VAN MÁR NÁLATOK UHD ADÁS?
DO YOU RECEIVE THE UHD SIGNAL?

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THIS PRESENTATION IS ABOUT

- UHD-1 or 4k market perception
- Human Visual System and Television
- Options enhance the current Television experience
- Cost implications in content creation and distribution
- Way forward

ERICSSON CONSUMERLAB ANNUAL RESEARCH

REPRESENTING
1.1 BILLION
PEOPLE

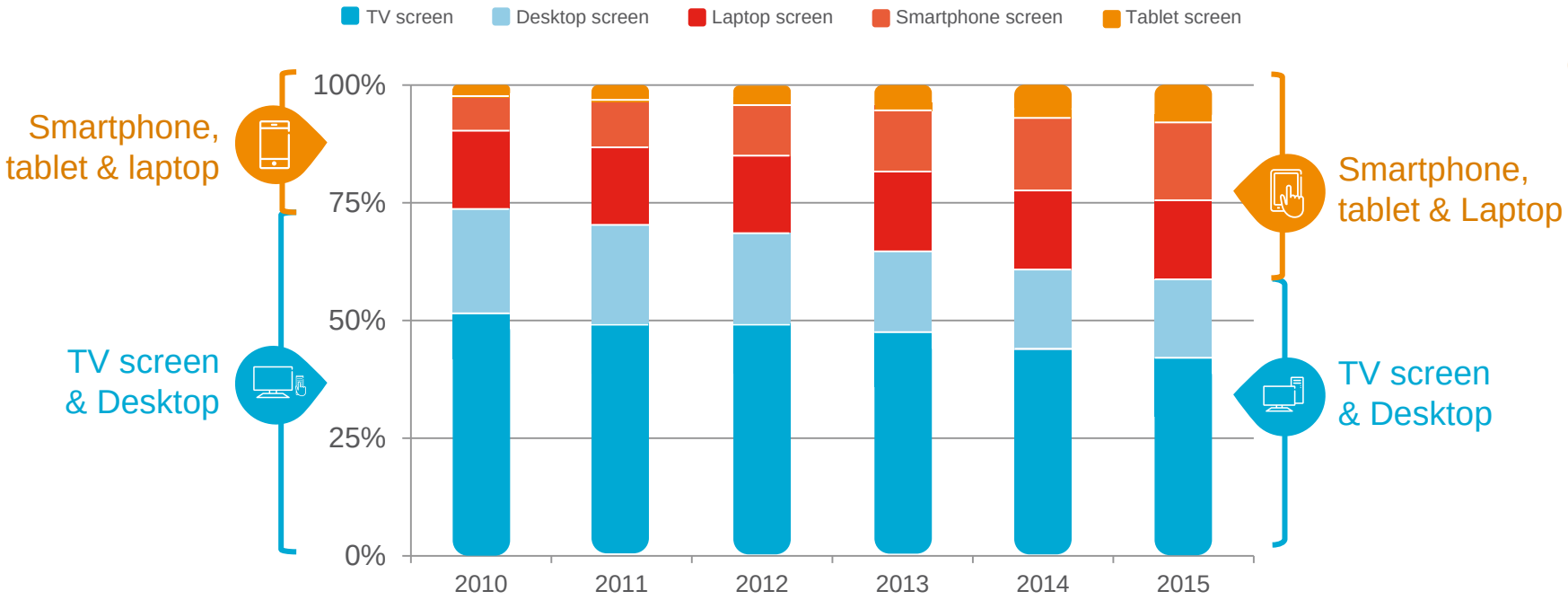
100,000
RESPONDENTS

MORE THAN
40
COUNTRIES

15
MEGACITIES
STUDIED

A SHIFT FROM FIXED TO MOBILE DEVICES

Share of self-reported total weekly TV/video viewing time, per year, done on respective device **



61%

of consumers watch TV & video on their smartphones, an increase of 71% since 2012

42%

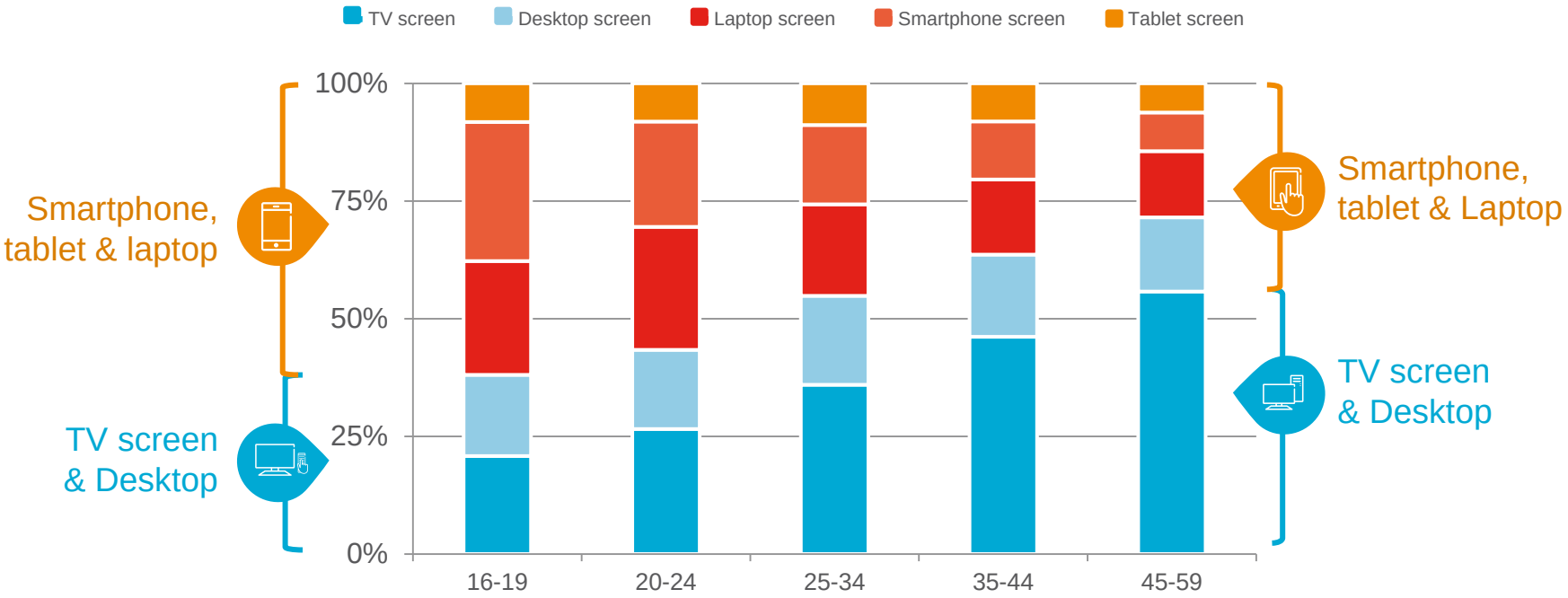
think it is very important to watch their TV & video content wherever they are

BASE: Population aged 16-59 with broadband at home who watch any type of TV/Video at least weekly in Brazil*, China, Germany, South Korea*, Spain, Sweden, Taiwan, UK and US. ** excluded. in 2010 figures, ** 3 years moving average ¼, ½, ¼*

Source: Ericsson ConsumerLab TV & Media 2010-2015 Study

MILLENNIALS = MOBILE DEVICE VIEWING

Self-reported share of total TV-time by age group, done on respective device **



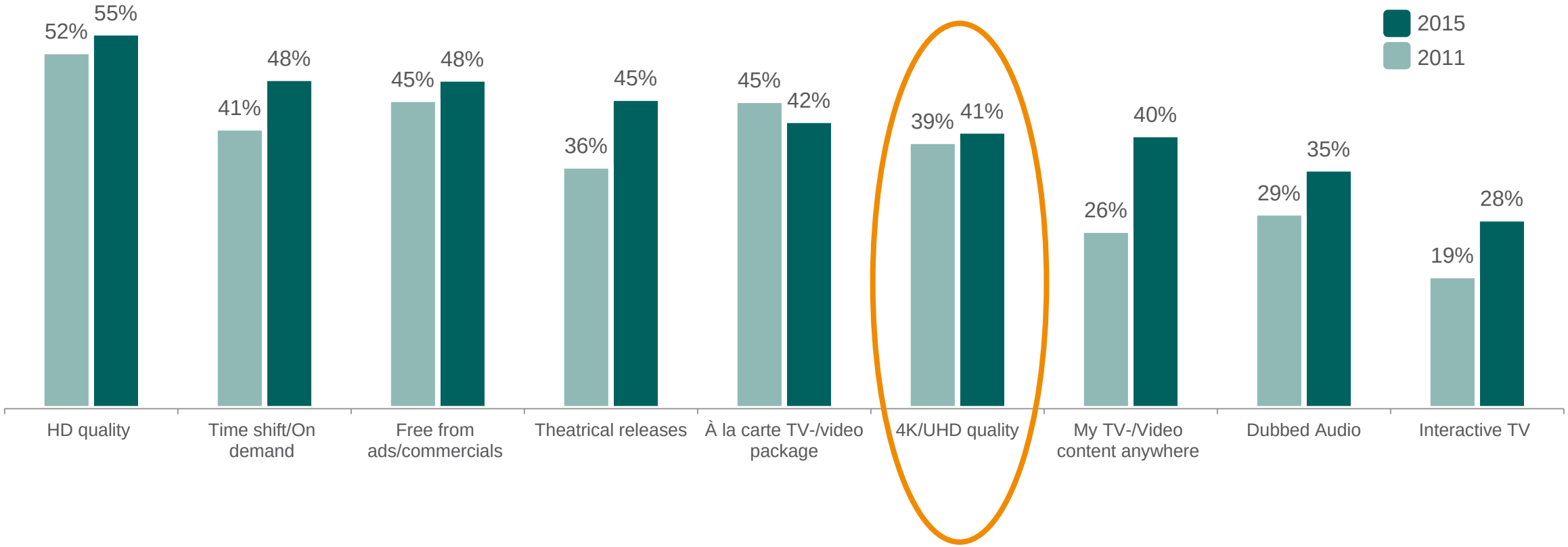
>60%

of all TV/video viewing hours are spent on a Mobile device screen among teenagers

BASE: Population aged 16-59 with broadband at home who watch any type of TV/Video at least weekly in Brazil, Canada, China, Colombia, France, Germany, Greece, Ireland, Italy, Mexico, Portugal, Russia, South Korea, Spain, Sweden, Taiwan, Turkey, UK, Ukraine and US
Source: Ericsson ConsumerLab TV & Media 2015 Study

IMPORTANCE OF TV MEDIA FEATURES

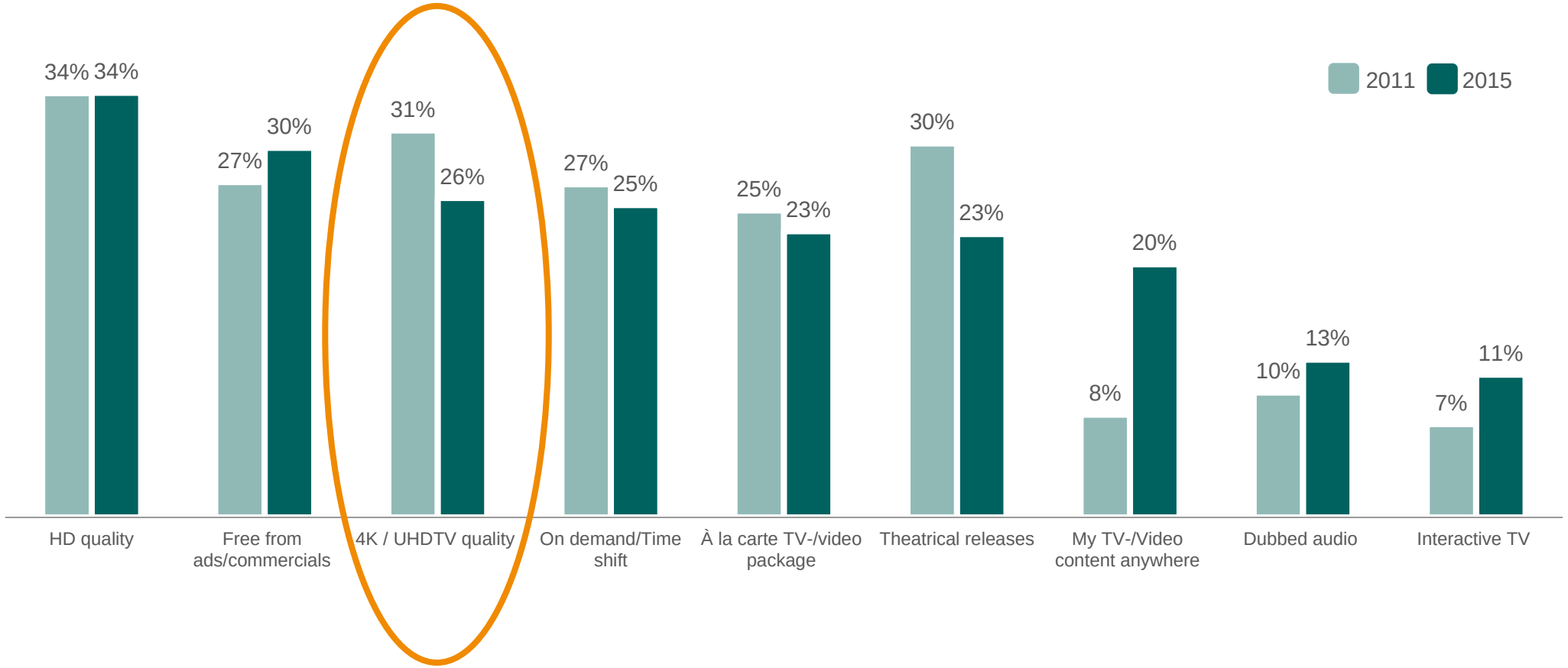
Percentage of consumers that say each TV Media feature is important
(Showing top 2 answers on 7-graded scale):



BASE: Population aged 16-59 with broadband at home who watch any type of TV/Video at least weekly in Brazil, China, Germany, Spain, South Korea, Sweden, Taiwan, UK, US
[Interest, top 2 answers on 7-graded scale]
Source: Ericsson ConsumerLab TV & Media 2015 Study

TV MEDIA FEATURES WORTH PAYING FOR

Percentage of consumers that say each TV Media feature is worth paying extra for:



BASE: Population aged 16-59 with broadband at home who watch any type of TV/Video at least weekly in Brazil, China, Germany, Spain, South Korea, Sweden, Taiwan, UK, US
Source: Ericsson ConsumerLab TV & Media 2011 & 2015 Study


DO YOU SEE
OR
DO YOU 'MAKE'?

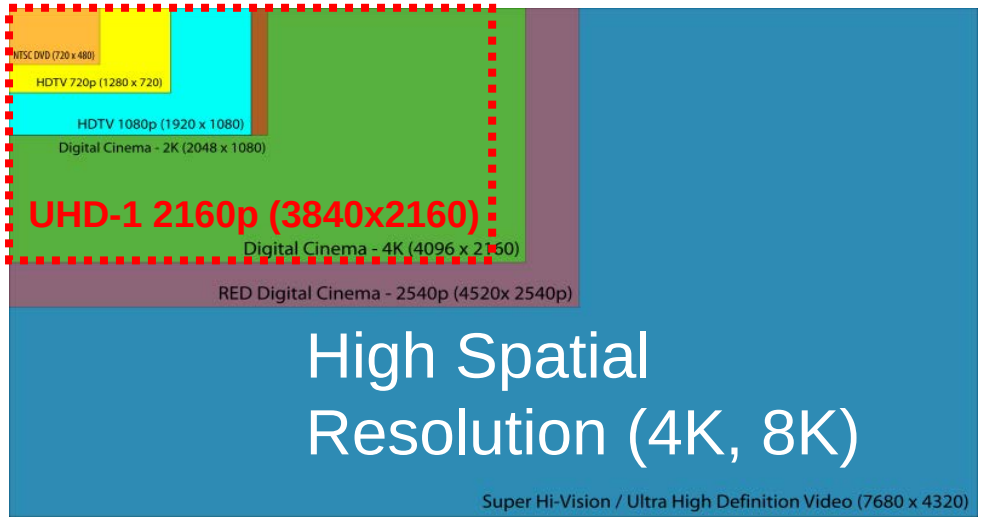
WE ‘MAKE’
WE DO NOT ‘SEE’

UHDTV discussions often don’t consider the Human Visual System (the HVS)

The eye is relatively low resolution, so the HVS ‘builds’ detail over time via saccadic motion and eye tracking and using contrast and color, combining input data with internal reference models based on memory

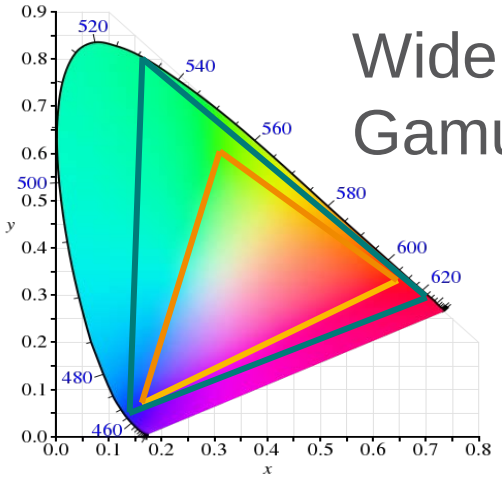
This is not at all how cameras work

IMMERSIVE VIEWING EXPERIENCE:
5 FACTORS



High Spatial Resolution (4K, 8K)

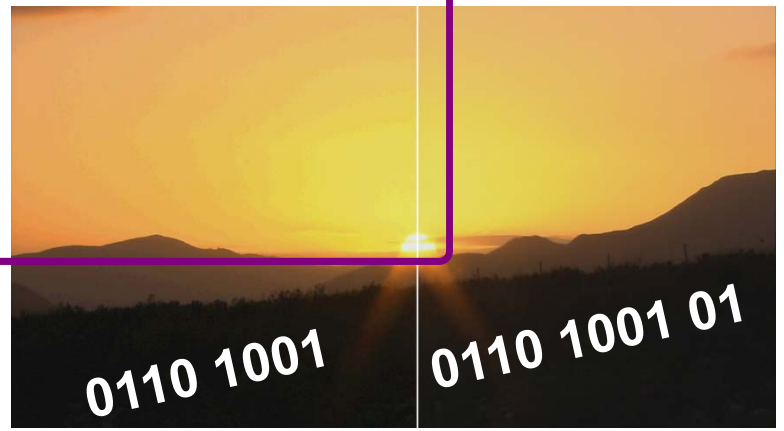
High Dynamic Range



Wide Color Gamut

10-bit Sampling

8b = Visible Banding



High Frame Rate

HIGH SPATIAL RESOLUTION
ULTRA-HD

Commonly called 4K UHDTV or 4K TV

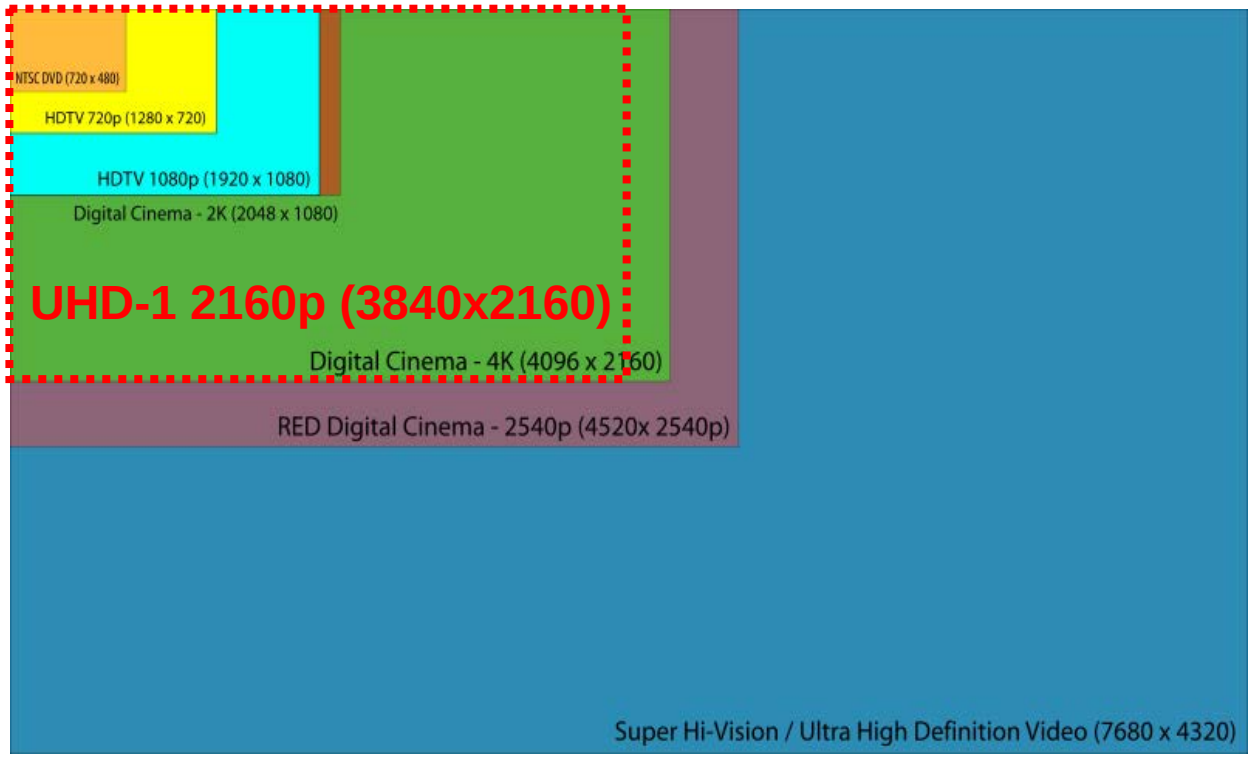
"4K" resolution (3840 x 2160)
- 4x more spatial resolution than 1080i HD

p50/59.94 frame rates
- 2x the temporal definition than 1080i*

But otherwise the same as today
- Dynamic range, colorspace, sample bit depth** as HD broadcast today

Together this makes UHD-1 Phase 1

Japan: UHD-2 or 8K TV
("Super Hi-Vision")



* p24/25/30 are allowed but not popular

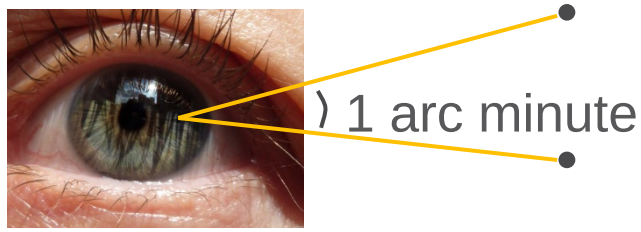
** 10-bit is allowed but not mandated

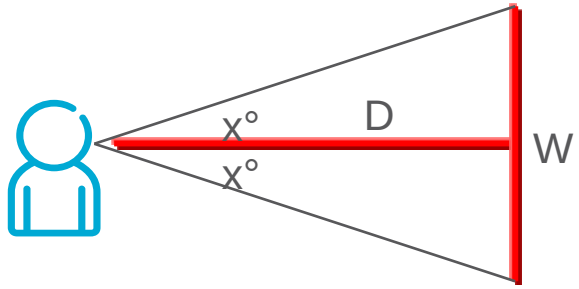
PROPER VIEWING DISTANCE
TO "SEE" SPATIAL RESOLUTION

Proper Viewing Distance (D)

HD (1080p) ~= 3H

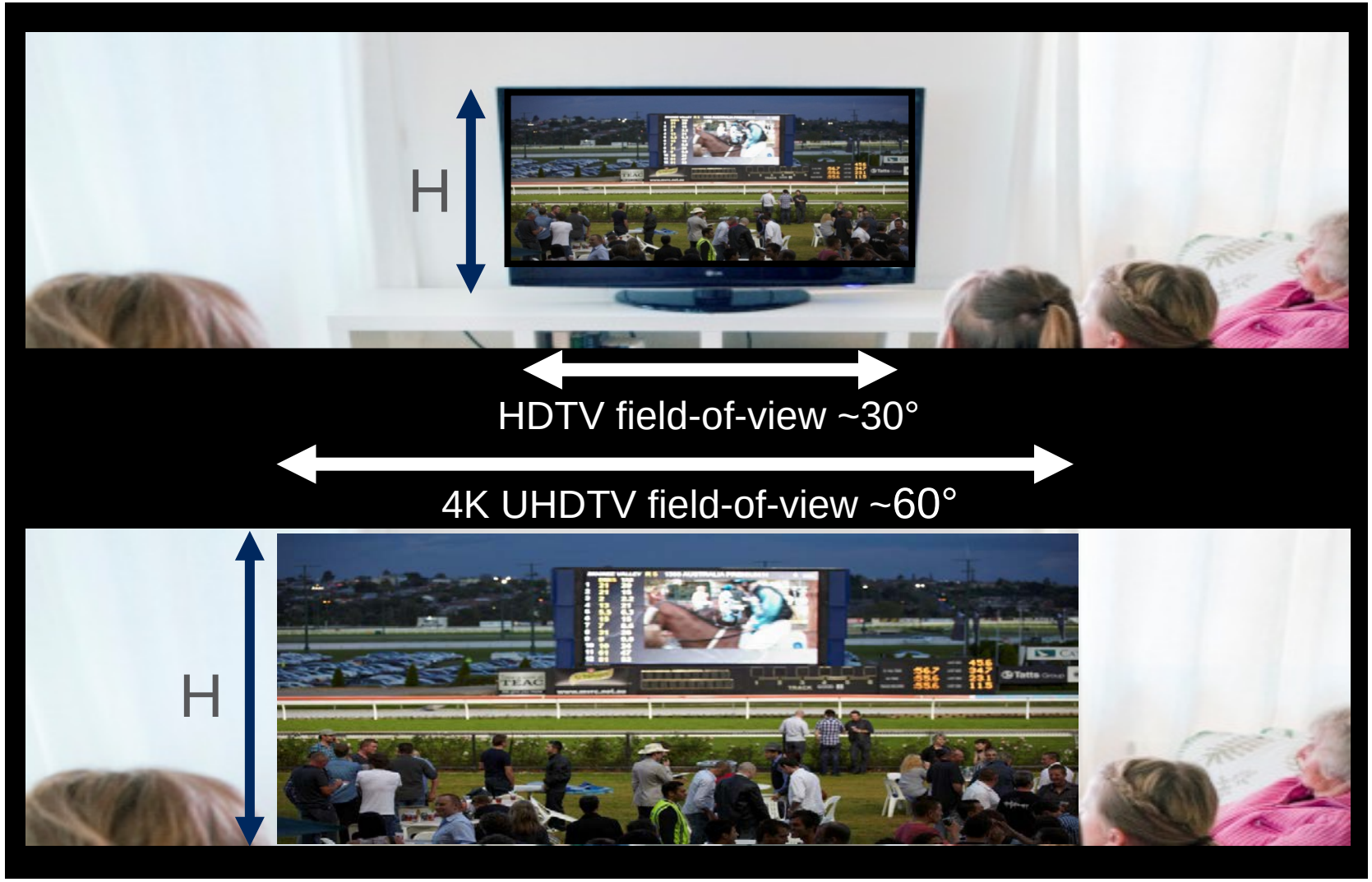
4K UHD (2160p) ~= 1.5H



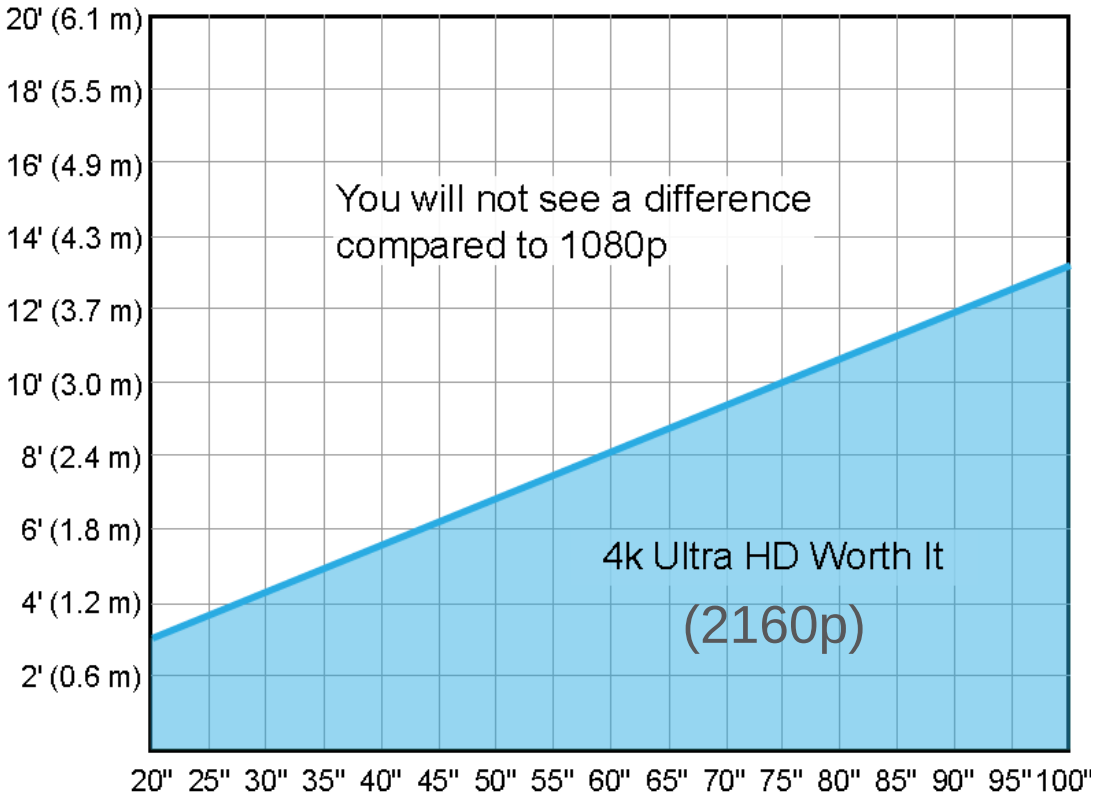


D = (W/2)/tan(x)

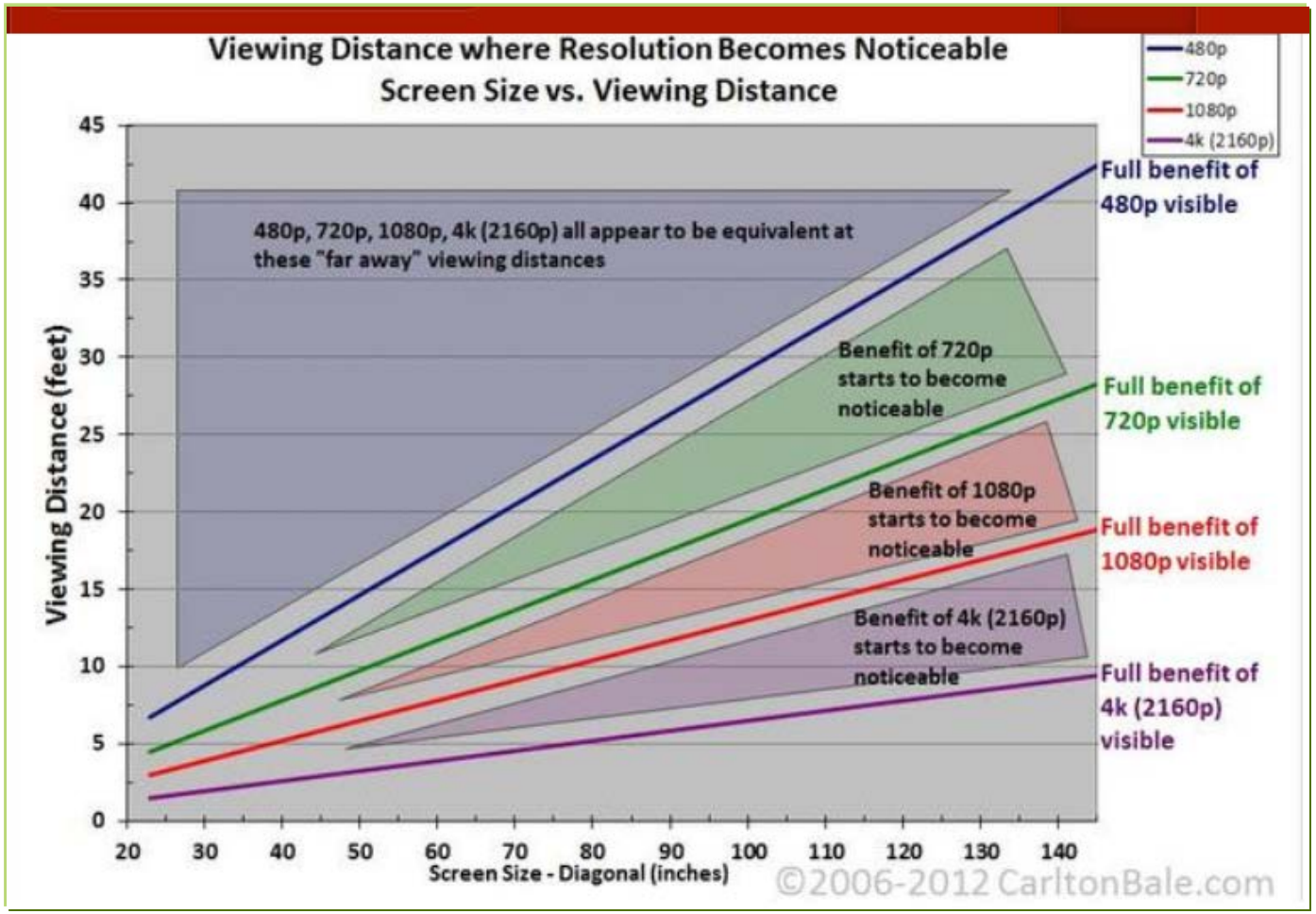
Screen size = √(H²+W²)



SCREEN SIZE VS. VIEWING DISTANCE



Source:
http://www.rtings.com/info/4k-ultra-hd-uhd-vs-1080p-full-hd-tvs



HDR - LUMINOUS INTENSITY

Candela per square meter (cd/m^2) or “nit”

Cinema today: 55 cd/m^2
- In dark viewing environment

Reference white for TV production: 100 cd/m^2
- Rec. ITU-R BT.1886
- Based on 1930s CRT!

Typical LCD TV today (standard dynamic range, SDR): 300-400 cd/m^2

HDR TVs, now to future: 1,000 to 4,000 cd/m^2

COMPARING SDR TO HDR

Standard Dynamic Range, Lowlight Exposure

Standard Dynamic Range, Highlight Exposure

High Dynamic Range, (simulated by tone mapping)

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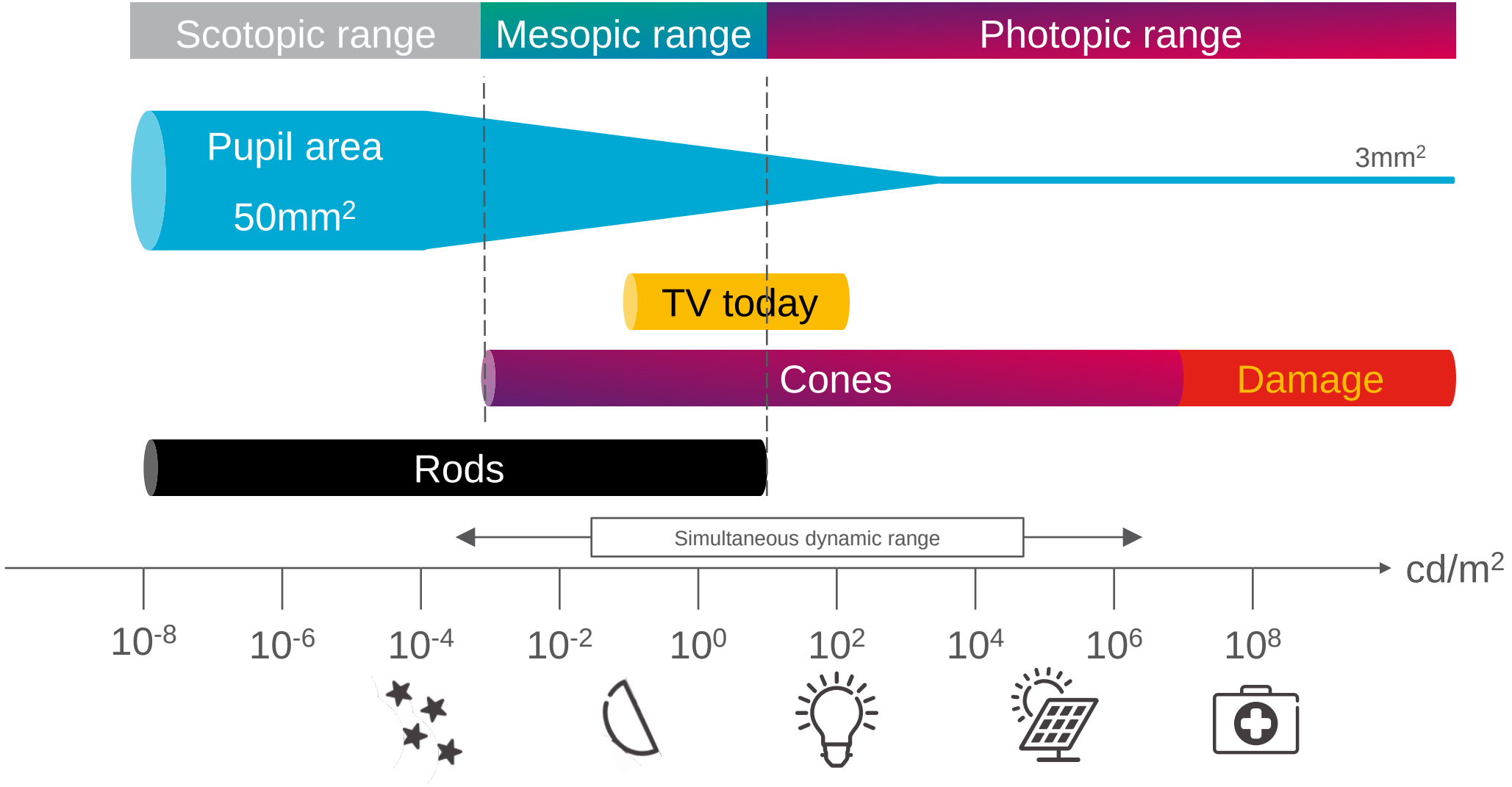
HDR AND PERCEIVED RESOLUTION

Which one has higher resolution?

HUMAN VISUAL SYSTEM: HDR & TV



HDR BUSINESS DRIVERS

High Dynamic Range (HDR) doesn’t require a large screen, works on tablets and phones

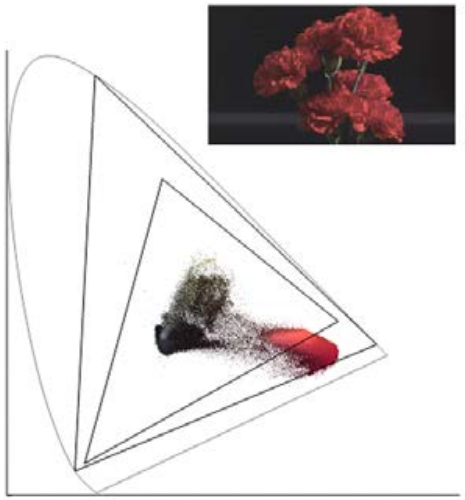
From the transmit side, HDR is potentially more economically viable to deploy than 4K UHDTV

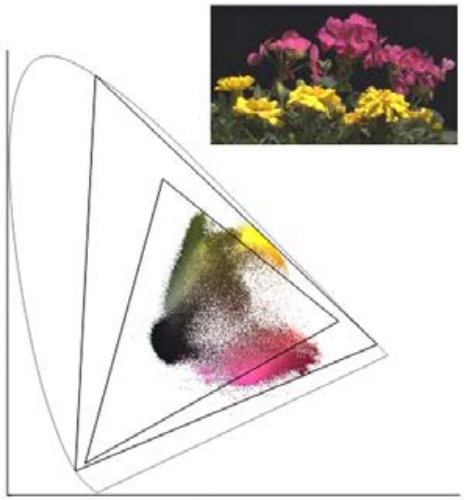
Once you have seen HDR, you realize how much better than current TV it is

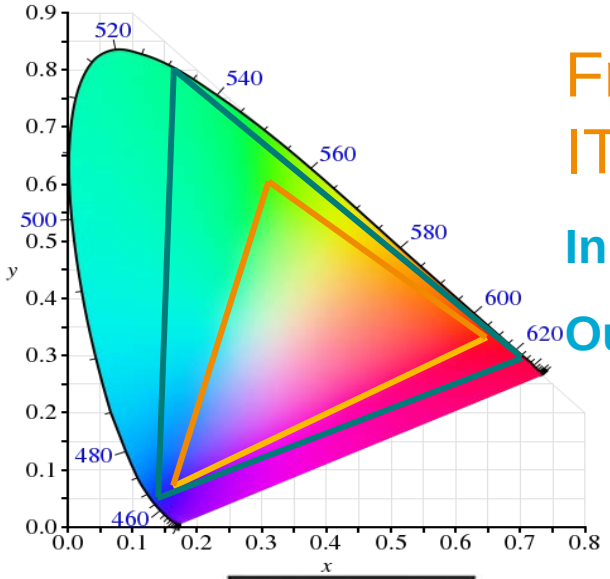
Cameras can capture HDR now, but we can’t see it at home

WIDE COLOR GAMUT (WCG)

CAPTURE MORE OF REALITY – RICHER COLORS



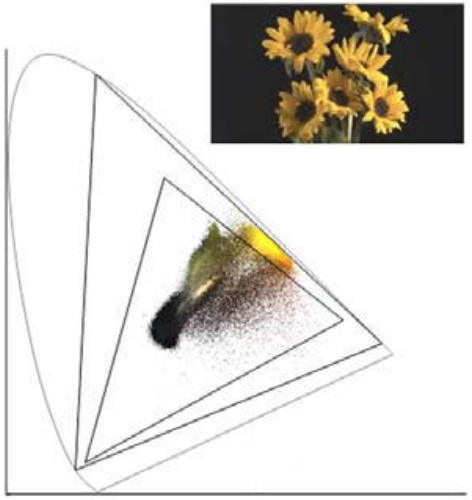


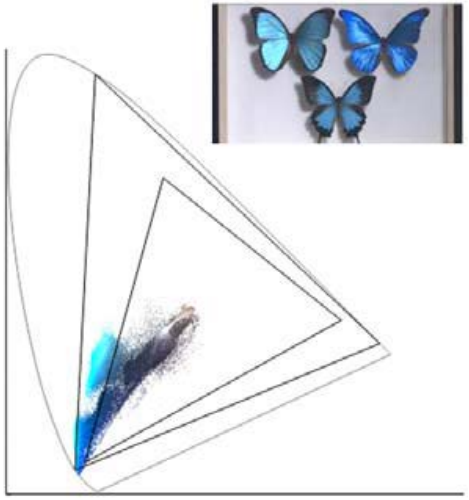


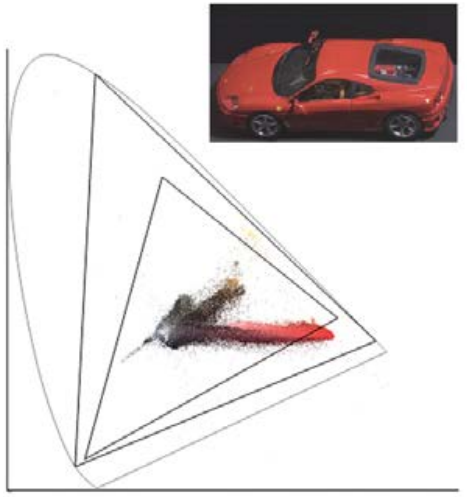
From Report
ITU-R BT.2246-3

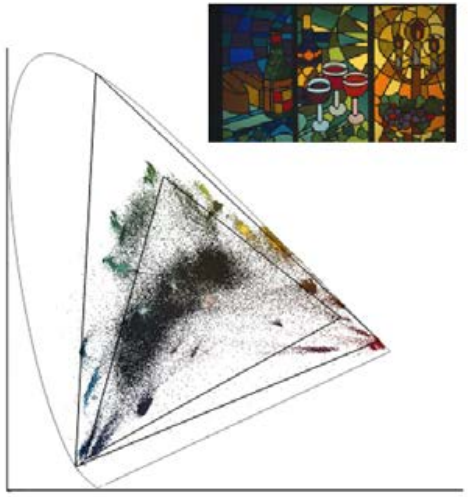
Inner triangle: HDTV primaries

Outer triangle: UHDTV primaries

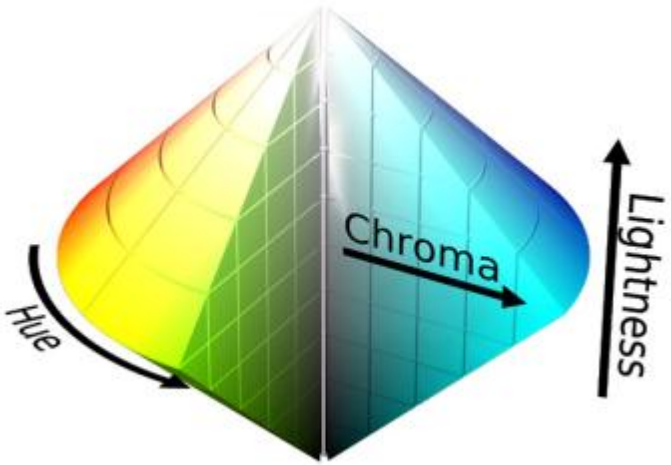




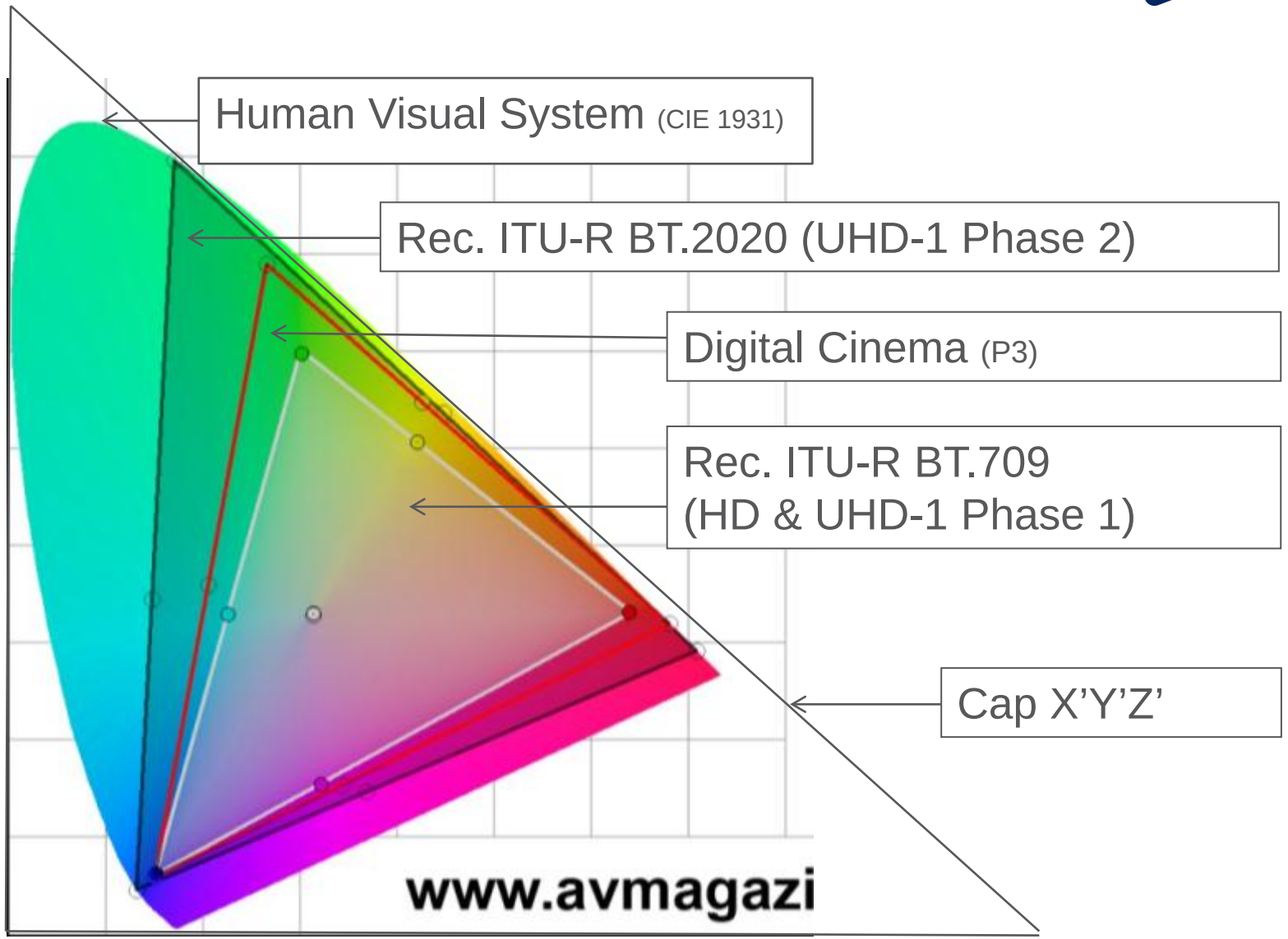




WCG & HDR ARE CLOSELY LINKED



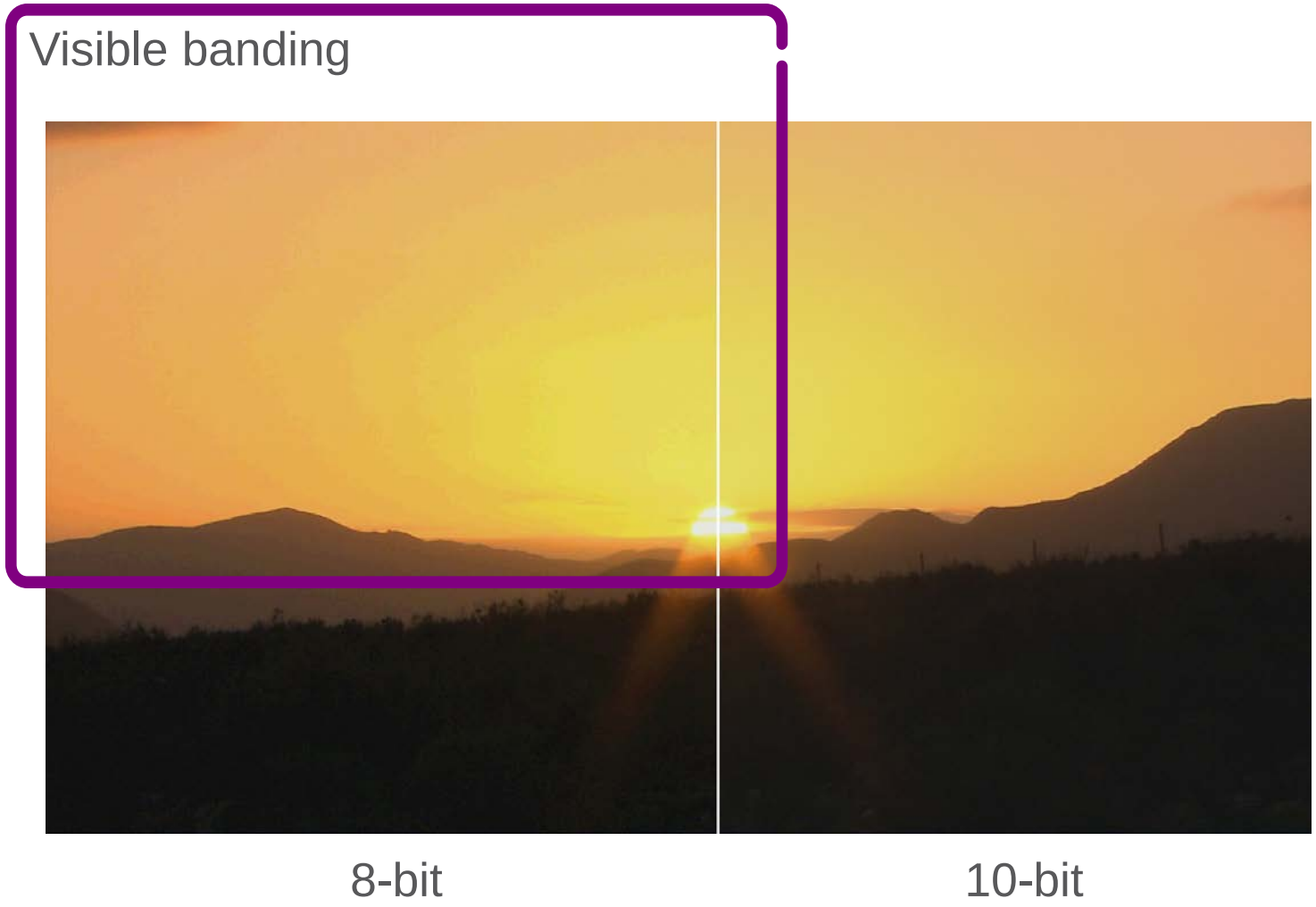
Color Volume
=
HDR & WCG



Relative Size of Colorspaces

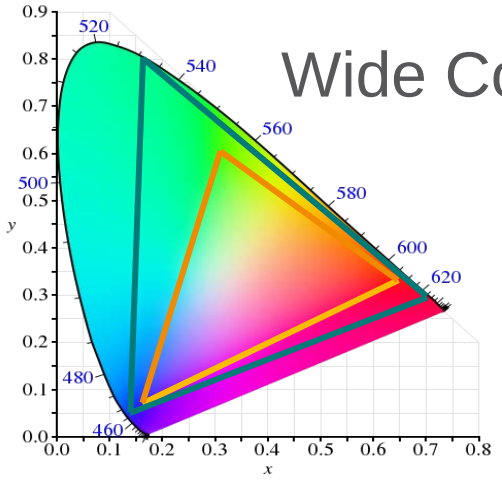
VISUAL QUALITY: SAMPLE BIT DEPTH

- Today, ***all*** direct-to-consumer digital TV uses 8-bit sampling
- Banding (posterization) with 8b, especially in plain areas
  - Sky, backgrounds, graphics, logo
  - Very noticeable with slow changes, such as fades
- Significantly improved PQ with 10-bit sample bit depth
  - No bandwidth cost in the compressed domain
  - HEVC Main-10 Profile allows 8-bit or 10-bit operation
- HDR and WCG exacerbates issues with 8-bit sampling



IMMERSIVE VIEWING EXPERIENCE = "HDR+"

High Dynamic Range



Wide Color Gamut

0110 1001 01

10-bit Sampling

The combination of HDR, WCG and higher sample precision – acts as a single HDR+ feature/function!

Immersive content production needs special attention – see iMAX movies

HIGH FRAME RATE (HFR)

Conventional Frame Rate

Motion Blur

Motion Judder

High Frame Rate

- Wider viewing angle = more immersive
  - Increased motion sensitivity = increased perceived motion artifacts
- **Higher frame rates needed to compensate:** 50/60 fps minimum (100/120 fps being vetted)

UHDTV SPORTS:
FRAME RATE @ 4K UHD

- If the camera and subject are static or moving slowly, **HFR doesn't do anything and 24 /25/30 fps is acceptable**
- *However this is less temporal resolution than SD or HD TV today*

Note: Almost all films are shot at (or around) 24 fps

- For most content, **50 or 60 fps** are needed to reduce motion artifacts
- *As progressive formats, these also give better temporal resolution than interlace*

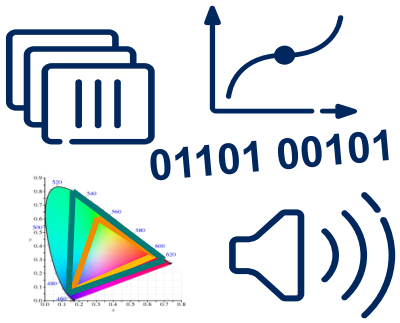
Note: A few films are now being shot at 48 fps HFR'

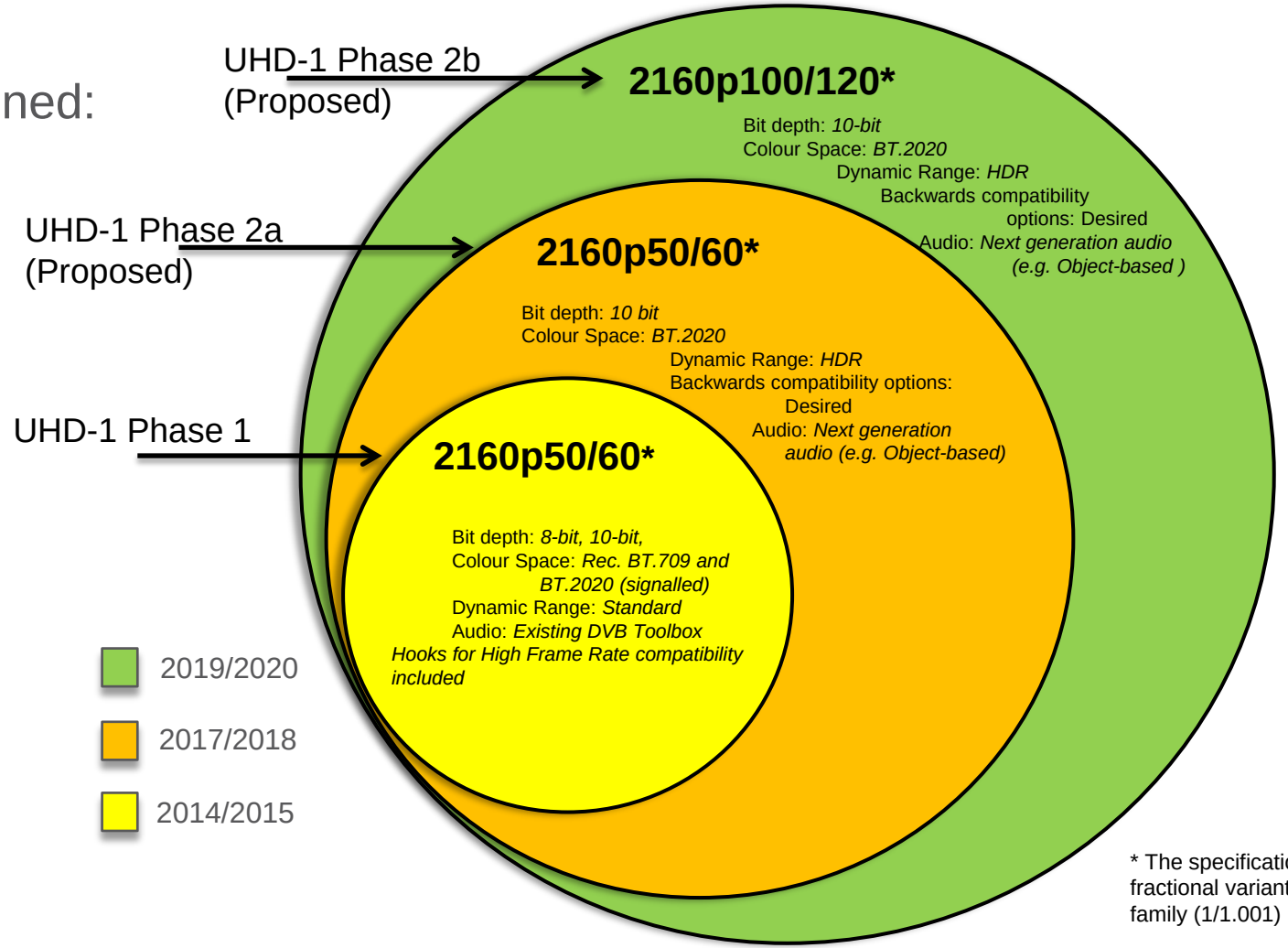
- As motion increases further, **100 or 120 fps** can further reduce motion artifacts but at correspondingly greater cost than 50/60 fps

Note: Frame rates of 240 fps or above may be needed to eliminate artifacts

UHD ROADMAP: UNCERTAINTIES

- UHDTV is all about the consumer experience
  - But only UHD-1 Phase 1 defined: **Does not include many immersive technologies!**
- UHD-1 Phase 2 in development
  - Not clear how technologies will be defined





Source: DVB CM-UHDTV

* The specification also includes fractional variants of the 60fps family (1/1.001)


ECONOMICS

CREATING NEW UDHTV CONTENT

Attribute (in comparison to 1080p 50/60)	4K only (p50/60) (UHD-1 Phase 1)	4K with HDR+	4K with HFR	Enhanced HD (HDR+, p50/60)
Do we need completely new digital 'film' cameras?	Possibly	Possibly	Yes	No
Do we need completely new TV cameras?	Yes	Yes	Yes	Yes
Do I need a new Truck / gallery?	Yes	Yes	Yes	Possibly not
Do I need new routers/cabling?	Yes	Yes	Yes	Probably not
Do I need more storage?	Yes	Yes	Yes, lots	No
Will post production be much more expensive?	Yes	Yes	Yes	Probably not much more

DELIVERING UHDTV CONTENT

Attribute	4K only (p50/60) (UHD-1 Phase 1)	4K with HDR+	4K with HFR	Enhanced HD (HDR+, p50/60)
Do I need more contribution bandwidth?	Yes	Yes	Yes, lots	No
Do I need more delivery bandwidth?	Yes	Yes	Yes, lots	Maybe
Can planned STB chips handle this?	Yes	Yes	No	Yes (10-bit)
Is my CDN affected?	Yes	Yes	Yes, lots	Not much
Can I make conventional HD/SD; e.g., via Format/Standards Conversion?	Yes	Yes	Yes, but might be issues	Yes

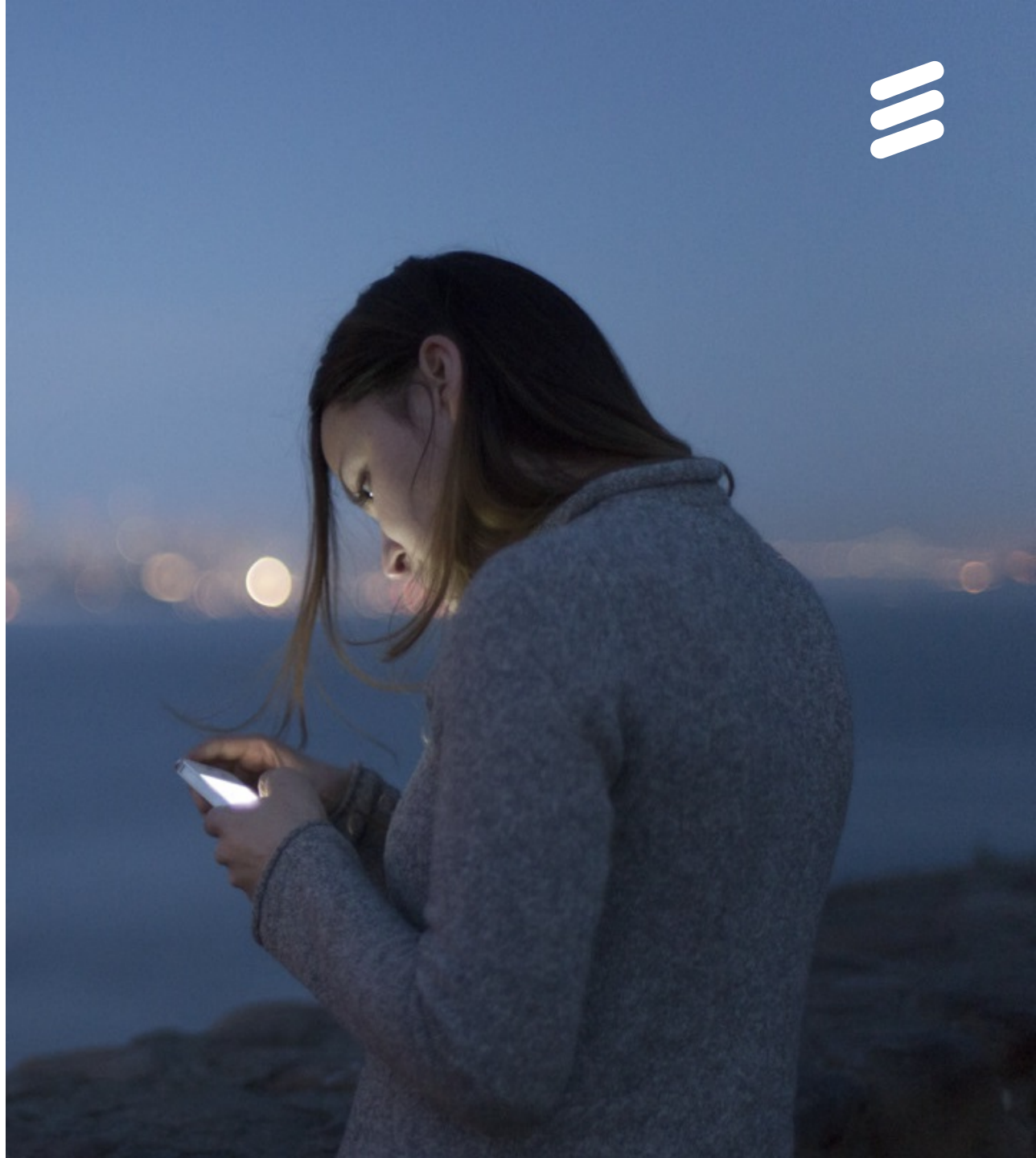
CONCLUSION

UHDTV is choices – not a single topic

Industry research like ConsumerLab can help you understand consumer behavior

Contributions standards development organizations are helping resolve some current contentious issues

Ericsson UHDTV Briefing Paper gives background information on the different choices – Please contact us



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