ateme

Transforming Video Delivery

Content-Aware Encoding for Next-Gen Content

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Apple HLS recommendation for HEVC OTT deliveries

Resolution	HDR Bitrate (kbps)
3840 x 2160	20000
3840 x 2160	13900
2560 x 1440	9700
1920 x 1080	7000
1920 x 1080	5400
1280 x 720	3850
1280 x 720	2900
960 x 540	1930
960 x 540	1090
960 x 540	730
768 x 432	360
640 x 360	160

Sum = 67020

- Content independent:
  - Fixed setting, corresponding to average sequence characteristics
  - Usually CBR
  - Suboptimal

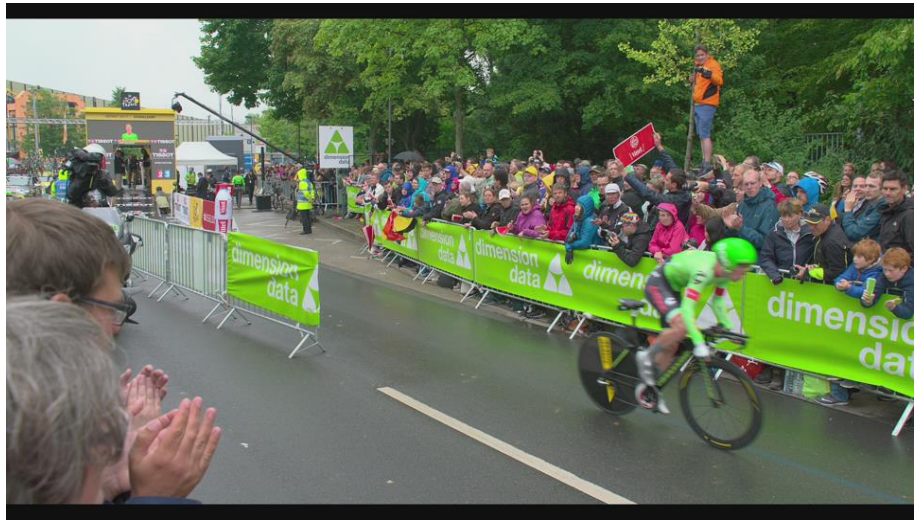
≠ Adapting to content diversity:

- Flexible
- CBR (constant) or VBR (variable)
- Optimal
- **Future-proof**

Future contents

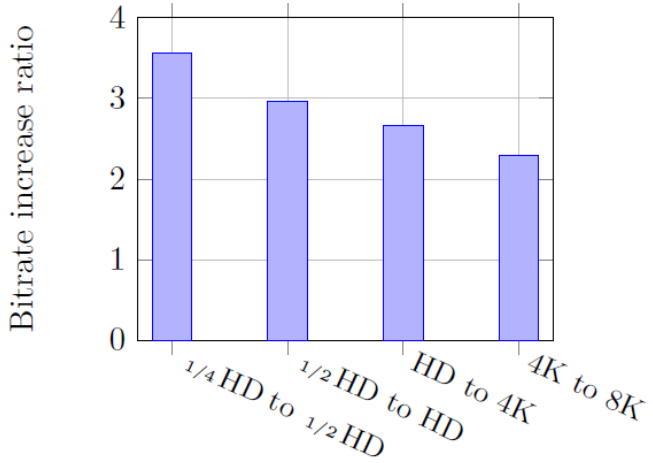
- Polynésie, **8K** 50 fps HDR PQ
  - The Explorers

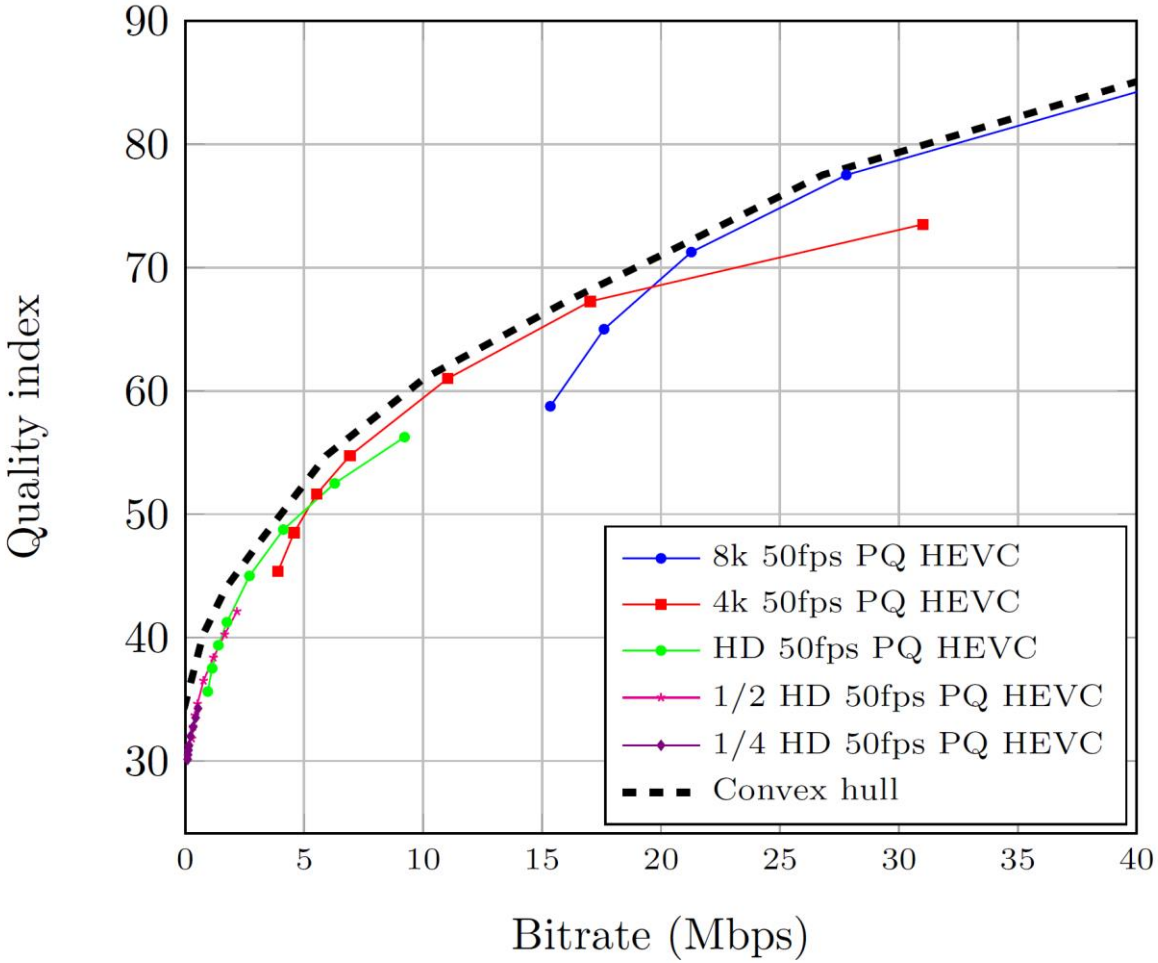
- Tour de France, 4K **100 fps** HDR HLG
  - A.S.O.



Resolution variation

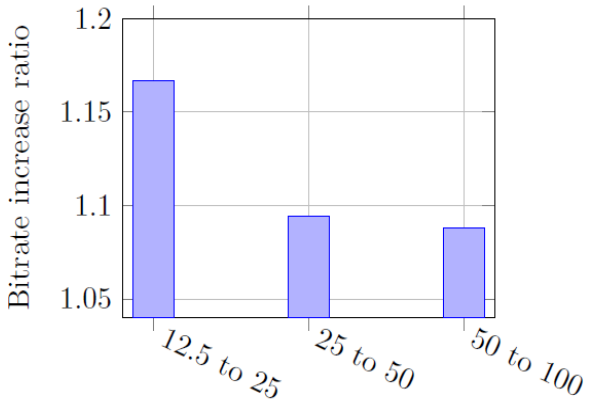
- Classical convex hull paradigm
  - Optimal R/D points
- Quality index valid across scales
  - Dependent on viewing conditions
- Most prominent feature to control bitrate

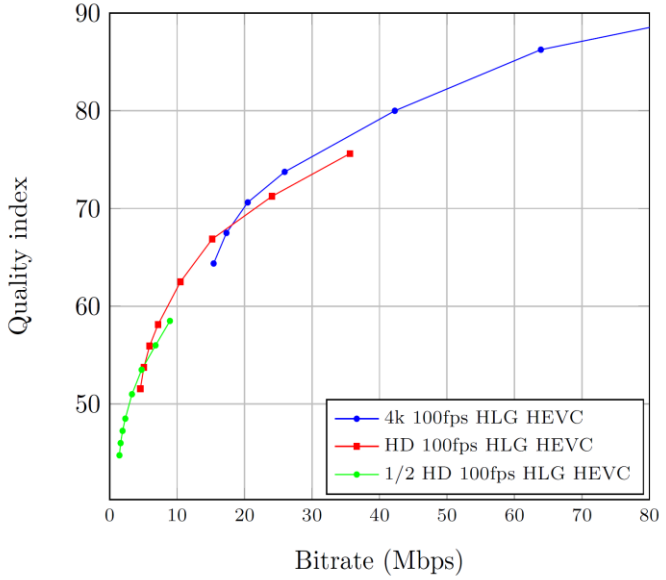


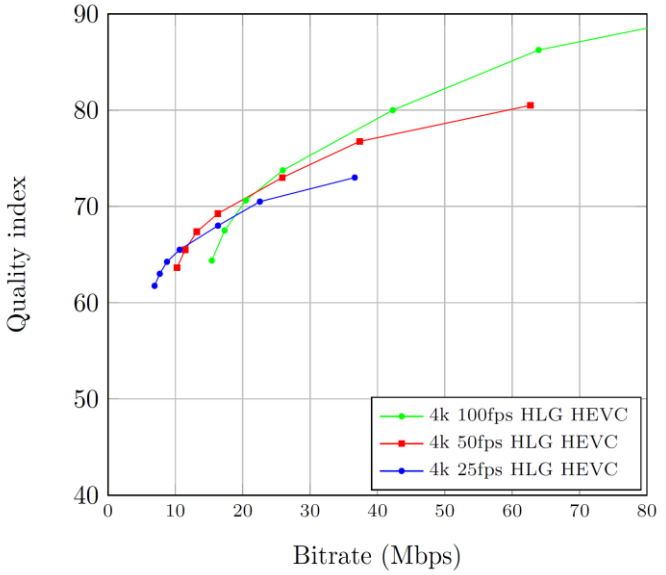


Framerate variation

- Same reasoning applies
- However, less studied, more difficult to model
- Less relevant for bitrate control, but still significant

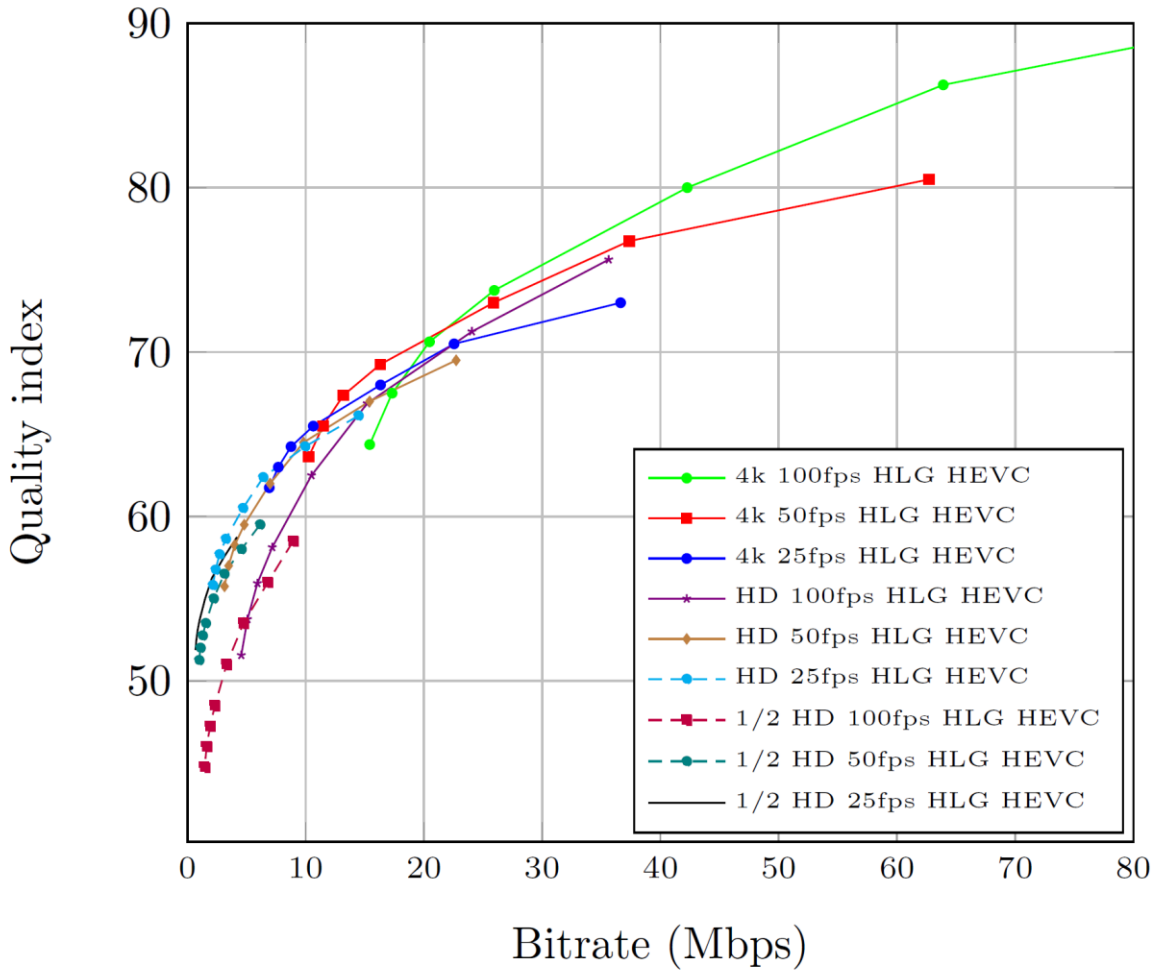






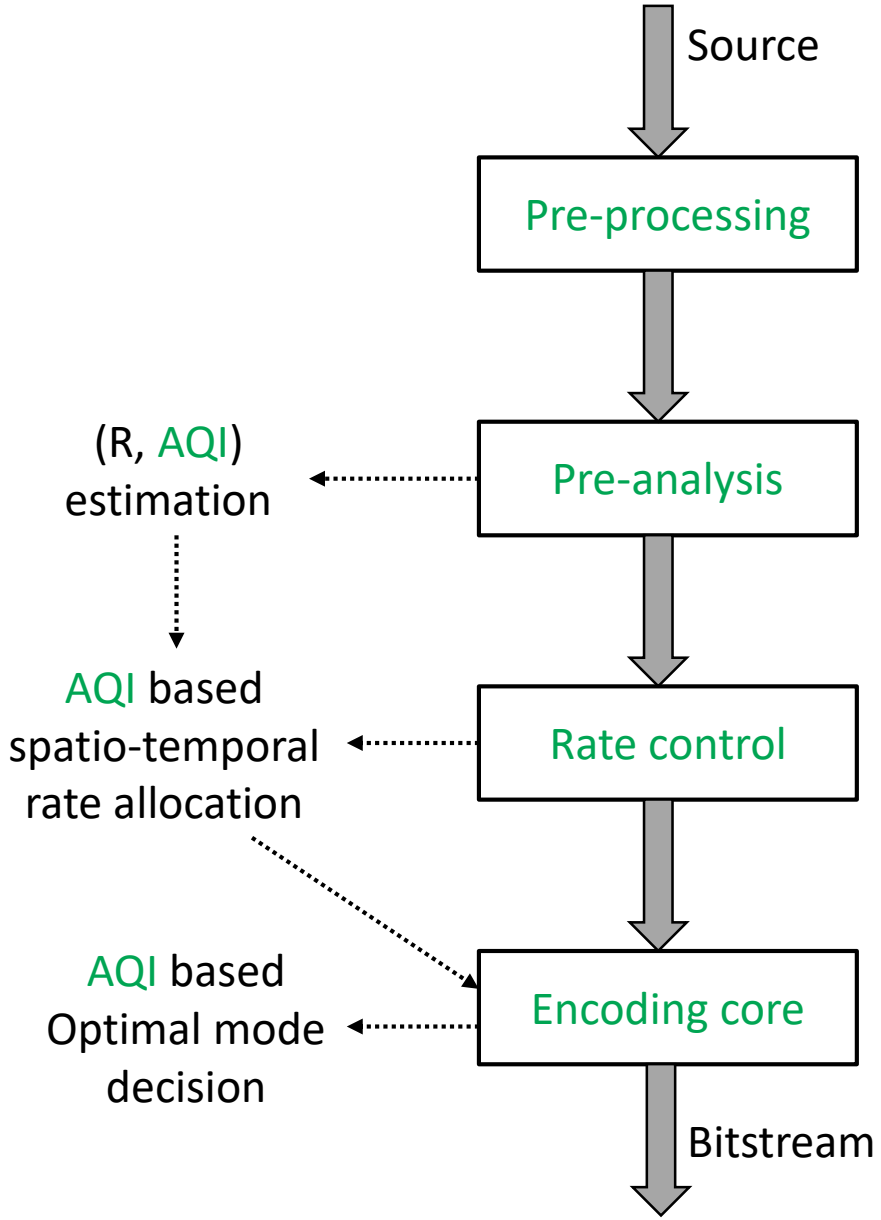
Resolution AND framerate variation

- Quality index must remain valid across resolutions and framerates
- Possible but challenging
- Additionally
  - HDR/SDR
    - Around 20% more bitrate for HDR
  - Codec variation?
    - HEVC/AV1/VVC…



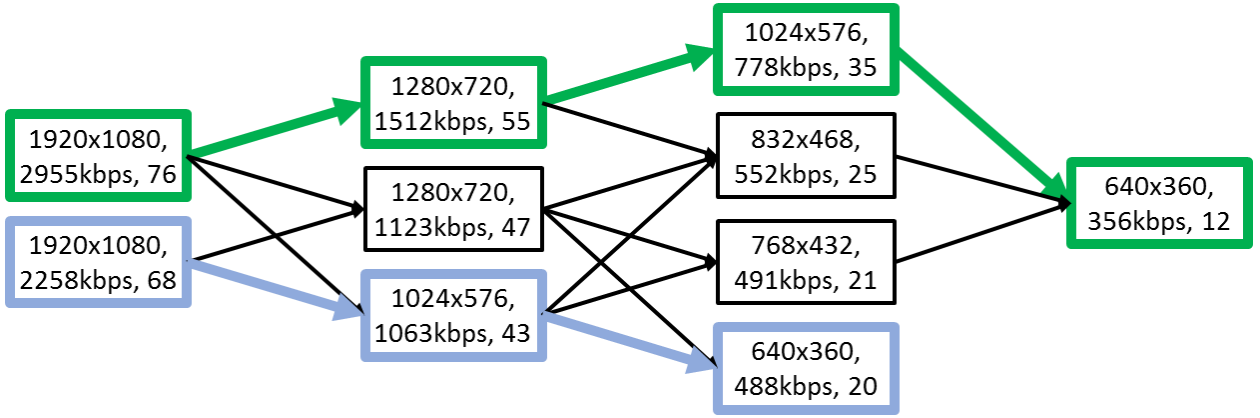
Quality index at the heart

- Even with AI, deriving a universal quality index remains a challenge
- ATEME approach: break down the task
- Quality vector containing indexes related to each dimension
  - Encoding quality, Spatial index, Temporal index, Dynamic range index, Color gamut index
  - QV = < EQ, SI, TI, DRI, CGI>
- Universal index: ATEME Quality index
  - AQI = f(QV, visual angle coverage)
- **Two machine learning based estimation algorithms:**
  - A posteriori VQ estimation
    - VQ metric with reference
  - A priori VQ estimation
    - Predicting the result of any encoding with any parameters, without actually encoding



Deriving a set of profiles

- Not machine learning based this time
- Computing a set of rate distortion points by varying relevant parameters
- Building a trellis respecting
  - Monotonicity in all dimensions (rate, resolutions, framerate, dynamic range, AQI, QV)
  - Significant enough rate step
  - Seamless quality transition
  - Sufficient encoding quality
- Integrate any arbitrary constraint
- Optimize for any criterion



→ **Extreme Flexibility**

Recommendations for Polynésie

Codec	Resolution	Fps	Dynamic range	Bitrate (kbps)
HEVC	**7680x4320**	50	HDR	**17606**
HEVC	**3840x2160**	50	HDR	**6924**
HEVC	**2560x1440**	50	HDR	**3095**
HEVC	**1920x1080**	50	HDR	**1755**
HEVC	**1280x720**	50	HDR	**1054**
HEVC	**960x540**	50	HDR	**642**
HEVC	**640x360**	**25**	HDR	**383**
HEVC	**480x270**	**25**	HDR	**224**

Comparison with Apple HLS recommendation for HEVC

HLS		ATEME content adaptive	
Resolution	**Bitrate HDR (kbps)**	**Resolution**	**Bitrate (kbps)**
3840 x 2160	**20000**	**7680x4320**	**17606**
3840 x 2160	13900		
2560 x 1440	9700		
1920 x 1080	7000	3840x2160	6924
1920 x 1080	5400		
1280 x 720	3850		
1280 x 720	2900	2560x1440	3095
960 x 540	1930	1920x1080	1755
960 x 540	1090	1280x720	1054
960 x 540	730	960x540	642
768 x 432	360	640x360	383
640 x 360	160	480x270	224
	Sum = 67020		**Sum = 14077 (31683 with 8K)**

Recommendations for Tour de France

Codec	Resolution	Fps	Dynamic range	Bitrate (kbps)
HEVC	3840 x 2160	**100 fps**	**HDR**	20477
HEVC	2560 x 1440	**100 fps**	**HDR**	9697
HEVC	1920 x 1080	**100 fps**	SDR	5859
HEVC	1280 x 720	**100 fps**	SDR	3649
HEVC	1280 x 720	50 fps	SDR	2381
HEVC	960 x 540	50 fps	SDR	1564
HEVC	960 x 540	50 fps	SDR	1042

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960 x 540	1930	960 x 540	1564
960 x 540	1090	960 x 540	1042
	Sum = 65770		**Sum = 44669**