G111 – Common test conditions to specify 8-bit internal bit depth for 8-bit source material

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Change Common Test to 8-bit for 8-bit source

- **Presently: HE streams are encoded with 10-bit IBDI**
  - 8-bit source up-converted to 10-bit

- **Recommend: 8-bit IBDI for 8-bit source**
  - Have 8/10 bit profiles, just like AVC
  - 10-bit IBDI has some gain (mostly chroma), but at a very high cost

10-bit IBDI: System Cost

- **Increased HW Encoder/Decoder Area**
  - 25% increase in pixel processing vs 8-bit HEVC = 20-23% overall area increase

- **Increased Memory Bandwidth**
  - 35+% increase in (already high) memory bandwidth
    - Faster DRAMs = higher cost
  - 10-bit pixel packing is difficult to do efficiently
  - Memory compression doesn't help worst-case (granularity)

- **Increased Memory Footprint**
  - Systems want 8-bit video buffers
    - Processing: deinterlacing, compositing, display
    - 10-bit = bandwidth penalty everywhere
  - Have to replicate DPB with 8 and 10-bit versions
  - Extra 16 Mbytes needed for HD
    - Equal to cost of AVD decoder

Results: 8-bit IBDI vs Baseline

	AI-HE			RA-HE			LB-HE			LP-HE		
	Y	U	V	Y	U	V	Y	U	V	Y	U	V
Class A	2.2	13.0	16.3	4.0	33.6	45.8						
Class B	1.7	3.5	3.3	3.0	10.2	9.9	3.1	11.7	13.5	2.9	11.3	14.0
Class C	0.9	1.4	1.5	1.7	3.8	4.5	1.7	4.8	5.4	1.5	4.3	4.5
Class D	0.6	1.4	1.3	1.1	3.3	3.6	1.1	6.5	6.2	0.9	5.4	5.3
Class E	2.3	5.6	5.4				7.1	20.9	15.8	6.2	21.7	16.4
Class F	0.2	0.2	0.3	0.8	1.9	1.6	0.2	0.4	0.3	0.2	0.0	-0.1
All	**1.3**	**4.1**	**4.6**	**2.2**	**10.5**	**12.9**	**2.4**	**8.4**	**8.1**	**2.2**	**8.0**	**7.9**
Enc Time	**99%**			**98%**			**126%**			**73%**		
Dec Time	**94%**			**96%**			**97%**			**95%**		

- Shows bit-rate increase going from baseline to 8-bit
- 10-bit streams converted to 8-bit

Class A Detail

Sequence	PSNR at lowest QP=37 for Reference (10-bit IBDI)			PSNR at lowest QP=37 for Test (8-bit IBDI)			BD-rate		
	Y	U	V	Y	U	V	Y	U	V
Traffic	34.12	37.75	39.81	34.10	37.70	39.78	3.1%	6.0%	6.5%
PeopleOnStreet	31.74	40.47	41.12	31.73	40.39	41.04	1.1%	6.3%	7.2%
Nebuta	28.09	36.69	34.90	28.08	36.56	34.83	0.8%	19.7%	9.8%
SteamLocomotive	37.22	44.99	45.09	37.13	44.60	44.63	11.0%	102.4%	159.8%
Average							4.0%	33.6%	45.8%
Average without SteamLocomotive							1.7%	10.7%	7.8%

- **Extraordinary chroma results from one stream (Steam Locomotive)**
    - Chroma PSNR is very high, even at lowest QP
- **Class E has same characteristics**
    - All Chroma PSNR > 43

Conclusions

- Although increasing the internal bit depth from 8-bit to 10-bit has a small average coding gain (mostly in chroma), its associated system cost far outweighs its benefits.

- Recommend that it remain for use in a profile supporting 10-bit input source material

- Common test conditions be changed to use 8-bit internal bit depth for all 8-bit input source material.