Next Gen Video Codecs

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Alphabet Soup

- HEVC = High Efficiency Video Coding
  - ITU-T H.265 | ISO/IEC MPEG-H Part 2
  - First Standardized: 2013
- AV1 = AOMedia Video 1
  - Alliance for Open Media Video 1
  - Open, claimed royalty-free
  - Available 2018
- VVC = Versatile Video Coding
  - ITU-T H.266 (assumed) | ISO/IEC MPEG-I Part 3
  - Final Draft Standard ballot (planned first standard): July 2020
- EVC = Essential Video Coding
  - ISO/IEC MPEG-5 Part 1
  - Final Draft Standard ballot (planned first standard): July 2020
- LCEVC = Low Complexity Enhancement Video Coding
  - ISO/IEC MPEG-5 Part 2
  - Draft Standard status

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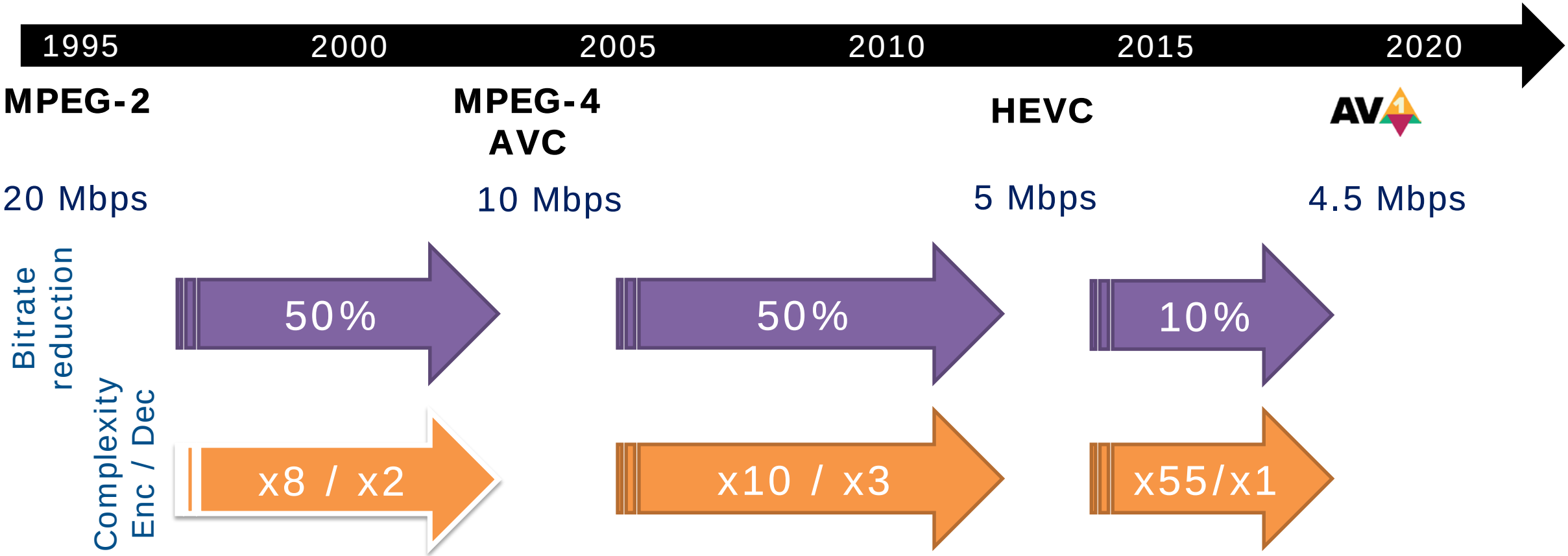
Codec Performance

Generalized HD bitrates and complexity, referred from reference model comparisons



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AV1 vs. HEVC: MediaKind Findings

Objective Measurements – Reference AV1 vs. Reference HEVC

Objective testing shows AV1 can achieve 10% less bitrate than HEVC, but much slower than real-time

	AV1 vs. HEVC / Bitrate difference (%)	
Test Resolution	SSIM YUV	PSNR YUV
4K	-11.91%	-12.24%
Full-HD	-9.47%	-10.17%
WVGA	-8.02%	-8.50%
WQVGA	-8.99%	-9.32%
All	-10.06%	-10.53%

AV1 in dual pass, CPU-used=1 vs. 'HM' HEVC reference model
Multiple videos using ITU video test sequences and methodology

Full test results published at SMPTE2018 conference proceedings:
Analysis of Emerging Video Codecs: Coding Tools, Compression Efficiency and Complexity, Julien Le Tanou, Médéric Blestel.

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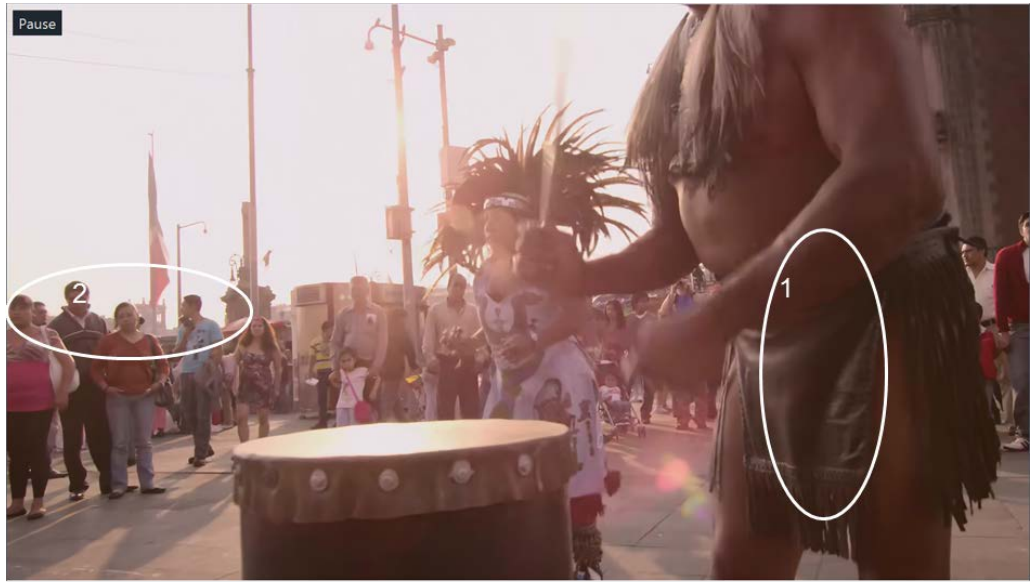
AV1 vs. HEVC: MediaKind Findings

PQ is content dependent - Consumers unlikely to be able to determine a clear difference or preference between AV1 and HEVC



#	Description	Winner	Issue
1	Arms	AV1 (clear)	HM is more blocky
2	Faces	HM (clear)	AV1 is more blurry

#	Description	Winner	Issue
1	Trees	HM (clear)	AV1 is blurry
1	Trees	HM (clear)	Intra Pumping
2	Leaves	AV1	HM is more blurry
3	Neck	AV1	AV1 is less blocky

- AV1 sequences more blurry and less sharp than HEVC on detailed structures and textures; AV1 also suffered from strong temporal artifacts such as intra pulsing or local flickering
- HEVC sequence suffered from blocking and ringing artifacts especially around moving objects

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AV1 Status

- libAom, the reference software developed by the AOM consortium is still evolving – Most activities concern speed-up of encoder while keeping circa same compression efficiency
- Other open-source encoder implementations are available
  - SVT-AV1 (Intel & Netflix) – Latest release is much faster than libAom, while continuing to reduce the compression efficiency gap
  - Rav1e (Mozilla and Xiph) – Latest release is 40-70% faster than previous
- Google decoder now available, LibAv1
- Hardware decoding chips now available:
  - Realtek (8K AV1/HEVC/VP9, HDMI v2.1 8K), Amlogic (4Kp120 AV1)
  - Amphion, Broadcom, MediaTek
  - Chips&Media licensing Wave510A IPR (4Kp60 support but scales to 8Kp60 or 4Kp120)
- LG and Samsung new TV models now support 4K AV1 decoding

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VVC – Versatile Video Coding

- Coding efficiency
  - Target 50% of HEVC bitrate
  - Support for HD/4K/8K UHD, 10b + HDR

- Versatility
  - Screen content coding (gaming, screen sharing)
  - Reference Picture Resampling (adaptive streaming resolution change)
  - Independent sub-pictures (tiled streaming of 360° video)

- 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

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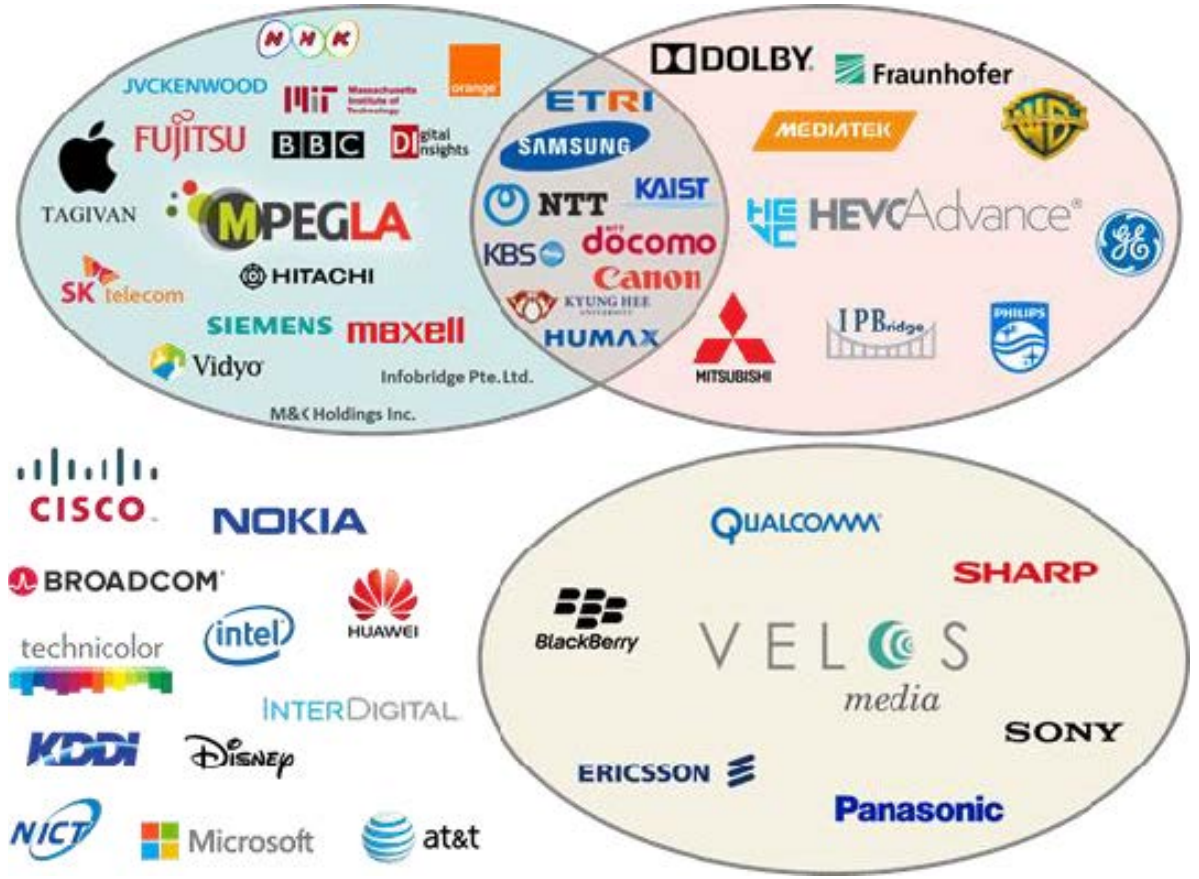
EVC – Essential Video Coding

- Coding efficiency improves with every new generation, but this is not the only factor that determines industry choice of codec
- EVC designed to meet both business and technical requirements, while following common Standards Org patent policy
  - Coding efficiency at least as good as HEVC
  - Encourage timely publication of licensing terms
  - Complexity suitable for practical real-time encoding



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EVC – Essential Video Coding (2)

- Baseline Profile
  - Includes only technologies that are older than IPR coverage (~20 years) or that have been submitted with royalty-free declaration
  - Overall testing results: EVC BP ETM3.0 vs. AVC JM19.0
    - Random access: YUV -30.8% to -32.7% -- EncT 42%, DecT 116%
    - Low delay: YUV -26.1% to -27.5% -- EncT 24%, DecT 136%
- Main Profile
  - Add a small number of additional tools that each provide a significant improvement in coding efficiency
  - Each tool so added is isolated and may be switched-off independently of other tools
  - Overall testing results: EVC MP ETM3.0 vs. HEVC HM16.6
    - Random access: YUV -23.9% to -26.5% -- EncT 450%, DecT 154%
    - Low delay: YUV -11.3% to -16.6% -- EncT 465%, DecT 119%

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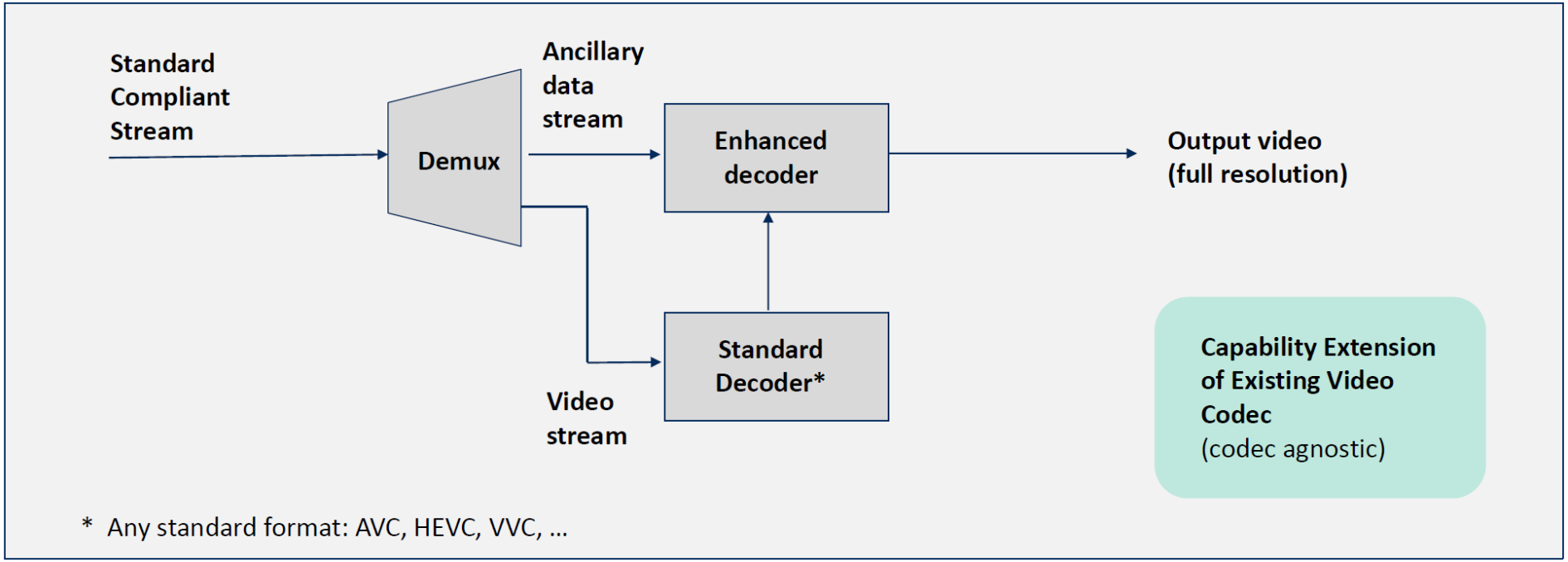
LCEVC – Low Complexity Enhancement Video Coding

- Codec-agnostic codec of enhancement data, where enhancing n-th generation codec results in
  - Compression performance as close as possible to (n+1)-th generation codec
  - Encoding and decoding complexity in line with n-th generation codec



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Codec Comparison to HEVC

Codec performance verses HEVC (HM 16.18):

Standard	Tested Encoder	Subjective Performance	PSNR Average Gain	Encoder Complexity	Decoder Complexity
AV1	aomenc July 2019	Comparable to HEVC, less blocking but softer with more temporal pulsing	13%	x55*	x1.1
EVC	ETM 3.0	Sharper than HEVC or AV1 but still some blocking	23%	x5	x1.7
VVC	VTM 6.0	Outperforms the other codecs	36%	x9	x1.9

Testing done Sept 2019

*slowest, highest-quality configuration

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Thank You … Questions?

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