U	V	YUV	Y	U	V	YUV
Class A	0.4%	-6.6%	-6.4%	-0.5%	0.3%	-6.3%	6.5%	-0.6%
Class B	0.6%	-4.6%	-3.9%	-0.4%	0.6%	-4.6%	-3.8%	-0.4%
Class C	0.6%	-3.9%	-3.9%	-0.4%	0.6%	-3.8%	-3.9%	-0.4%
Class D	0.5%	-3.8%	-3.9%	-0.4%	0.4%	-4.0%	-4.0%	-0.5%
Class E								
Overall	0.5%	-4.7%	-4.5%	-0.4%	0.5%	-4.7%	-4.5%	-0.5%
	0.5%	-4.5%	-4.3%		0.5%	-4.4%	-4.4%	
Class F	0.5%	-2.0%	-2.0%	-0.1%	0.4%	-1.9%	-2.0%	-0.1%

	Low delay B Main				Low delay B HE10			
	Y	U	V	YUV	Y	U	V	YUV
Class A								
Class B	0.6%	-6.9%	-6.4%	-0.8%	0.6%	-6.7%	-5.8%	-0.8%
Class C	0.7%	-5.5%	-5.4%	-0.6%	0.6%	-5.5%	-5.4%	-0.7%
Class D	0.4%	-5.5%	-6.0%	-0.7%	0.5%	-6.4%	-6.2%	-0.8%
Class E	0.4%	-5.4%	-5.5%	-0.7%	0.4%	-4.4%	-4.4%	-0.6%
Overall	0.5%	-5.9%	-5.9%	-0.7%	0.5%	-5.9%	-5.5%	-0.7%
	0.5%	-4.5%	-4.4%		0.5%	-4.6%	-4.0%	
Class F	0.7%	-3.6%	-4.1%	-0.3%	0.5%	-3.4%	-4.8%	-0.5%

Proposal 2

Test 2 : cbc_r_qp_start = 31 - cbc_r_qp_shift = 1

	Random Access Main			YUV	Random Access HE10			YUV
	Y	U	V		Y	U	V	
Class A	-0.1%	3.9%	3.9%	0.4%	-0.1%	3.9%	3.6%	0.4%
Class B	-0.2%	4.3%	4.3%	0.6%	-0.2%	4.3%	4.3%	0.6%
Class C	-0.2%	3.2%	3.2%	0.4%	-0.2%	3.3%	3.1%	0.4%
Class D	-0.2%	3.0%	3.0%	0.4%	-0.2%	3.0%	2.8%	0.3%
Class E								
Overall	-0.2%	3.6%	3.6%	0.4%	-0.2%	3.7%	3.5%	0.4%
	-0.2%	2.9%	2.8%		-0.2%	3.0%	2.6%	
Class F	-0.3%	3.0%	3.2%	0.3%	-0.4%	3.1%	2.8%	0.3%

	Low delay B Main			YUV	Low delay B HE10			YUV
	Y	U	V		Y	U	V	
Class A								
Class B	-0.1%	1.7%	1.2%	0.2%	-0.1%	1.4%	1.7%	0.2%
Class C	-0.1%	1.3%	1.3%	0.1%	-0.1%	1.2%	1.4%	0.1%
Class D	-0.1%	1.3%	0.9%	0.1%	-0.1%	0.9%	0.6%	0.1%
Class E	-0.1%	3.0%	4.6%	0.6%	0.0%	3.1%	2.7%	0.5%
Overall	-0.1%	1.7%	1.8%	0.3%	-0.1%	1.5%	1.6%	0.1%
	-0.1%	1.5%	1.5%		-0.1%	1.3%	1.3%	
Class F	0.0%	1.7%	1.3%	0.3%	-0.3%	1.7%	-0.4%	-0.1%

Proposal 2

Test 3 : cbr_qp_start = 22 – cbr_qp_shift = 2

	Random Access Main			YUV	Random Access HE10			YUV
	Y	U	V		Y	U	V	
Class A	0.9%	-17.0%	-16.9%	-1.3%	0.9%	-16.7%	-17.0%	-1.4%
Class B	1.4%	-15.1%	-15.1%	-1.7%	1.4%	-15.3%	-15.2%	-1.7%
Class C	1.5%	-12.5%	-12.3%	-1.1%	1.5%	-12.5%	-12.6%	-1.2%
Class D	1.2%	-12.9%	-12.9%	-1.3%	1.2%	-13.2%	-13.0%	-1.4%
Class E								
Overall	1.2%	-14.4%	-14.3%	-1.4%	1.2%	-14.5%	-14.5%	-1.4%
	1.2%	-14.1%	-13.9%		1.2%	-14.1%	-14.1%	
Class F	1.3%	-8.5%	-8.6%	-0.6%	1.4%	-8.3%	-8.7%	-0.5%

	Low delay B Main			YUV	Low delay B HE10			YUV
	Y	U	V		Y	U	V	
Class A								
Class B	1.2%	-16.8%	-17.0%	-1.9%	1.2%	-16.9%	-16.6%	-1.9%
Class C	1.4%	-13.6%	-13.8%	-1.3%	1.3%	-14.2%	-14.2%	-1.5%
Class D	1.1%	-13.6%	-14.3%	-1.4%	1.2%	-15.4%	-15.4%	-1.6%
Class E	0.0%	-14.9%	-14.7%	-2.0%	0.6%	-14.6%	-15.2%	-2.1%
Overall	1.1%	-14.9%	-15.1%	-1.5%	1.1%	-15.4%	-15.5%	-1.7%
	1.1%	-14.5%	-14.6%		1.1%	-15.1%	-15.0%	
Class F	1.5%	-9.9%	-10.2%	-0.7%	1.4%	-9.5%	-11.4%	-0.9%

Conclusion

- 2 proposals related to the chroma QP derivation
 - Proposal 1: replace correspondence table QPC–QPI by a straightforward analytic formula
 - Negligible BDR impact
 - Proposal 2: use a generic formula controlled by 2 new parameters
 - fine control of the relation between luma and chroma QPs
 - gives much more flexibility to control the QPC from QPY
 - of interest in applications requiring local QP adaptation (CU–level)