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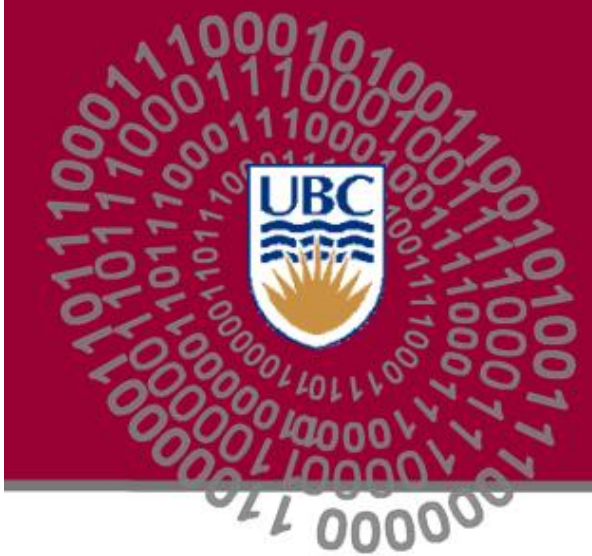

Evaluation of Backward-compatible HDR Transmission Pipelines

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a place of mind
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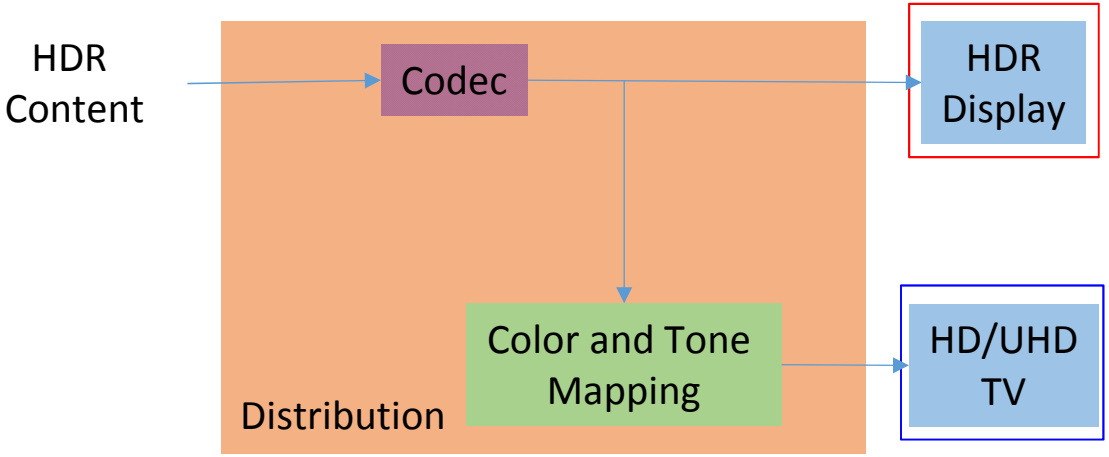
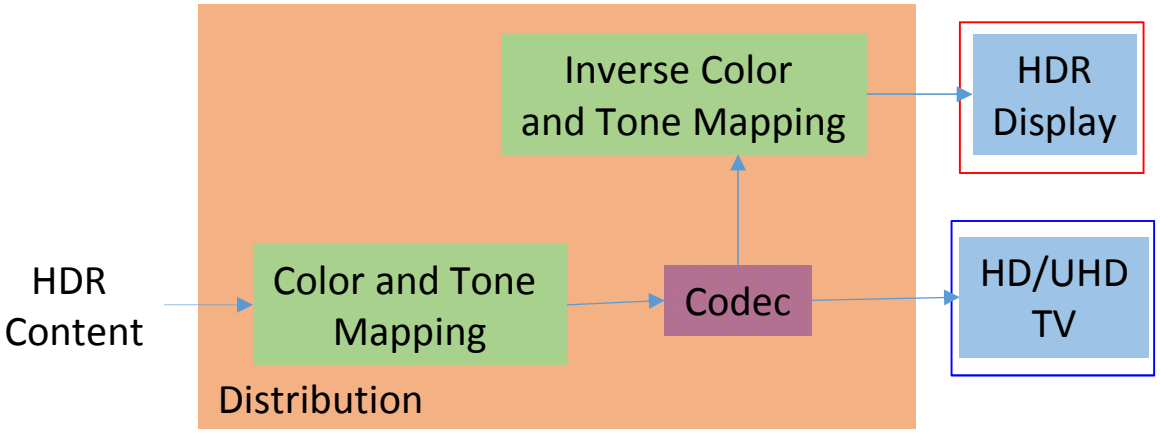
Pipelines for HDR Distribution

- Scenario 1: HDR10



M37318:
HDR10 outperformed SDR10

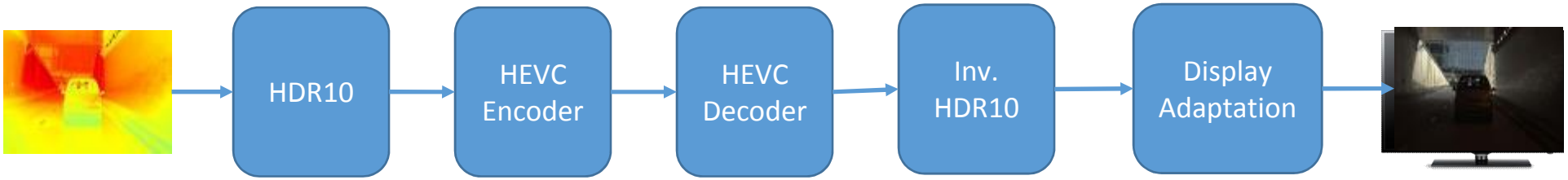
- Scenario 2: SDR10

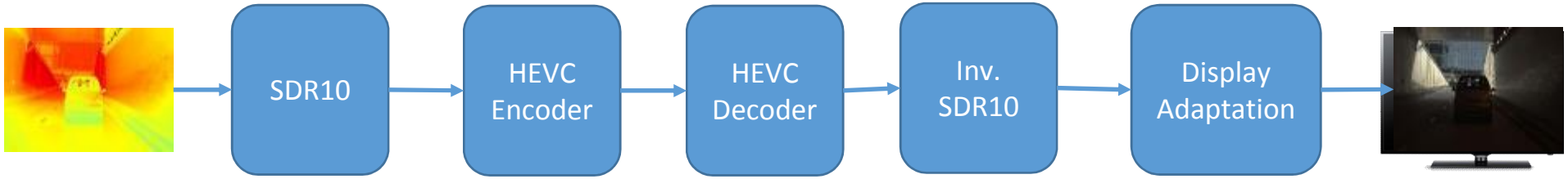


This contribution:
Compare transmission pipeline HDR10 with pipeline SDR10 for SDR viewing

Summary

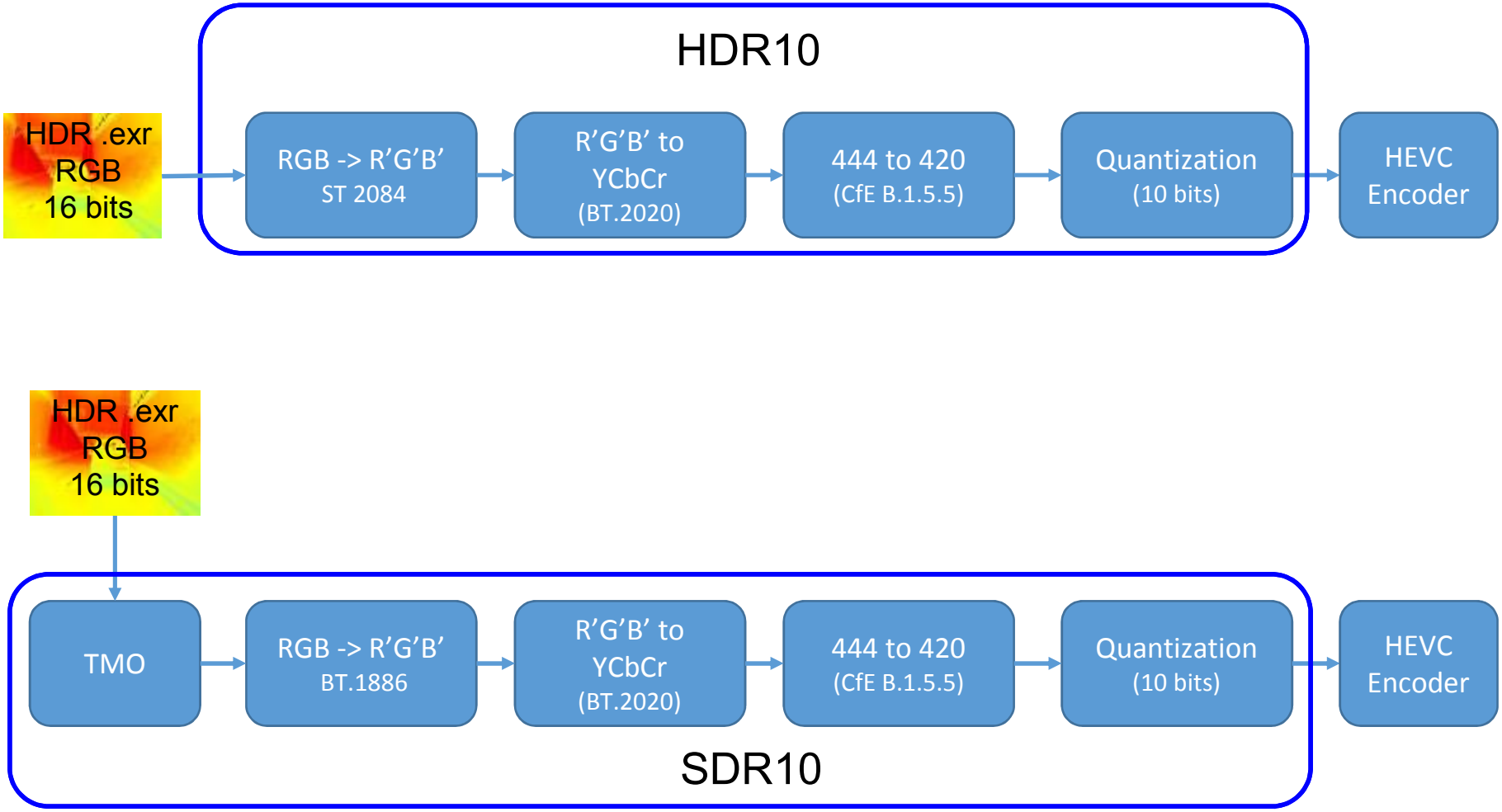
- HDR10 versus SDR10 pipeline





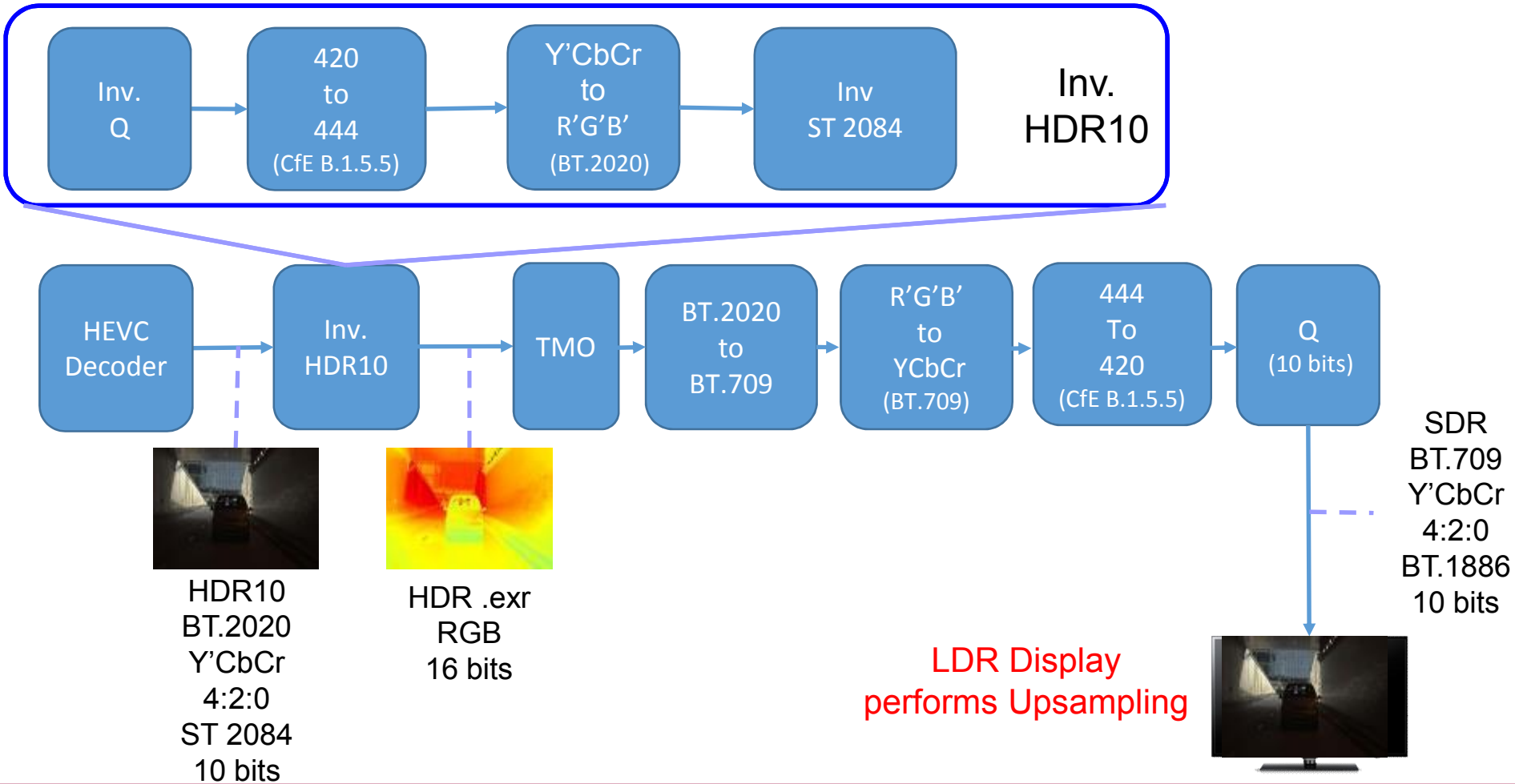
Encoder Side

- HDR10 versus SDR10 pipeline - Emitter



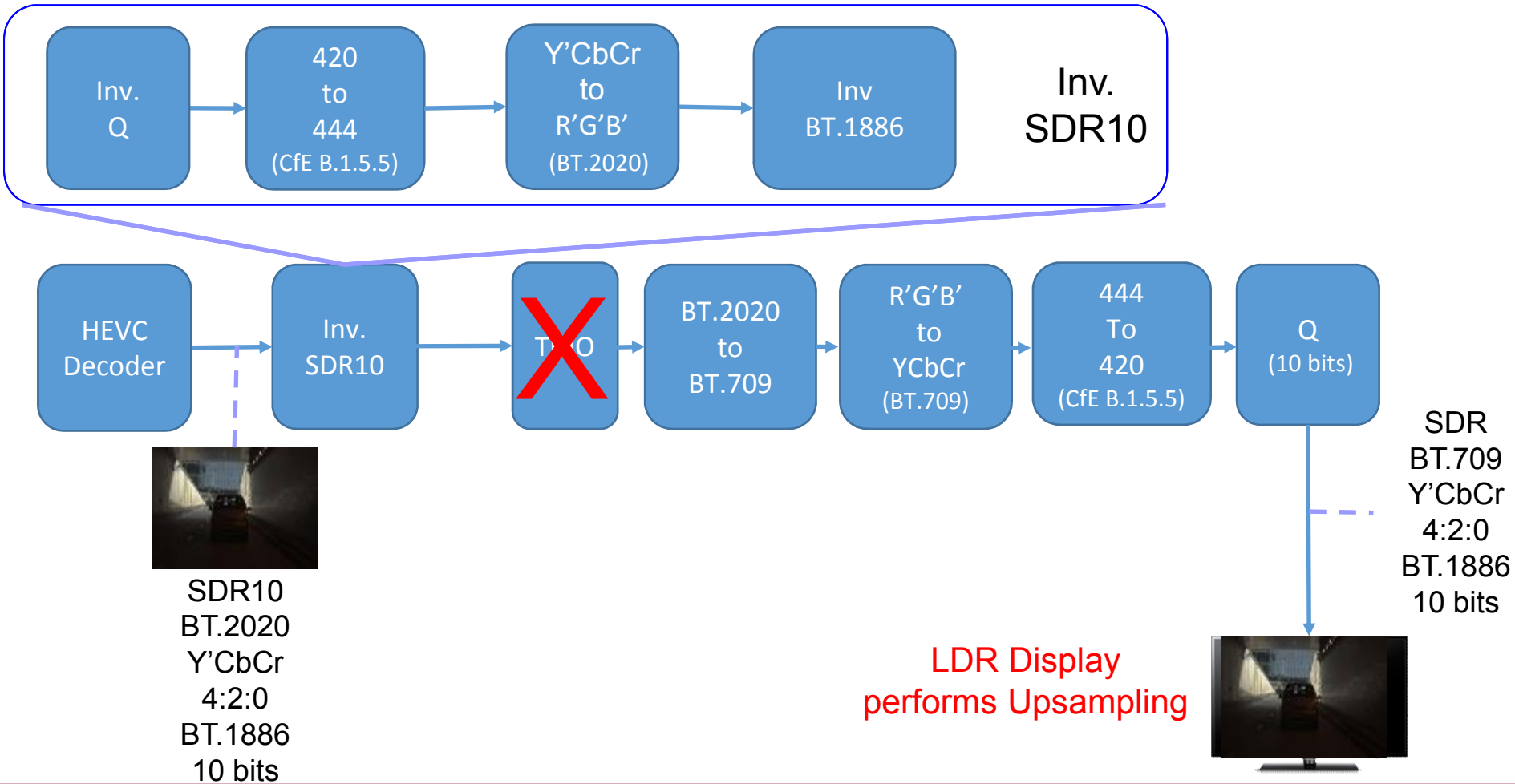
Test 1 : Addressing display in Y'CbCr 4:2:0 mode (STB case)

- HDR10 pipeline – addressing SDR display - Receiver



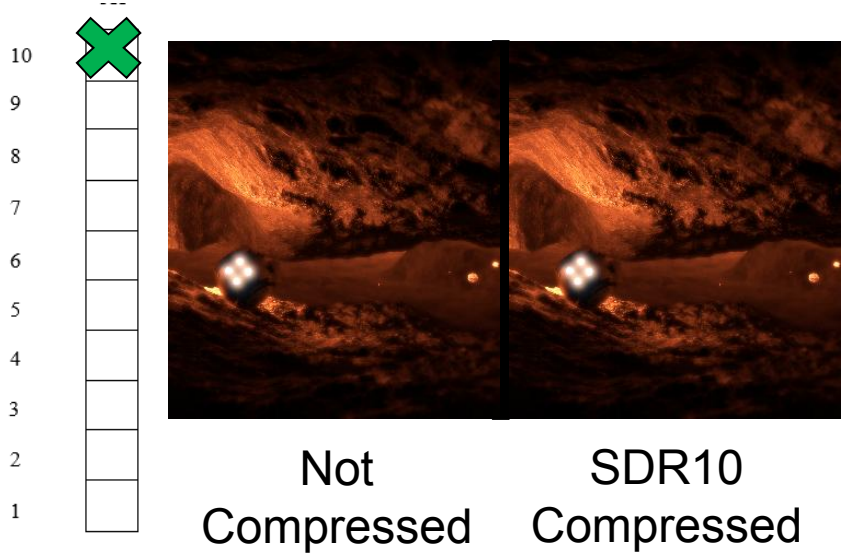
Test 1 : Addressing display in Y'CbCr 4:2:0 mode (STB case)

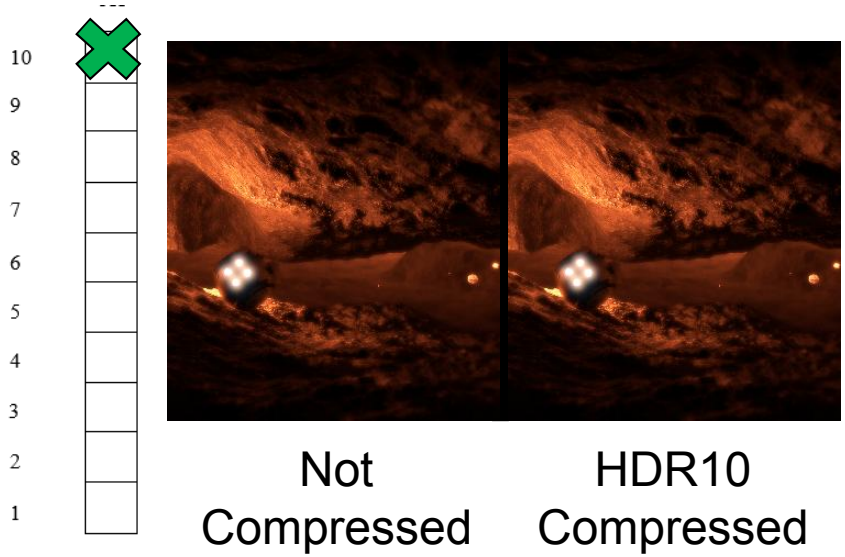
- SDR10 pipeline – addressing SDR display - Receiver



Test 1: Methodology

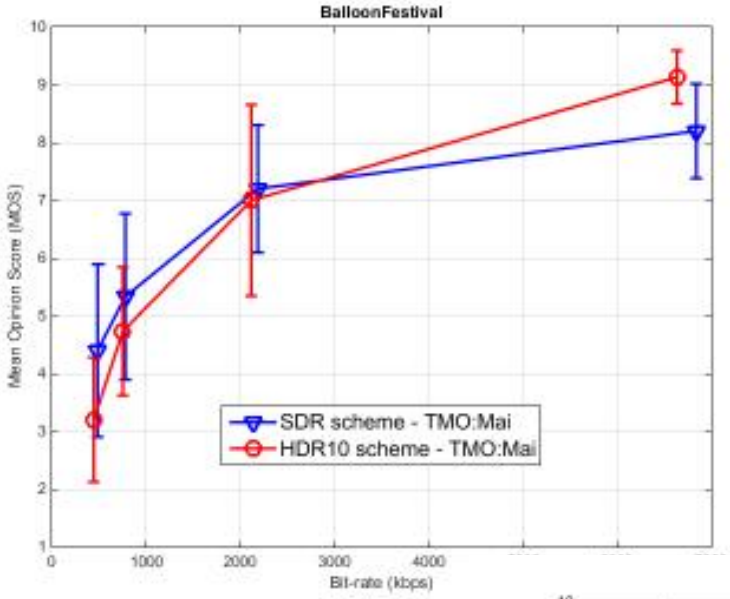
- Double Stimulus Comparison

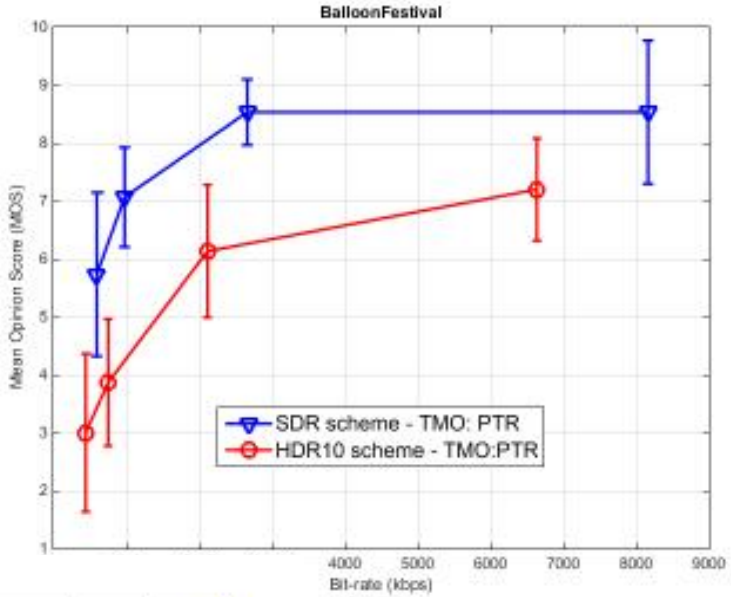


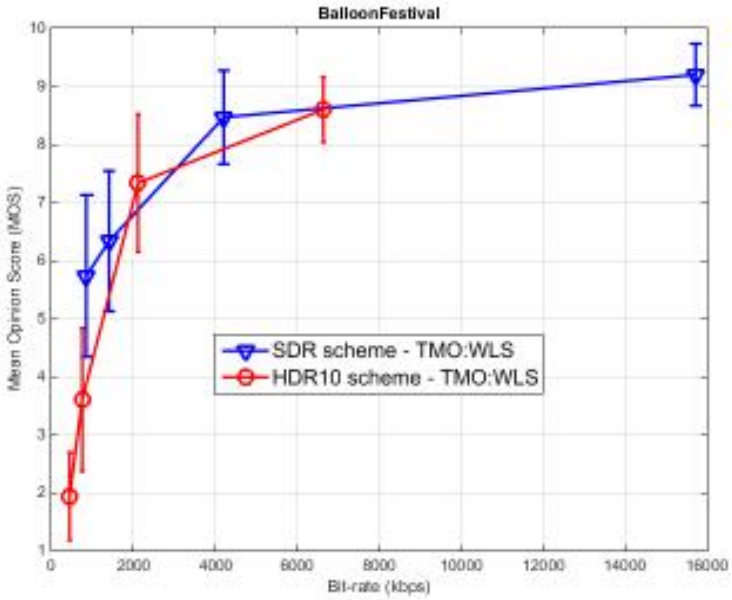


- 3 different TMOs
  - The Photographic Tone Reproduction (PTR) – invertible
  - Compression Optimized (Mai) – invertible
  - Weighted-Least Square (WLS) – non-invertible

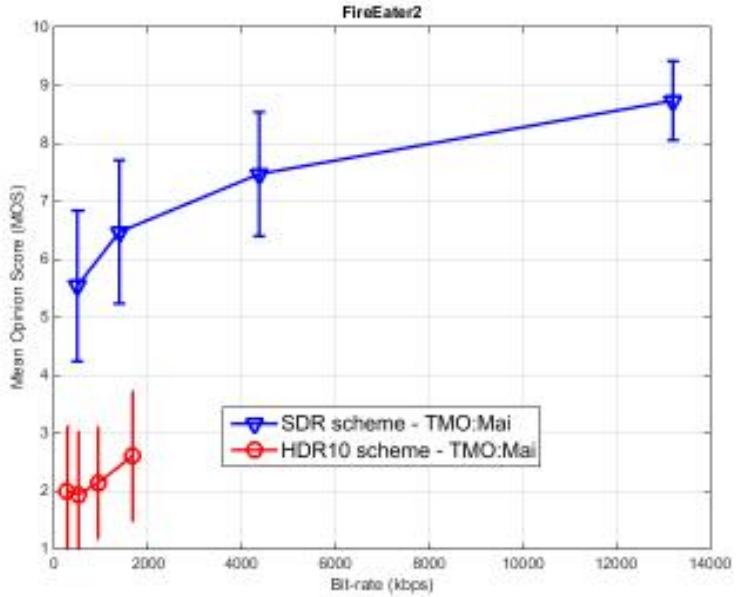
BalloonFestival

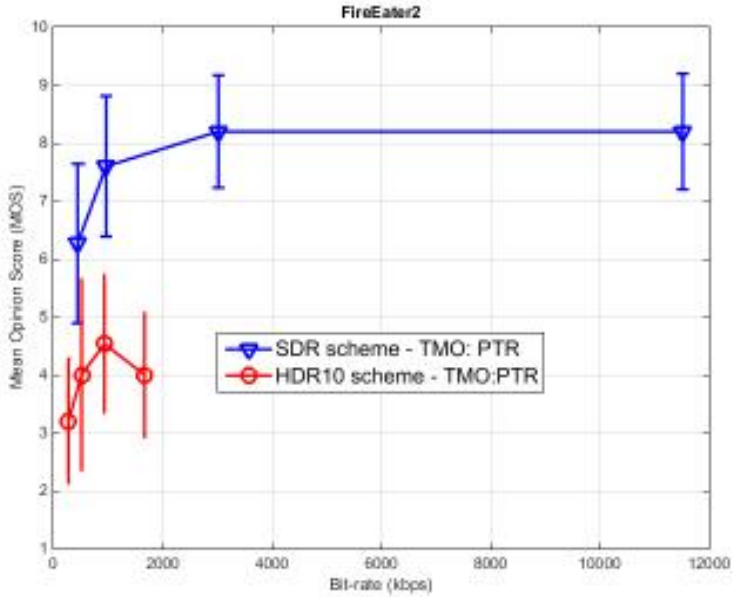


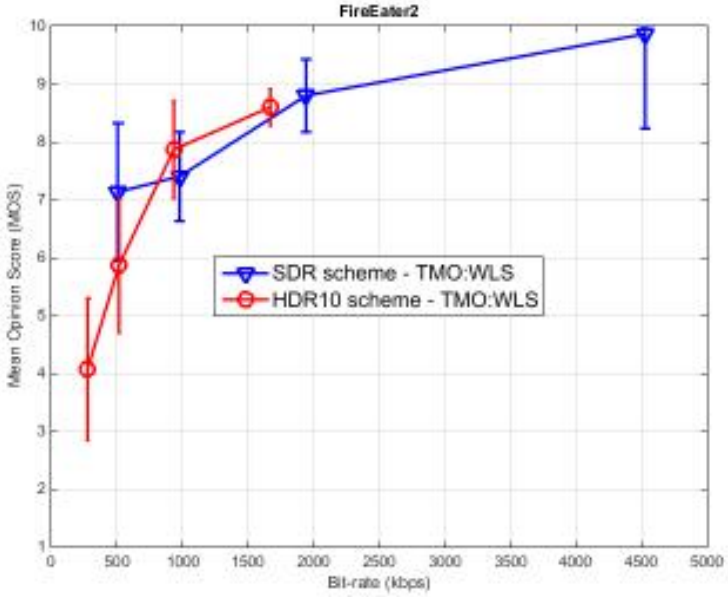




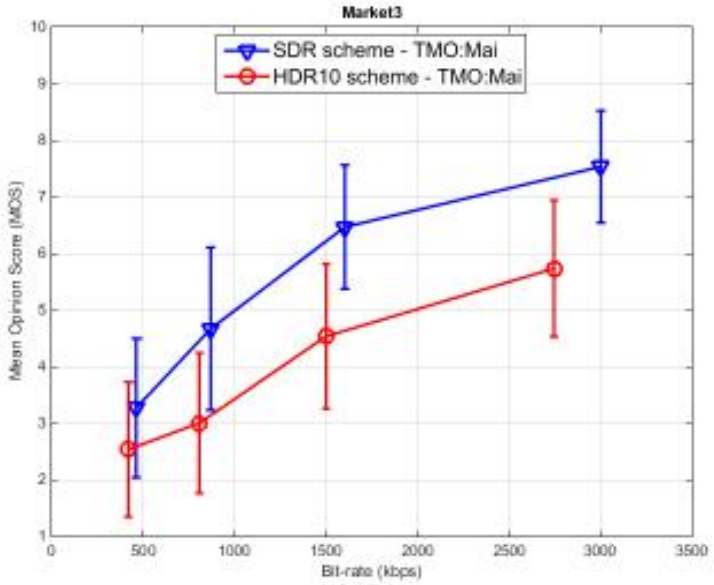
FireEater2

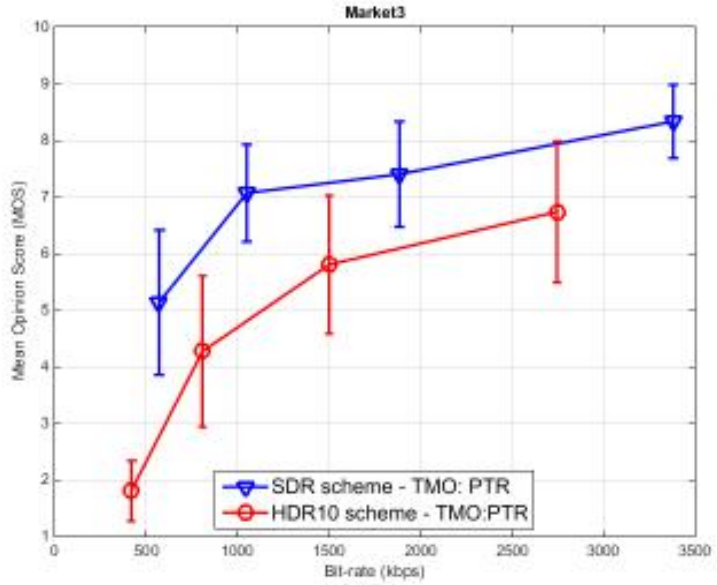

FireEater2
Mean Opinion Score (MOS)
Bit-rate (kbps)
SDR scheme - TMO:Mai
HDR10 scheme - TMO:Mai

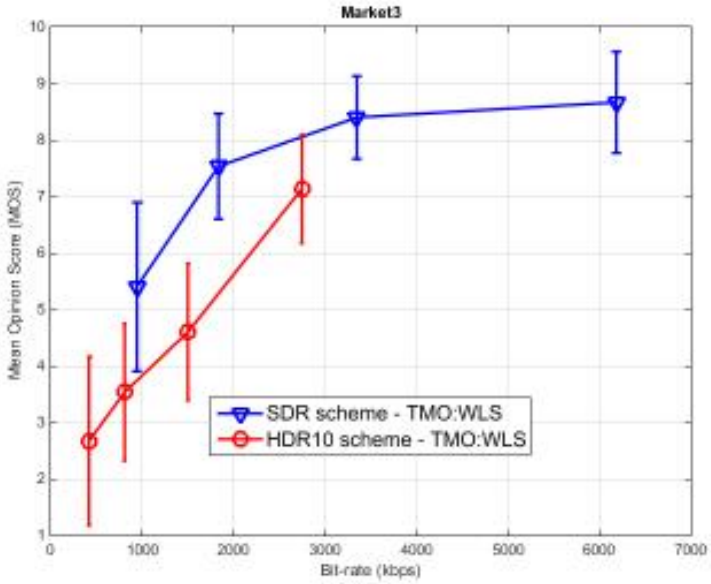

FireEater2
Mean Opinion Score (MOS)
Bit-rate (kbps)
SDR scheme - TMO: PTR
HDR10 scheme - TMO:PTR


FireEater2
Mean Opinion Score (MOS)
Bit-rate (kbps)
SDR scheme - TMO:WLS
HDR10 scheme - TMO:WLS

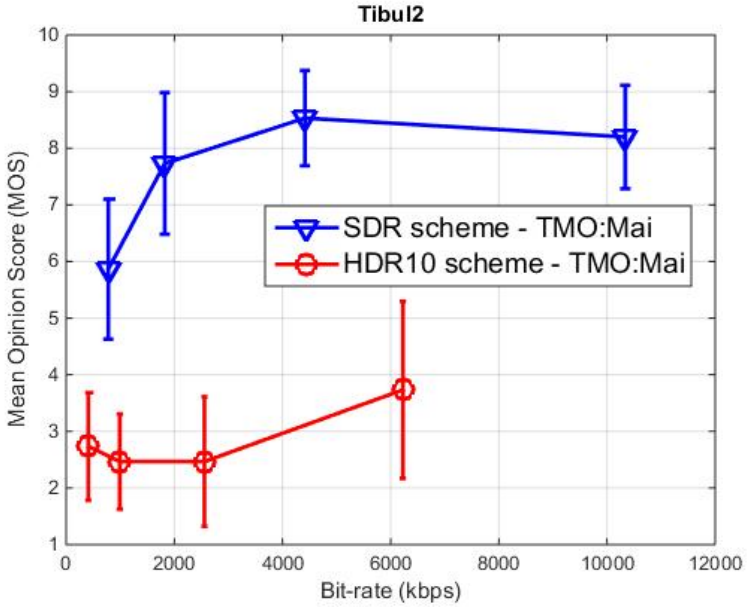
Market3

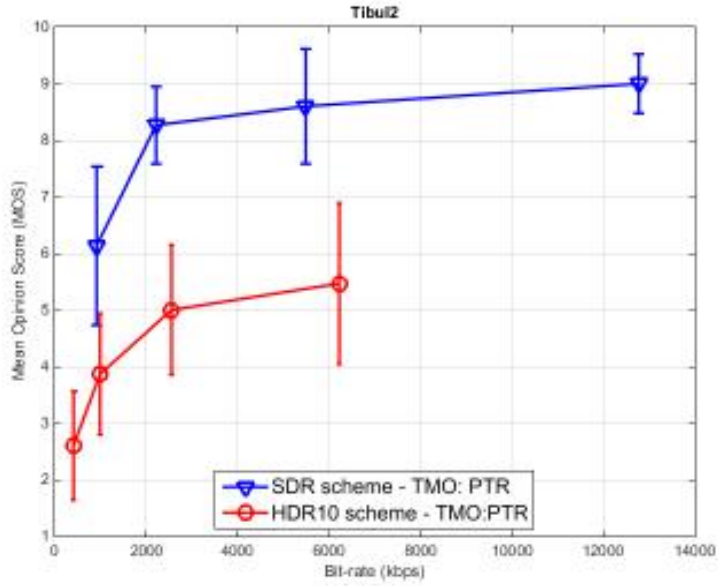

Market3
SDR scheme - TMO:Mai
HDR10 scheme - TMO:Mai
Mean Opinion Score (MOS)
Bit-rate (kbps)

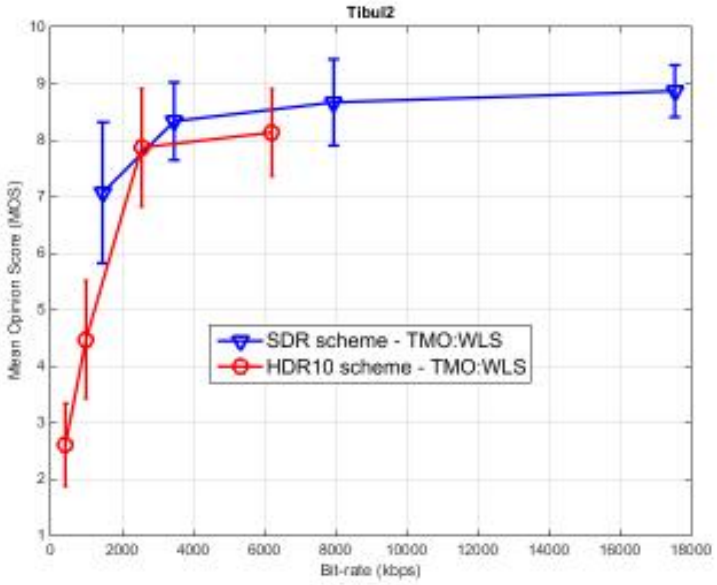

Market3
SDR scheme - TMO: PTR
HDR10 scheme - TMO:PTR
Mean Opinion Score (MOS)
Bit-rate (kbps)


Market3
SDR scheme - TMO:WLS
HDR10 scheme - TMO:WLS
Mean Opinion Score (MOS)
Bit-rate (kbps)

Tibul2


Tibul2
Mean Opinion Score (MOS)
Bit-rate (kbps)
SDR scheme - TMO:Mai
HDR10 scheme - TMO:Mai


Tibul2
Mean Opinion Score (MOS)
Bit-rate (kbps)
SDR scheme - TMO: PTR
HDR10 scheme - TMO:PTR

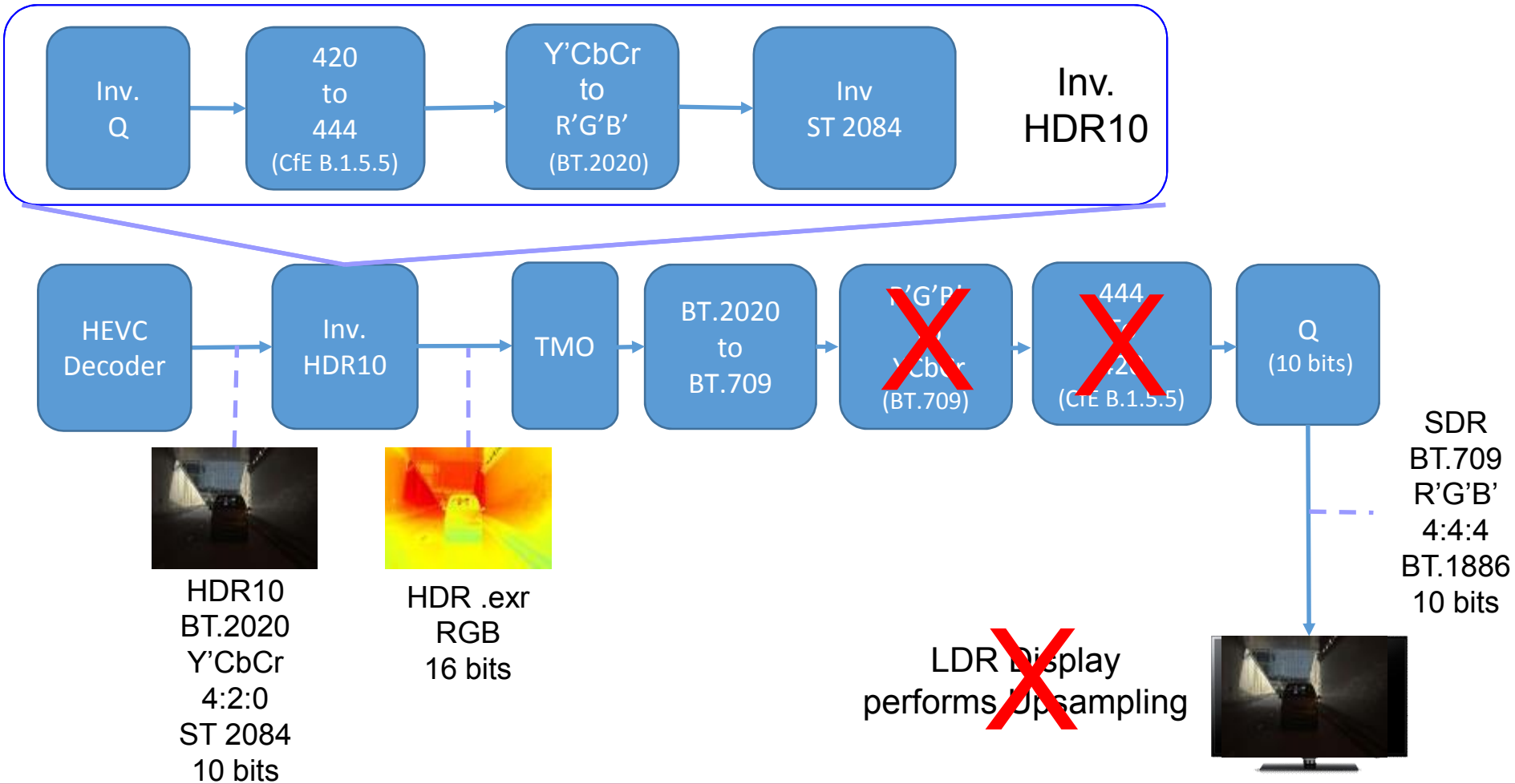

Tibul2
Mean Opinion Score (MOS)
Bit-rate (kbps)
SDR scheme - TMO:WLS
HDR10 scheme - TMO:WLS

Summary of Test 1

- Further tests on HDR10 showed that the main cause of lower SDR quality is the downsampling that takes place in both ST 2084 and BT.1886 domains
  - HDR10 with 4:4:4 – HUGE improvement
  - Dropped 4:2:0 in the BT.1886 - Significant improvement but still not as good as SDR10
- Suggestions
  - Improve chroma subsampling in HDR10
  - Improve chroma coding

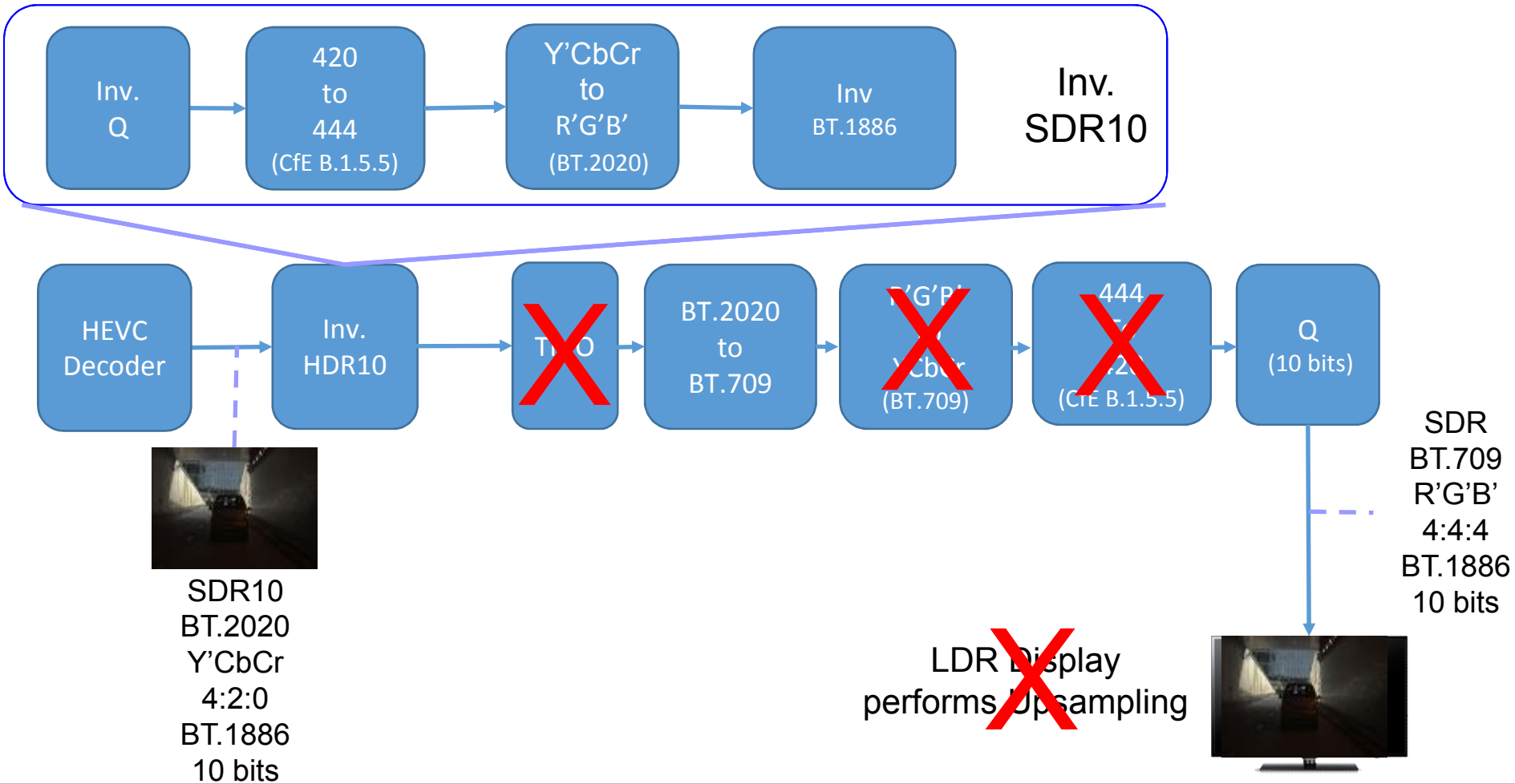
Test 2 : Addressing display in R'G'B' 4:4:4 mode (TV case)

- HDR10 pipeline – addressing SDR display:



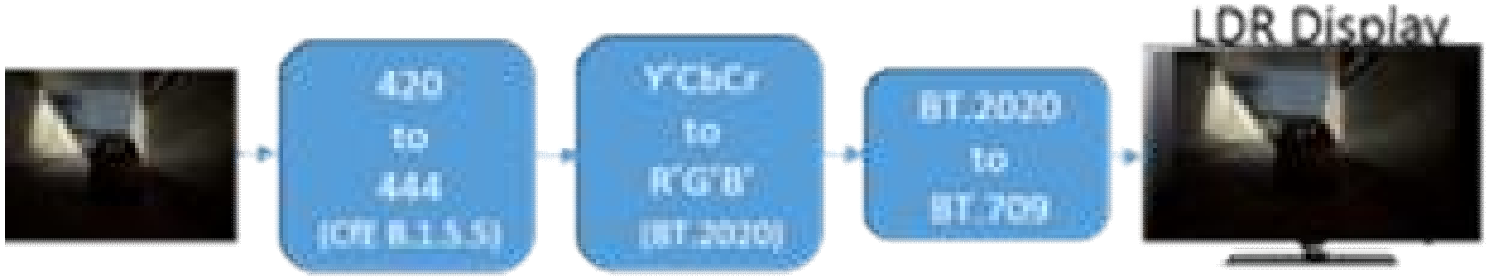
Test 2 : Addressing display in R'G'B' 4:4:4 mode (TV case)

- SDR10 pipeline – addressing SDR display:



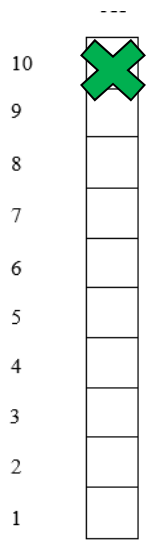
Test 2 : Addressing display in R'G'B' 4:4:4 mode

- Objective: Compare transmission pipeline SDR10 with pipeline SDR10 for SDR viewing
- SDR10 for SDR:



Test 2 : methodology

- The subjective quality of the decoded tone mapped SDR using pipeline HDR10 and SDR10



Test

FireEater2

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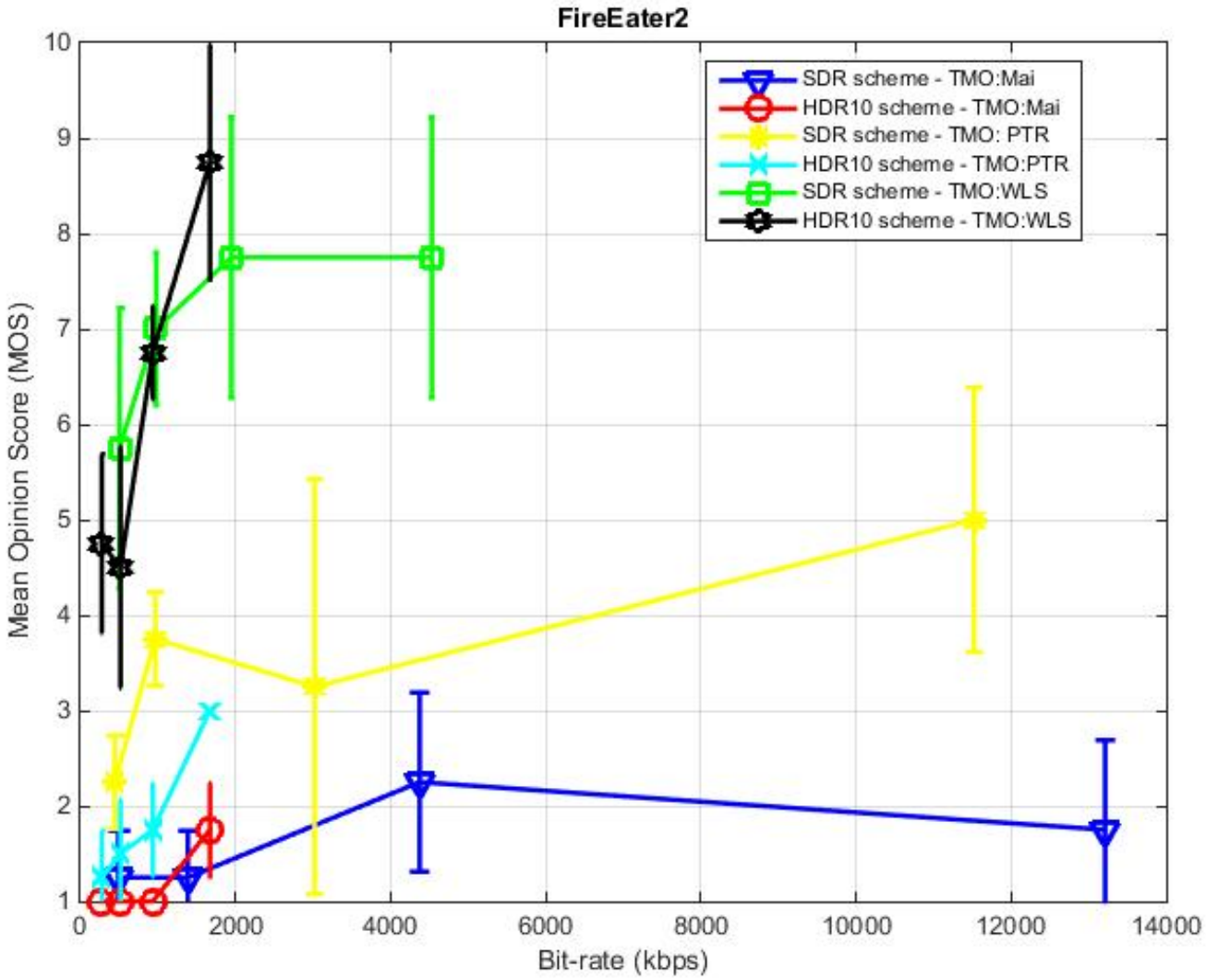
PTR

WLS

FireEater2


FireEater2
SDR scheme - TMO:Mai
HDR10 scheme - TMO:Mai
SDR scheme - TMO: PTR
HDR10 scheme - TMO:PTR
SDR scheme - TMO:WLS
HDR10 scheme - TMO:WLS
Mean Opinion Score (MOS)
Bit-rate (kbps)
1
2
3
4
5
6
7
8
9
10
0
2000
4000
6000
8000
10000
12000
14000

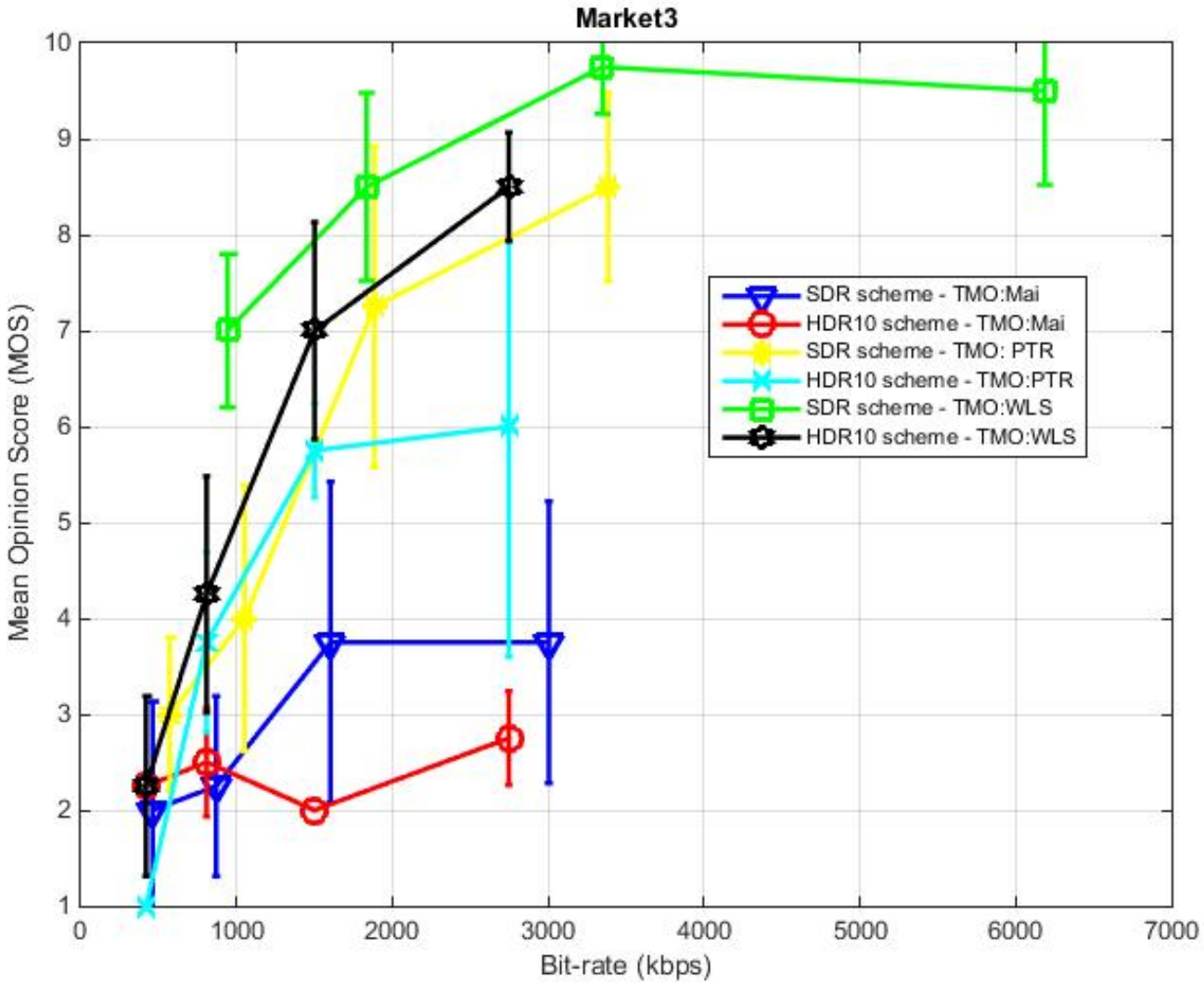
Market3

Mai et al

PTR

WLS

Market3


Market3
Mean Opinion Score (MOS)
Bit-rate (kbps)
SDR scheme - TMO:Mai
HDR10 scheme - TMO:Mai
SDR scheme - TMO: PTR
HDR10 scheme - TMO:PTR
SDR scheme - TMO:WLS
HDR10 scheme - TMO:WLS
1
2
3
4
5
6
7
8
9
10
0
1000
2000
3000
4000
5000
6000
7000

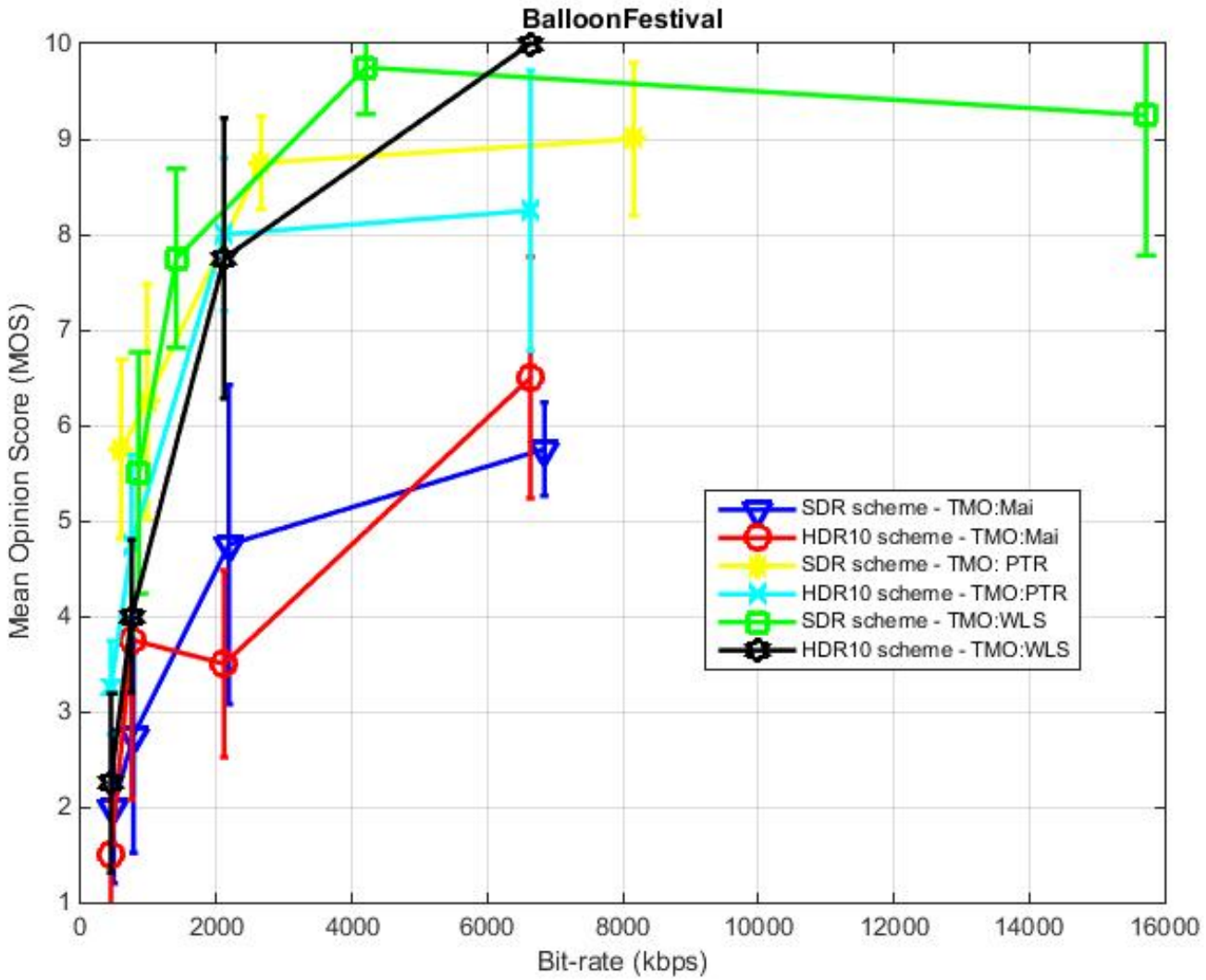
BalloonFestival

Mai et al

PTR

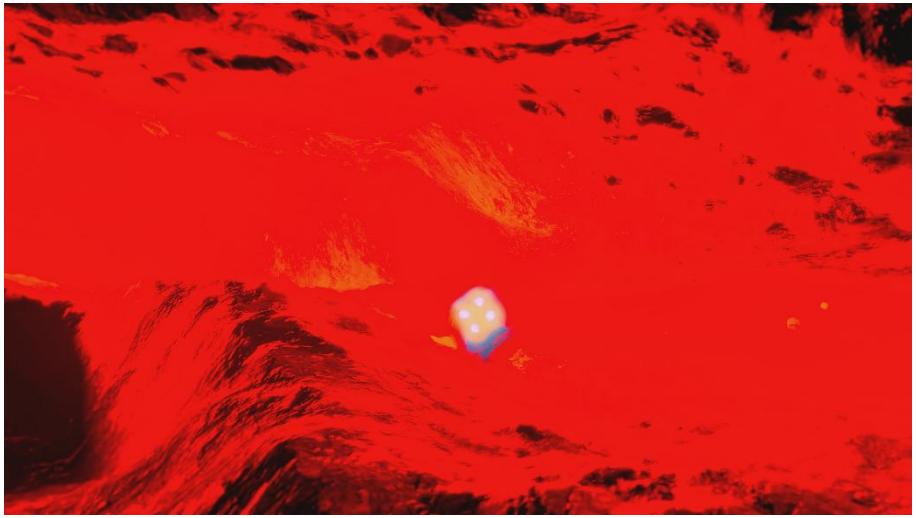
WLS

BalloonFestival

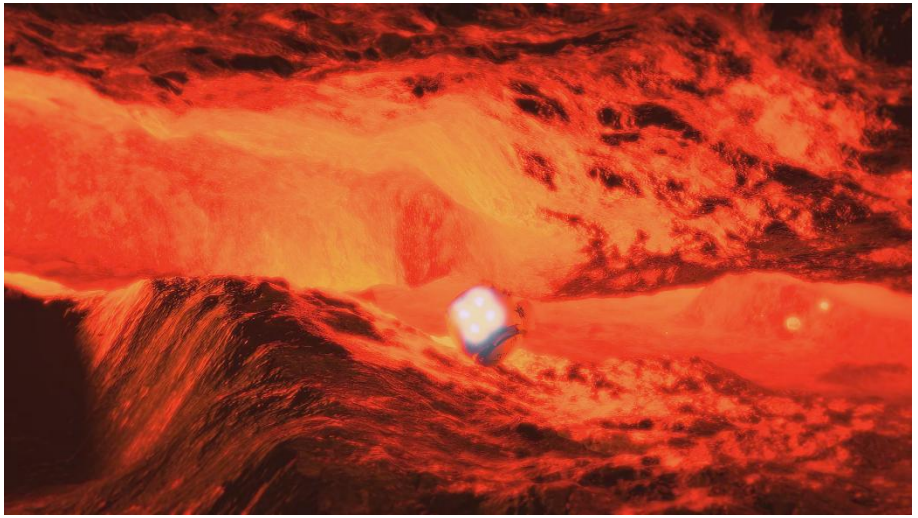


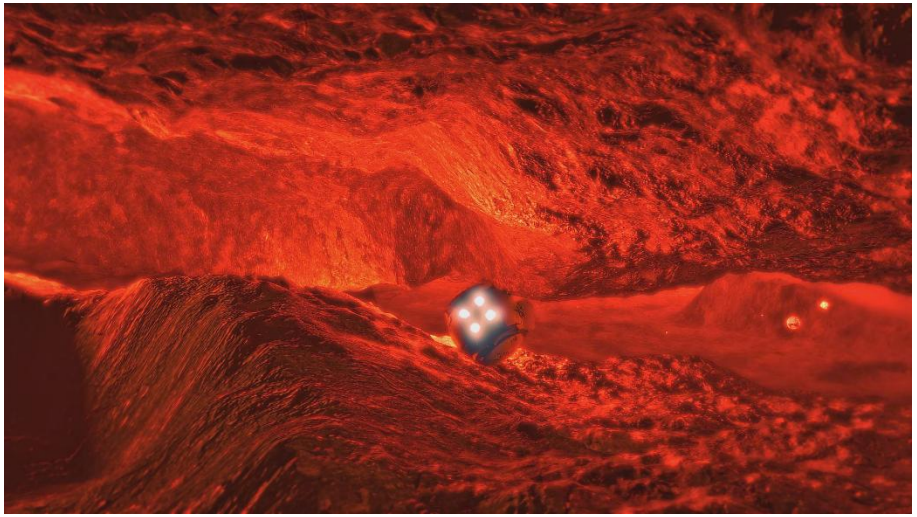
Tibul2

Mai et al



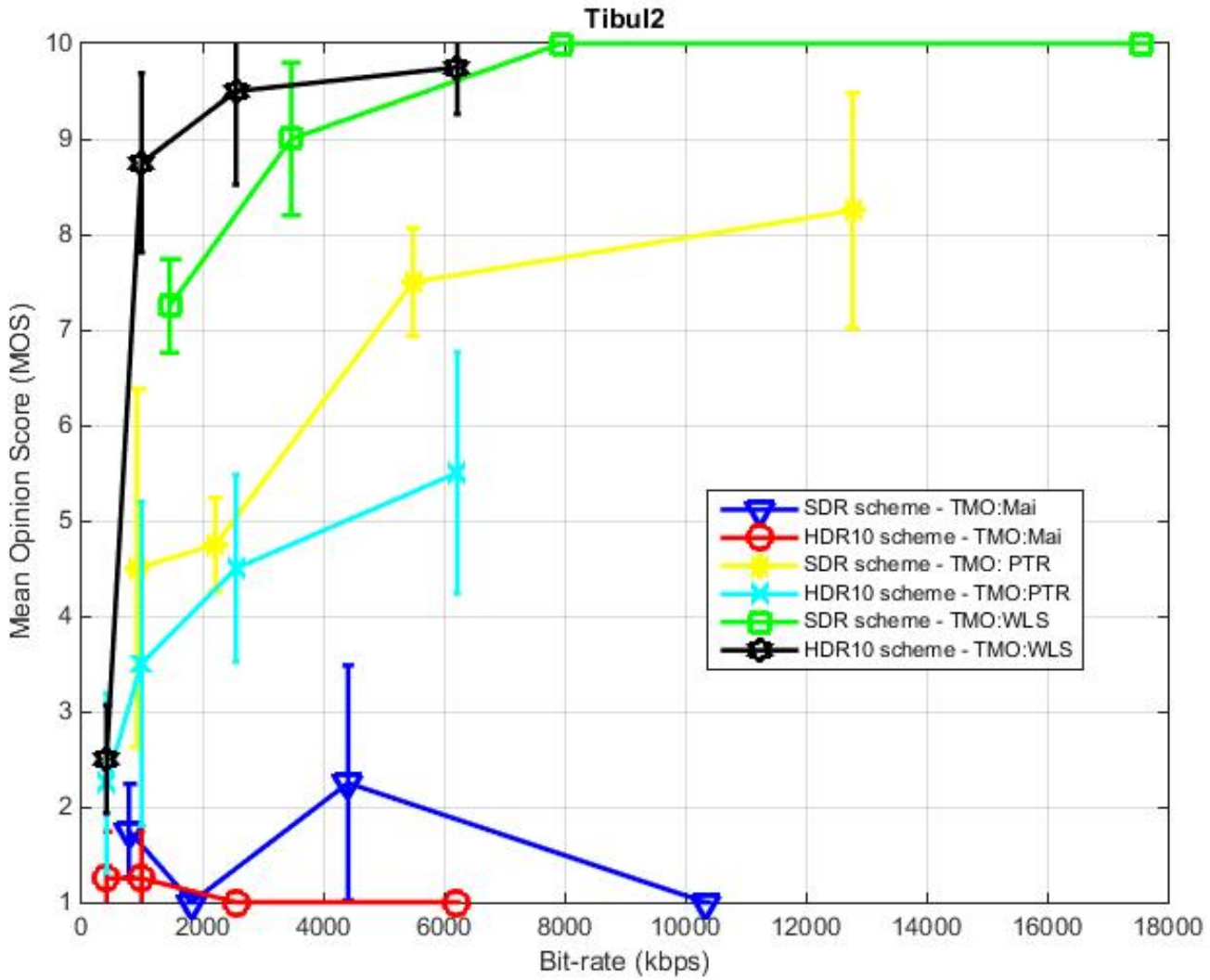
PTR





WLS

Tibul2


Tibul2
Mean Opinion Score (MOS)
Bit-rate (kbps)
SDR scheme - TMO:Mai
HDR10 scheme - TMO:Mai
SDR scheme - TMO: PTR
HDR10 scheme - TMO:PTR
SDR scheme - TMO:WLS
HDR10 scheme - TMO:WLS

Conclusions

- HDR10 outperforms SDR10 on HDR display
- SDR quality in HDR10 suffers from chroma subsampling in two different domains (PQ & SDR)
- HDR10 could achieve good SDR quality with good tone mapping operator (not necessarily invertible)

Contact Information

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THANK
YOU