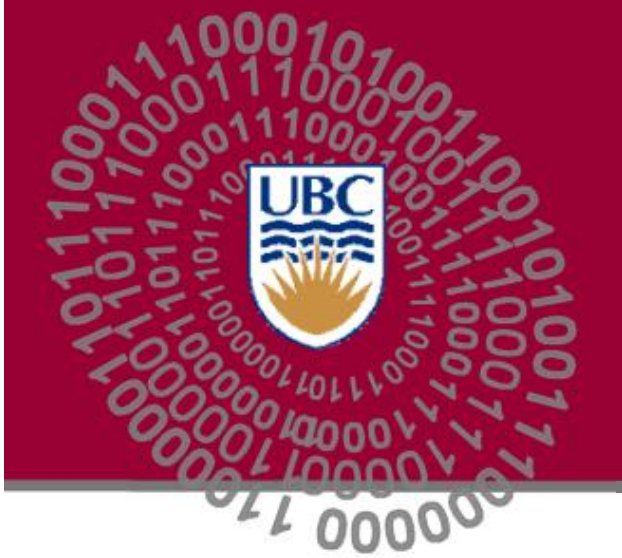
UNIVERSITY OF BRITISH COLUMBIA



Evaluation of HDR Coding Pipelines

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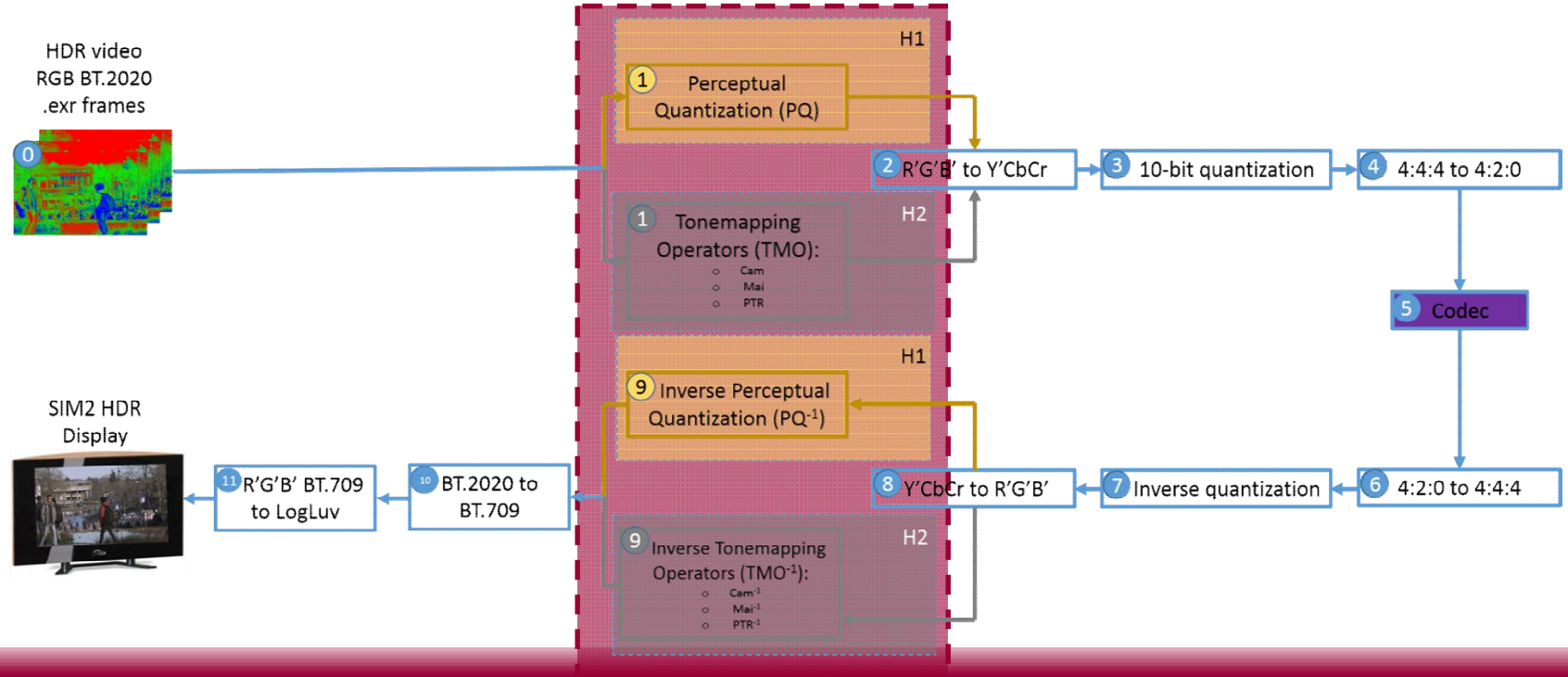
Digital Multimedia Lab

Our Objective

- Scenario 1: Perceptually uniform HDR video compression (H1)
- Scenario 2: Tonemapped HDR content compression (H2)

- Our objective: Compare the performance of H1 and H2



Single Layer HDR Video Coding Pipeline

- The tone mapping operator (TMO):
  - Temporally coherent
  - Invertible
- So, we selected:
  - Camera TMO
  - The Photographic Tone Reproduction (PTR)
  - Histogram equalization method (Mai)

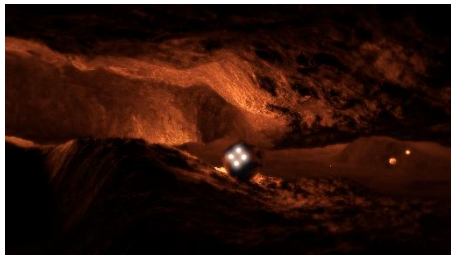
Test Set up: HDR Video Database

Sequence	Resolution	Frame Rate (fps)	Number of Frames	Scene Type
FireEater2	1920×1080	25	200	Outdoor/Night
Market3	1920×1080	50	400	Outdoor/Day light
Tibul2	1920×1080	30	240	Computer-generated

FireEater2

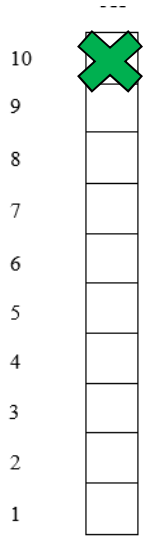
Market3

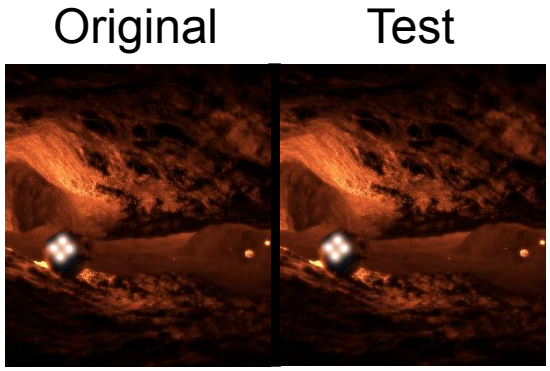
Tibul2



Test Set up: Subjective Tests

- We performed one set of subjective test
- Objective: Compare transmission pipeline H1 with pipeline H2
  - The subjective quality of original HDR videos is compared with that of the decoded HDR using pipeline H1 and H2 at four different bit rate levels



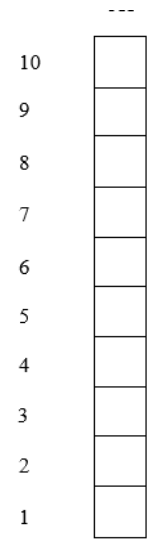


Test Set up: Subjective Tests

- At four different QP levels:
  - Market3 QP= {'29','33','37','41'}; CFE QP= {'21','25','29','33'}
  - Tibul2 QP = {'19','24','29','34'}; CFE QP= {'19','24','29','34'};
  - BallonFestival QP= {'18','26', '34', '38'}; CFE QP = {'18','22','26','30'};
- Why not MPEG QPs?
  - No noticeable visual quality levels when viewed on a SIM2 display.
- The random access high efficiency (RA-HE) configuration of HEVC was used to ensure achieving the highest compression performance

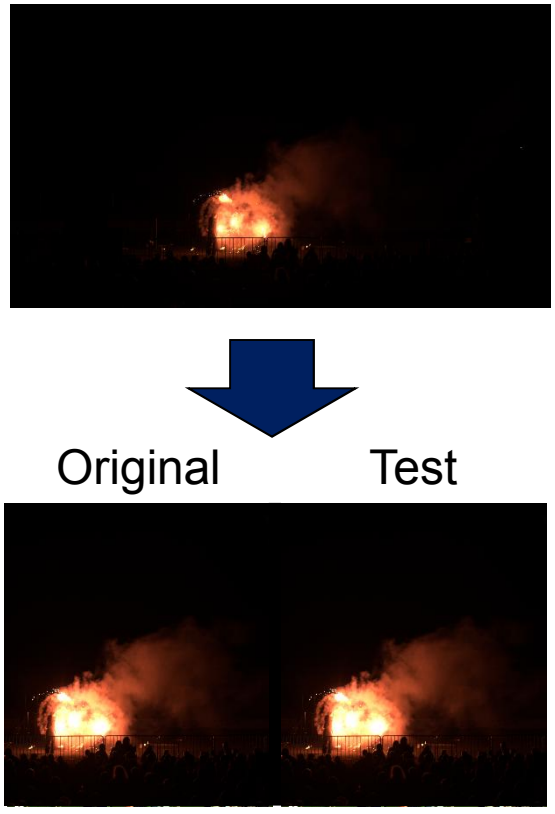
Test Set up: Subjective Tests

- Subjective test methodology:
  - 4 HDR videos × (1 PQ + 1 Camera TMO + 1 PTR TMO + Mai TMO) × 4 QPs = 64 test videos
  - Comparison of the original video to itself was also inserted in the test resulting in 64 + 4 = 68 test videos
- Discrete rating scale ranging from 1 being the worst quality to 10 being the best quality matching the original video



Test Set up: Subjective Tests

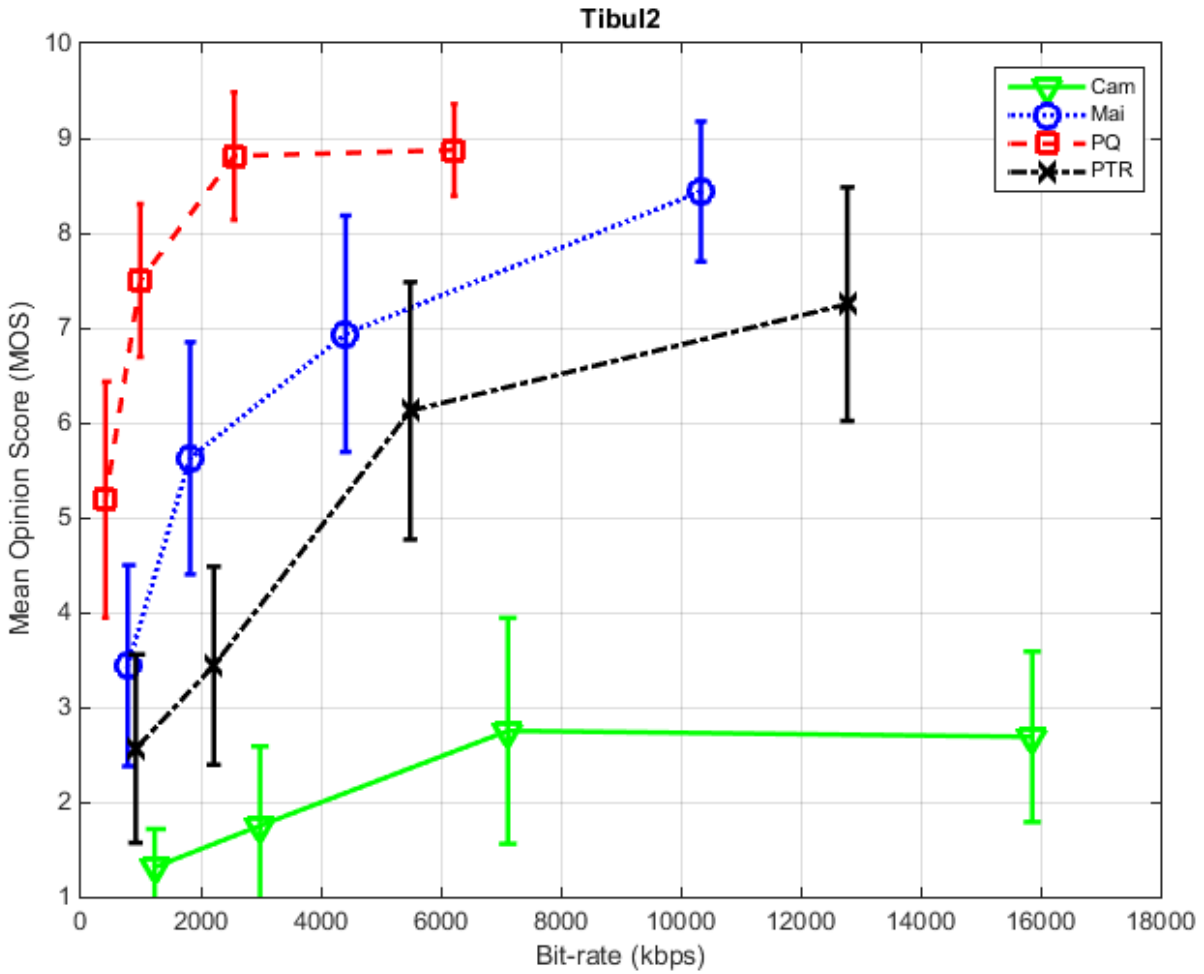
- Side-by-side presentation
  - Videos need to be cropped to avoid reducing the resolution



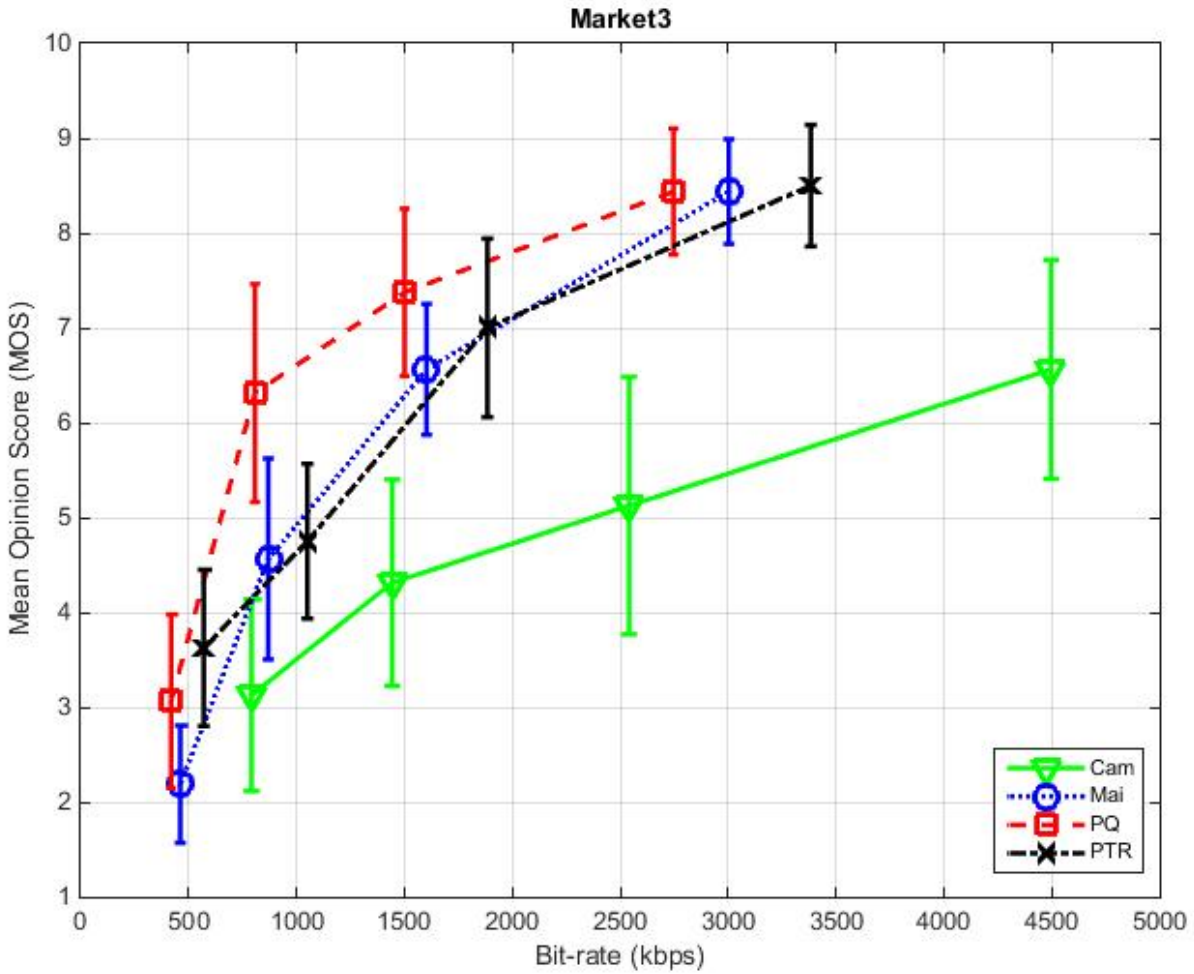
Test Set up: Subjective Tests

- Viewers:
  - Eighteen adult subjects including 10 males and 8 females
  - 3 participants at each test session
- Pre-test training:
  - 2-video training test with 4 compression level, before the actual test

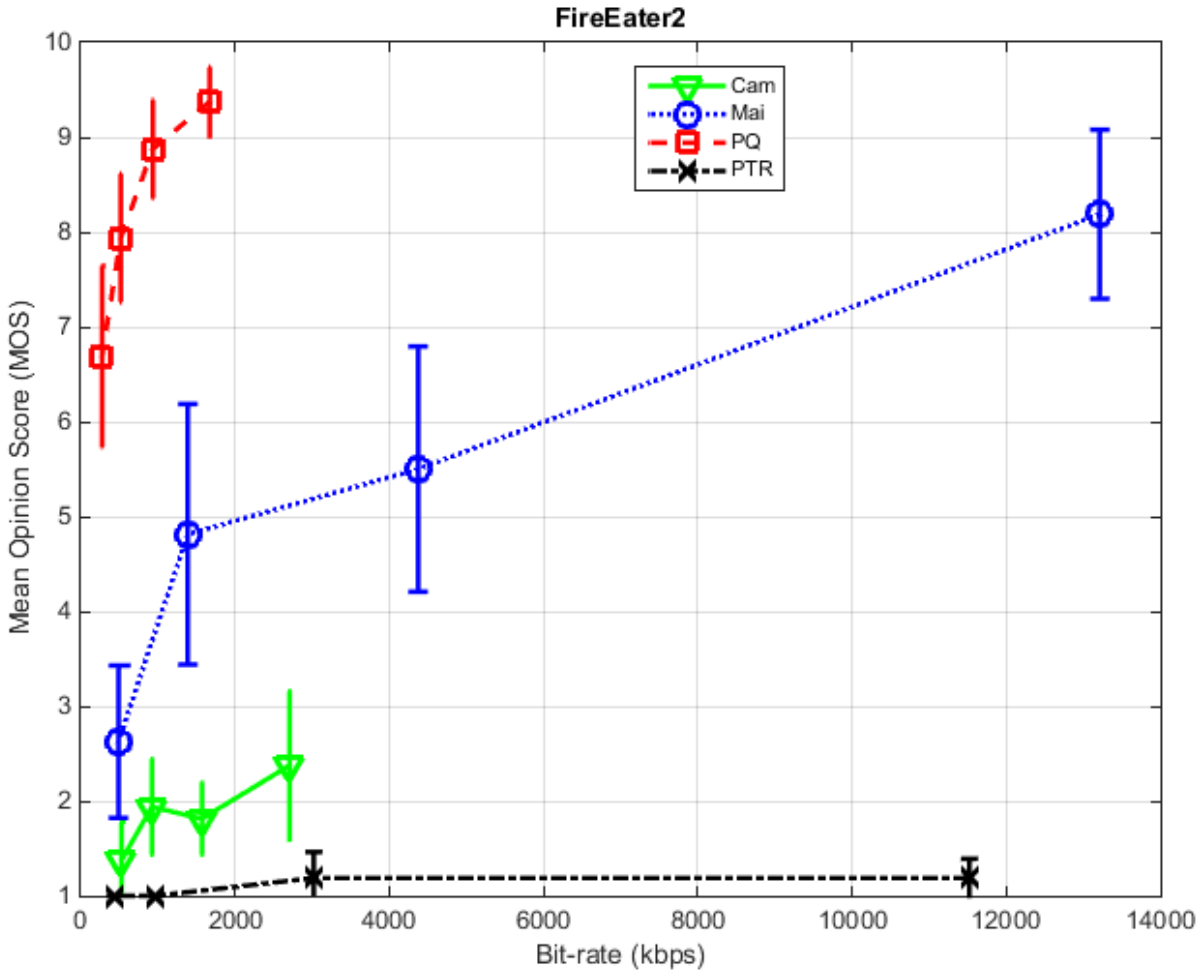
Results


Tibul2
Mean Opinion Score (MOS)
Bit-rate (kbps)
Cam
Mai
PQ
PTR
10
9
8
7
6
5
4
3
2
1
0
2000
4000
6000
8000
10000
12000
14000
16000
18000

Results

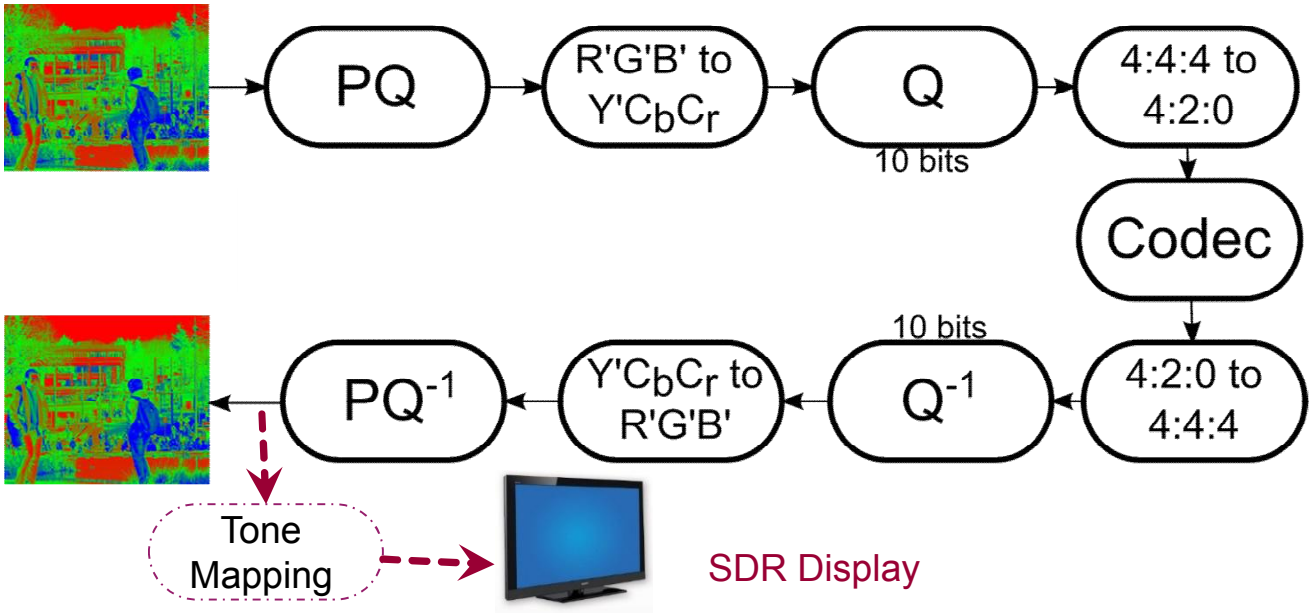


Results


FireEater2
Cam
Mai
PQ
PTR
Mean Opinion Score (MOS)
Bit-rate (kbps)
10
9
8
7
6
5
4
3
2
1
0
2000
4000
6000
8000
10000
12000
14000

Conclusions

- It is preferable to transmit the original HDR stream (PQ) rather than the tone mapped version of the HDR.
  - Lower bitrate at the same subjective quality level
  - Tone mapped version can be generated at the receiver end in case of having a SDR display



Contact Information

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THANK
YOU