VIDEO TECHNOLOGY, ENCODING, DELIVERY

DIGITAL MEDIA E-5
EXPLORING DIGITAL MEDIA

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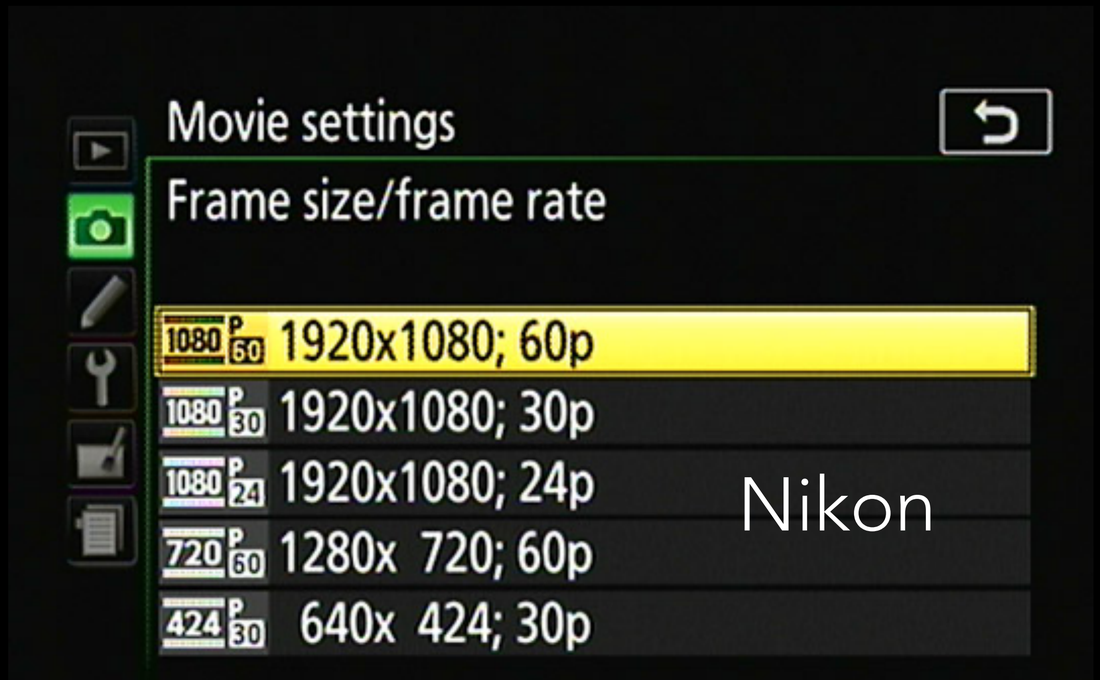
FRAME RATES

Image from https://documentation.apple.com

Canon

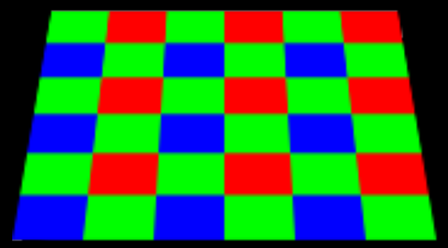


Nikon

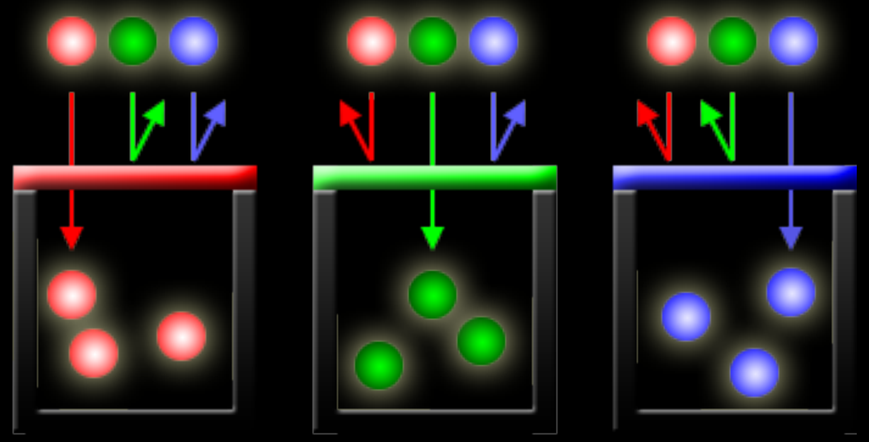
Sony

What the Camera Captures

Color Sensors (digital)



Bayer Pattern



Of Red, Green, and Blue we are most sensitive to Green information

Image from red.com

What are the components of video information?

Image from red.com

How Big is all of this Data?

Giga/Mega/Kilo**bits** = unit of measure for data transfer (bitrate)

Giga/Mega/Kilo**bytes** = unit of measure for data storage (file size)

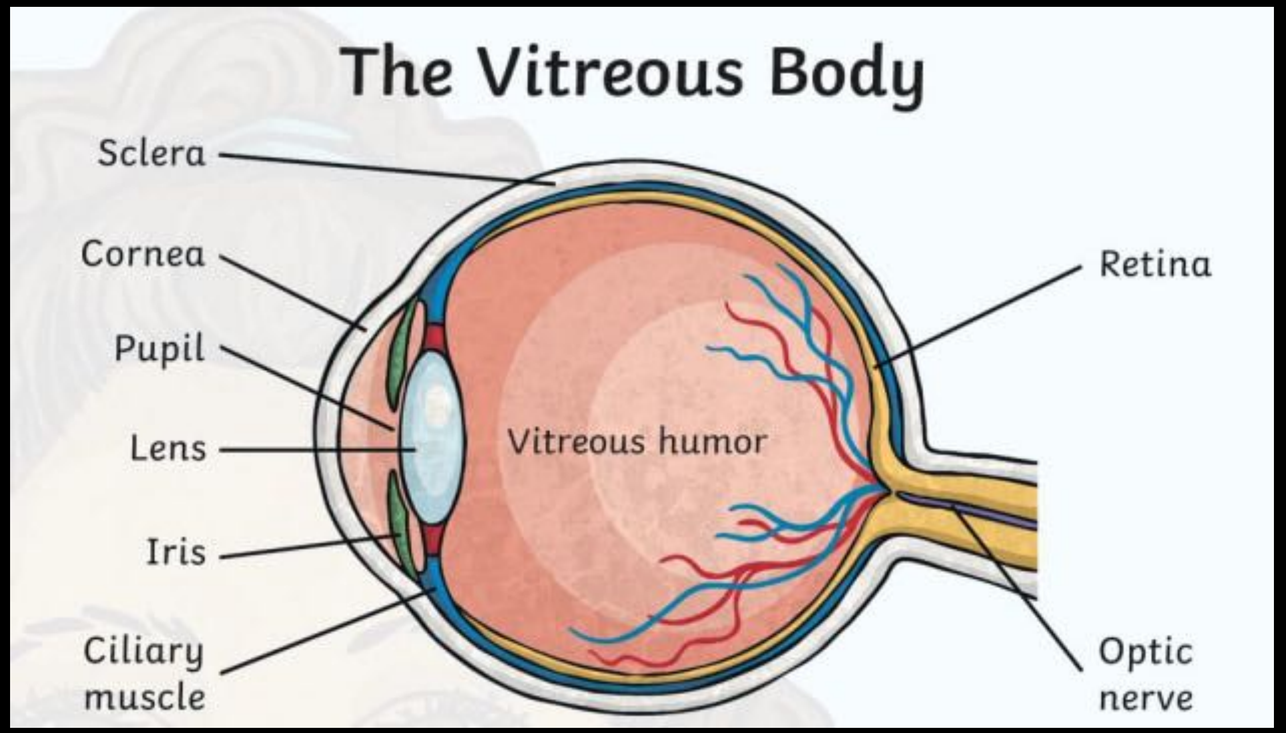
data rate = color depth × vertical resolution × horizontal resolution × refresh frequency

UNCOMPRESSED VIDEO	Bit Depth	Resolution	Frame rate	Total bitrate	5 minutes of video
720p@30 8-bit	8 (*3)	1280x720	30	663 Mbps	24.86 GB
1080p@60 10-bit	10 (*3)	1920x1080	60	3.73 Gbps	140 GB
4K UHD@60 12-bit	12 (*3)	3840x2160	60	17.91 Gbps	671 GB
8K UHD@60 12-bit	12(*3)	7680 × 4320	60	71.6 Gbps	2.7 TB

How Big is all of this Data?

TOO BIG

What Do We Do About it?



The Human Visual System is Imperfect

Image from www.twinkl.it

What Do We Do About it?

Spend more bits here!

More Sensitive

Brightness (Luma)

Light Areas

Lower Frequency Detail

Less Sensitive

Color (Chroma)

Dark Areas

High Frequency Detail

Chroma Subsampling

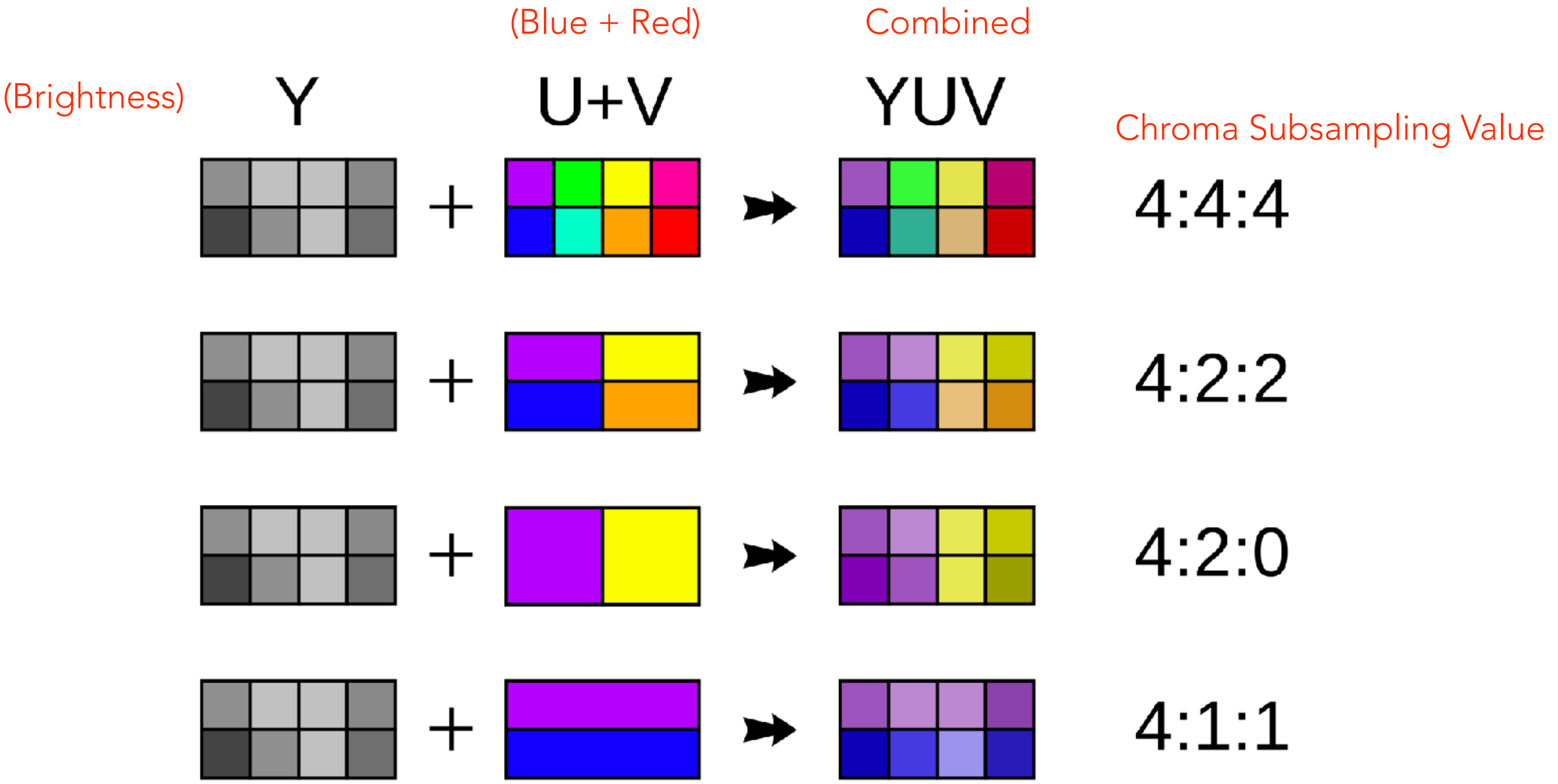


Image from wikipedia


WEEK 0: WELCOME
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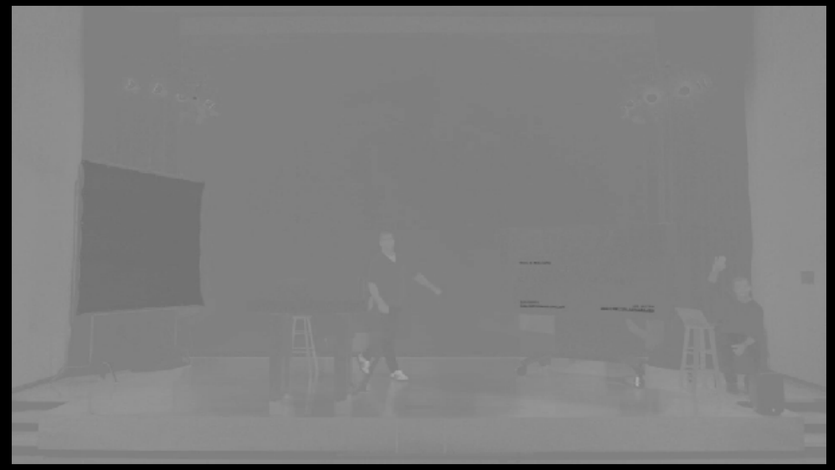
Cb (blue component)

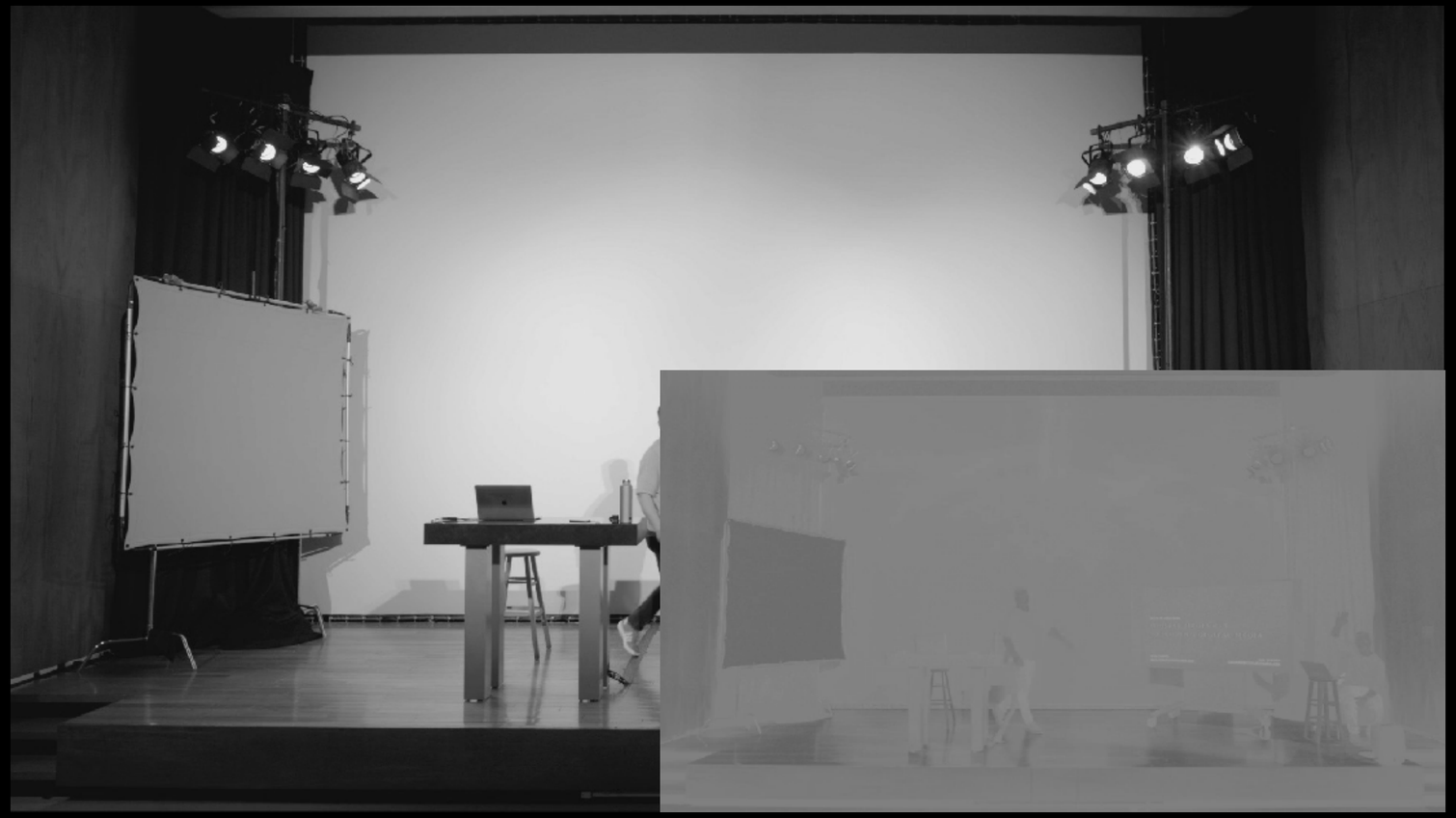


Y (luminance)

Cr (red component)

4:2:0

Y (luminance)



4:2:0 (1/4 chroma information)

Chroma Subsampling

4:1:1

4:2:0

4:2:2

4:4:4

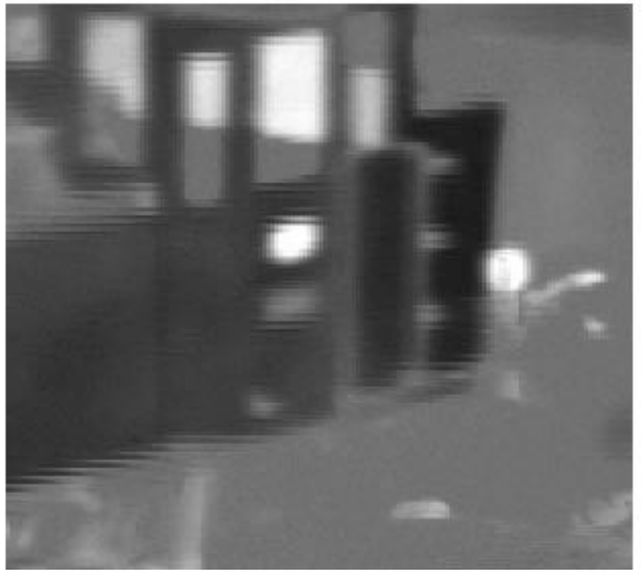


Image from wikipedia

Bit Depth

8-bit, 10-bit, 12-bit, 16-bit… ????

Bit Depth

8-bit, 10-bit, 12-bit, 16-bit… ????

Binary Representation (base 2)

Bit-Depth	Binary Representation	Maximum Base10 Value	Number of Colors
1-bit	1	1	1
8-bit	11111111	255	16,777,216
10-bit	1111111111	1,023	1,073,741,824
12-bit	111111111111	4,095	68,719,476,736
16-bit	1111111111111111	65,536	281,474,976,710,656

Bit Depth

8-bit, 10-bit, 12-bit, 16-bit… ????

Common Artifact: Banding, especially on gradients

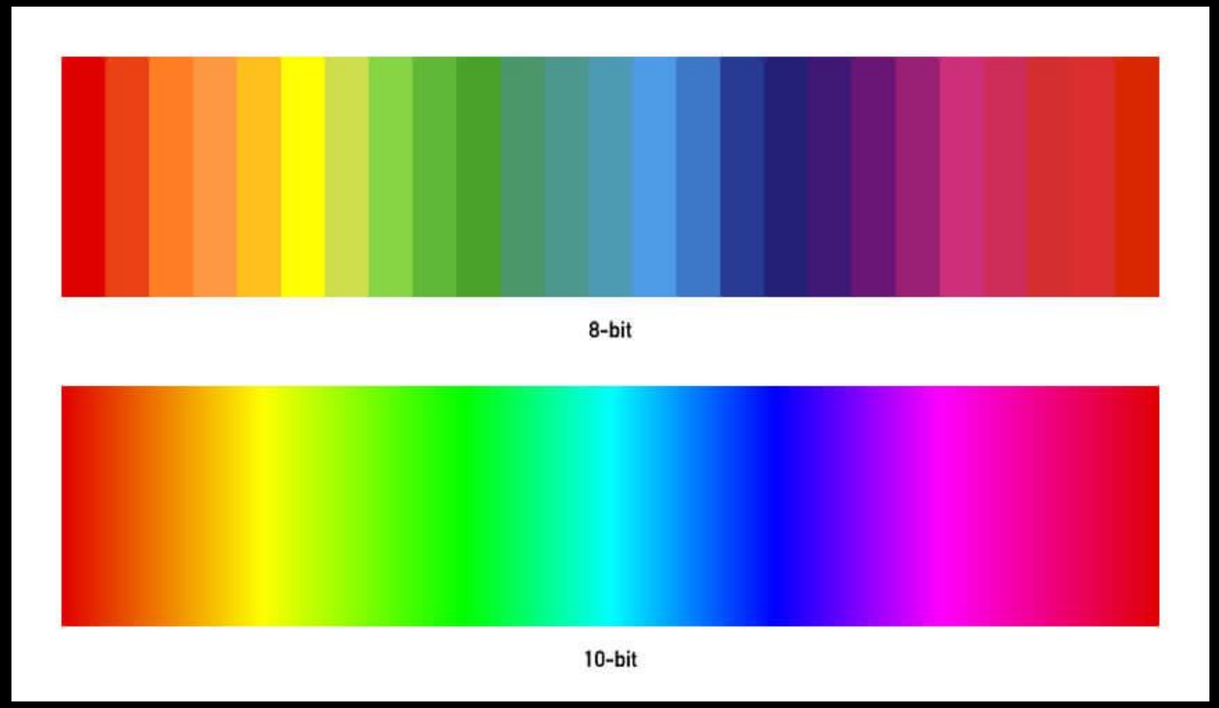


Image from fujifilm

Image By Steve F, CC BY-SA 2.0

Storing the Data

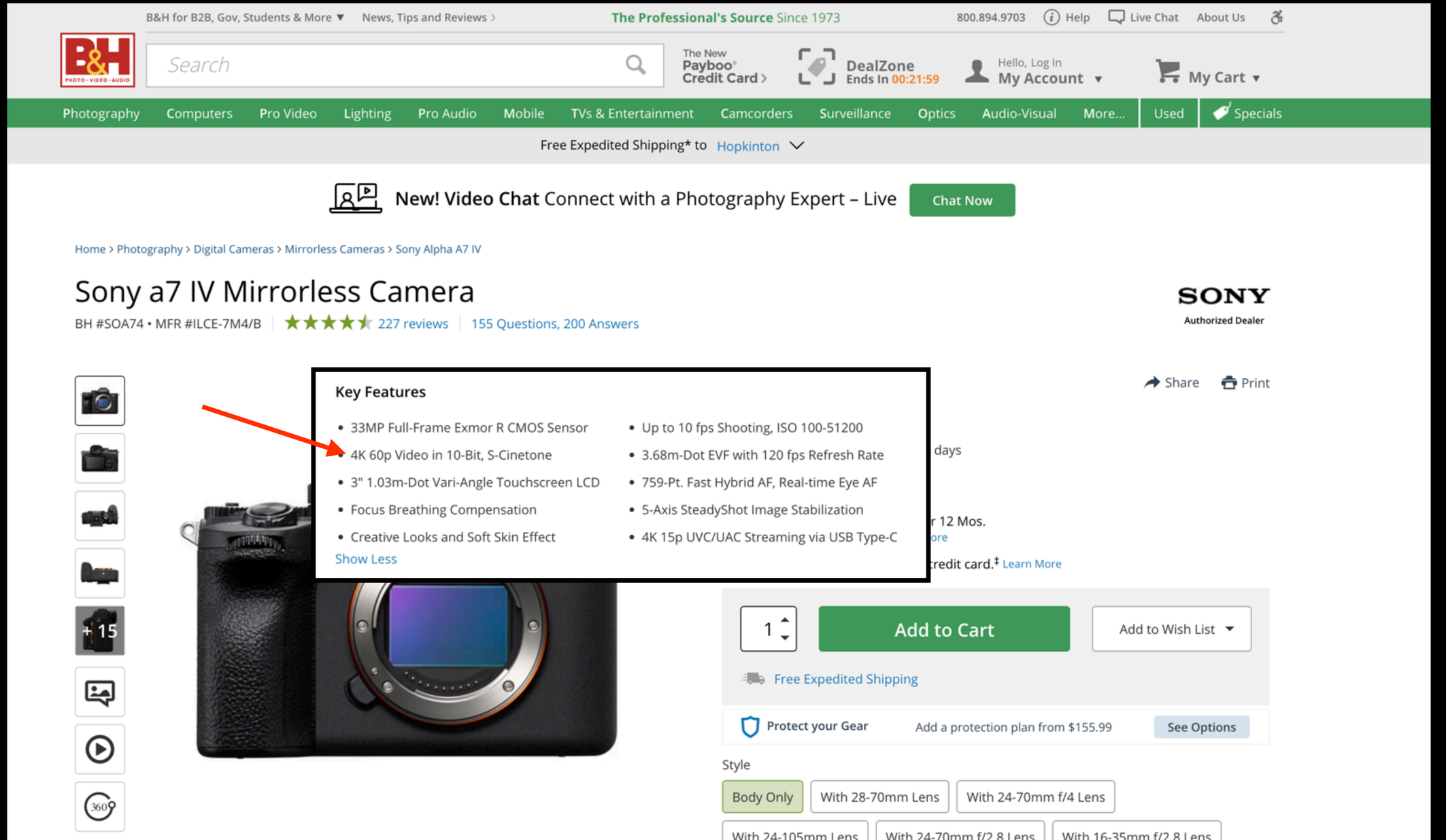


Image from b&h

Storing the Data

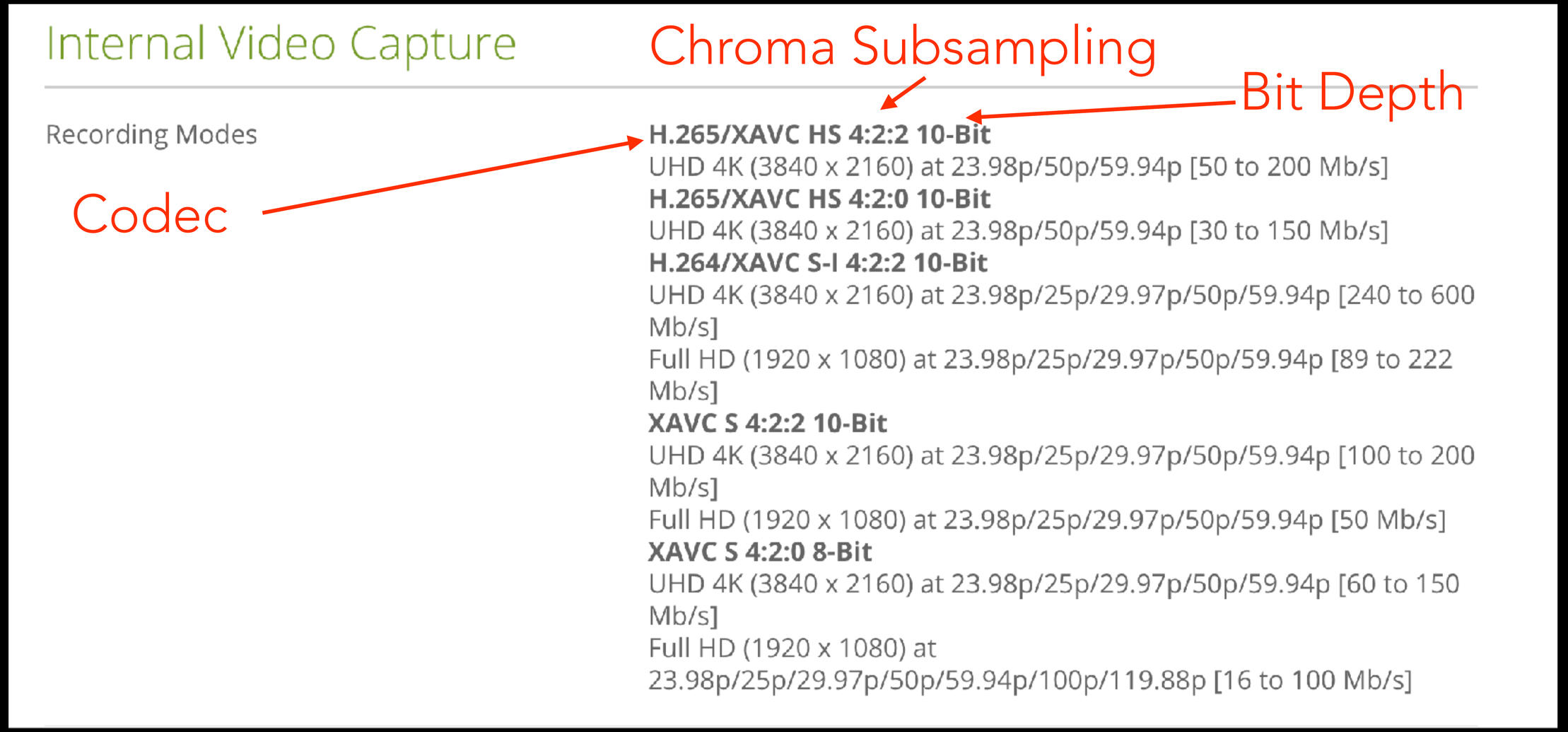
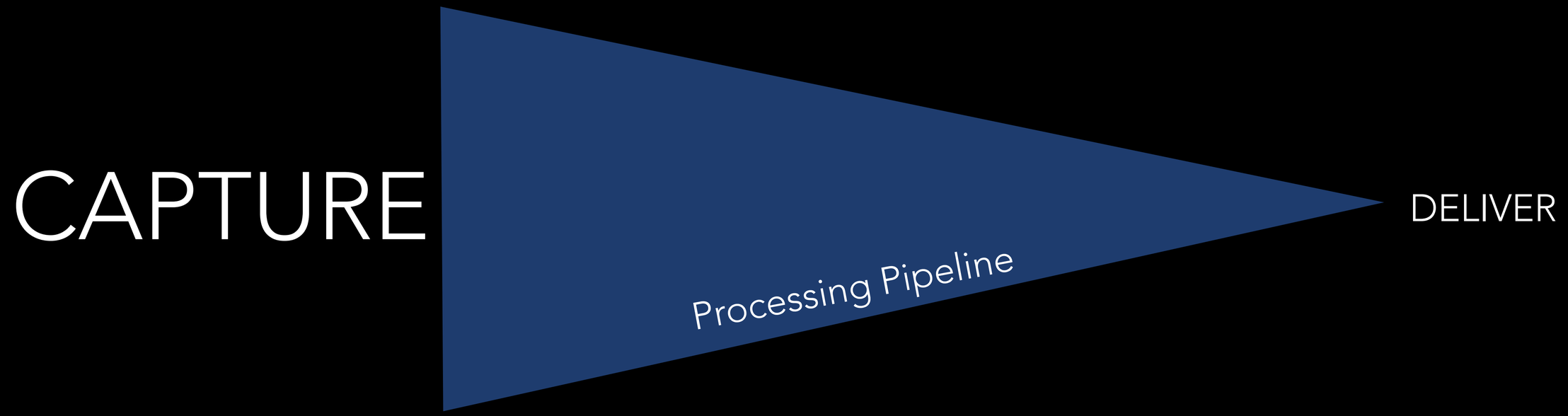


Image from b&h

Storing The Data

Acquisition format should be higher than the delivery format

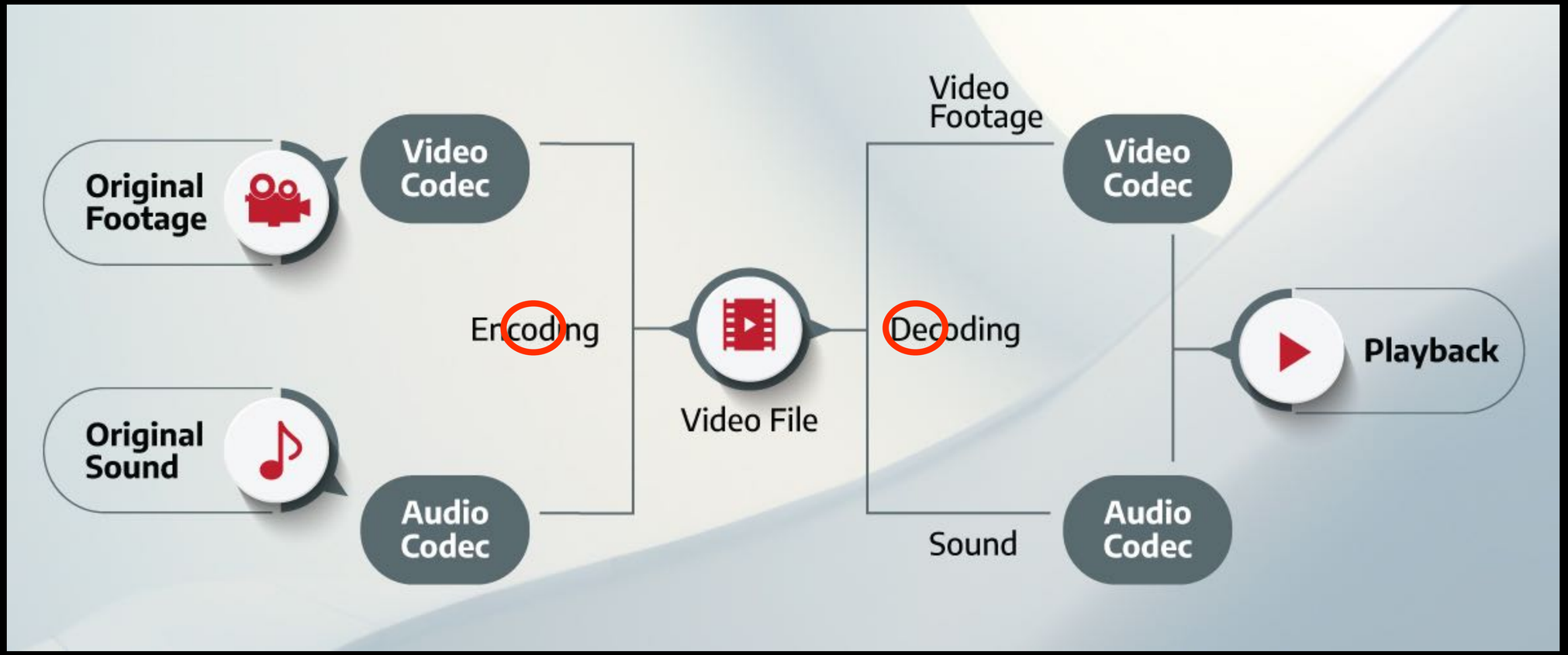


At least 10-bit 422 when possible

depends*

Video Compression

Codec

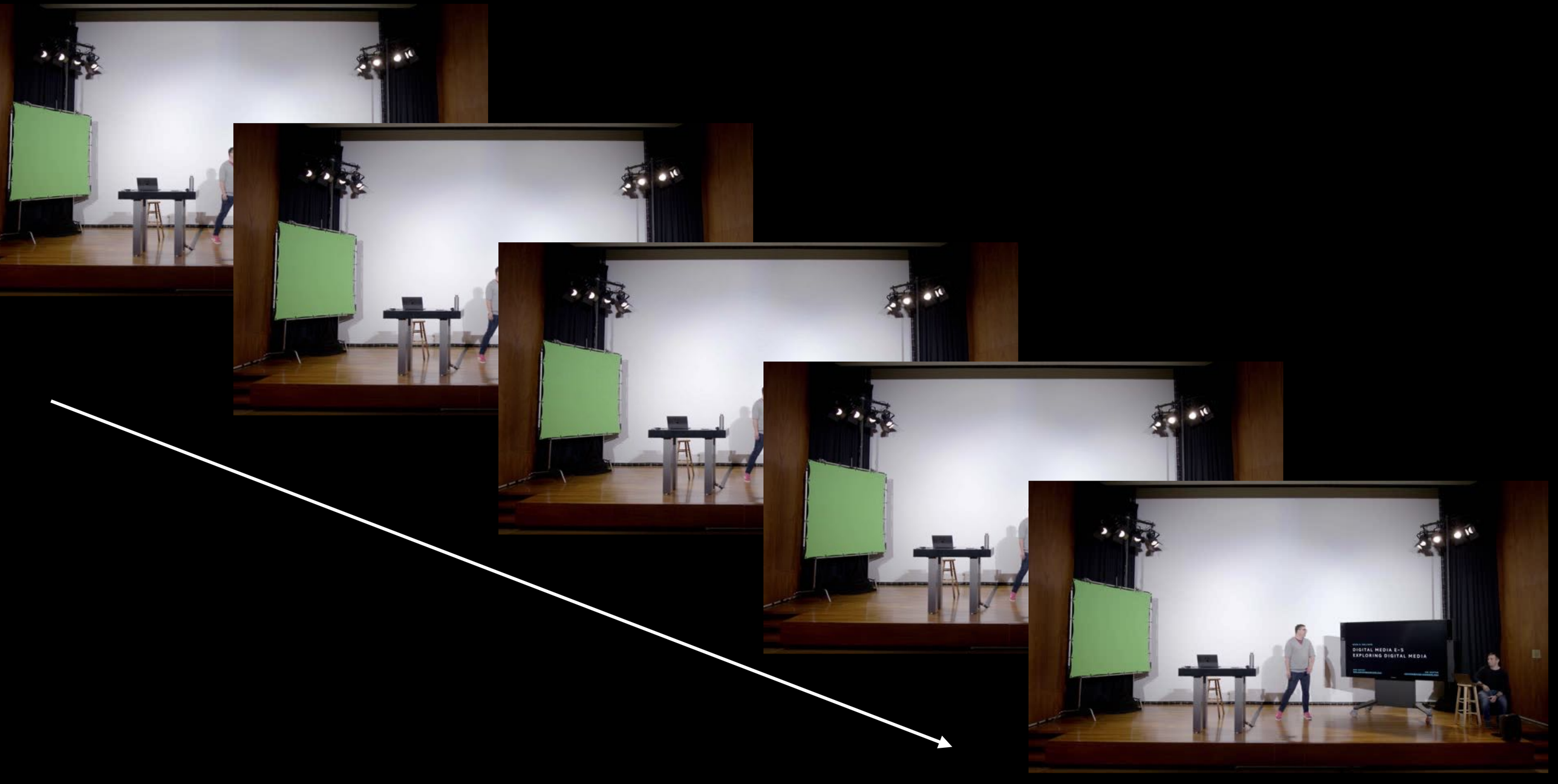


En**cod**er **Dec**oder

Image from brid.tv

Video Compression

Frames



Video Compression

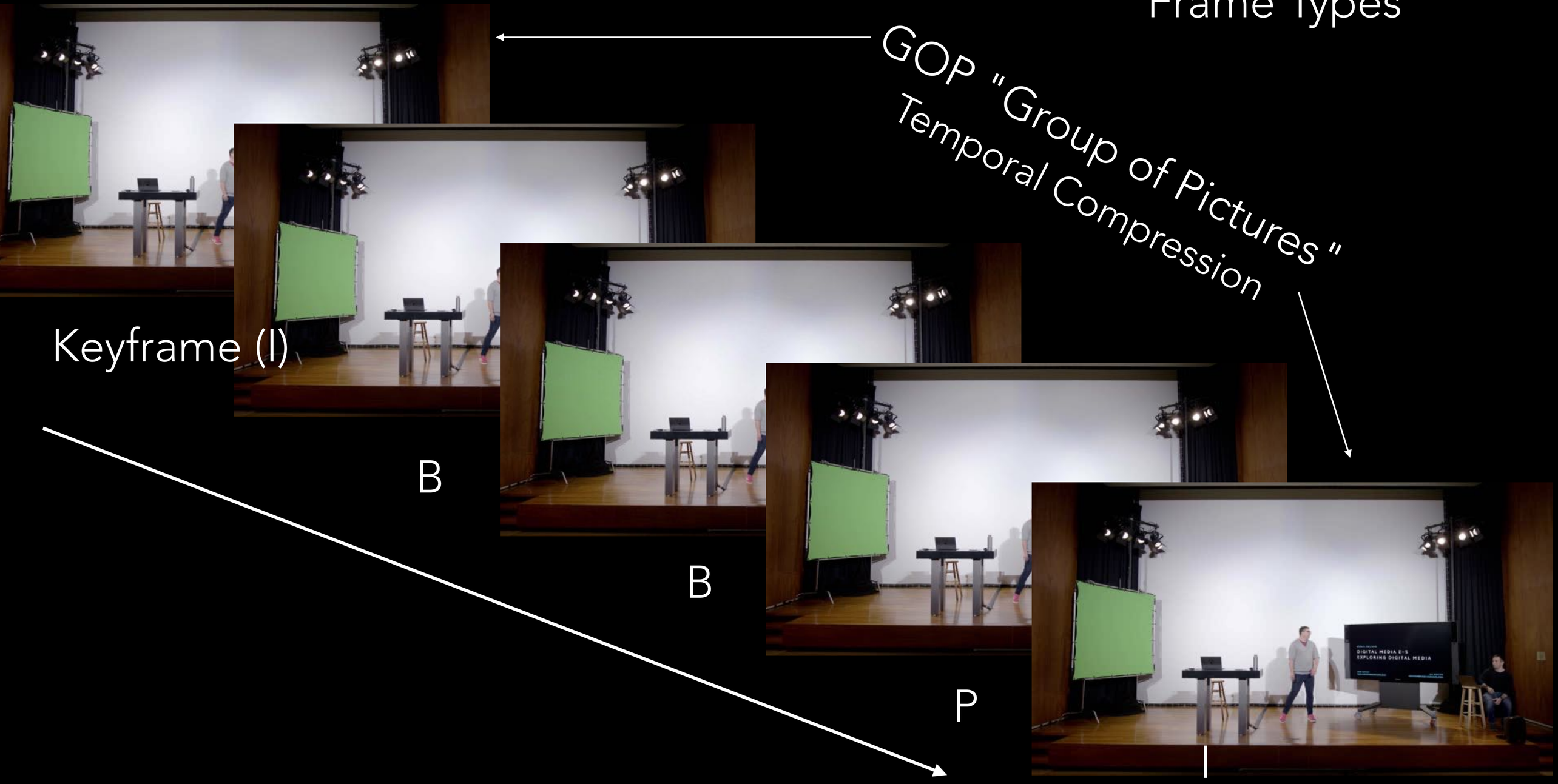
Frames

Video Compression

Frame Types

GOP "Group of Pictures"

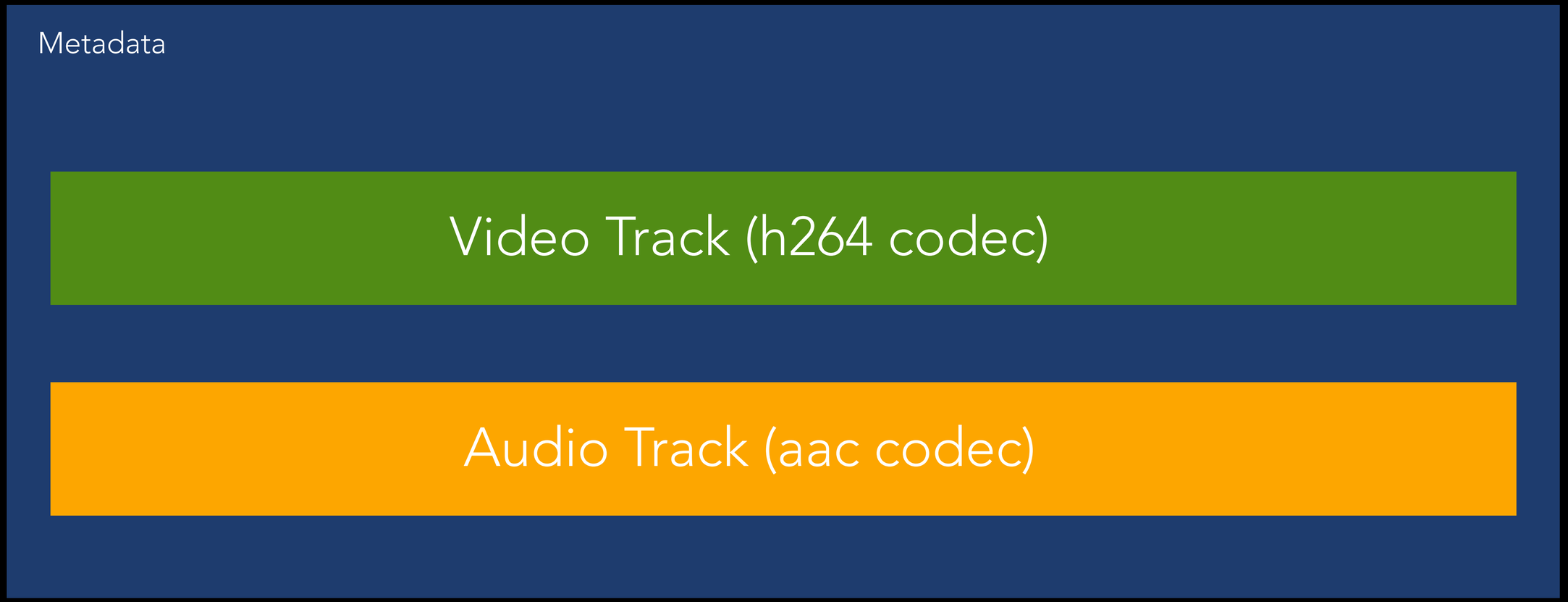
Temporal Compression



Video Compression Frames

Video Compression

my_file.mp4



Video Delivery

How do I send you my file? How do you view it?

Video Delivery

Single File Approach (progressive download)

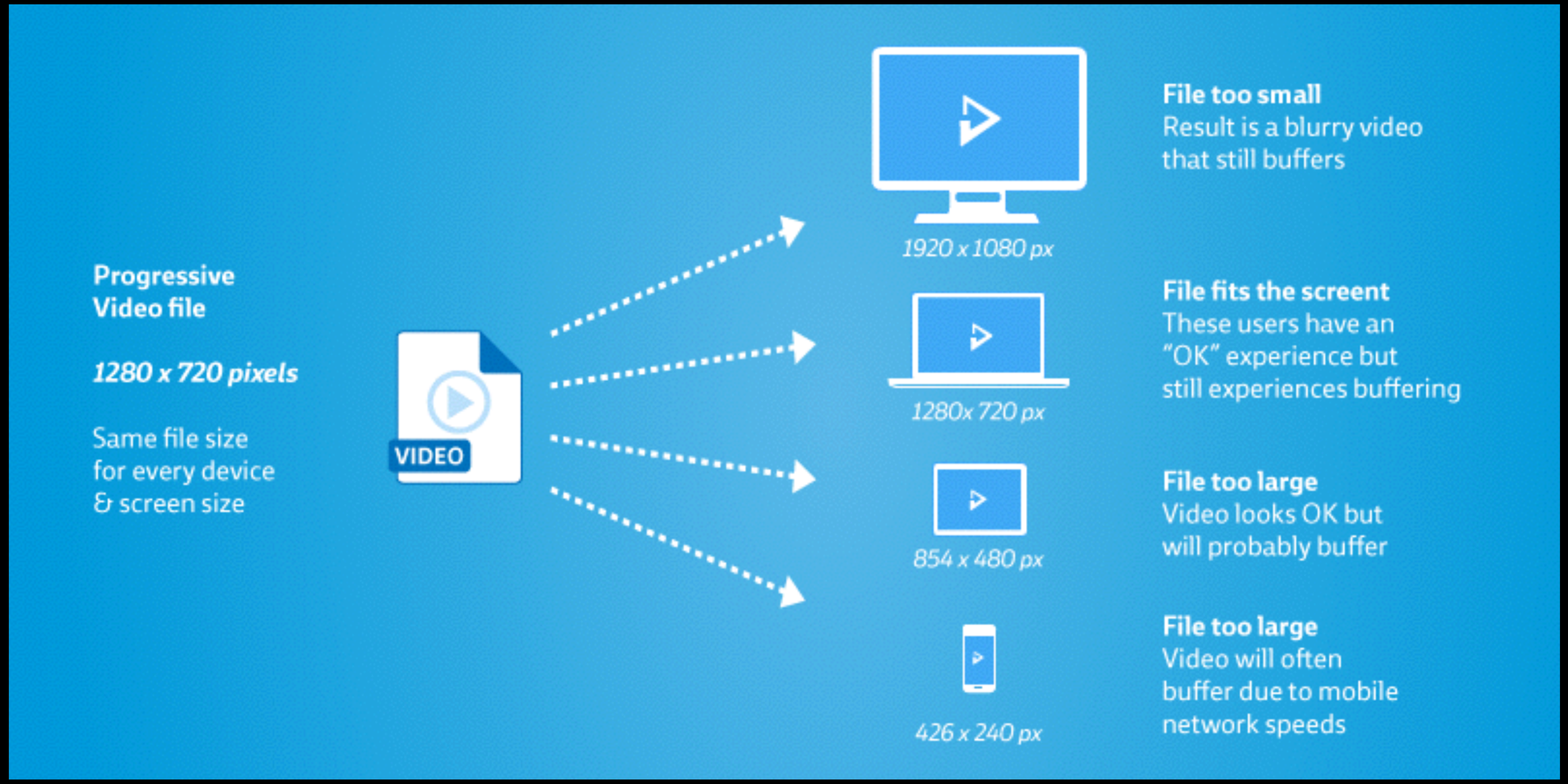


Image from bitmovin

Video Delivery

Adaptive Bitrate

Image from bitmovin

Video Delivery

Adaptive Bitrate

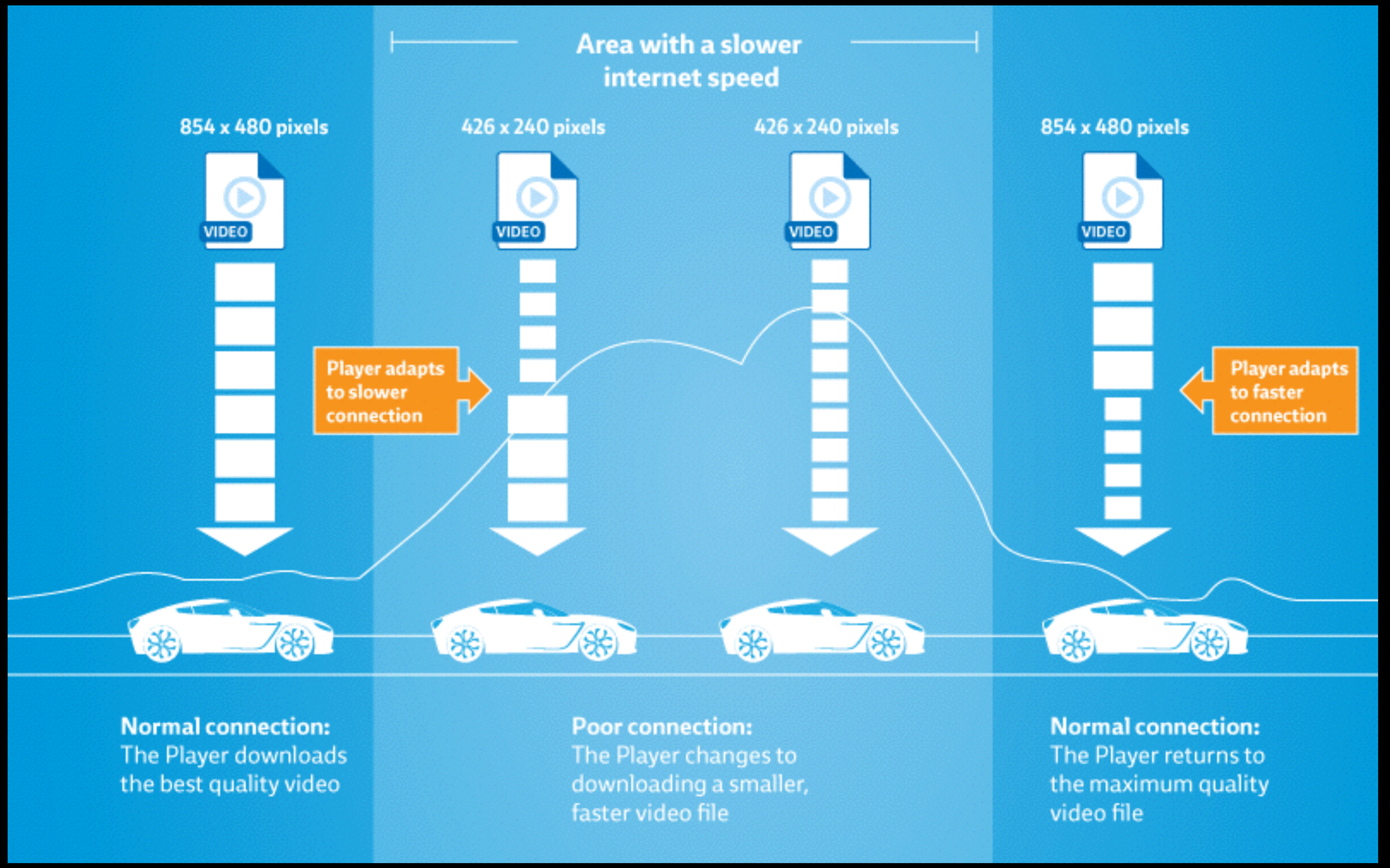
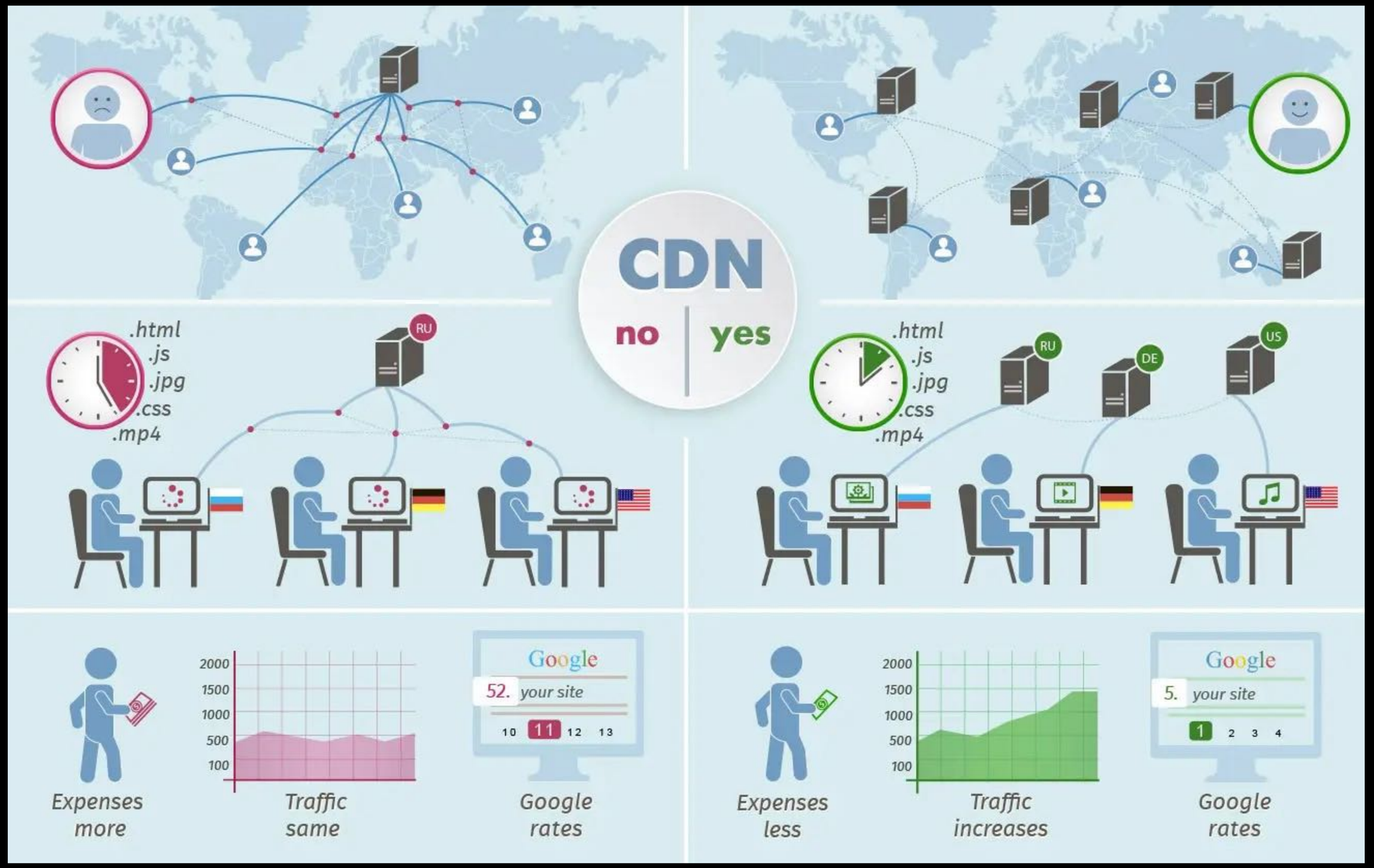


Image from bitmovin

Video Delivery

Content Delivery Network (CDN)



How To Deliver Your Video

	YOUTUBE	VIMEO	ONLINE VIDEO PLATFORM (BRIGHTCOVE/MUX)	BUILD YOUR OWN
PRICING	FREE	FREE OR SUBSCRIPTION	SUBSCRIPTION	UP TO YOU
COST	NOTHING	LOW COST	MEDIUM COST	HIGH UP-FRONT COSTS (POTENTIALLY) LOWEST HIGH-VOLUME OR LONG-TERM
PROS	FREE, EASY TO TURN ON AD BASED REVENUE	LOW COST, EASY TO CUSTOMIZE	MAINTAIN OWNERSHIP, MORE CONTROL	LOWEST-COST LONG TERM
CONS	LIMITED CONTROL, CONTENT REQUIREMENTS	LIMITATIONS ON MONETIZATION UNLESS YOU USE THEIR MORE EXPENSIVE PLATFORM	HIGHER COST	HARDEST TO DO

High Dynamic Range (HDR) Video

What is HDR, Why?

Image from amazon

I hate these "artist's representations"

Image from www.ravepubs.com

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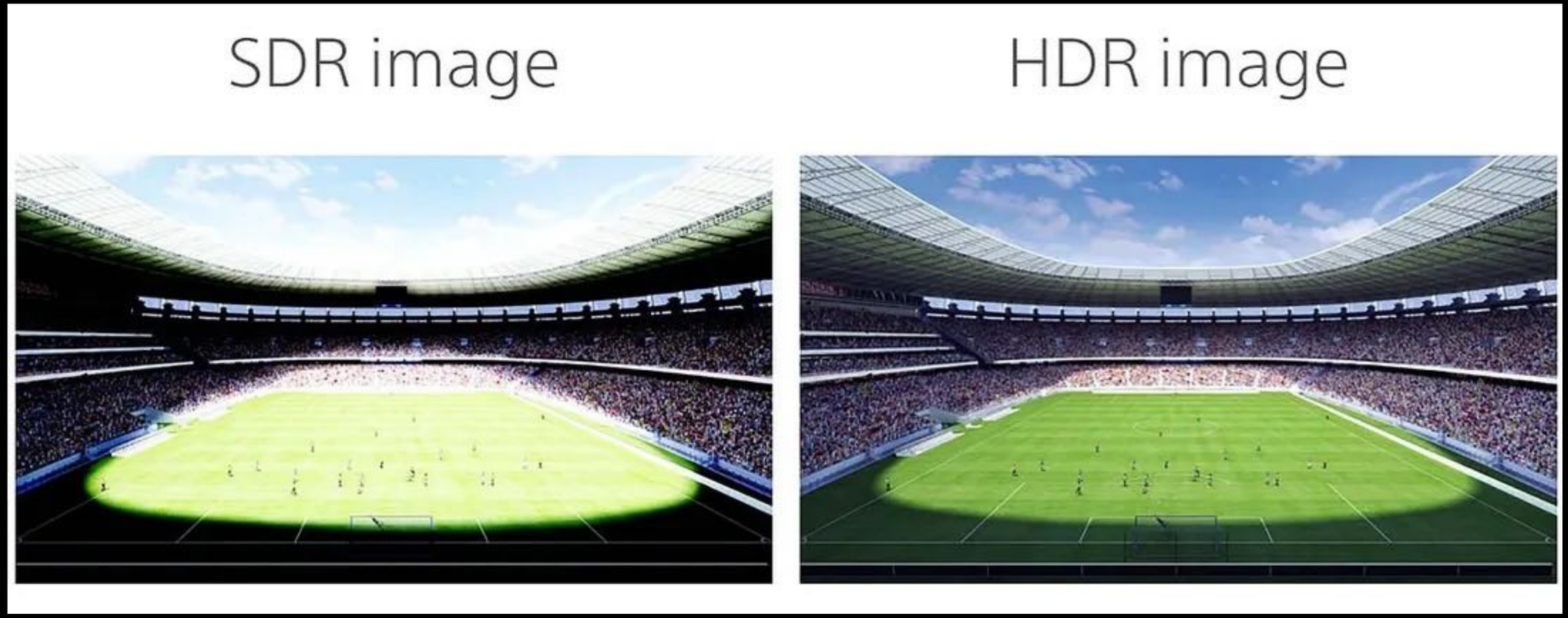

Image from https://www.cnet.com/

High Dynamic Range (HDR) Video

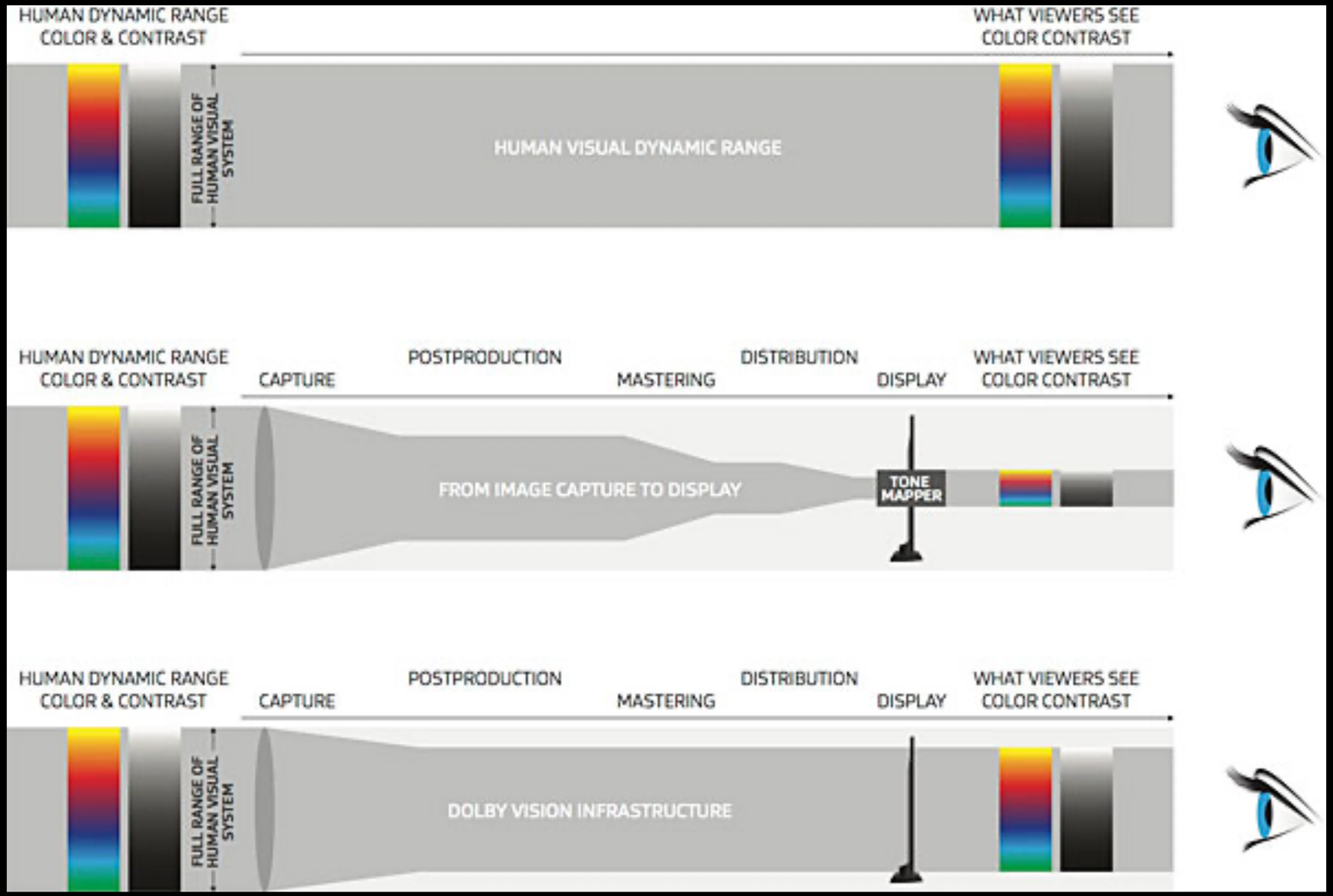

Image from https://www.soundandvision.com

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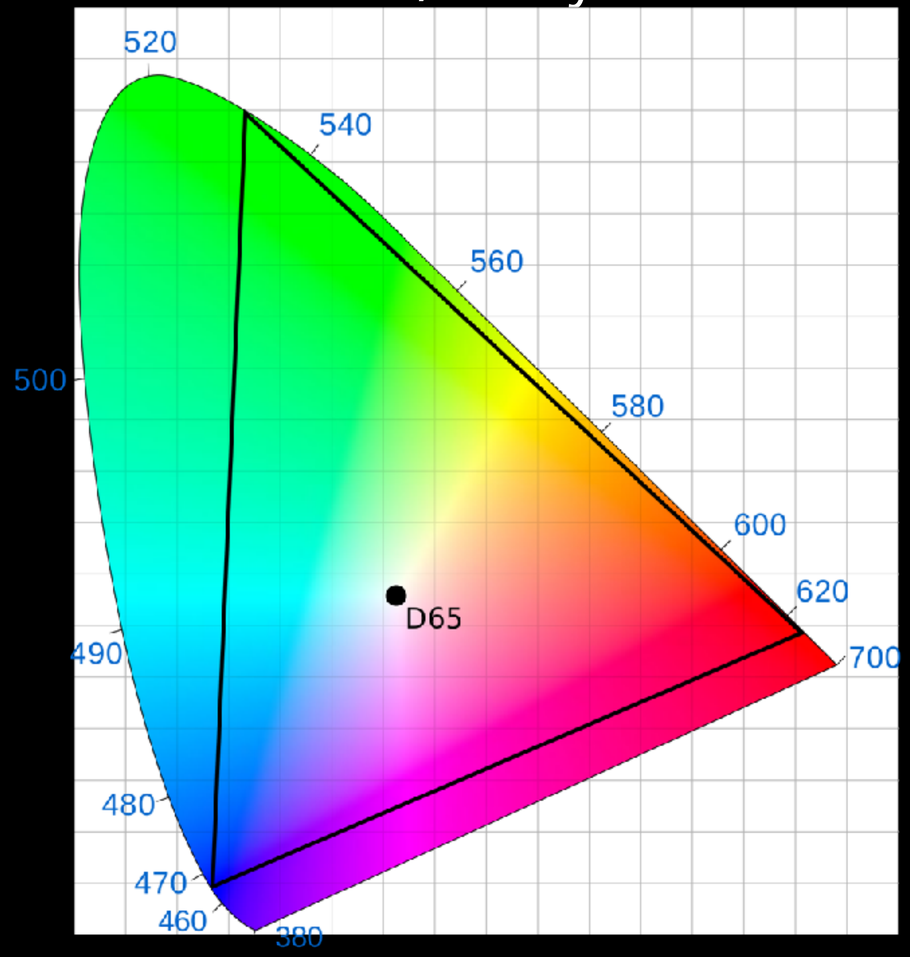


Wide Color Gamut (WCG)

Image from Sakuramboderivative work GrandDrake

Image from https://www.filmtechapp.com

High Dynamic Range (HDR) Video

Image from amazon

Flavors of HDR

	METADATA	COMPATIBILITY / ADOPTION	BENEFITS
HDR 10	STATIC PER VIDEO	HIGHEST	ADOPTION
HDR10+	DYNAMIC	LOW	"BETTER HDR"
Dolby Vision	DYNAMIC	HIGH	"BETTER HDR"
HLG	STATIC	MODERATE	BROACAST COMPATIBILITY

Making HDR

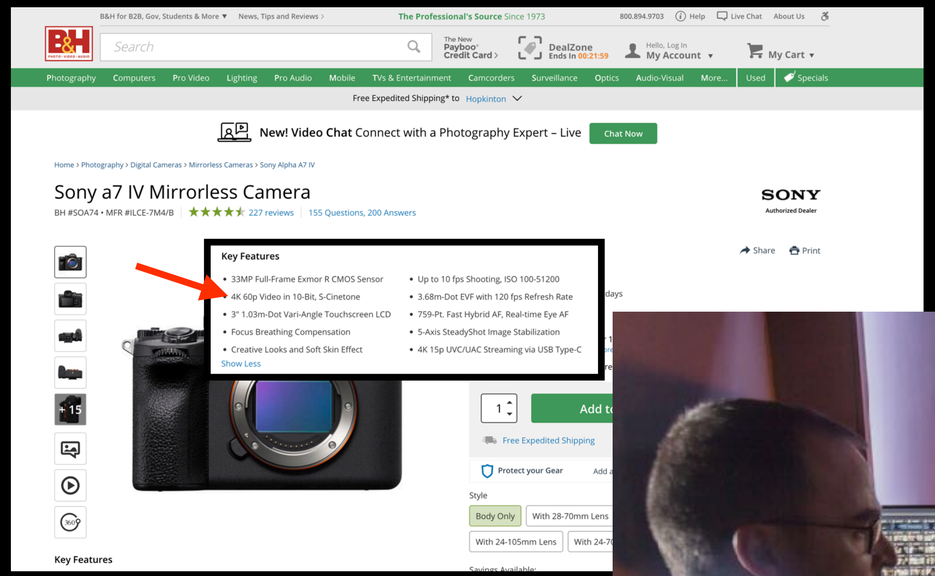


Image from b&h

Image from https://www.studiodaily.com

Image from https://www.youtube.com/

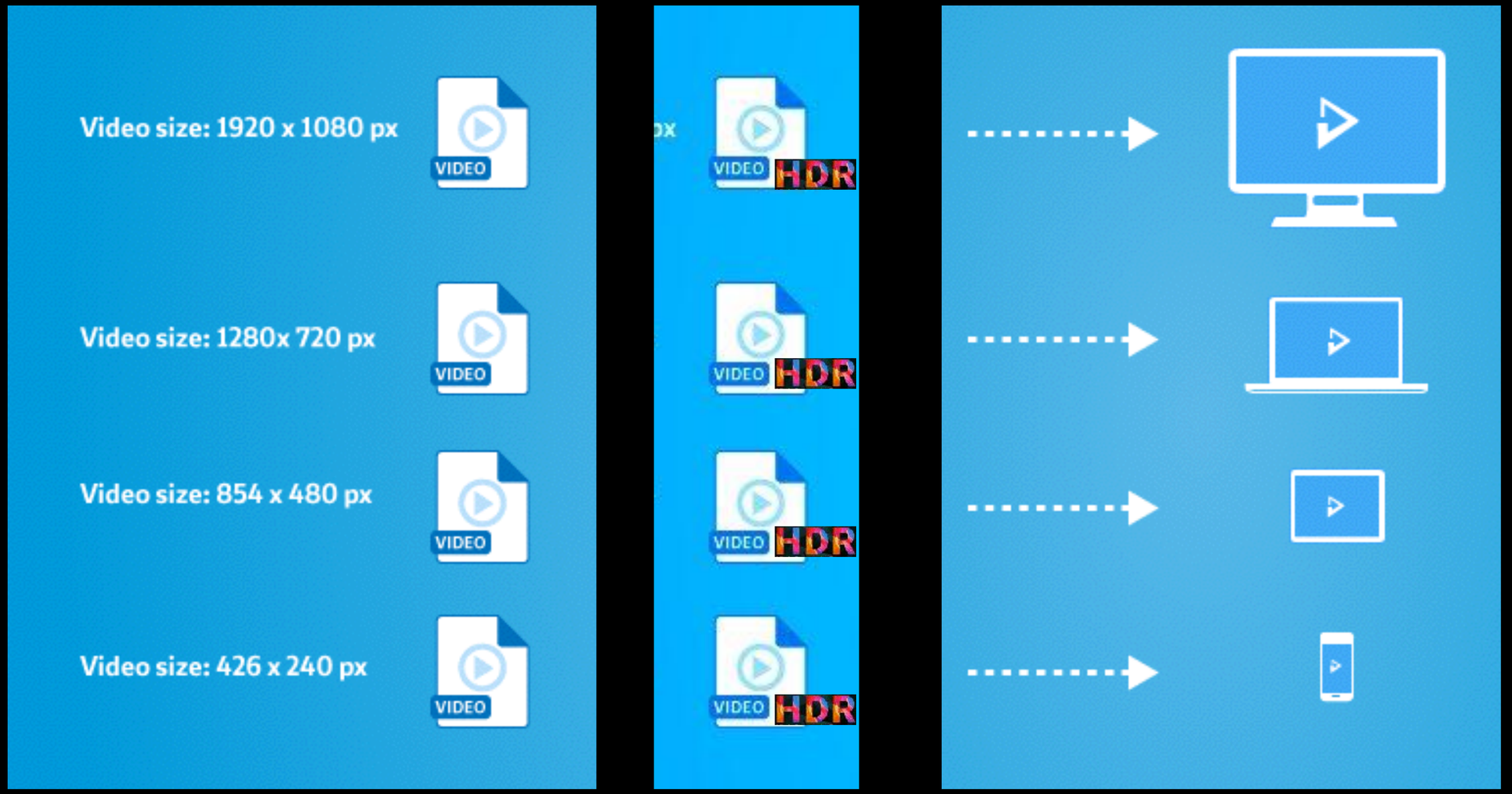
Making HDR

Image from https://www.flatpanelshd.com/

Image from https://wccftech.com/

Distributing and Playing HDR

Adaptive Bitrate



HDR Takeaways

Capture in as high a quality as you can afford
Making HDR depends on your camera/monitor!
HDR adoption is growing
This is a complicated world that will get easier

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