Video Codec Trend

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I. Market Requirements

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Market Requirements

Ultra Resolution and High Performance Codec

- The HD digital video services over network are expected to steadily grow
- The overall amount of video data will grow at a very fast pace
- 4K/8K codec requirements are emerging due to AR/VR and broadcasting requirements

SDTV

SHARP
UDTV(7680 x 4320)

QCIF

Ipad
QXGA(2048x1536)

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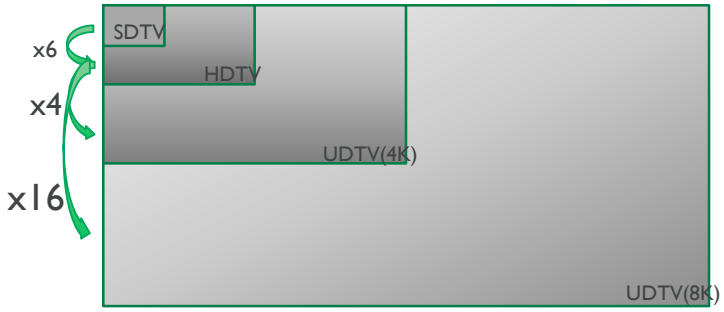
Bigger Resolution and Data Rates

Tremendous Increase of Storage & Transmission Cost



- Raw Data rates in terms of various video formats

	Width	Height	Frame rate	Color format	Depth	Bit-rate (Mbps)	Ratio to SD
SD	720	480	30	YUV4:2:0	8bits	124	1
HD	1,920	1,080	30	YUV4:2:0	8bits	746	6
UHD	3,840	2,160	30	YUV4:2:0	8bits	2,986	24
	7,680	4,320	30	YUV4:2:0	8bits	11,944	96
	7,680	4,320	60	YUV4:4:4	12bits	71,664	578

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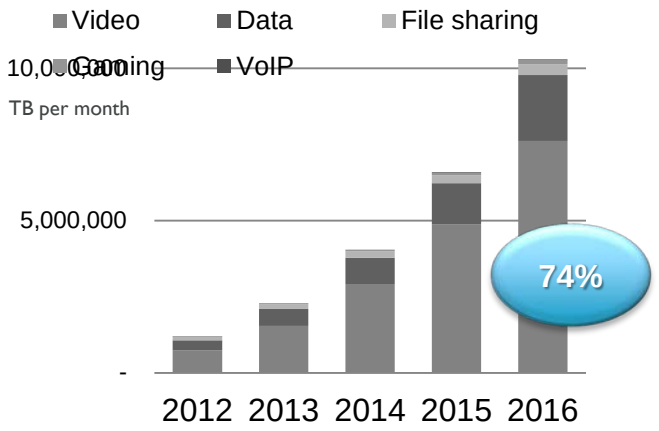
Mobile Streaming

Video Continue to be majority of internet data traffic

- Booming requirements for network infrastructure (4G/5G)
- High-resolution video driving video traffic
- Adaptive streaming solutions gaining adoption i.e. Netflix, Youku, Youtube, IPTV

Mobile Internet Traffic



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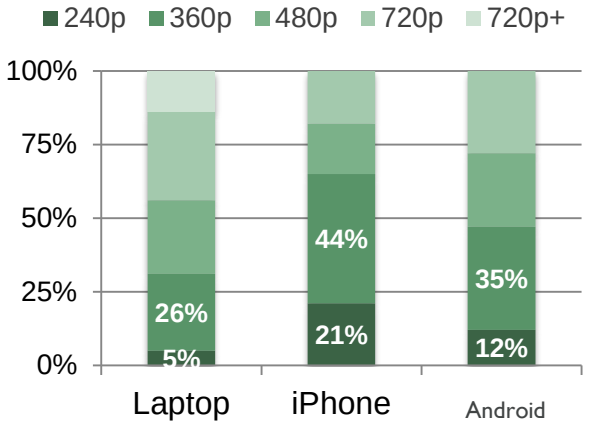
Video Volume By Resolution



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VR/AR

VR/AR Will Build Next Generation Computing System

- Fundamental changes in communication, entertainment or other applications
- Requires High-resolution and high performance video codec technology
- Over 120 Billion markets in 2020

VR Virtual Reality

AR Augmented Reality

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Main Video Standards Overview

Current Popular Video Standards

- MPEG1 (1992) : Lossy compression of video for VCD and broadcasting (1.5Mbps)
- H.263 (1995) : Low-bit-rate compressed format for video conferencing
- MPEG2 (1996) : Lossy compression of video for DVD and broadcasting
- RealVideo (1997) : Based on H.263 and widely used as streaming media format
- MPEG4 (1999) : Higher compression efficiency of video for web and broadcasting (Divx/Xvid based on it)
- H.264 (2003) : The most commonly used video formats developed by JVT (ITU/MPEG)
- VC-1 (2003) : Developed by Microsoft and used in Blue-ray and HD-DVD
- VP8 (2008): Open and royalty free video format owned by Google and created by On2 Technologies
- H.265 (2013): Successor to the widely used H.264 for UHD broadcasting and internet
- VP9 (2014) : Successor to VP8, is an open and royalty free video coding format developed by Google
- AVS2 (2016): Chinese video standards for HD/UHD broadcasting, successor of AVS/AVS+

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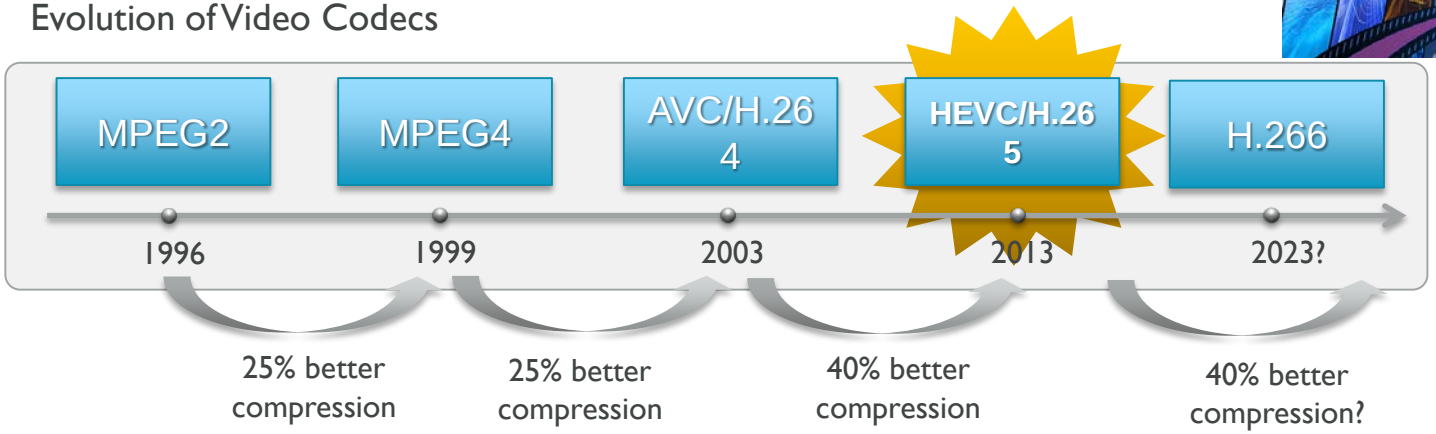
Why Need New Video Codec?

Evolution of Video Codecs



HEVC (High Efficiency Video Coding) Standardization

- ISO/IEC HEVC : MPEG-H Part2 (ISO/IEC 23008-2)
- ITU-T: ITU-T Rec. H.265
- 3 Profiles
  - Main(8bit 4:2:0), Main10(8/10bit 4:2:0), Main Still Picture(8bit 4:2:0)
- 2 Tiers
  - Main tier(Consumer), High tier(Professional)

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HEVC Overview

Scope & Goal

- Development of a standard for video coding technology more advanced (in terms of achievable combinations of compression capability, computational complexity, etc.) than the current AVC standard
- Expected to reduce bitrate requirements by half with comparable image quality at the expense of increased computational complexity

HEVC Key Features

- Larger blocks: more efficient representation of overhead (e.g., MB mode, MV, all signaling bits, etc.)
- Better prediction: more accurate and finer prediction by advanced intra/inter prediction
- Higher precision: minimizing loss due to finite processing precision

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III. Video Codec Trend

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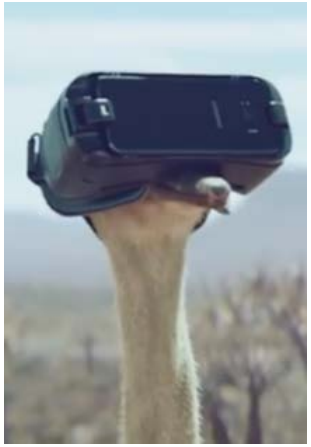
Video Codec Trends

- General
  - Drive towards 8K60 support
    - Especially for TV
    - Less so for encode in short term
  - AV1 (VP9 Successor)
  - High frame rate performance
    - 90fps for VR (60fps OLED)

- Encode
  - High frame rate encode
  - High Dynamic Range (HDR
  - Still mainly 4K based
  - Interest in 8K but limited for now

- Key Drivers
  - Japanese Olympics for 8K60 decode
    - Need TV's in market end 2019, SoCs by end 2018, IP early 2018
  - 360° Video & Mixed Reality
    - Need high frame rate aiming for 4K or 2K per eye
    - Video is decode only, Mixed Reality is encode & decode



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YUV422/YUV444/Higher Bit-depth

- YUV422 for video
  - View it as a 'specification improvement' rather than a real improvement
  - Used for 'Professional' market
- YUV444 for video
  - It is preferred for highest quality video encoding
  - Cost is high in mobile devices, but do expect future premium products and TV to require it
  - Surprise fact, 8-bit YUV444 is requested for Video Conferencing
    - Required for sharing spreadsheets!
- What about higher bit-depth?
  - 8bit 1080P -> 10bit 4K 60fps -> 12bit 8K 60fps?

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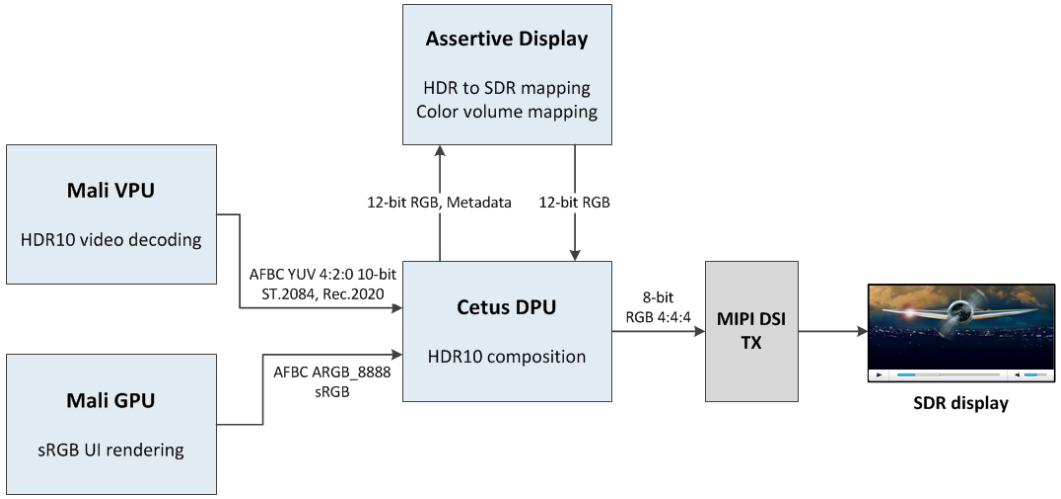
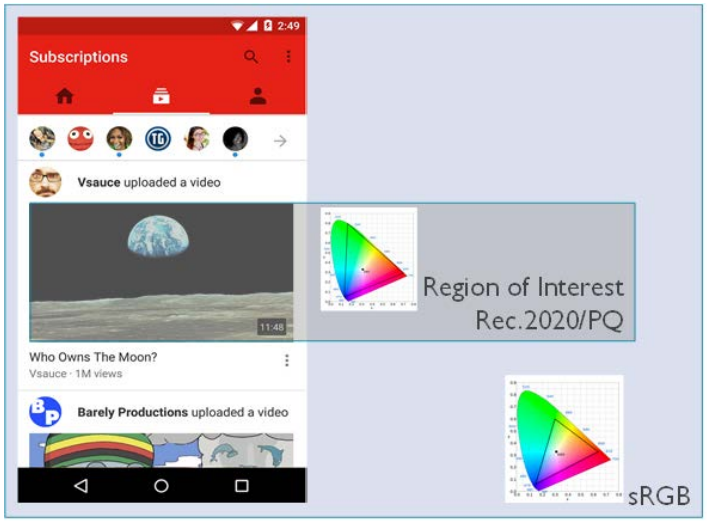
End to End HDR





- End to end HDR
  - Support from camera to display – involving ISP, GPU, VPU, DPU, AD
  - Support different HDR formats (Dolby Vision, HDR10, HDR10+, HLG, China HDR)
  - Integration with AI engines

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360 Degree VR Video

- VR is performance hungry
  - <20ms motion to photon latency
  - 4K+ (4320x2160) (2kx2k per eye) by 2020
  - 75-120 fps requirements
  - Rendered Twice for Both eyes
  - Wider Field of View (90+ degrees)
- VR needs Specific Techniques
  - Timewarp / Spacewarp
  - Lens distortion correction/Chromatic Aberration
  - Foveated rendering
  - Eye Tracking

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