



DIGITAL PRODUCTION
CHALLENGE II

AMSTERDAM 2017

Digital shoot,
Film shoot,
Digital postproduction,
Digital workflow,
How to choose?

Tuesday 28 November to Friday 1 December 2017









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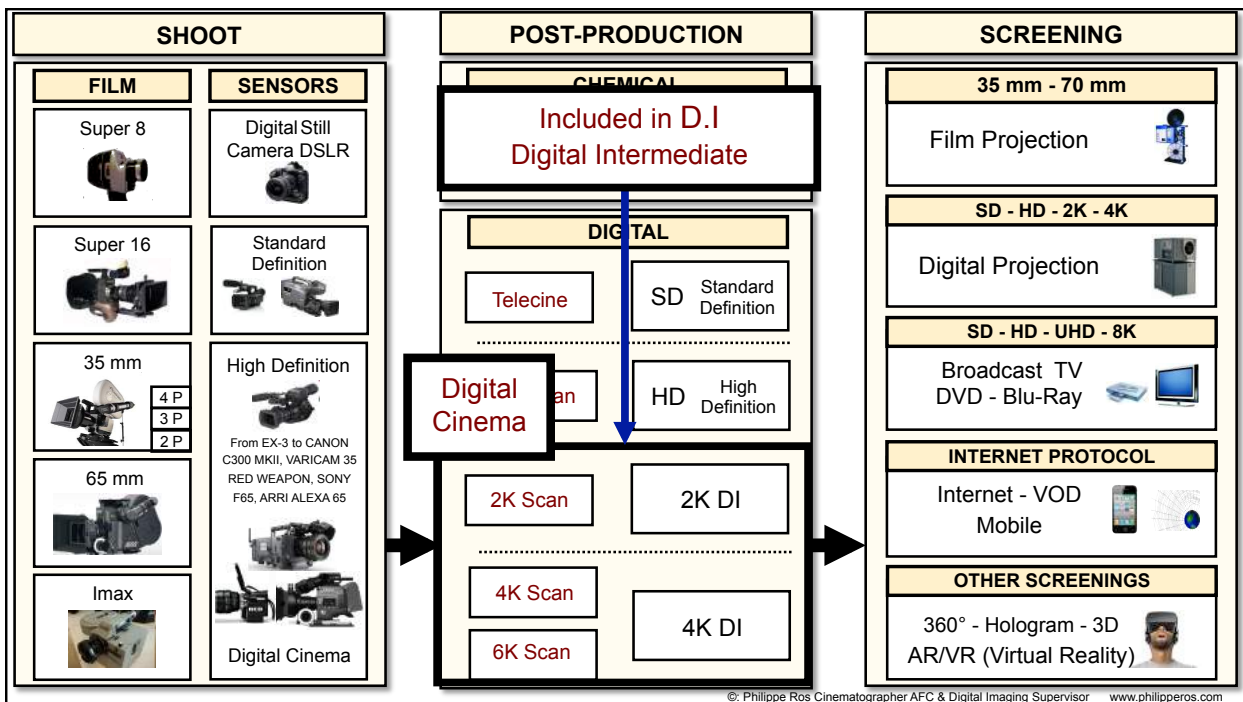
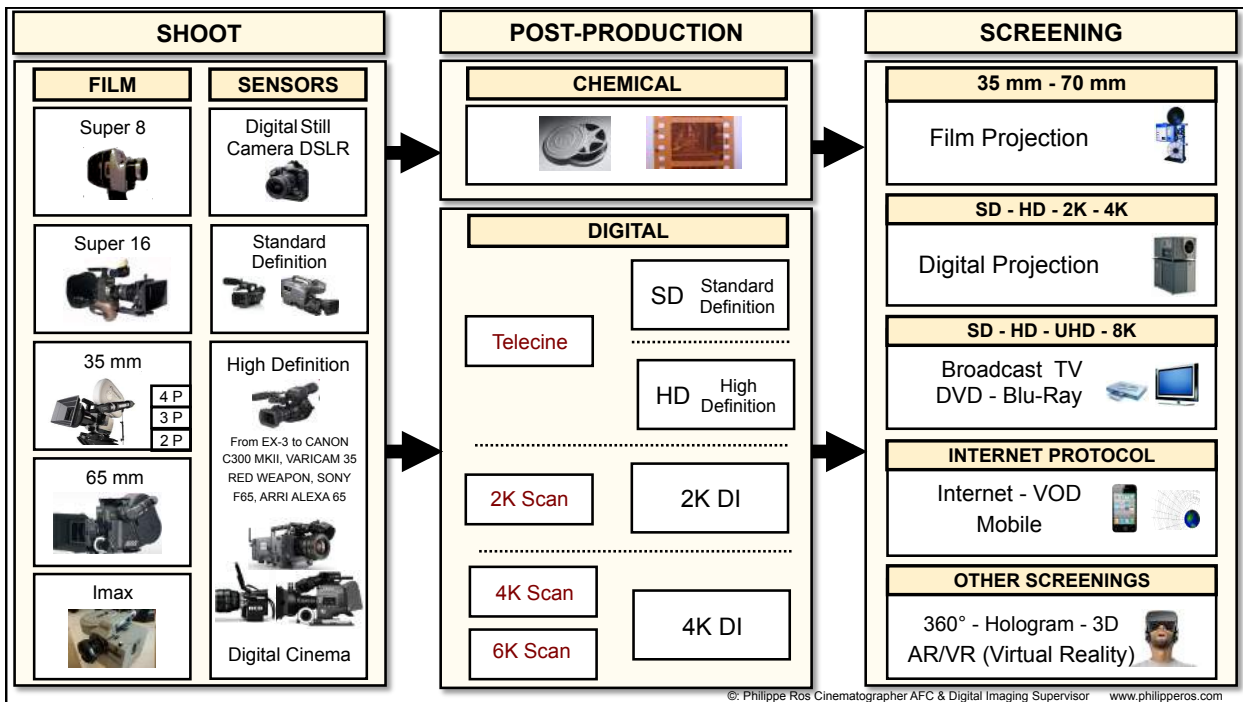
The first questions

What is the feature or program's end destination?

Multiple Deliveries

▪ D-cinema digital projection (2K / 4K)? 3D?	
▪ 35 mm theater exhibition? Imax? Imax 3D?	
▪ HD digital projection? E-cinema? Large displays	
▪ Ultra HD? HDTV broadcast? 3D broadcast?	
▪ Augmented/Virtual Reality distribution?	
▪ Internet? VOD? Mobile phones?	
▪ DVD? Blu-ray distribution?	
▪ Current TV broadcast?	

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The digital intermediate

The digital intermediate

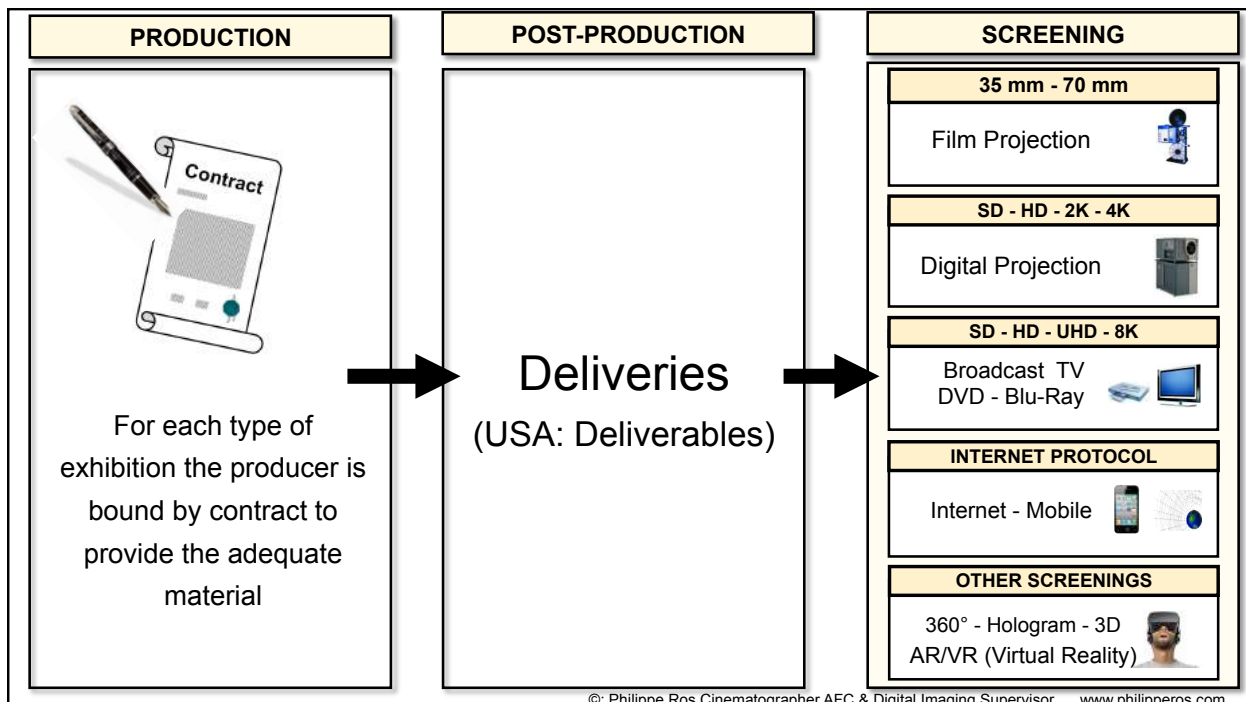
The process consists of the following components:

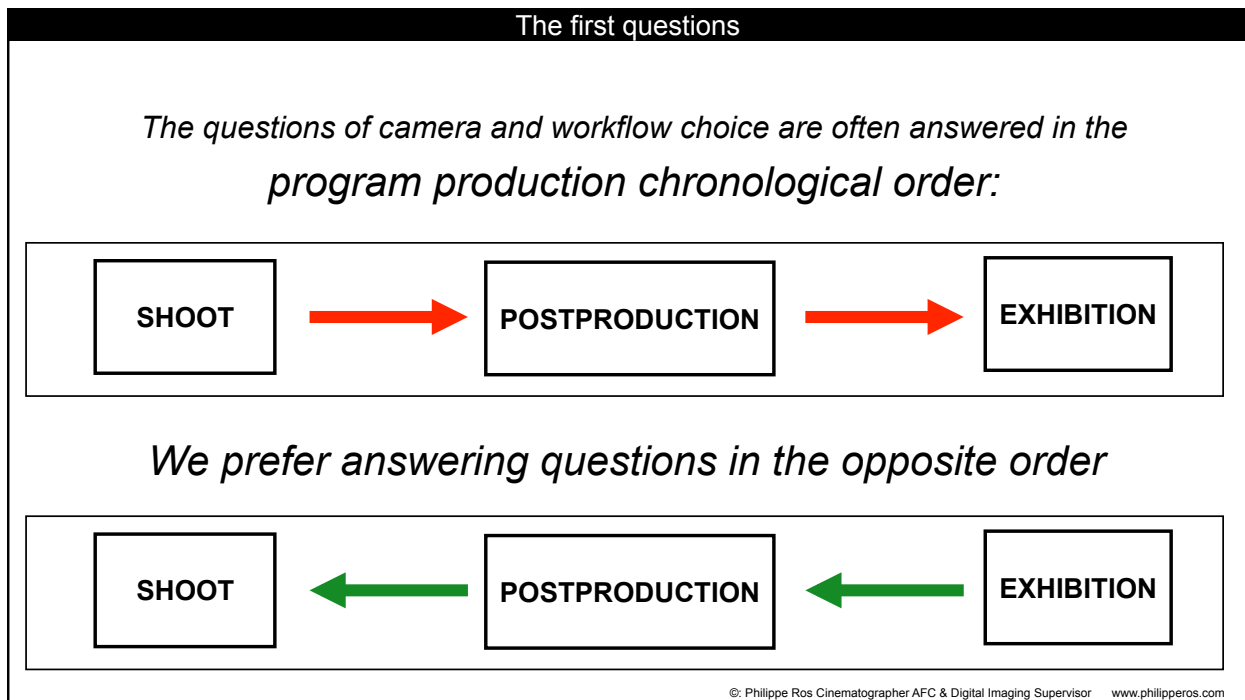
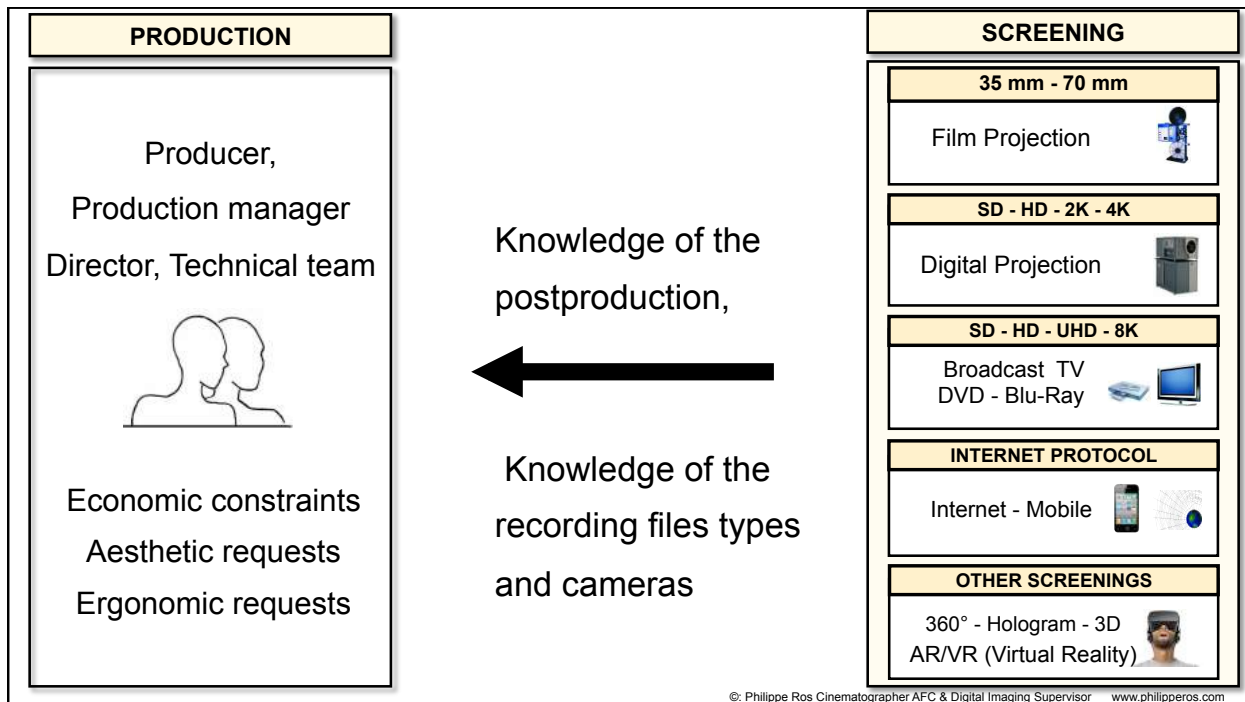
- Editorial Prep
- Scanning (when it's film)
- Assembling
- Color Correction
- Dustbusting
- Digital Opticals
- Special VFX
- Digital Previewing
- Recording
- Digital Deliverables

The original capture can be a regular film as well as a digital one.



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File formats or file types?: **File types**

Cameras generate recording file types, scan generate files which are used all along the process till the grading
Post-production generate file types.
All these files types own specificites : definition, frequency (speed), color space...

THESE CHARACTERISTIC ARE GIVING AN ID TO THE FILE TYPE;

RECORDING FILE TYPES

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The first questions

The DCP

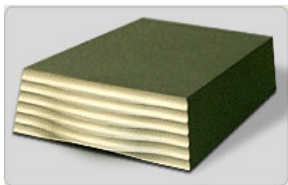
- D-cinema digital projection (2K / 4K)? 3D?



The DCP or Digital Cinéma Packaging is the release format for D-Cinéma (Digital Cinema), the frame being encoded in JPEG 2000.

D-Cinema **2K** frame format: 2048 pixels x 1080 lines

D-Cinema **4K** frame format: 4096 pixels x 2160 lines



Reusable hard disk capacity:

2 long-feature films

FORMAT: Compressed, split up in "reels"

SECURITY: Encrypted using [128-bit AES](#)



The first questions

DPC FPS STANDARDS 2015

■ D-cinema digital projection (2K / 4K)? 3D?

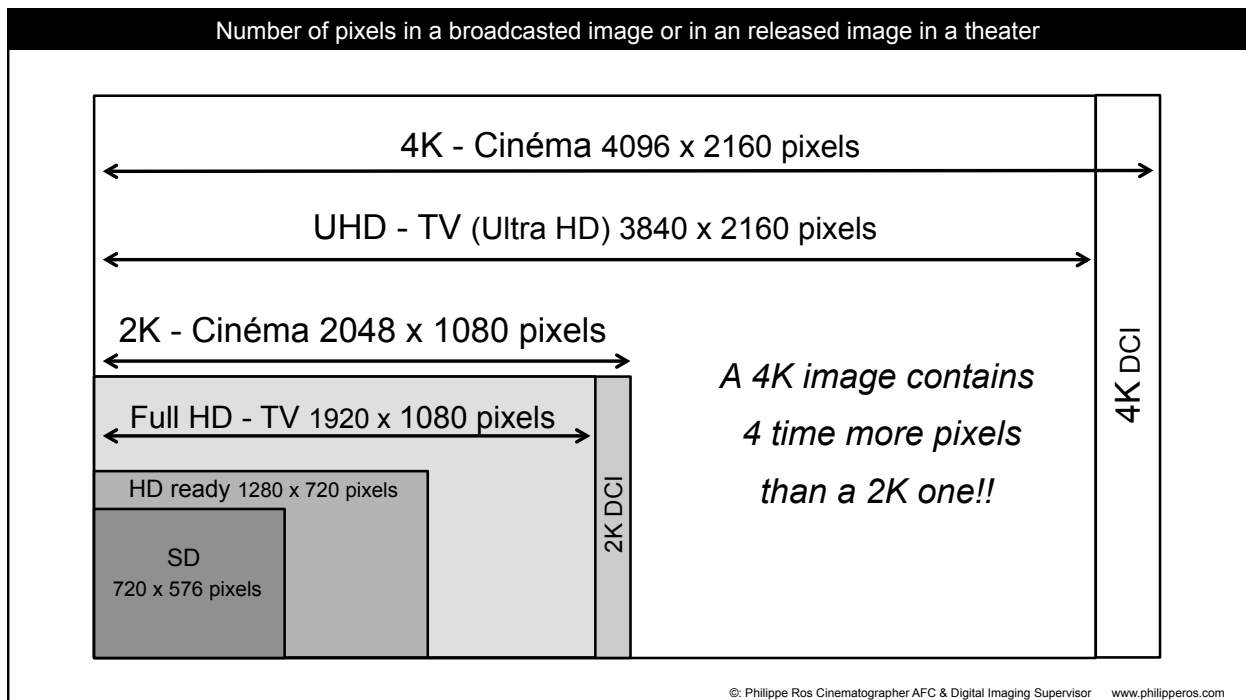
Here is the list of speeds that has been standardized (SMPTE 2009, ISO 2011)

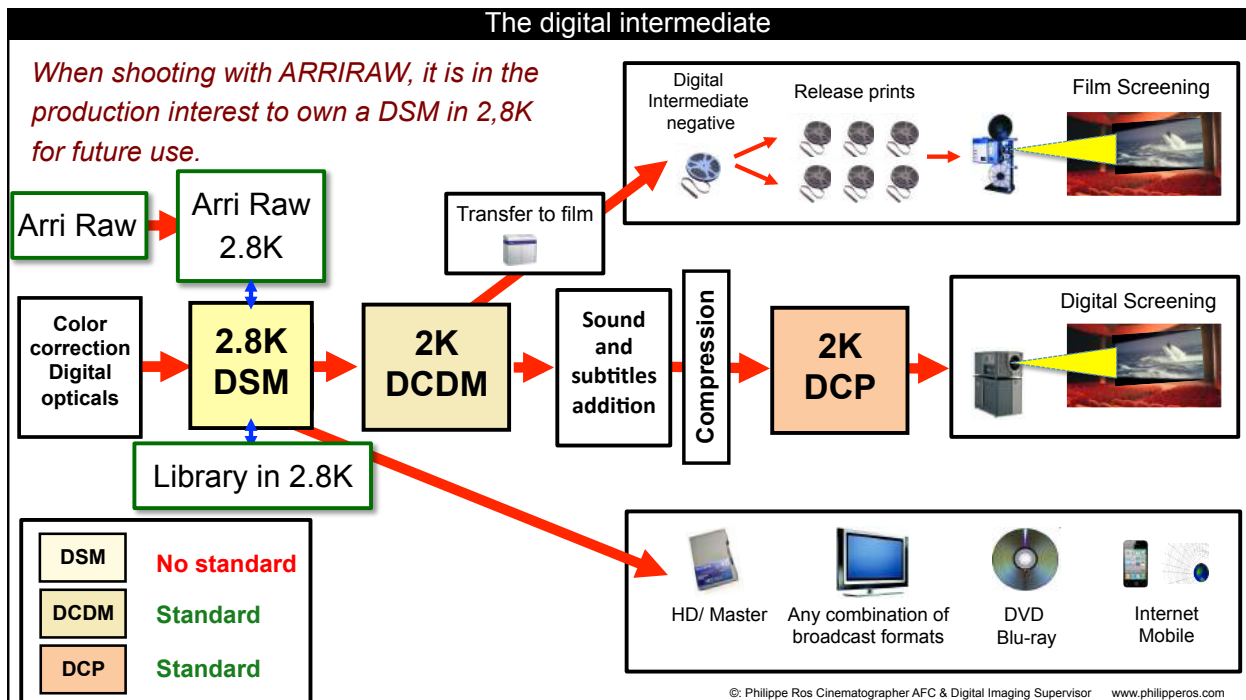
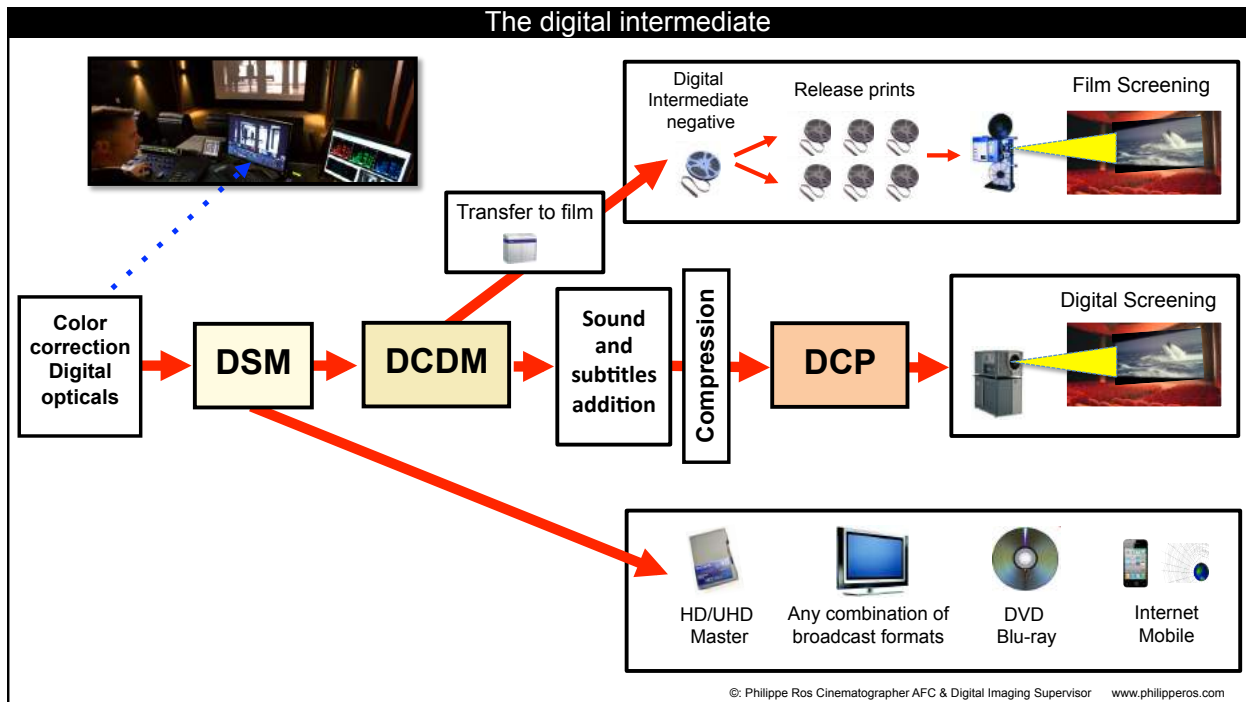
2K	4K	3D
24 fps 2D 2K	24 fps 2D 4K	24 fps 3D 2K
25 fps 2D 2K	25 fps 2D 4K	25 fps 3D 2K
30 fps 2D 2K	30 fps 2D 4K	30 fps 3D 2K
48 fps 2D 2K		48 fps 3D 2K *
50 fps 2D 2K		50 fps 3D 2K *
60 fps 2D 2K		60 fps 3D 2K *

(All these 6 will run on many of even the oldest installations) (eg Any TI-DLP based projector with a Doremi server will do all six, and Doremi has more than 70% of the world market.... The majority of owners, however, do not know that their equipment can do it)

* The last three can only run on server/projectors manufactured after jan 2012 (Requires an Internal Media Block in the projector) and were standardized by SMPTE in 2013 only. All others 2009.

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Some infos

- 1 bits
- 1 Byte = 1 Octet = 8 bits
- One disk of 320 Mo or 320 MB
- A feature film width : 1h ½ = 1,2 To

Multiple of Octets

Name	Symbol	Value
Kiloctet	Ko	10 ³
Mégaoctet	Mo	10 ⁶
Gigaoctet	Go	10 ⁹
Téraoctet	To	10 ¹²
Pétaoctet	Po	10 ¹⁵
Exaoctet	Eo	10 ¹⁸
Zettaoctet	Zo	10 ²¹
Yottaoctet	Yo	10 ²⁴

Bitrate required to transmit one HD image

- 1920 pixels (L) x 1080 lines (H) x 3 (colour chanel) x 10 bits x 25 fps = 1,55 Gb/s
- 1920 pixels (L) x 1080 lines (H) x 3 (colour chanel) x 8 bits x 25 fps = 1,25 Gb/s

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Storage device (Media)

STORAGE DEVICE - MEDIA

WHAT IS IMPORTANT TO KNOW ABOUT MEDIA PERFORMANCES

- Type of file format recordable (Codec, frame rate, resolution, bitrate, color sampling, quantification, container)
- High speed recording capacities. Frame rate is an important parameter
- Recording times/capacities
- Minimum/maximum read/write speed
- Some manufacturers guarantee speeds, some not.
- Transfer speeds (offload) linked to readers/accessories/adapters. Transfer speeds vary and are dependent on host device.
- Combination between camera and media (example: Arri Amira approves or not media)

WHAT IS IMPORTANT TO KNOW ABOUT THE WAY CAMERA MANUFACTURERS ARE HANDLING & CHOOSING THE MEDIA - THE RECONSTRUCTION

- Example: SxS Cards, they are designed for motion picture and they contain safety tools (controller with an intelligence function). Files can be reconstructed in a special Sony center in Brussels

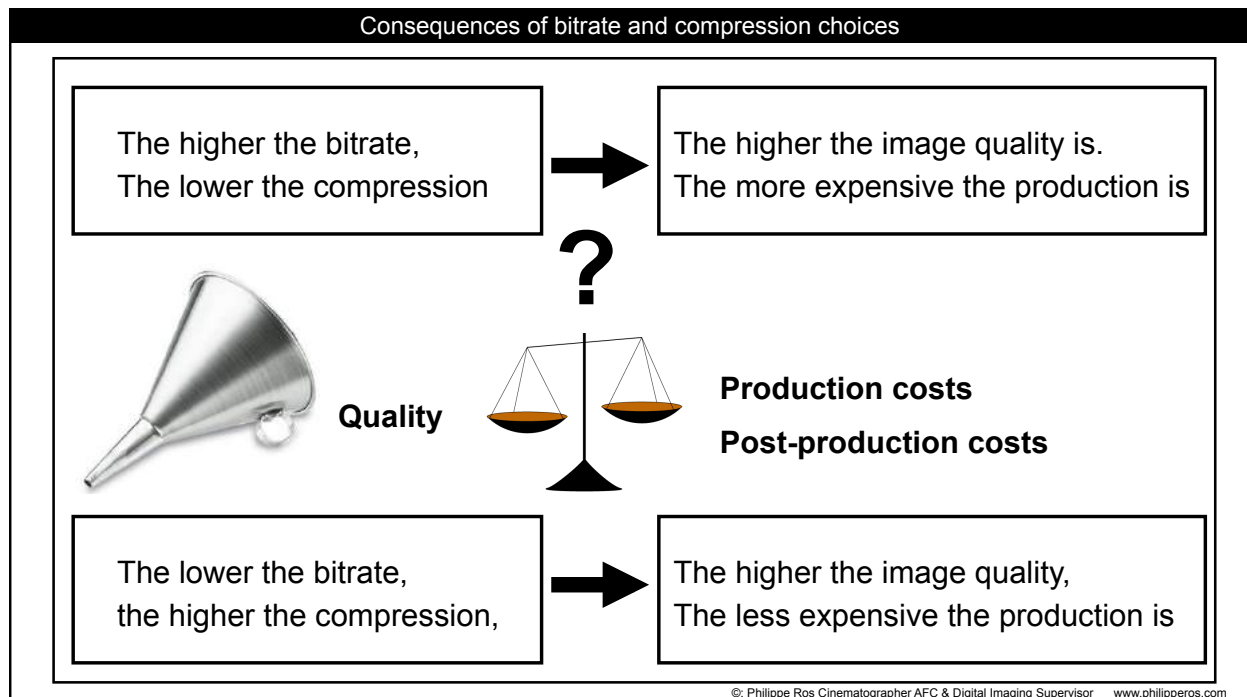


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Important point


The frequency or frame rate or speed is a key point.
Don't choose any setting of frame rate without knowing the delivery demands.

Consequences of bitrate and compression choices




The new balances

Generally each program results from a compromise between:



Quality **Production costs**

Nowadays:




Quality **Production costs**
Post-production costs
Exhibition costs

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Bitrate & Codec

The bitrate, Mbp/s (number of information per second) depends :

- On the image width (from 960 pixels to 4096 pixels, even more)
- On the image height (from 720 pixels to 3072 pixels, even more)
- On the signal processing (Raw, RVB or Component Y-Cb- Cr)
- On the quantization (8-bit, 10-bit, 12-bit, 16-bit, 32-bit)
- On the frequency (or speed) (23.98, 24, 25, 29.97,30, 50, 59.94,60 fps, ...)
- On the Codec type used (Jpeg 2000, ProRez, XAVC, Mpeg2...)




Codec : Coding - Decoding


Example : JPEG 2000 (300 Mb/s) - ProRes 12-bit 4:4:4:4 (280Mb/s) - AVC-Intra 100 (100 Mb/s)

Three important notions


Bitrate



Compression



Information reduction





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Consequences of bitrate and compression choices

What is the advantage for SFX and grading of having :




- 10 bits rather than 8 bits ?
- 10 bits RGB rather than 10 bits Y-Pb-Pr ?:
 - ✓ Keying made easier
 - ✓ Compositing made easier
 - ✓ Better rendering of flesh tones
 - ✓ Color correction made easier

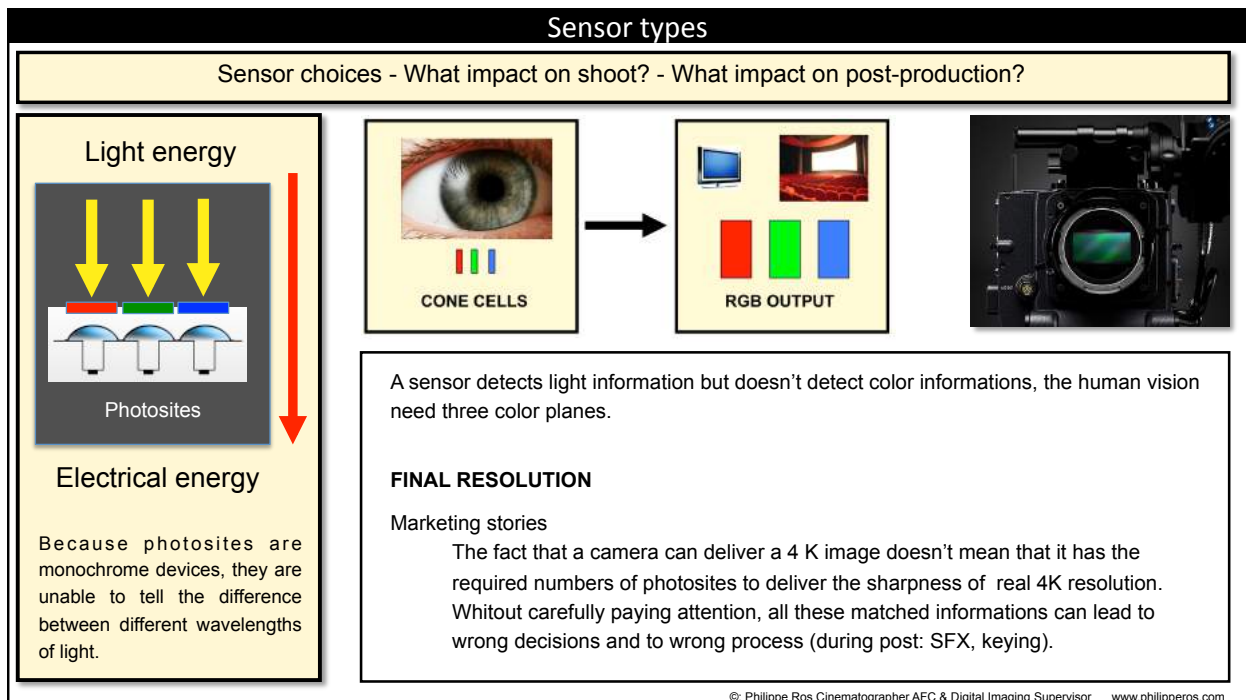
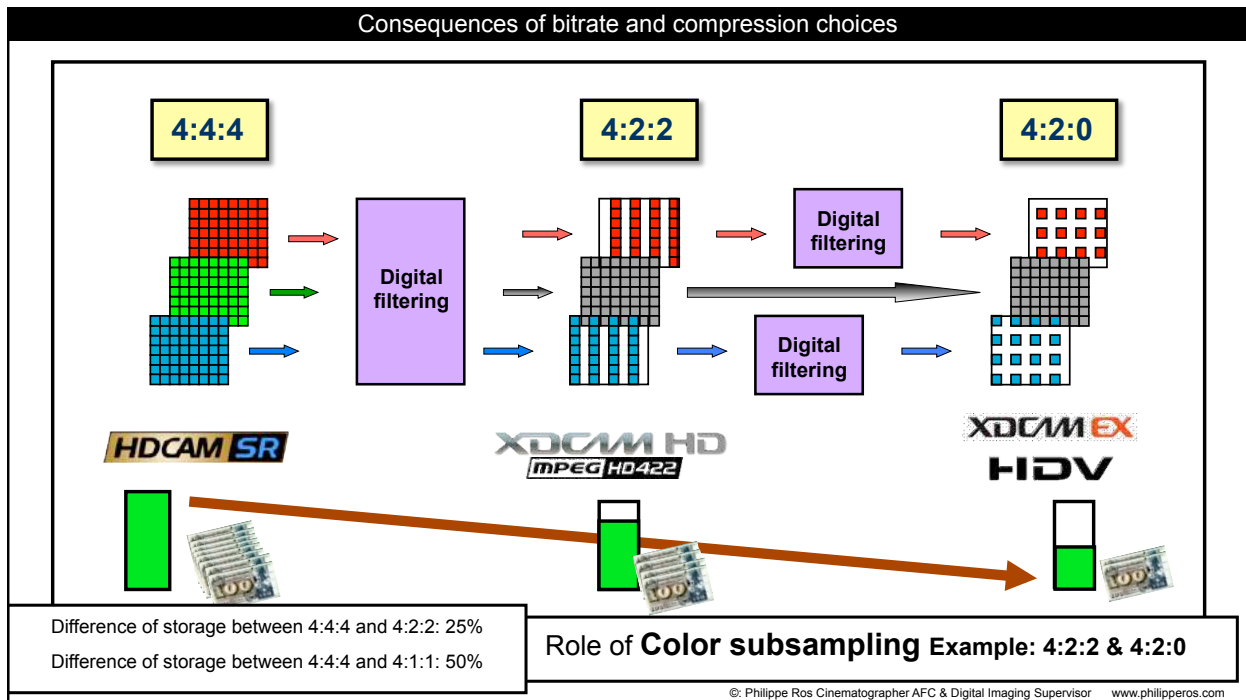
All these choices are not trivial.
The consequences on the finished film's quality and cost must totally be taken into account.

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Consequences of bitrate and compression choices

 Alexa (Arri SxS recording) 12 bits 4:4:4:4 330 Mb/s	 F35 (Sony) 10 bits 4:4:4 440 Mb/s or 880 Mb/s	 EOS C300 (Canon) 8 bits 4:2:2 50 Mb/s
4096 shades of grey in the Red channel	1024 shades of grey in the Red channel	256 shades of grey in the Red channel
4096 shades of grey in the Green channel	1024 shades of grey in the Green channel	256 shades of grey in the luminance channel
4096 shades of grey in the Blue channel	1024 shades of grey in the Blue channel	256 shades of grey in the Blue channel
Colour depth: 4096 x 4096 x 4096= More than 68 billion of colors	Colour depth: 1024 x 1024 x 1024= More than 1 billion of colors	Colour depth: 256 x 256 x 256 But with component Y Cb Cr sampling: More than 1,2 million of colors but less possibilities due to compression

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Camera sensor - Pixels vs Photosites

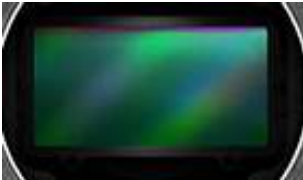
Great confusion or / and good marketing between:

- Number of photosites
- Size of the sensor
- Number of sensors
- Type of sensor
- Number of pixels recorded
- Resolution / sharpness / MTF
- Recording format
- Exhibition format

In postproduction 2K and 4K refers to the output of a line array scanner scanning film, so that for each frame scanned at 4K, you wind up with 4K red pixels, 4K green and 4K blue.

There are no pixels on a sensor but photosites. Pixels appears during sampling and recording

The type of sensor will have a direct influence on the workflow and therefore on the budget



SENSOR

RECORDING

POSTPRODUCTION & EXHIBITION

PHOTOSITES

SAMPLING & PIXELS


PIXELS

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Sensor types

▪ **The 3 x sensors cameras (examples)**


F23 (Sony)
3-chip 2/3-inch
1920 x 1080 x 3
photosites




HDW-F900 (Sony)
2/3" 3-CCD sensor
1920 x 1080 x 3
photosites

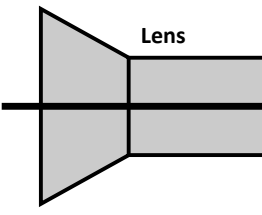


AJ-HPX 3700
2/3" 3-CCD sensor
1920 x 1080 x 3
photosites

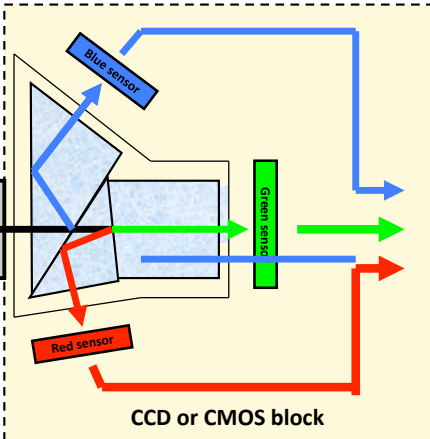


EX-3 (Sony)
3 x 1/2" CMOS sensor
1920 x 1080 x 3 photosites






Camera block



CCD or CMOS block

RGB OUTPUT



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Sensor types

- The 1 x sensor cameras - The Striped pattern (examples)**

UNIT CELL

MACRO CELL

Genesis
(Panavision)
Mono CCD sensor Striped pattern
5760 x 2160 photosites

F35 (Sony)
Mono CCD sensor
1920 x 1080 x 3
photosites

RGB OUTPUT

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Sensor types

- The 1 Sensor cameras - The Bayer pattern - The CFA**

In the Bayer pattern, green samples are arranged in a checkerboard pattern, and the red and blue samples are arranged in rectangular grid pattern. The density the green samples are twice that of the red and blue ones. The CFA (Color Filter Array or CFM Color Mosaic Array) is positioned on top of the sensor to filter out the red, green, and blue components of light falling onto it.

B	G	B	G	B	G	B	G	B	G
G	R	G	R	G	R	G	R	G	R
B	G	B	G	B	G	B	G	B	G
G	R	G	R	G	R	G	R	G	R
B	G	B	G	B	G	B	G	B	G
G	R	G	R	G	R	G	R	G	R

2 x G G for 1 x R & 1 x B

The reason for why there are more green samples than red or blue samples is that the human visual system is more sensitive to luminance rather than chrominance. Luminance contains important spatial information, and we would like to preserve as much spatial detail as possible during the process.

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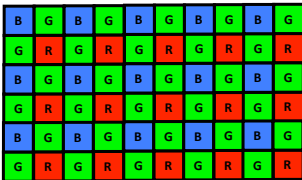
Sensor types

▪ **The 1 Sensor cameras** - The Bayer pattern

A Bayer filter could be defined as a **digital negative** which is used during post-production to restore an RGB flow

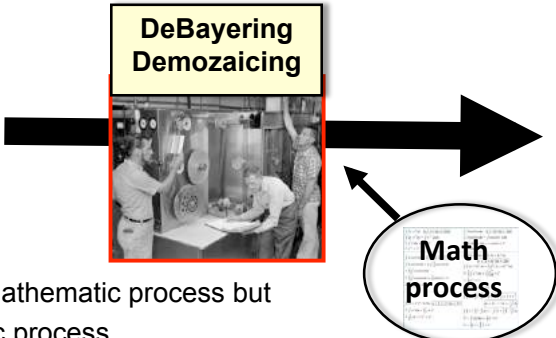
We are in front of a **lab**, a software which develops images and which:

- Is not always built-in
- Is not always done real time.
- Can be done in various ways than the mcamera manufacturer (Irridas, Glue Tools, Phantom, ColorFront)




DeBayering is not only a mathematic process but also an artistic process.

DeBayering Demozaicing




RGB OUTPUT





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Sensor types


▪ **The 1 Sensor cameras** - The Bayer pattern



VENICE
(Sony)



ALEXA
(Arri)

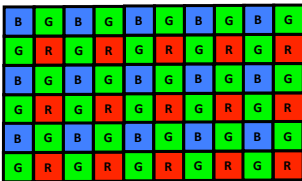

EPIC
(Red Digital Cinema)


F55
(Sony)

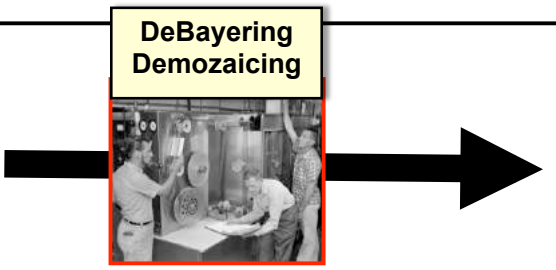

C700
(Canon)


VARICAM PURE
(Panasonic)



URSA
(Black Magic)



DeBayering Demozaicing



RGB OUTPUT



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