




VIDEO COMPRESSION – TRENDS & OUTLOOK

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TIME TO PLAY 
TV. Anywhere. Now.

SUBSCRIBER'S VIEW



- › **All from one provider – Triple Play**

- TV - Linear TV / VOD, Telephone, High Speed Internet

- › **One household, multi screens**

- Various formats are required

- › **Subscribers get used to HD TV**

- More channels are demanded, 4K ahead!

- › **Conclusion**

- TV no longer the only major application. Cable need to carry more services for different applications

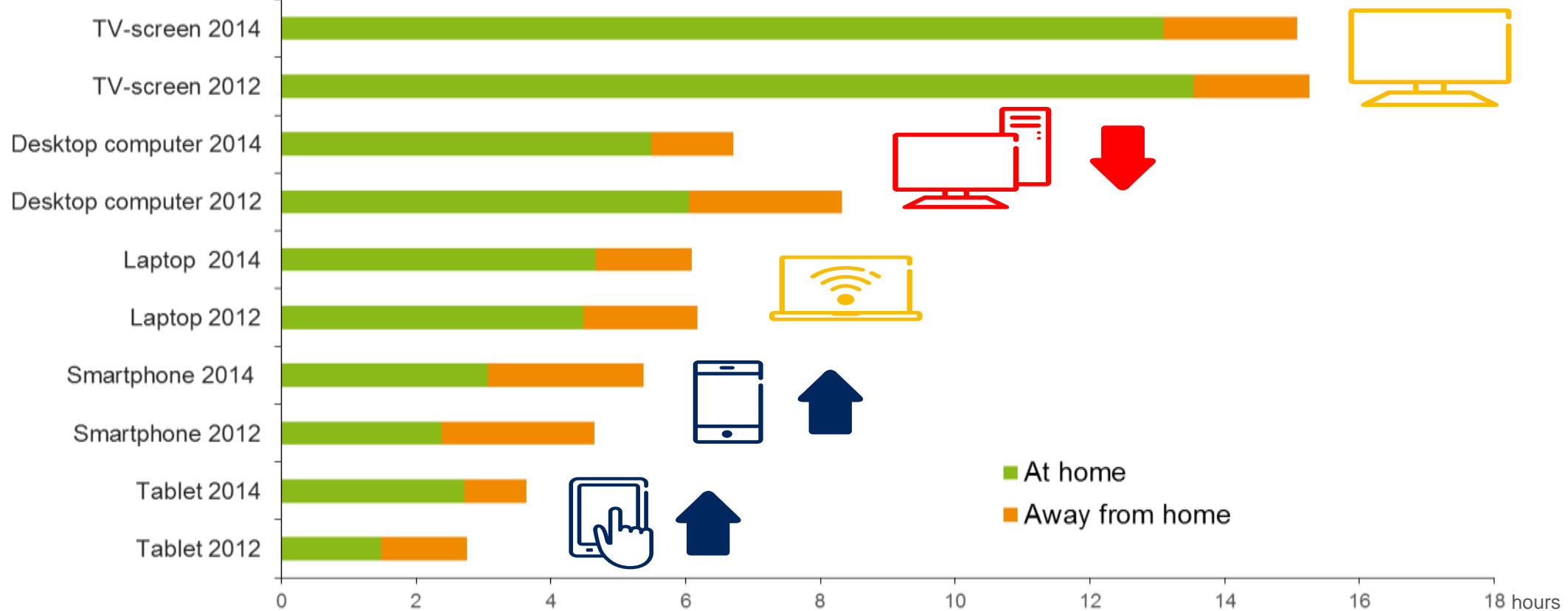
- › e.g. High Speed Internet at higher rates, more HD channels

- › **Bandwidth matters !!**

DEVICE VIEWING

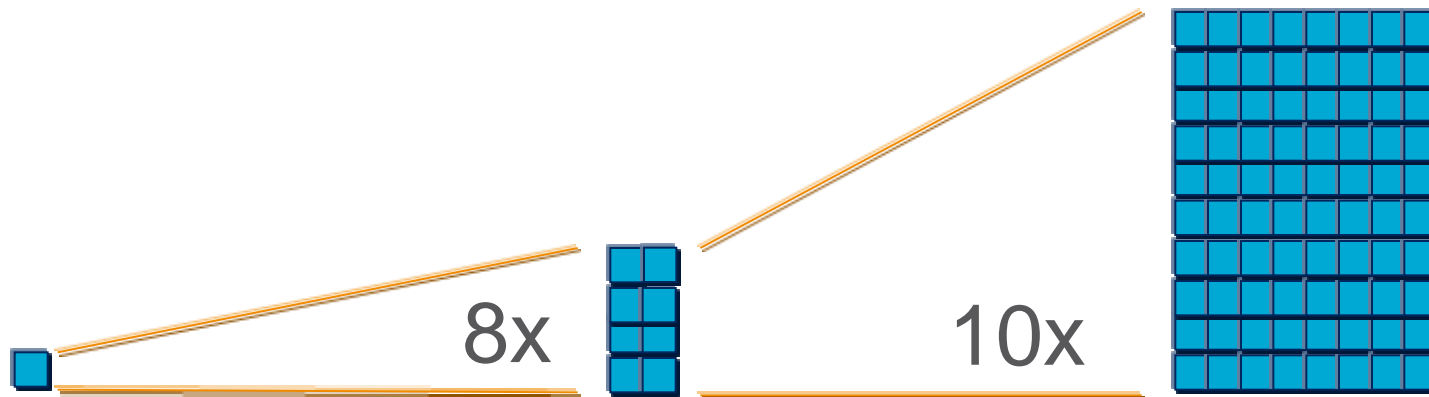
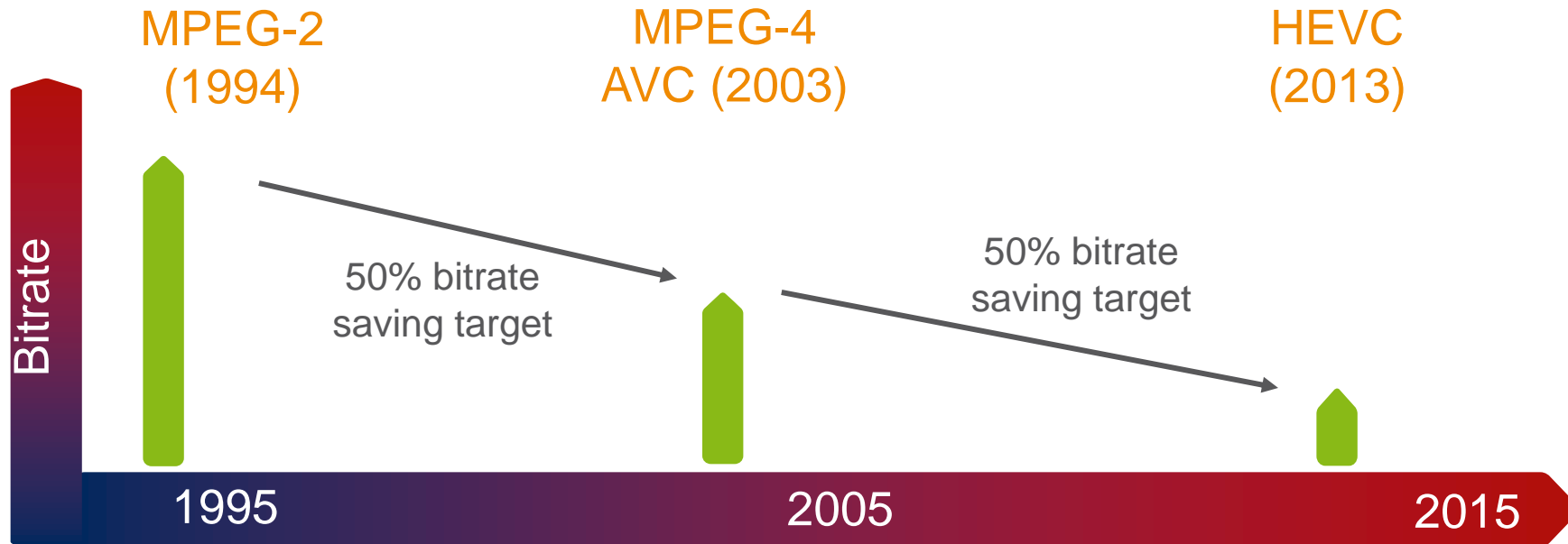


Average hours watching video on each device per week



25% increase in willingness to pay for anywhere access compared to 2012

EFFICIENCY EVOLUTION



50%

BITRATE SAVING

10x

COMPLEXITY

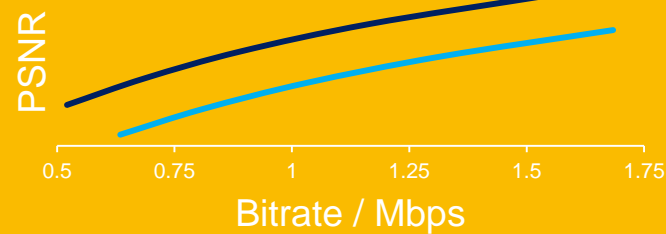
HEVC POTENTIAL



STANDARD DEFINITION (SD)



Saints 360p

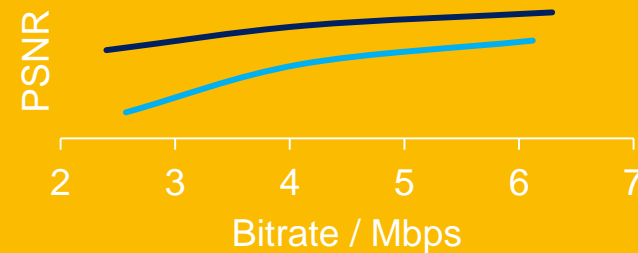


40%

HIGH DEFINITION (HD)



Cactus 720p

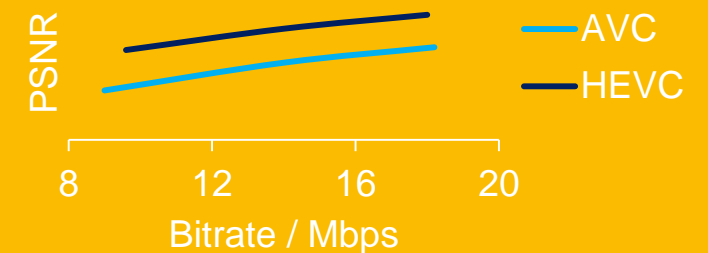


50%

ULTRA-HD (UHDTV - 4K)



Surfing 2160p



53%



HEVC ENCODING PLATFORMS

Always the best encoding performance of its type

Pure COTS

(no acceleration)



Hybrid COTS

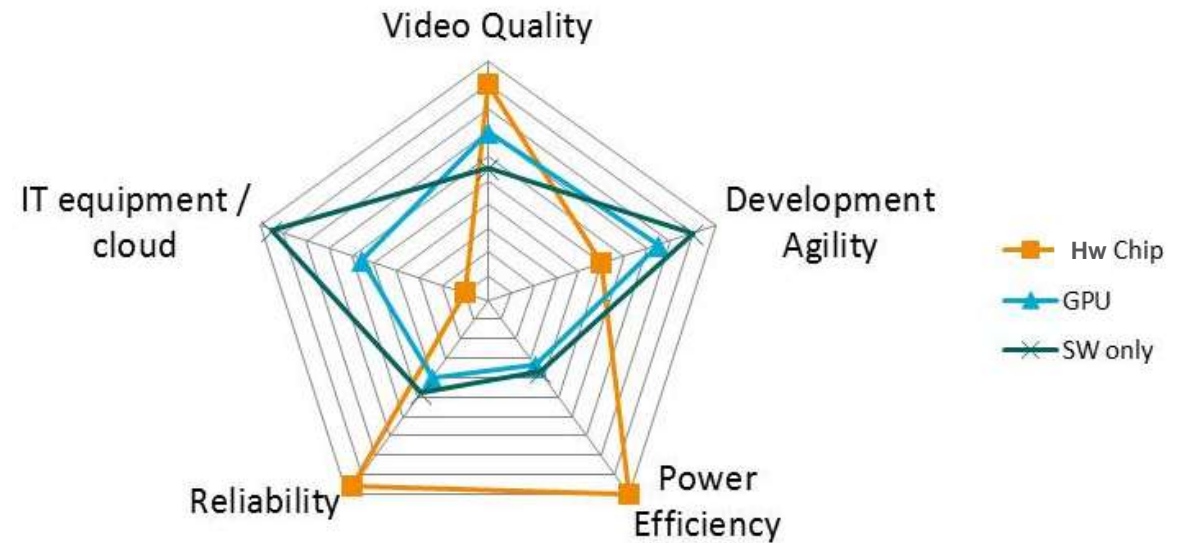


Performance



BEST TOOL FOR THE JOB

- › Different encoding implementations have relative merits and advantages



DEPLOYMENT TIMESCALES



Market Solution	Application	2013	2014	2015	2016	2017
Content Acquisition	News Gathering		Trial	Early Adopter		Mainstream
	Events				Trial	Early Adopter
Content Exchange	All				Trial	Early Adopter
Content Distribution	All		Trial	Early Adopter		Mainstream
Multi-Platform Video Processing	Cable & Sat DTH				Trial	Early Adopter
	Telco / IPTV		Trial	Early Adopter	Mainstream	
	DVB-T2			Trial	Early Adopter	Mainstream
	VoD / UHDTV VoD		Trial		Early Adopter	Mainstream
	UHDTV Live DTH			Trial	Early Adopter	Mainstream
Multi-Screen Video Processing	ABR / OTT streaming		Trial	Early Adopter	Mainstream	
LTE Broadcast	HEVC for Mobile		Early Adopter	Early Adopter	Mainstream	



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4K ULTRA HIGH-DEFINITION TV (UHDTV)

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RESOLUTION REVOLUTION



RESOLUTION REVOLUTION



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FORMAT PROLIFERATION



> Before 2008

- A few smartphones
- No tablets

> 2015 onwards

- TV anywhere
- OTT growth
- New devices



IMMERSIVE EXPERIENCE



Central field of vision 90°



IMMERSIVE EXPERIENCE



BIGGER AND BETTER?

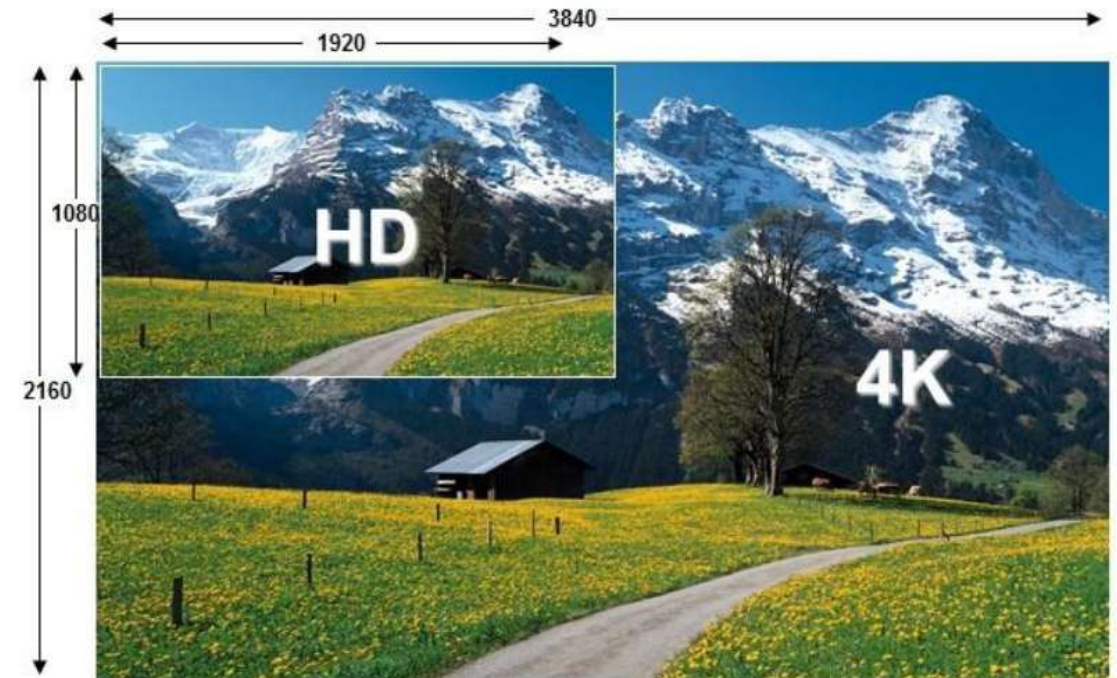


› 4K UHDTV is a hot topic

- Strong push from consumer electronics
- Early tests starting

› 2016 onwards

- UHDTV (Ultra High Definition TV) may change
- HDR (High Dynamic Range)
- HFR (High Frame Rate)
- Color
- Audio debates



HIGH DYNAMIC RANGE



Current TV sets require >1kW power consumption to realize HDR

In discussion: HD with HDR or UHD right away?

ANOTHER UHD QUESTION



Frame rate

- › 50 fps?, 60fps? 100fps? 120fps? It depends on:
 - Who is asking
 - What they are trying to show
 - Their business model
- › But...do consumers care?
- › How much will it cost?



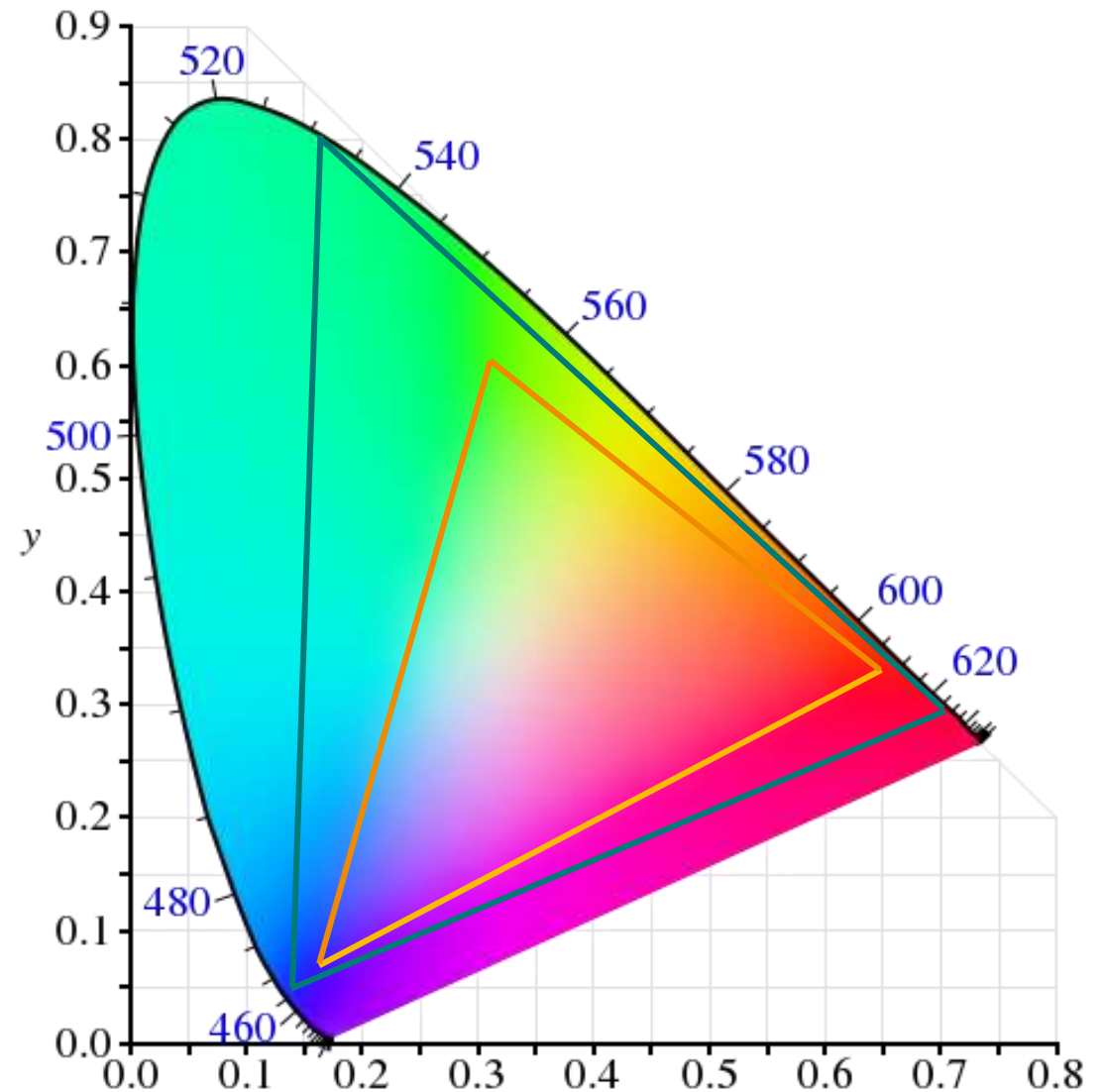
COLOR GAMUT

Expanded color space for more realistic presentations

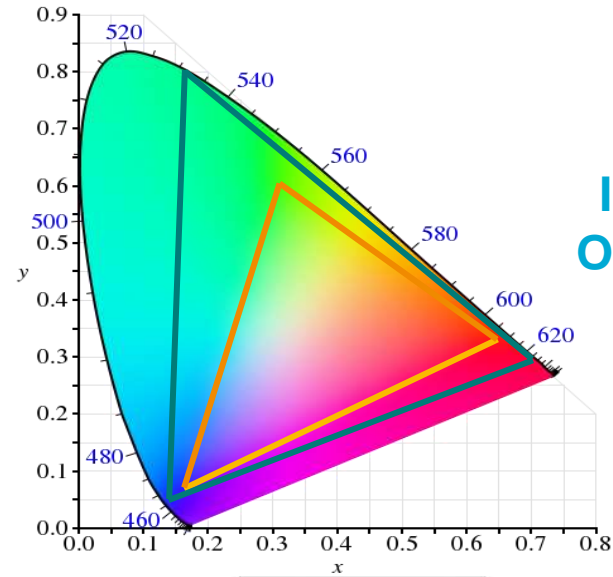
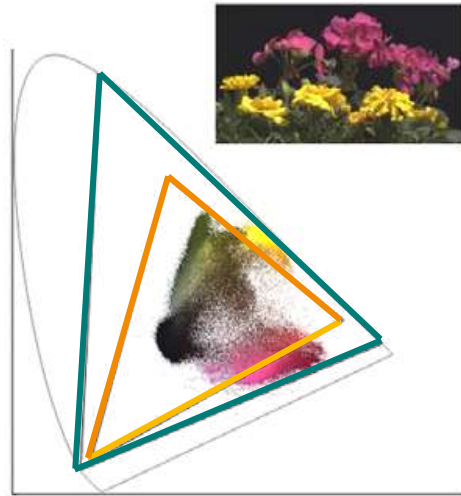
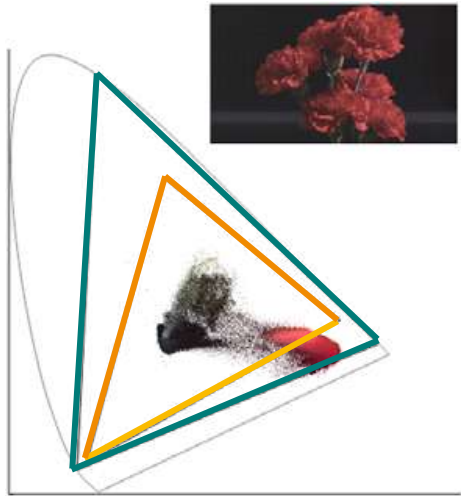
- › UHDTV offers more realism
 - But, we need technology with the right color space
- › Quantization of levels
 - With more colors to represent, higher bit sample rates (10-bit) are critical

UHD Color Space per ITU-R Rec. BT.2020

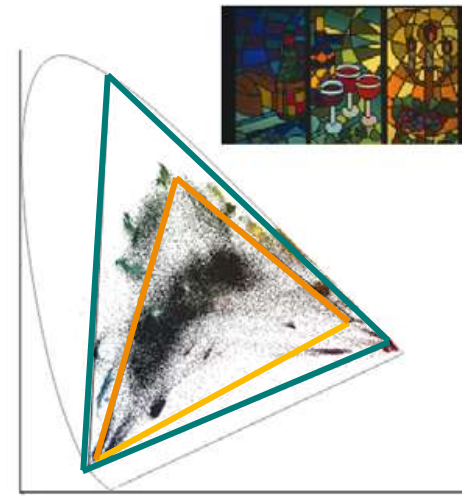
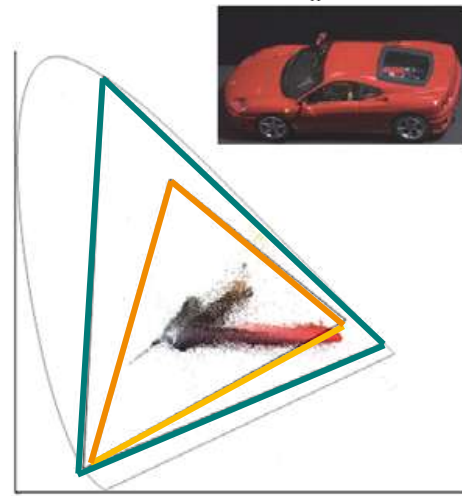
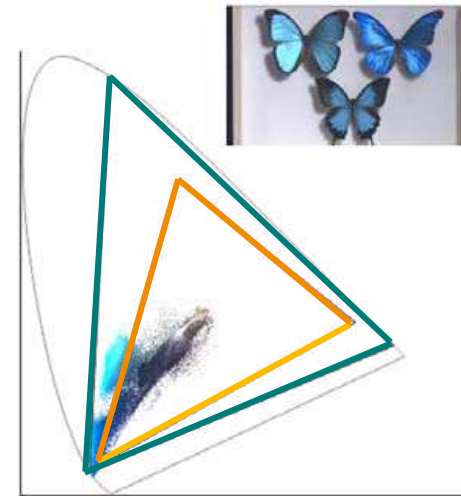
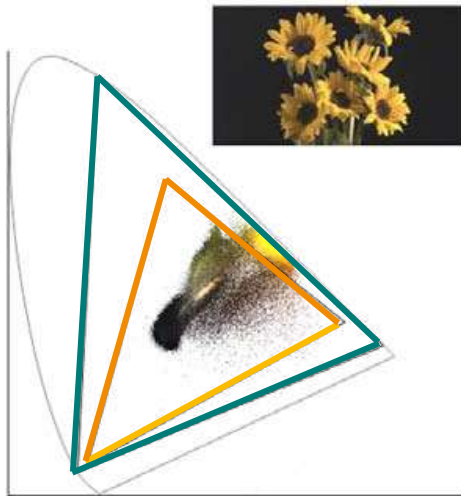
HD Color Space per ITU-R Rec. BT.709



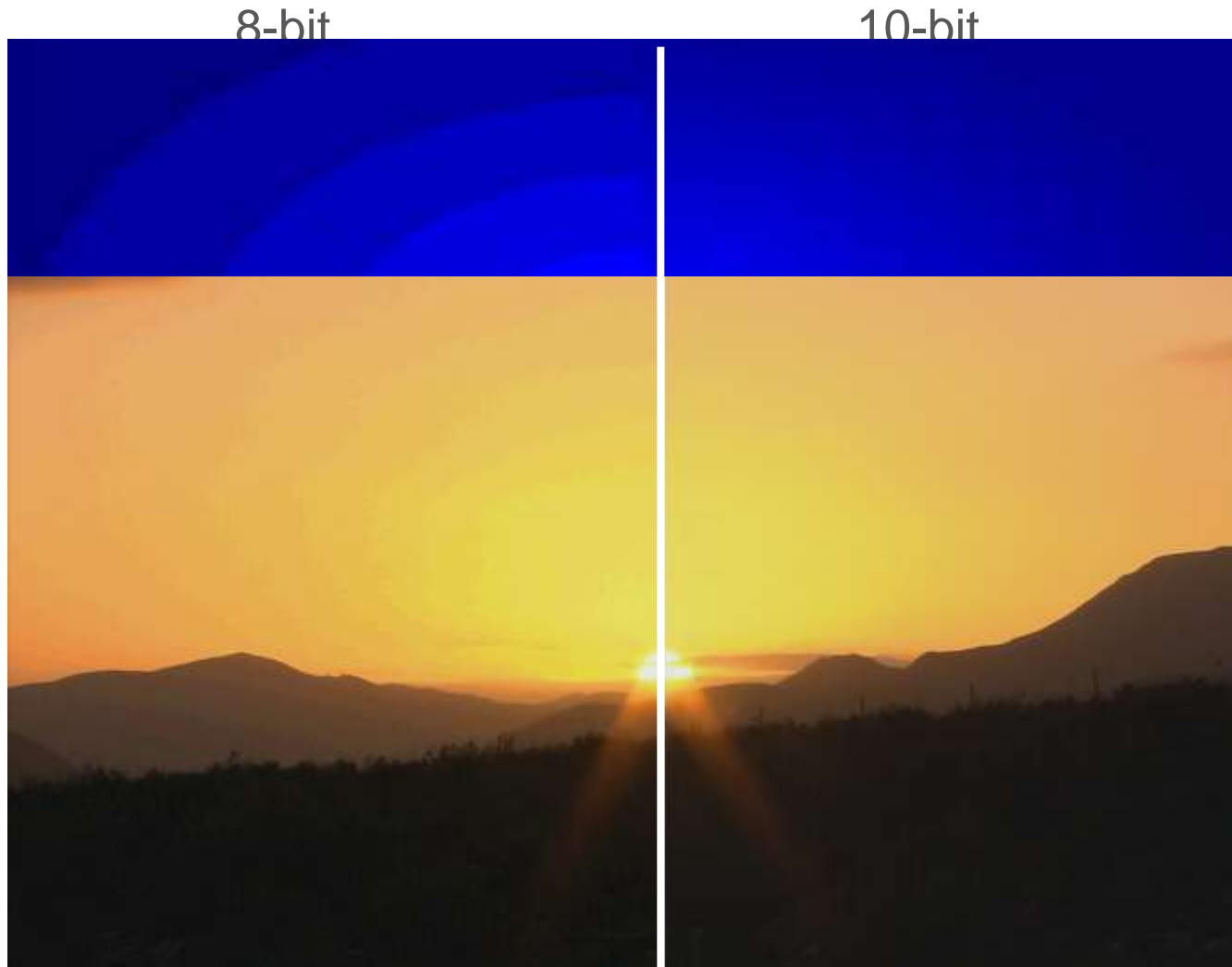
COLOR DISTRIBUTION OF OBJECTS ON THE X-Y CHROMATICITY COORDINATES



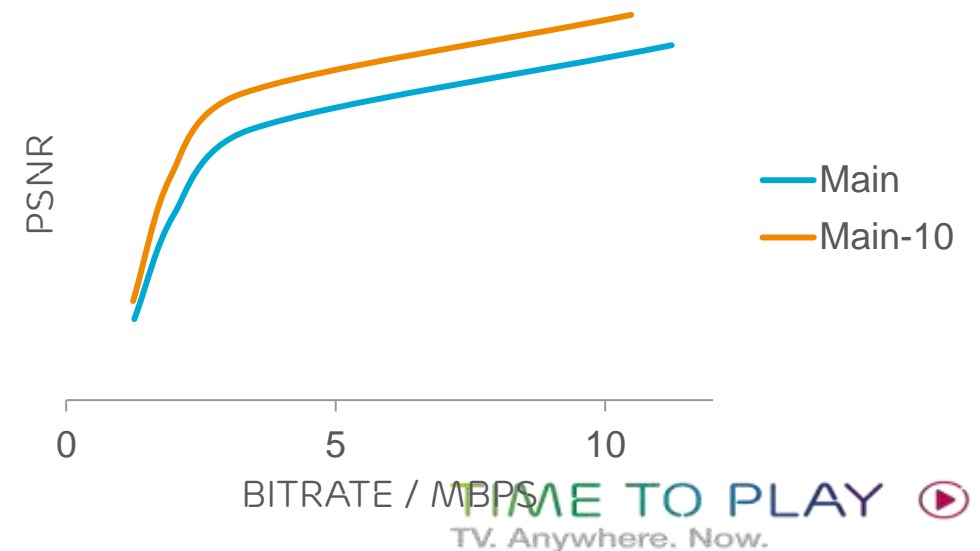
From Report
ITU-R BT.2246-1
Inner triangle: HDTV primaries
Outer triangle: UHDTV primaries



SAMPLE BIT DEPTH



- › Banding (posterization) with 8bit
 - Sky, backgrounds, graphics, logo
 - More noticeable with slow changes, such as fades
 - Visually intrusive especially on the larger screens often required to enjoy UHD

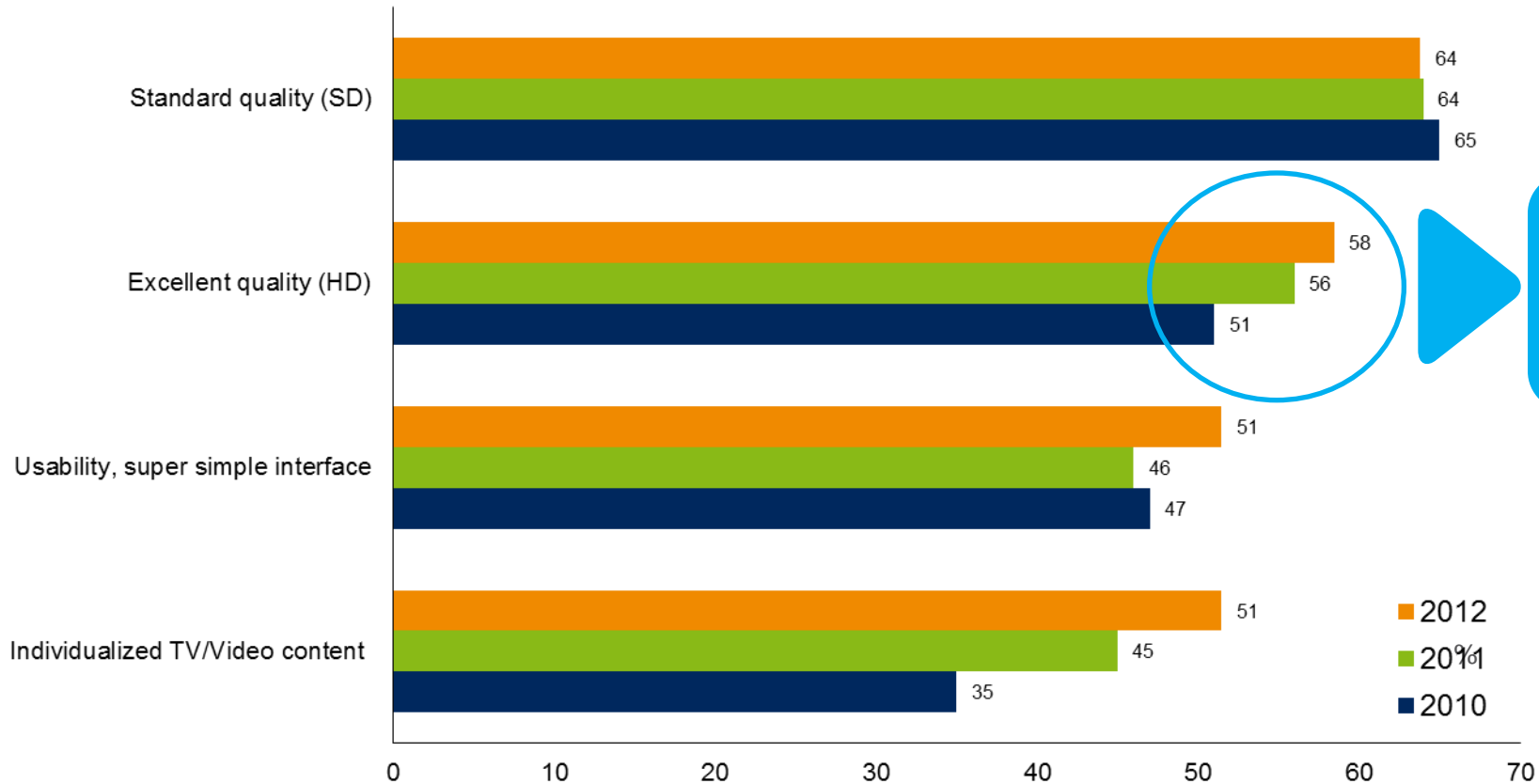


WHY SHOULD I DEPLOY?



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CONSUMER - WILLINGNESS TO PAY



High Quality Experience
7% increase 2010 → 2012



Base: Core 7 markets (US, UK, Sweden, Germany, Spain, China and Taiwan) [Interest, top 2 answers on 7-graded scale]

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HOW CAN I EFFICIENTLY DELIVER 4K UHD TV?

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DATA RATES FROM CAMERA



Uncompressed source	Horizontal Pixels	Vertical Pixels	Frames per Second	Total Payload	
				10-bit 4:2:0 10-bit 4:2:2	12-bit 4:2:0 12-bit 4:2:2 12-bit 4:4:4 10-bit 4:4:4:4
4320p60 / 59.94	7680	4320	60	48Gbps	96Gbps
4320p50	7680	4320	50		
4320p30 / 29.97	7680	4320	30	24Gbps	48Gbps
4320p25	7680	4320	25		
4320p24 / 23.98	7680	4320	24	12Gbps	24Gbps
2160p60 / 59.94	3840 / 4096	2160	60		
2160p50	3840 / 4096	2160	50		
2160p48	4096	2160	48	6Gbps	12Gbps
2160p30 / 29.97	3840 / 4096	2160	30		
2160p25	3840 / 4096	2160	25		
2160p24 / 23.98	3840 / 4096	2160	24	3Gbps	6Gbps
1080p60 / 59.94	1920 / 2048	1080	60		
1080p50	1920 / 2048	1080	50		
1080p48	2048	1080	48		

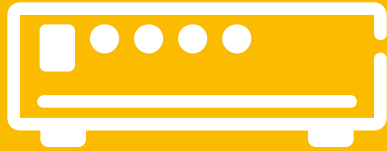
DATARATES FOR 4K UHD TV THROUGH THE END TO END CHAIN



		Contribution / Backhaul		Distribution / DTH Delivery
		Over Satellite	Over Telco	Satellite, Cable, Terrestrial, Telco IPTV
MPEG-4 AVC	2160p30			10 - 30 Mbps
	2160p60	80 - 105 Mbps	200 - 320 Mbps	12 - 39 Mbps
HEVC (Linear 1st Generation)	2160p30			7 - 21 Mbps
	2160p60			8 - 27 Mbps
HEVC (Linear 2nd Generation)	2160p30			5 - 15 Mbps
	2160p60	56 - 73 Mbps	200 - 320 Mbps	6 - 20 Mbps
Equivalent to today's HDTV at...	1080i30/720p60	20 Mbps- MPEG-4 Hi422 8bit	80 Mbps- MPEG-4 Hi422 10bit 120 Mbps- JPEG-2000	5 - 12 Mbps- MPEG-4 9 - 16 Mbps- MPEG-2

DECODING AND HEVC UHD TV

> STB Chips



> Smart TVs



8/10-bit?

50Hz+?

Color
Space ?

HDR?

Fully Compliant?

SUMMARY/CONCLUSION



Our consumption habits are changing, but demand for affordable quality persists

HEVC is now a proven technology, deployments starting to happen

LTE Broadcast is one of the very first use cases with trials already in place

UHD will be impaired by lack of standards for frame rate, bit depth (colour depth / HDR)

Education is needed on UHD value and the viewing distance/screen size tradeoff

Higher frame rates are needed for UHD but will often come with a cost

HEVC is here and here to stay and will gradually replace H.264



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