The Role of New Codecs and AI in Video Processing Evolution

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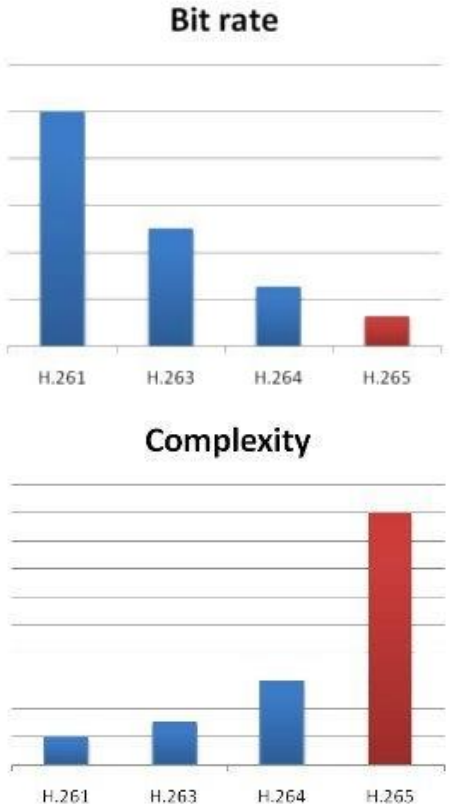
Video codec evolution

The evolution on video codecs has allowed to double the compression efficiency every 10 years.

The increased efficiency mainly comes from the increase in the encoding tools available:

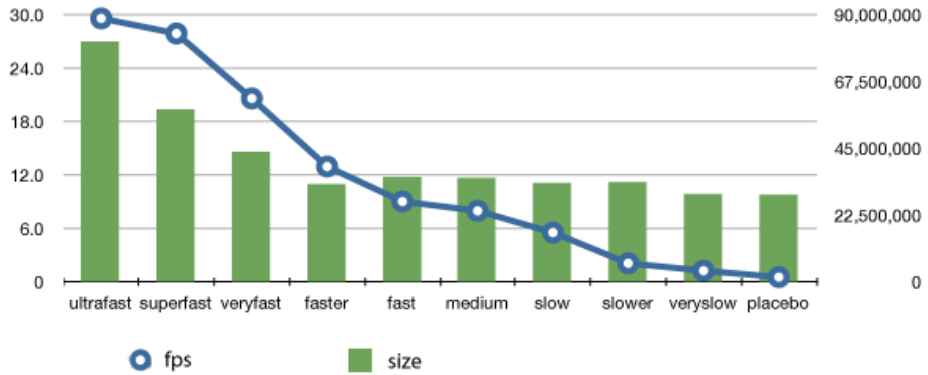
- More prediction modes;
- More block sizes;
- More flexible GOP structures and referencing;
- Higher accuracy in the motion estimation…

The increase in number and complexity of the encoding tools directly contribute to the increase of the encoder's computational costs.



Video codec evolution

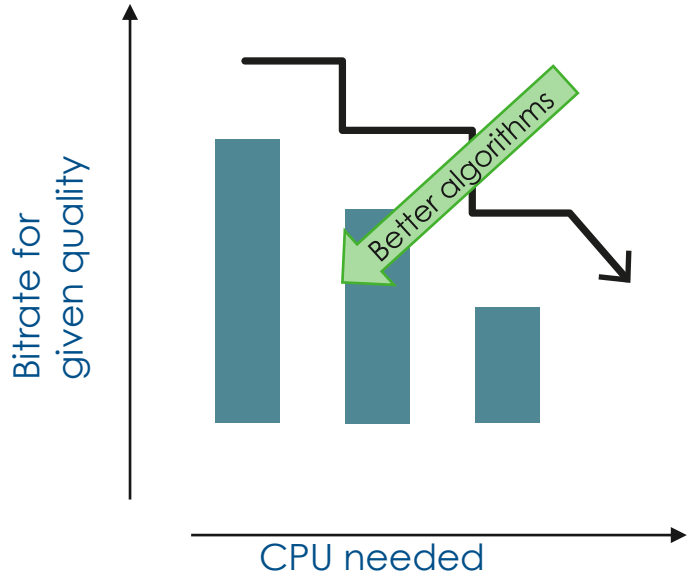
Codec implementations such as x264 and x265 (ffmpeg) define different CPU presets that allow trading compression efficiency for computational costs.



Profile comparison for a 60s HD sequence encoded using different x264 presets.

Encoding tools are progressively disabled or restricted so that compression efficiency is traded by computational savings.

Video compression is CPU intensive with many options
Better algorithms save money

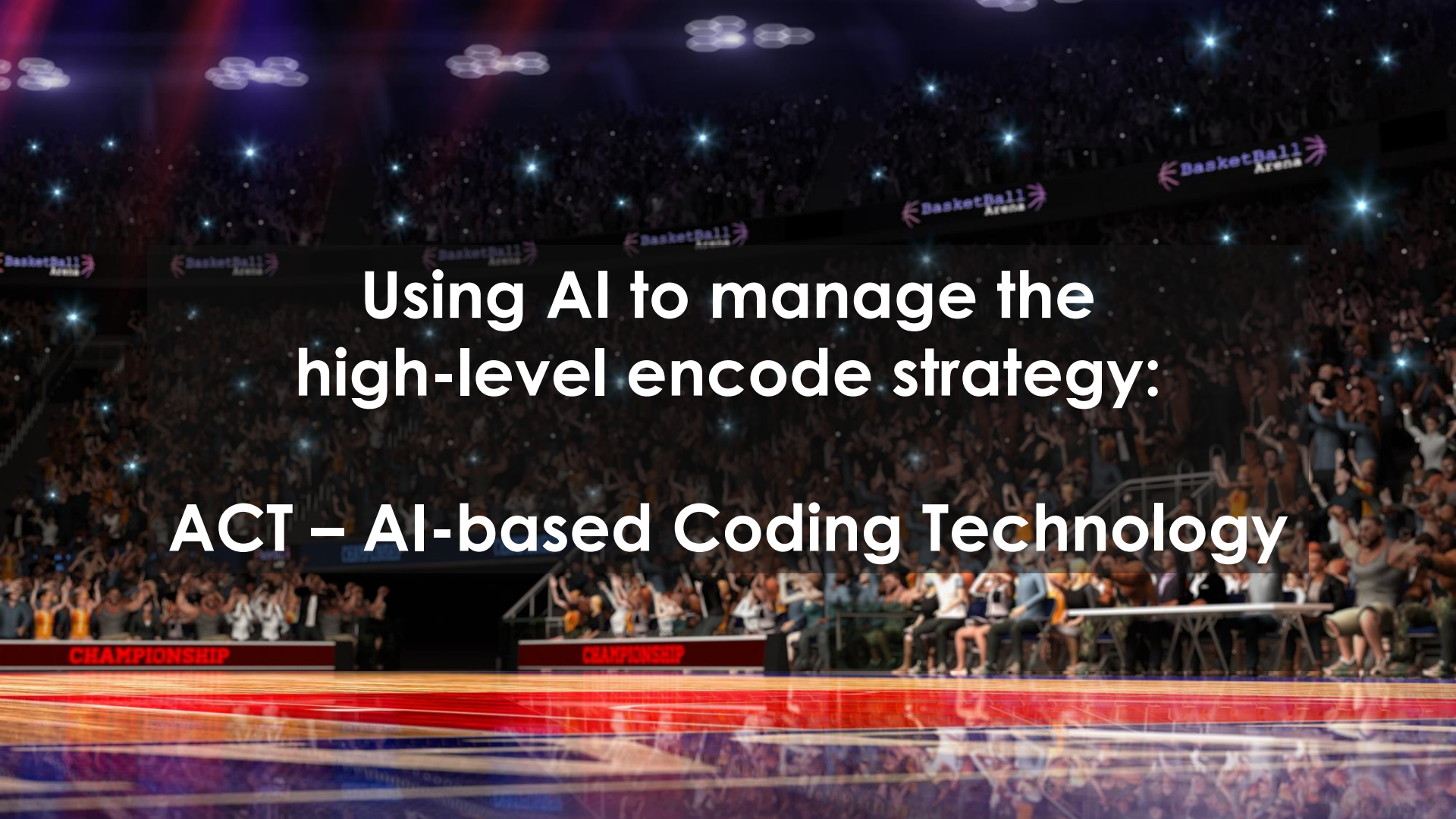


Same codec (e.g. HEVC)

All encoders trade off CPU cost against bitrate efficiency (= delivery cost)

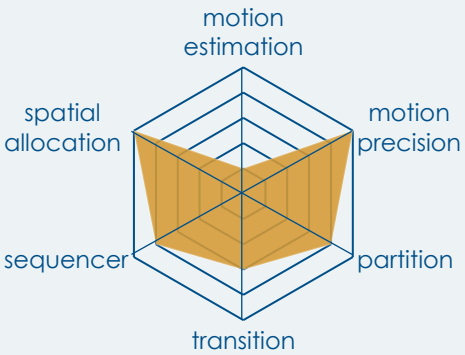
Can we use AI to get:

- the same efficiency with less cost, or
- better efficiency with the same cost?

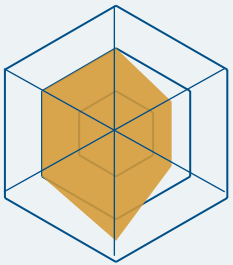

Using AI to manage the
high-level encode strategy:
ACT – AI-based Coding Technology

ACT – technical concept / source evolution

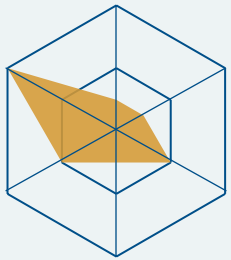
The source analysis defines the tools used by the codec engine



cartoon

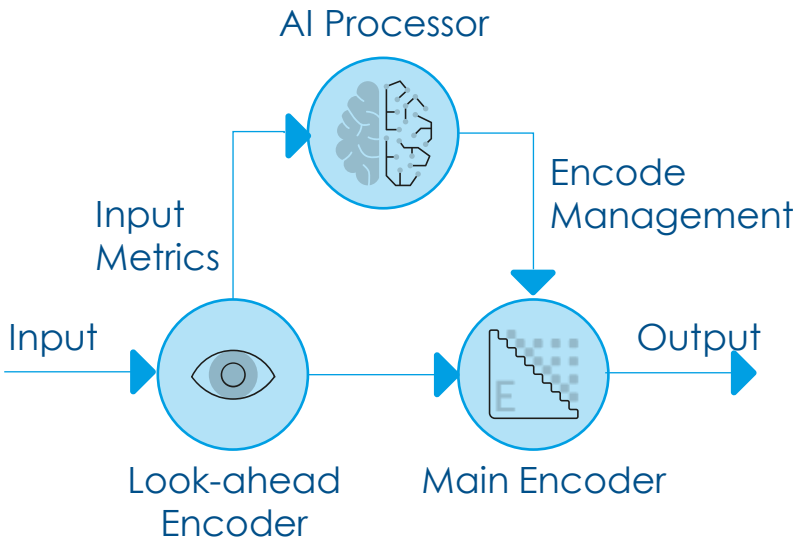


sport



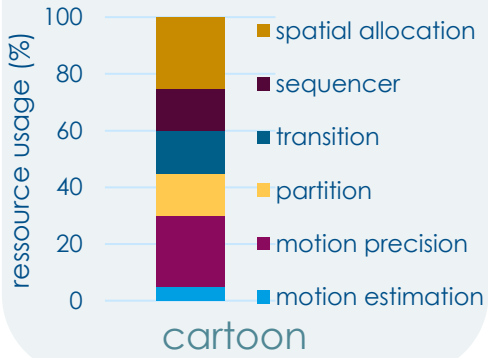
news

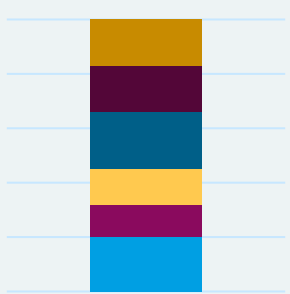
Using AI to make good encoder resource mapping decisions

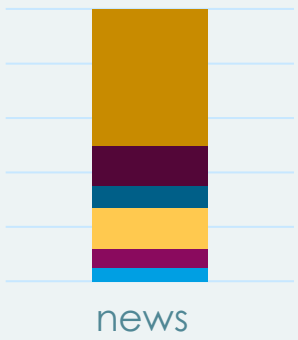


ACT – technical concept / codec evolution

The algorithms inside the codec are constantly adapted based on the source

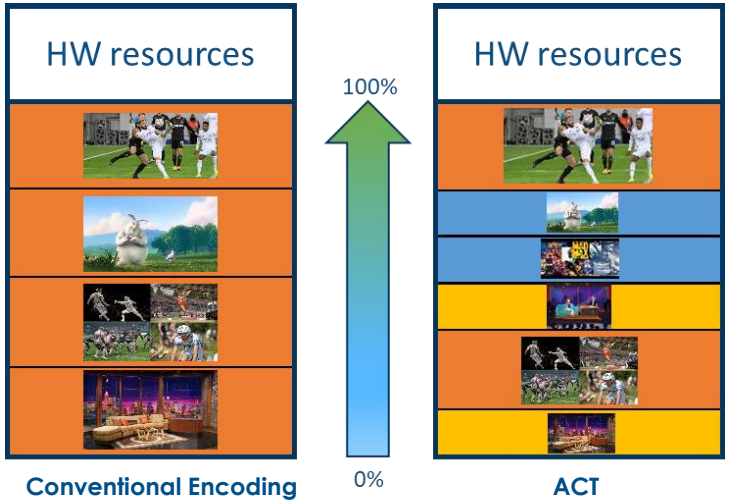




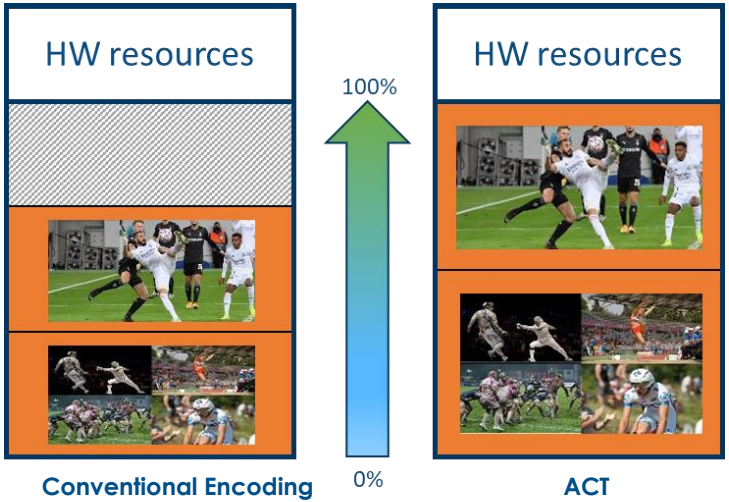


ACT for cost control

Guaranteed density



Maximize infrastructure usage



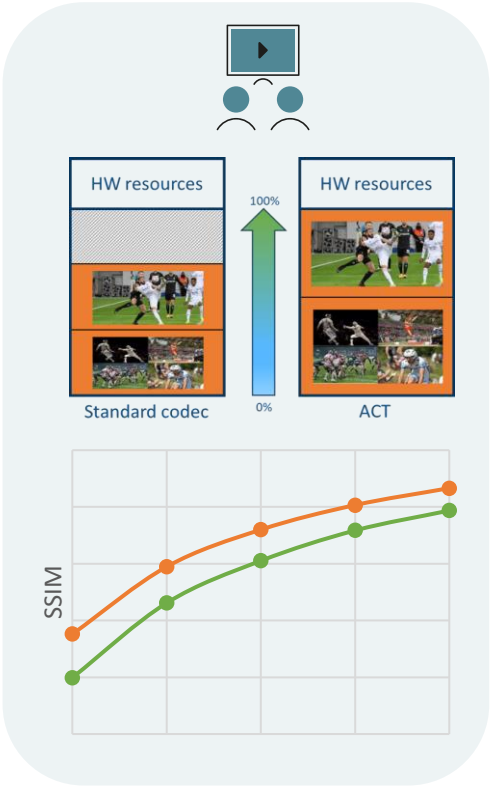
ACT for a better Video Quality

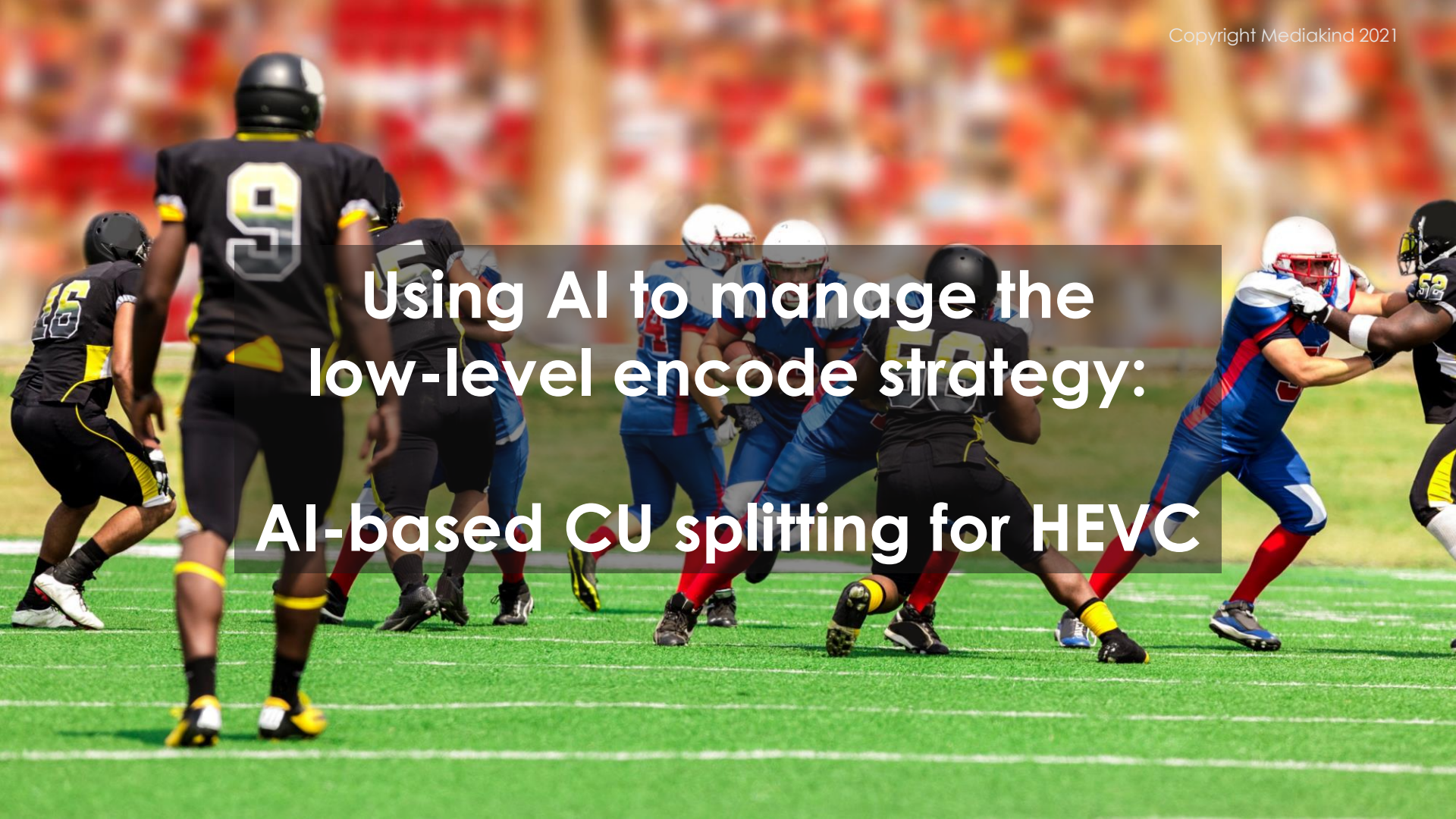
Same operational cost

- ACT automatically activates codec algorithms and tools to increase the video quality.

- Example with an OTT channel
  - Compared to a fixed preset mode
  - HD 1080p top resolution leverages ACT
  - Same number of vCPU, define to run the fixed preset configuration

- Bandwidth gain for the same VQ (SSIM)
  - 19% in average
  - Up to 40%

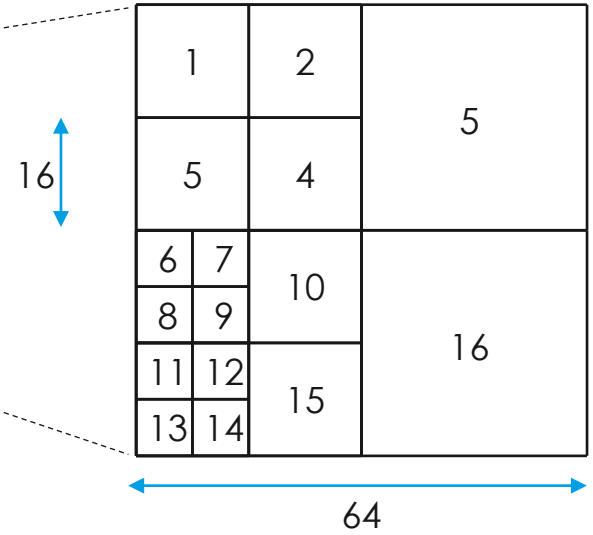




Using AI to manage the low-level encode strategy:

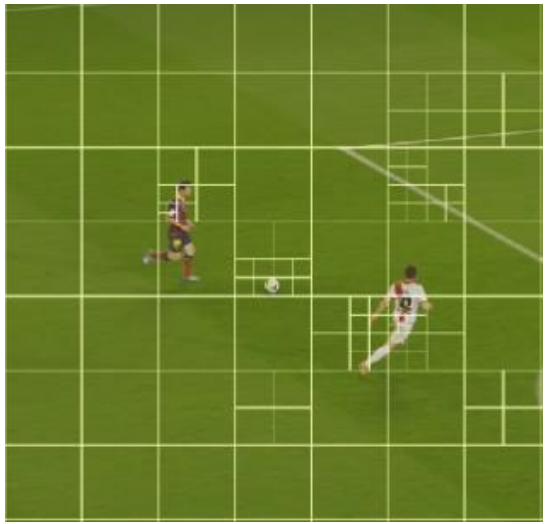
AI-based CU splitting for HEVC

HEVC Coding Tree Units

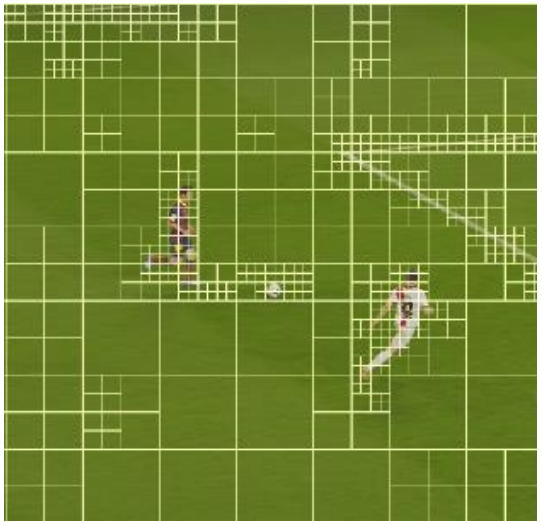


How CUs change with compression operating point

Lower bitrate

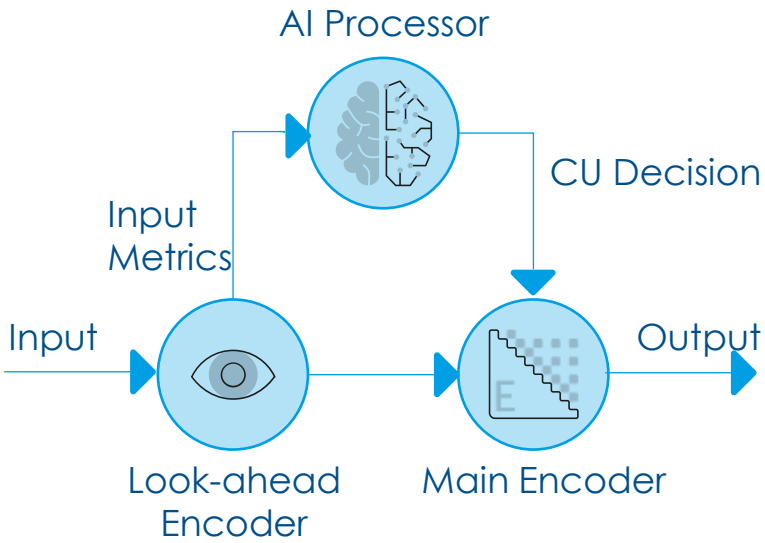


Higher bitrate



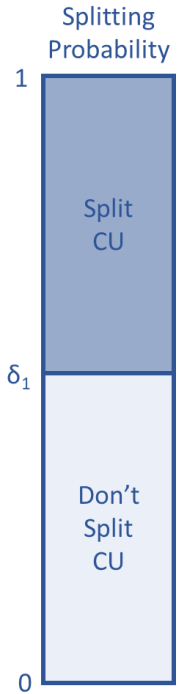
CU splitting for the same frame using QP=46 (left) and QP=18 (right)

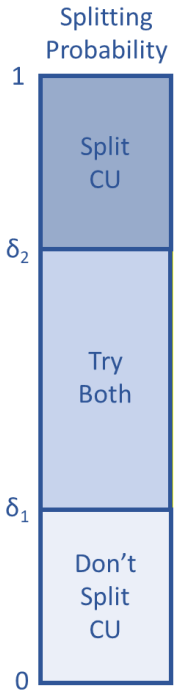
Using AI to make good CU decisions more efficiently



Binary vs probabilistic approach to CU splitting
Sometimes you just need to try both options....

Single decision threshold

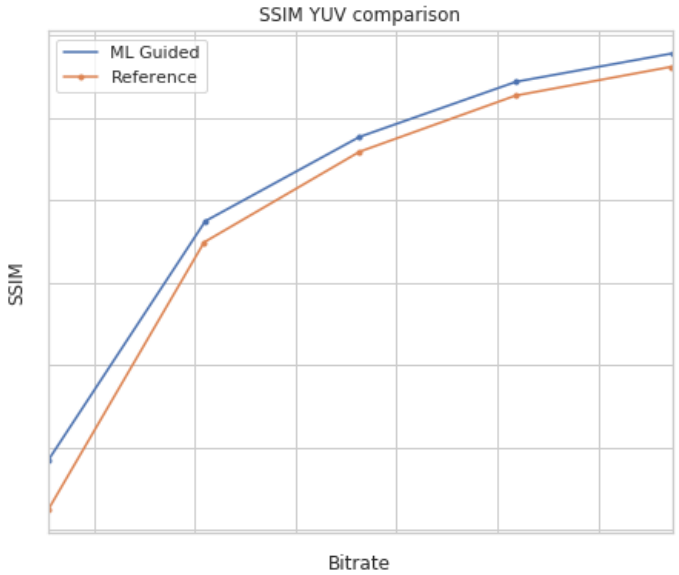




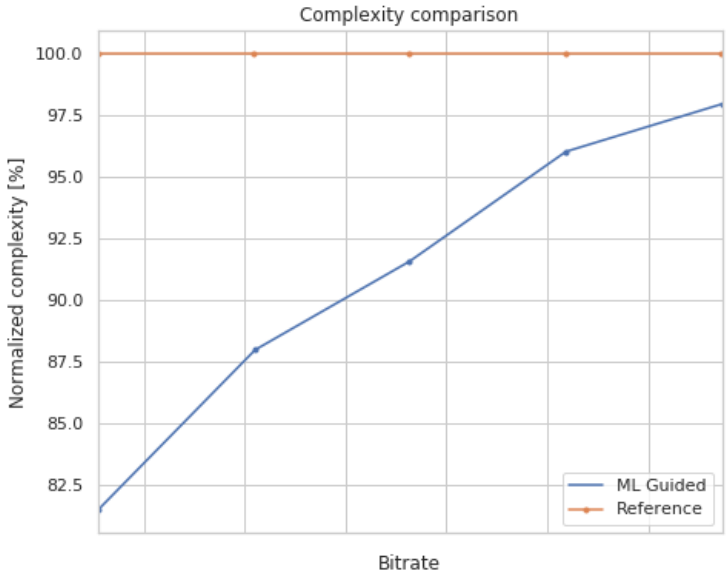
Dual decision thresholds

Example results – 4K @ 60fps
Bitrate efficiency vs processing

Recycling some of the compute savings into enabling more compression options

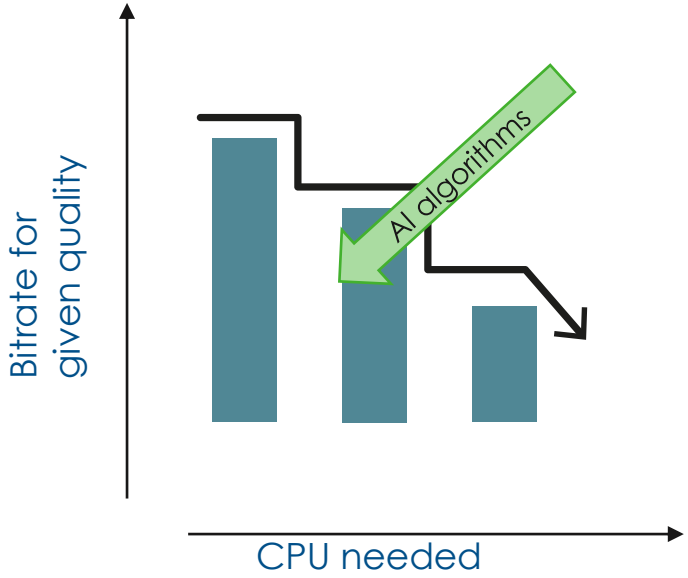


10% bitrate saving



at a lower compute cost

AI does improve video compression
Saving broadcasters and operators money



Where is it best?

- Complex data patterns
- Alternative is very CPU intensive
- Both high-level and low-level decisions

Other applications for AI in Video compression

AI can be used to manage other low level encoding strategies:

- Estimate likelihood of Intra or Inter prediction modes;
- Shortlist direction of Intra prediction;
- Skip mode prediction.

Other AI applications can be used to increase content monetization:

- Super-resolution: generating high-quality high-resolution content from lower resolution sources (e.g. HD to UHD up-conversion);
- Content semantic analysis: analyse and classify video content to target advertisement, generate automatic highlights or create automatic captions or audio descriptions.

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