Versatile Video Coding (VVC)

on the final stretch

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Versatile Video Coding (VVC)

Joint ITU-T (VCEG) and ISO/IEC (MPEG) project

Coding Efficiency

50% over H.265/HEVC

HD / UHD / 8K resolutions

10bit / HDR

Versatility

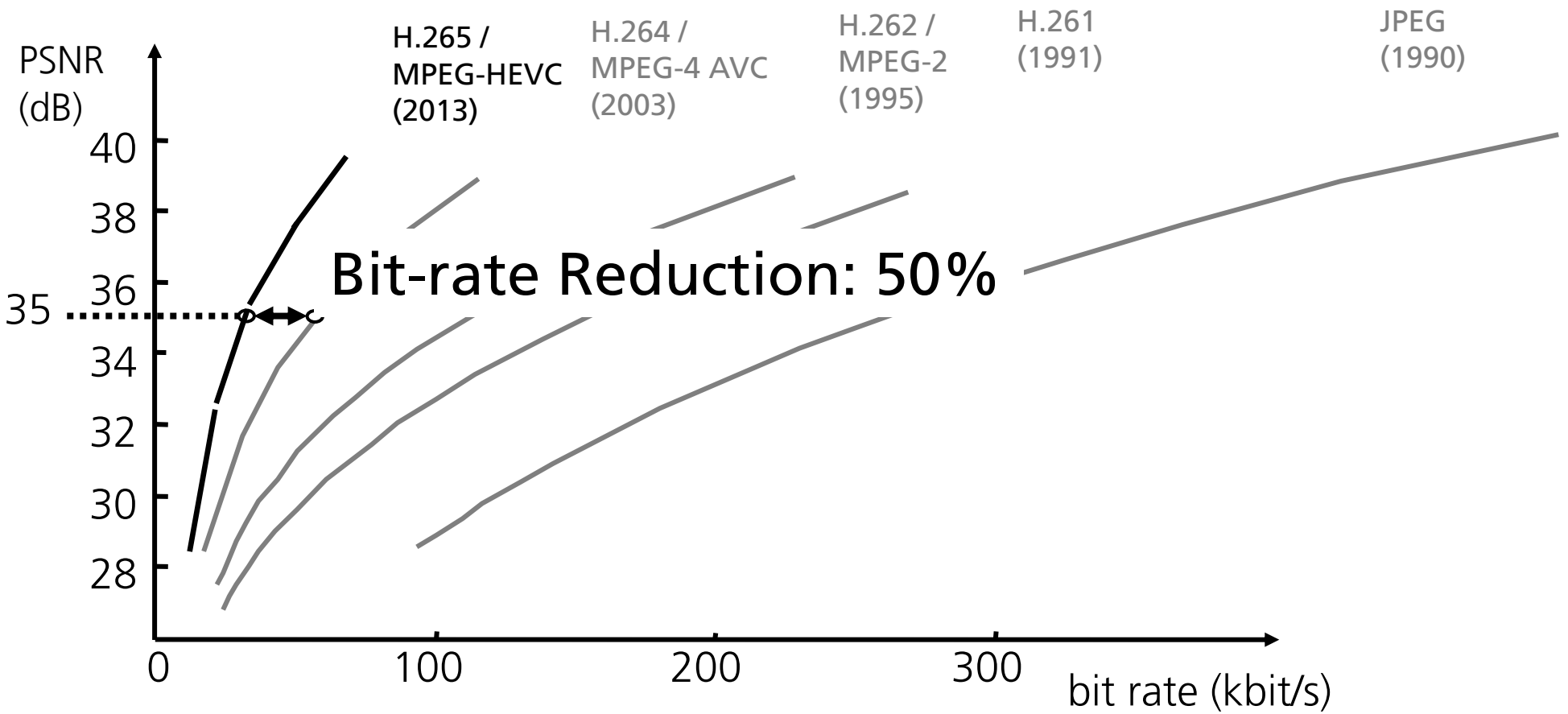
Screen content

Adaptive resolution change

Independent sub-pictures

VVC – Coding Efficiency

History of Video Coding Standards



VVC – Coding Efficiency

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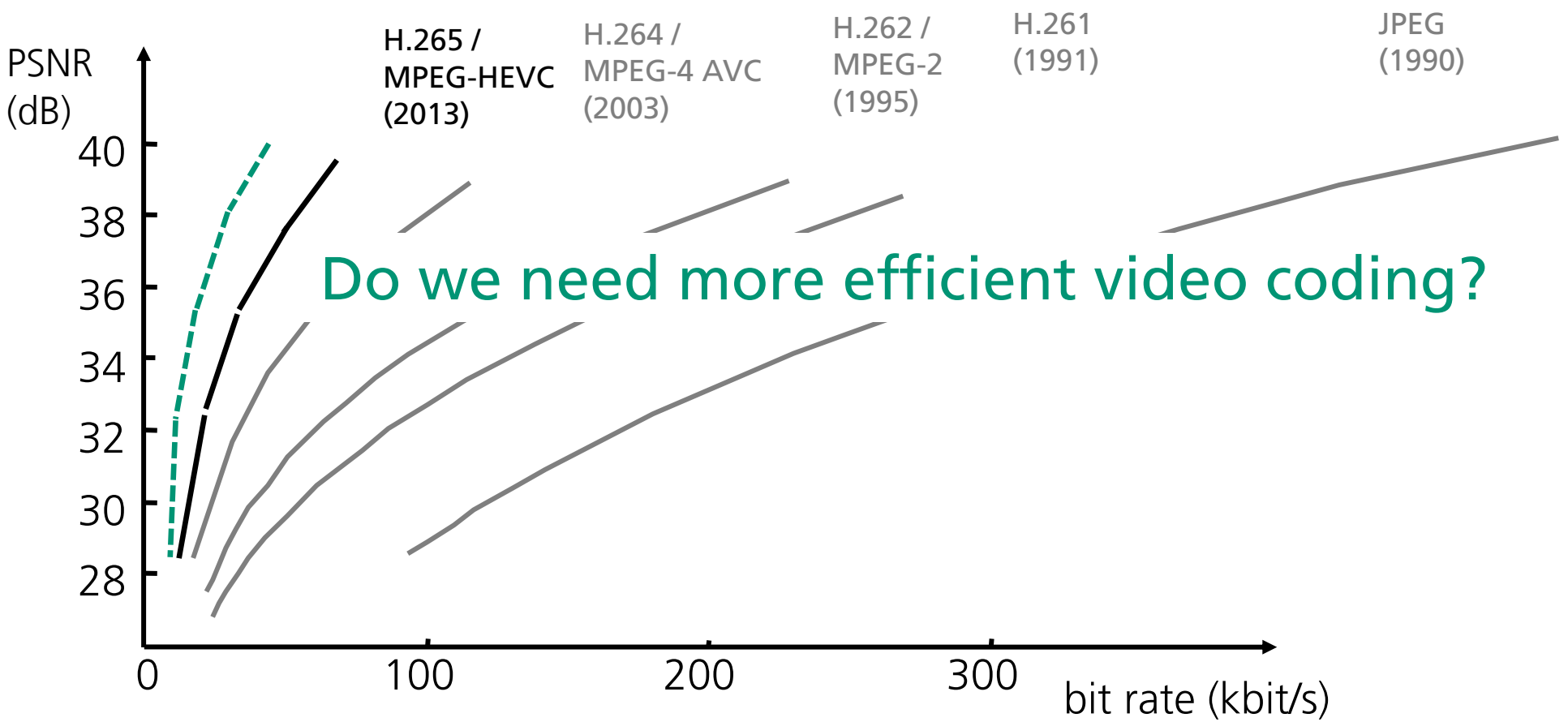


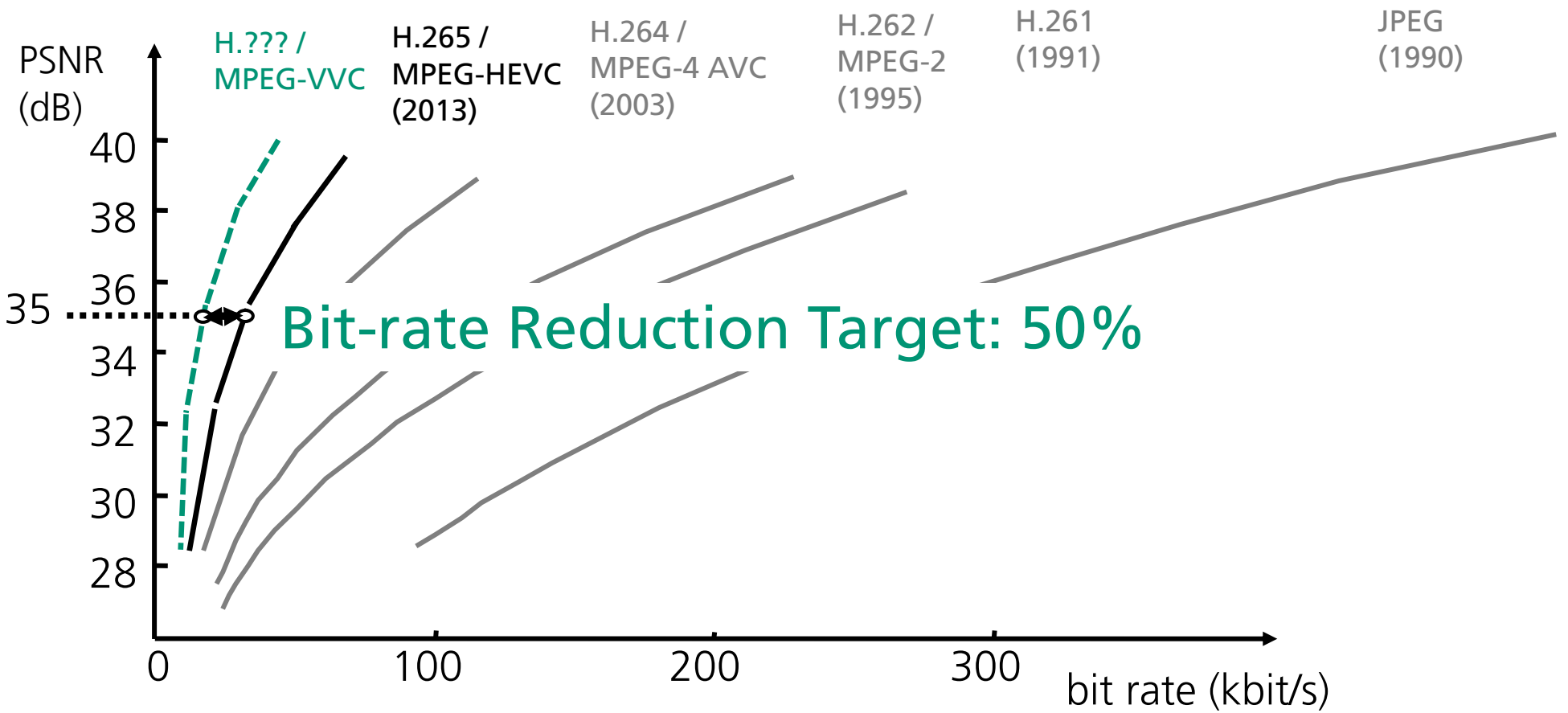
VVC – Coding Efficiency

Jevons Paradox

"The efficiency with which a resource is used tends to increase (rather than decrease) the rate of consumption of that resource."

VVC – Coding Efficiency

Target for the final VVC standard



VVC – Timeline

2015 Oct. – Exploration Phase

- Joint Video Exploration Team (JVET) of ITU-T VCEG and ISO/IEC MPEG established October ‘15 in Geneva
- Joint Video Exploration Model (JEM) as software playground to explore new coding tools
- 34% bitrate savings for JEM relative to HEVC provided evidence to start a new joint standardization activity with a…

2017 Oct. – Joint Call for Proposals (CfP)

- Submit bitstreams and decoded video for proposed video coding technology
- Compare submission with HEVC anchor for given sequences, bitrates and coding conditions

2018 Apr. – Development Phase

- Subjective evaluation results of submitted CfP responses and HEVC anchor
- Lean initial starting point of standard development

2020 Jul. – Final Standard

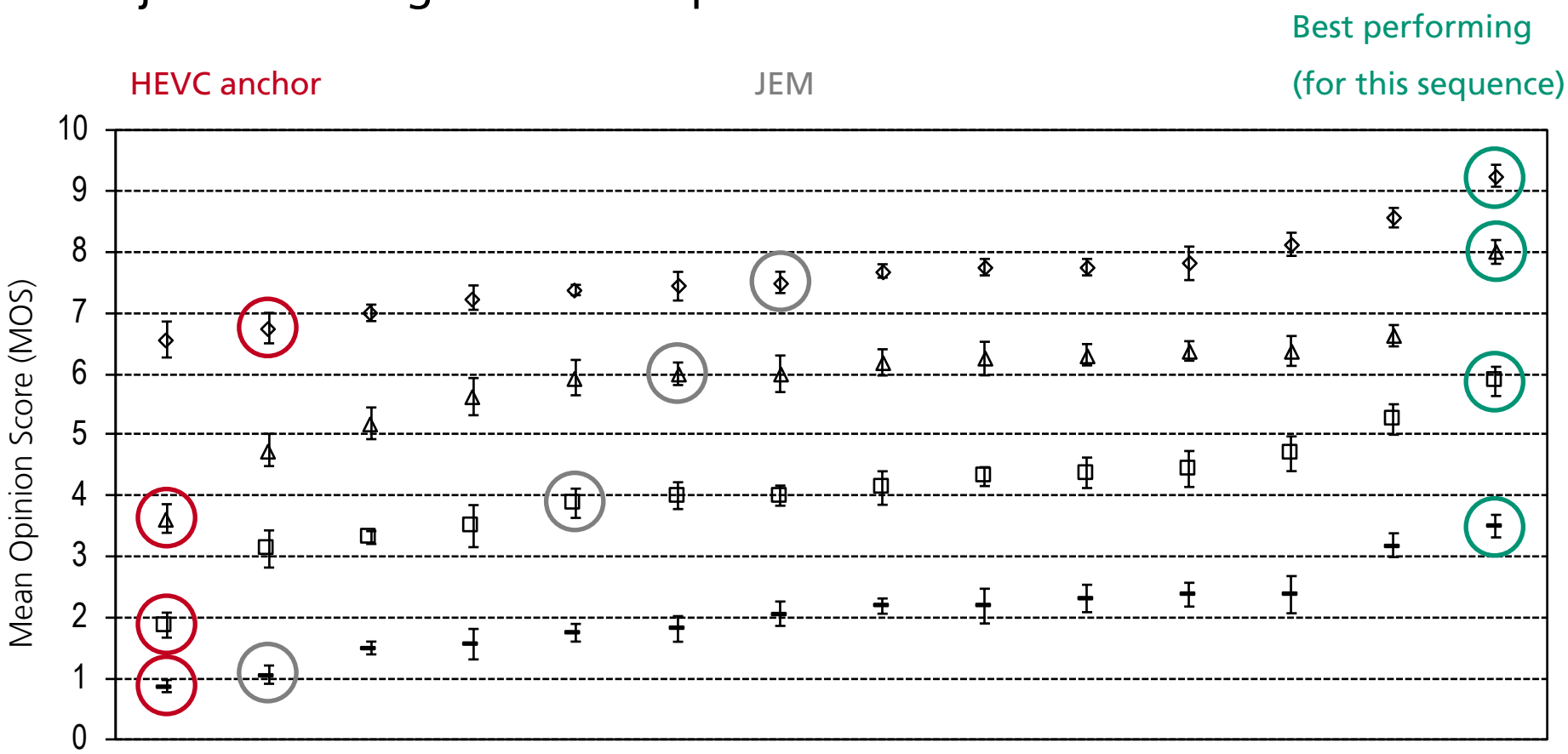
VVC – Call for Proposals

Results

- JVET received submissions from 32 organizations.
- 40% or more bitrate savings in terms of PSNR over HEVC were shown.
- All submissions were superior in terms of subjective quality than…
  - HEVC (in most test cases).
  - JEM (in a relevant number of test cases).

VVC – Call for Proposals

Subjective testing result example



SunsetBeach (UHD, HLG)

◇ 10 Mbit/s

△ 6 Mbit/s

□ 3 Mbit/s

– 1.5 Mbit/s

JVET-J0080: "Results of Subjective Testing of Responses to the Joint CfP on Video Compression Technology with Capability beyond HEVC", 10th JVET Meeting, San Diego, April 2018

VVC – Development

Draft 1 and First Test Model (VTM-1.0)

- Start off with a clean slate
- Add quadtree plus multi-type tree block partitioning (QT+MTT)
  - Fundamental impact on all coding tools to be added
  - Most common partitioning scheme among all CfP submissions
- VVC Test Model (VTM) as reference implementation of VVC specification draft
- Test promising coding tools from CfP on that lean basis (efficiency / complexity aspects)
- Agree on adding tested coding tools until sufficient bitrate reduction is achieved

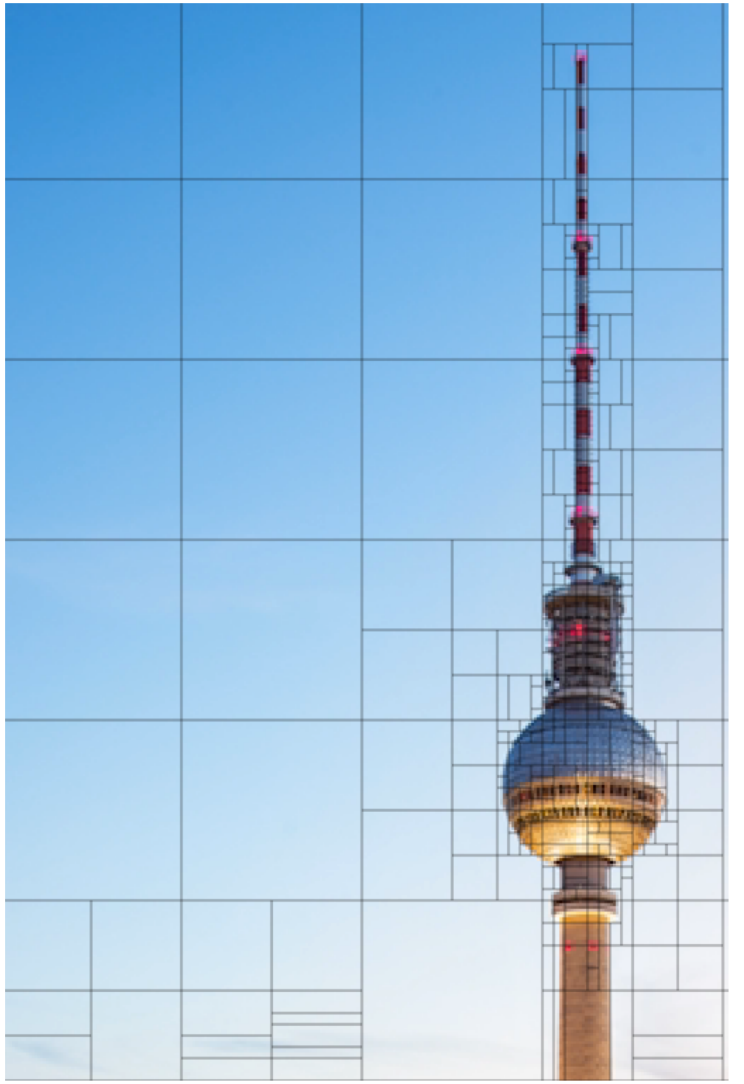
VVC – Development

Draft 6 and VTM-6.1 - New coding tools for coding efficiency

- Flexible Block Partitioning with Multi-type Tree (MTT)
- Separate Tree for Luma and Chroma (CST)
- Dependent Quantization (DQ)
- Joint coding of chrominance residuals (JCCR)
- Bi-prediction with CU weights (BCW)
- Decoder-side motion vector refinement (DMVR)
- Symmetric motion vector difference (SMVD)
- Sub-block transform (SBT)

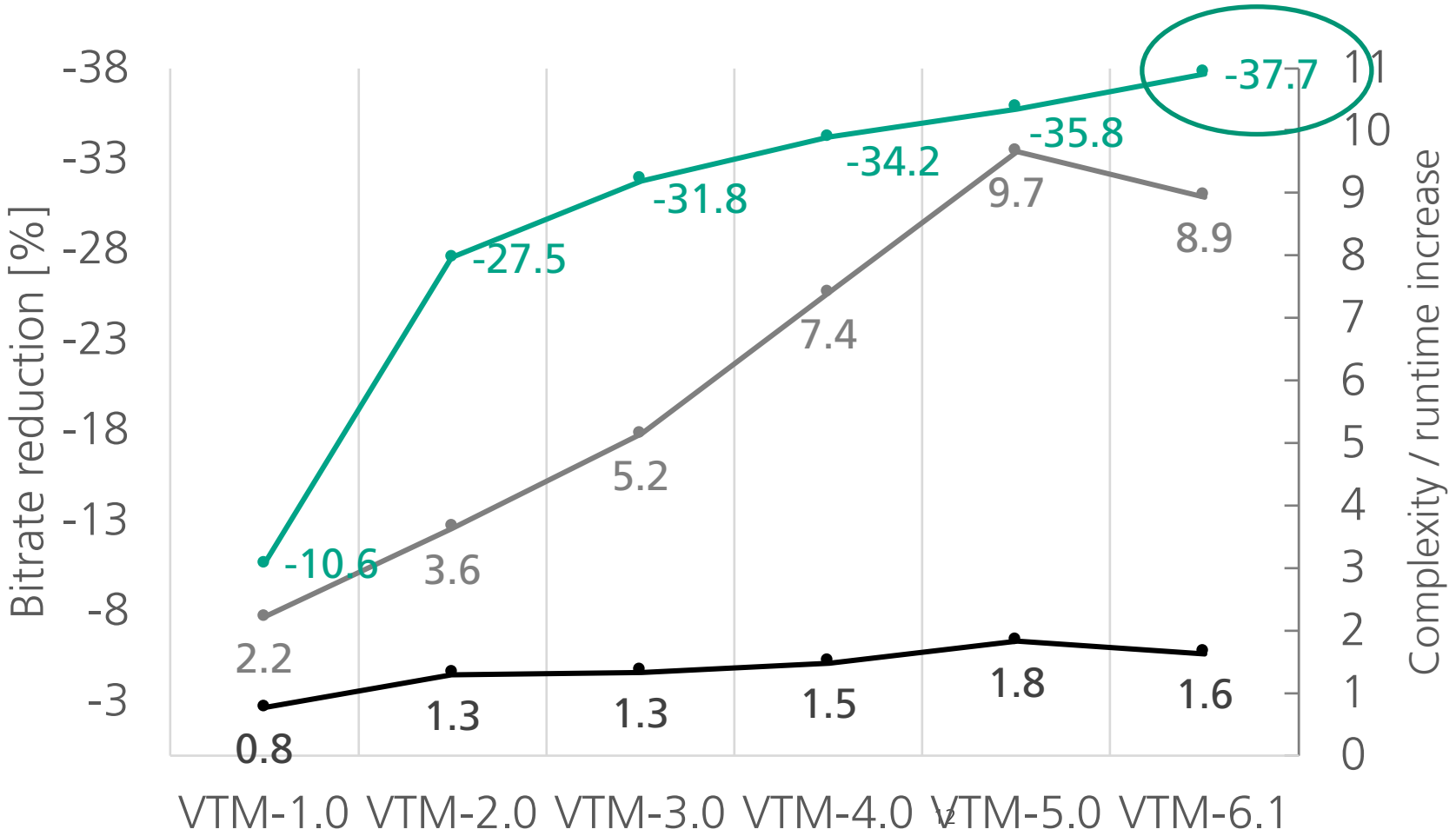
Many incremental improvements of classic hybrid video coding design

- Affine Motion Compensation
- Subblock-based Temporal Merging Candidates
- Adaptive motion vector resolution (AMVR)
- Triangular partition mode (TPM)
- Bi-directional optical flow (BDOF)
- Merge with MVD (MMVD)
- Intra sub-partitioning (ISP)
- Matrix based intra prediction (MIP)
- Cross-component Linear Model (CCLM)
- Luma mapping with chroma scaling (LMCS)
- Transform Skip Residual Coding (TSRC)
- Quantized residual DPCM …



VVC – Coding Efficiency

VVC reference software (VTM) vs. HEVC reference software (HM)



Same ball park as HEVC vs. AVC

Subjective gains expected to be higher (to be confirmed)

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Done!

Versatility

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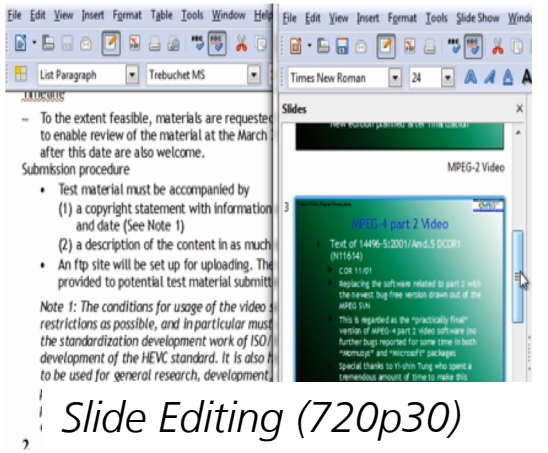
VVC – Versatility

Screen content coding (SCC)

- Application: new emerging content
  - Gaming
  - Screen sharing / remote desktop
  - …

Arena of Valor (1080p60)



Slide Editing (720p30)

- Problem: Video codecs typically optimized for natural video (different signal characteristic)
- Solution: Special screen content coding tools

  HEVC v4 SCC extensions -> not in main profile!

  VVC supports SCC already in v1

VVC – Versatility

Reference picture resampling (RPR)

- Application: Adaptive streaming with resolution switching
- Problem: Pictures with different resolutions cannot reference each other in inter-picture prediction -> reduces coding efficiency
- Solution: Resample reference picture in case of different resolutions

  VVC supports reference picture resampling

  More efficient resampling filters currently under investigation

  RPR as enabler for spatial scalability in VVC v1 (exact design under investigation)

VVC – Versatility

Independent sub-pictures

- Application: Tiled streaming of 360-degree videos

- Problem: Managing a decoder pixel budget dynamically post-encoding

  -> throwing 24K video (parts) at a 4K decoder

- Solution: More efficient coding of independent sub-pictures (in-picture padding)

  Flexible block addressing for easier extraction and merging of sub-pictures

  HLS design to avoid slice header rewriting

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Almost Done!

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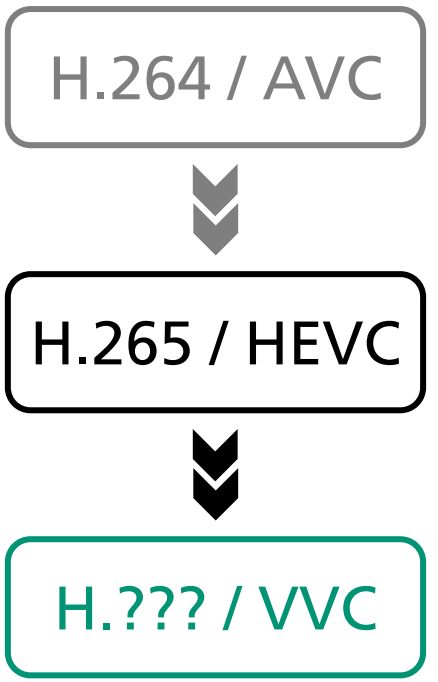
Versatile Video Coding (VVC)

Summary

- Coding Efficiency – VVC Test Model 6.1 over HEVC (HM)
  - 38% PSNR-based bitrate reduction for HD and UHD
  - 8.9x encoder and 1.6x decoder runtime
- Versatility – enabled by:
  - Screen content coding tools (gaming, screen sharing,…)
  - Reference picture resampling (adaptive streaming)
  - Potential spatial scalability using RPR filters
  - Independent sub-pictures (360 video, ROI)
- Final Standard by July 2020



Thank you very much!

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