DIGITAL PRODUCTION CHALLENGE

How to deal with the developments of the digital era

Warsaw, 28 – 30 November 2013

Film shooting

Digital shooting

Digital postproduction

Digital workflow

How to choose ?

FOCAL

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The first questions

What is the feature or program's end destination?

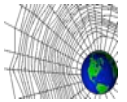
- **35 mm theater exhibition? Imax? Imax 3D?**

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

- **HD digital projection, E-cinema, large displays?**

- **Ultra HD? HDTV broadcast? 3D broadcast?**

- **Internet?**



- **Current TV broadcast?**

- **DVD - HD distribution?**

The DCP

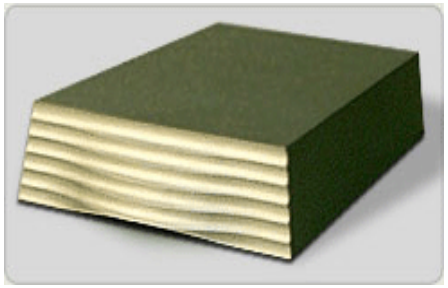
The first questions

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

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

D-Cinema 2K frame format: 2048 pixels x 1080 lines (this is neither HD nor 2K).

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



FORMAT: Compressed, split up in 'reels'

SECURITY: Encrypted using 128-bit AES

Reusable hard disk capacity:
2 long-feature films

Commun hard disk dimensions:
17 x 12 x 4 cm (L x l x h)

SHOOT

FILM

Super 8

Super 16

35 mm

4 P
3 P
2 P

65 mm

Imax

SENSORS

Digital still camera

Standard Definition

From DVcam to Digital Betacam

High Definition

From EX-3 to EPIC, ALEXA, F65

Digital Cinema

POST-PRODUCTION

CHEMICAL

DIGITAL

Telecine — **SD Standard Definition**

TeleScan — **HD High Definition**

2K Scan — **2 K**

4K Scan — **4 K**

SCREENING

35 mm / 70 mm

Film screening

SD / HD / 2K / 4K

Digital screening

SD / HD / ULTRA HD

TV Broadcast - DVD
Mobile Blu-Ray Internet

SHOOT

FILM

Super 8

Super 16

35 mm

4 P
3 P
2 P

65 mm

Imax

SENSORS

Digital still camera

Standard Definition

From DVcam to Digital Betacam

High Definition

From EX-3 to EPIC, ALEXA, F65

Digital Cinema

POST-PRODUCTION

Included in **D.I.**
Digital Intermediate

DIGITAL

Telecine

SD Standard Definition

HD High Definition

Digital Cinema

2K Scan

2 K

4K Scan

4 K

SCREENING

35 mm / 70 mm

Film screening

SD / HD / 2K / 4K

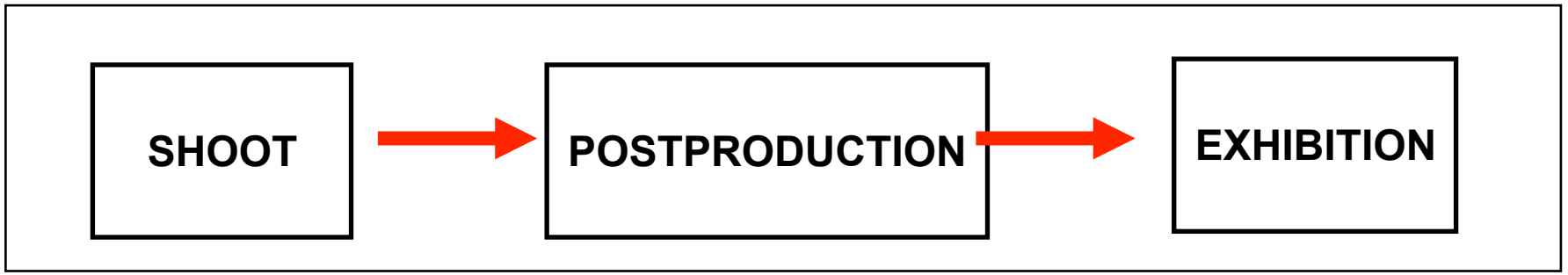
Digital screening

SD / HD / ULTRA HD

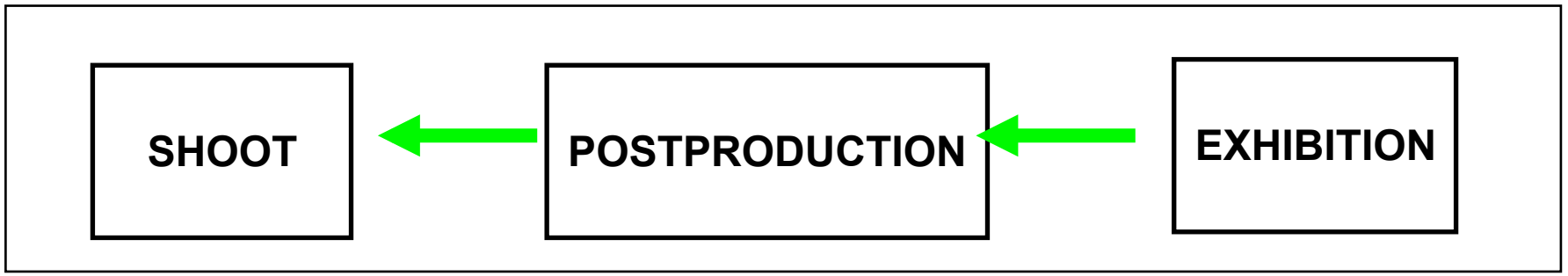
TV Broadcast - DVD
Mobile Blu-Ray Internet

The first questions

This diagram represents only a chronological flow but does not allow to choose shooting and postproduction tools



We prefer answering questions in the opposite order



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

DSM / DCDM / DCP

KW 2

DSM

Digital Source Master

The DSM is the result of the mastering process of the post-production and contains the finalised image and audio data. These serve as starting point for the creation of the Digital Cinema Package (DCP). The DSM can also be used to convert a master for archival purposes.

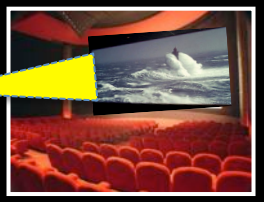
DCDM

Digital Cinema Distribution Master contains all of the digital material needed for projection.
Images and sound.
Color Space; x,y,z Tiff 16 bits

Digital Intermediate negative

Release prints

Film Screening



Transfer to film

Color correction Digital opticals

DSM

DCDM

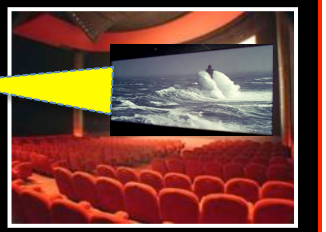
Sound and subtitles addition

Compression

DCP = 35 mm copy print

DCP

Digital Screening



DSM	No standard
DCDM	Standard
DCP	Standard

HD Master

Any combination of broadcast formats

DVD - Blu-ray

Role of **Quantification & Sampling**

Alexa (SxS recording)
12 bits 4:4:4:4
330 Mb/s

4096 shades of grey in the **Red** channel

4096 shades of grey in the **Green** channel

4096 shades of grey in the **Blue** channel

Colour depth:

4096 x 4096 x 4096=
More than 68 milliard of colours

F35 (Sony)
10 bits 4:4:4
440 Mb/s or 880 Mb/s

1024 shades of grey in the **Red** channel

1024 shades of grey in the **Green** channel

1024 shades of grey in the **Blue** channel

Colour depth:

1024 x 1024 x 1024=
More than 1 milliard of colours

EOS C300 (Canon)
8 bits 4:2:2
50 Mb/s

256 shades of grey in the **Red** channel

256 shades of grey in the **Green** channel

256 shades of grey in the **Blue** channel

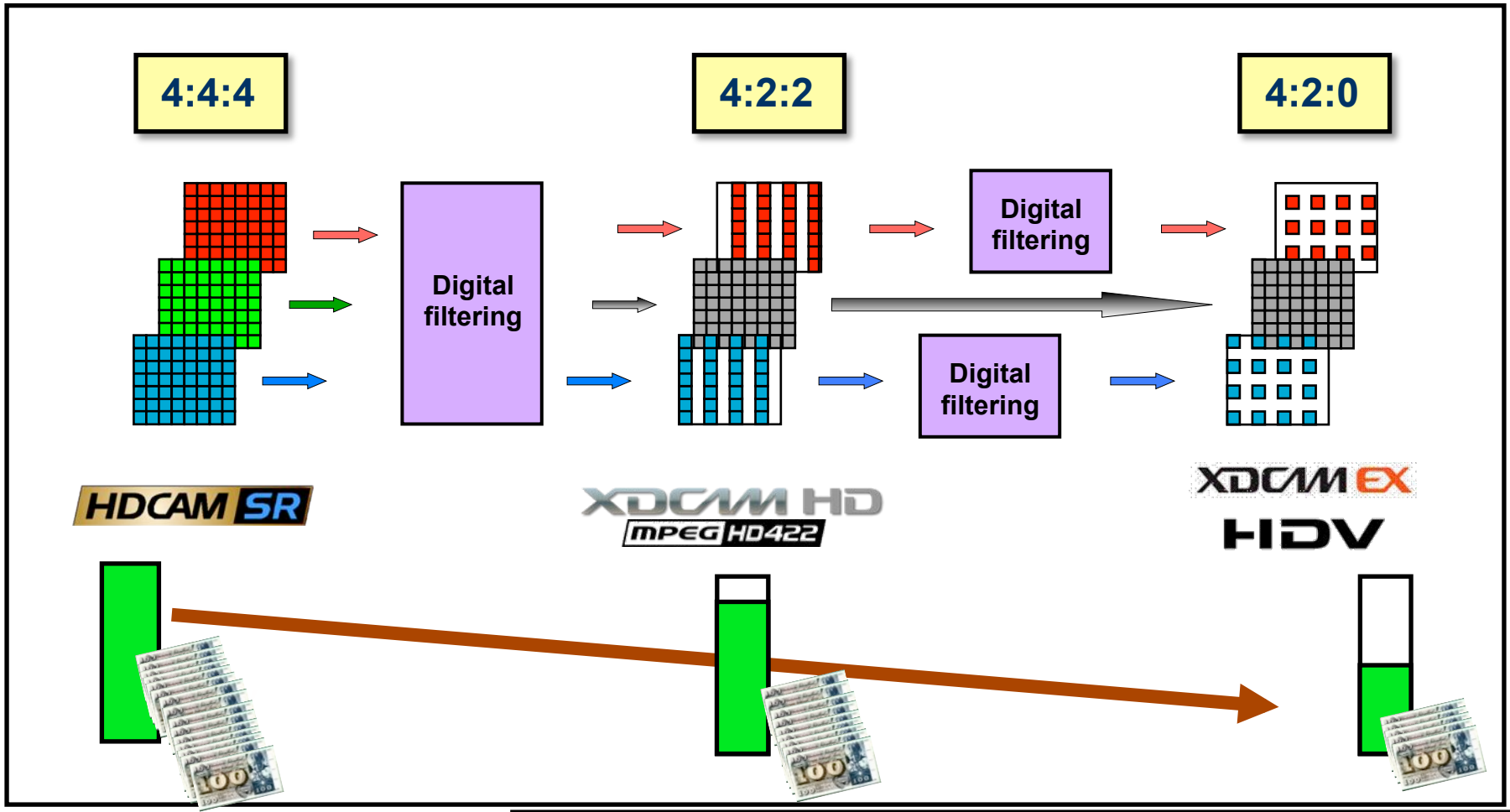
Colour depth:

256 x 256 x 256 with component Y Cb Cr sampling:

16 777 216 colours

but less possibilities due to compression

Consequences of bitrate and compression choices



Chroma sub sampling

Practice of encoding images by implementing less resolution for **Chroma Information (R and B)** than for **Luma information (Y, grey pixels)**. It is used in many **Video Encoding** schemes — both analog and digital — and also in **JPEG Encoding**.

Role of **Color subsampling** **Example: 4:2:2 & 4:2:0**

Difference of storage between 4:4:4 and 4:2:2: 25%

Difference of storage between 4:4:4 and 4:1:1: 50%

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.

Bitrate and codec

The bitrate **(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)
- **On the quantification`** (8 bits, 10 bits or 12 bits)
- **On the frequency (or speed)** (23.98, 24, 25, 29.97,30, 50, 59.94,60 im/sec)
- **On the Codec type used** (Jpeg 2000, HDCal SR, HDCam, Mpeg2…)

Codec : Coding – Decoding

Example : JPEG 2000 (300 Mb/s) - HDCam SR (440 Mb/s) – HDCam (140 Mb/s) – AVC-Intra 100 (100 Mb/s)

Three important notions

Bitrate

Compression

Information reduction

Consequences of bitrate and compression choices

The higher the bitrate,
The lower the compression

→

The higher the image quality,
The more expensive the production.

?

Quality

Production costs

Post-production costs

The lower the bitrate,
the higher the compression,

→

The higher the image quality,
The less expensive the production

Consequences of bitrate and compression choices

Camera

CANON C 300

3840 x 2160 photosites

8 bits 4.2.2
Uncompressed camera output

AJA Ki Pro Mini

Portable recorder
Transcoding

External recording

Codec

50 Mb/s
CF cards

Codec Mpeg2
8 bits 4:2:2
encapsulé en MXF

8 bit output only!!!!
Quality

185 Mb/s

Codec
Apple ProRes 422 (HQ)

Quantification

1920 x 1080 pixels

8 bits

256 grey levels by RGB color

1920 x 1080 pixels

10 bits

1024 grey levels by RGB color

Color Sampling

Subsampling

4:2:2 Y-Cr-Cb COMPONENT

3 colors split in Y luminance (B&W) and Cr & Cb, red and blue difference components

Subsampling

4:2:2 Y-Cr-Cb COMPONENT

3 colors split in Y luminance (B&W) and Cr & Cb, red and blue difference components

Exhibition

TV Broadcasting

Theater Release

Consequences of bitrate and compression choices

Camera

CANON C 500

3840 x 2160 photosites

3G SDI

4K RAW

Uncompressed camera output

Gemini

Portable recorder

Transcoding

External recording

ANOTHER SOLUTION

50 Mb/s

CF cards

Codec Mpeg2

8 bits 4:2:2

encapsulé en MXF

Mb/s

DPX

10 bit 4:4:4

Quantification

1920 x 1080 pixels

8 bits

256 grey levels by RGB color

4096 x 2160 pixels

10 bits

1024 grey levels by RGB color

Color Sampling

Subsampling

4:2:2 Y-Cr-Cb COMPONENT

3 colors split in Y luminance (B&W) and Cr & Cb, red and blue difference components

4:4:4 RGB

Luminance information equal to chroma information

Exhibition

TV Broadcasting

Theater Release

Consequences of bitrate and compression choices

Camera

Sony PMW-EX3

1920 x 1080
x 3 photosites

8 bits 4.2.2
Uncompressed
camera output

AJA Ki Pro Mini

Portable recorder
Transcoding

External recording

ANOTHER SOLUTION

35 Mb/s
Carte SxS

Codec Mpeg2
Long GOP HQ mode VBR
8 bits 4:2:0
encapsulé en MXF

185 Mb/s

Codec
Apple ProRes 422 (HQ)
or
Apple ProRes 422
Apple ProRes (LT)
Apple ProRes (Proxy)

Quantification

1920 x 1080 pixels

8 bits

256 grey levels by RGB color

1920 x 1080 pixels

10 bits

1024 grey levels by RGB color

Color Sampling

Subsampling

4:2:2 Y-Cr-Cb COMPONENT

3 colors split in Y luminance (B&W) and Cr & Cb, red and blue difference components

Subsampling

4:2:2 Y-Cr-Cb COMPONENT

3 colors split in Y luminance (B&W) and Cr & Cb, red and blue difference components

Exhibition

TV Broadcasting

Theater Release

Consequences of bitrate and compression choices

Camera

Sony PMW-F3

x photosites

10 bits 4.4.4
S Log
Uncompressed camera output

Gemini

Portable recorder
Transcoding

External recording

ANOTHER SOLUTION

35 Mb/s
Carte SxS

Codec Mpeg2
8 bits 4:2:0
encapsulé en MXF

Mb/s

DPX
10 bit 4:4:4

Quantification

1920 x 1080 pixels

8 bits

256 grey levels by RGB color

1920 x 1080 pixels

10 bits

1024 grey levels by RGB color

Color Sampling

Subsampling

4:2:0 Y-Cr-Cb
COMPONENT

3 colors split in Y luminance (B&W) and Cr & Cb, red and blue difference components

4:4:4 RGB

Luminance information equal to chroma information

Exhibition

TV Broadcasting

You can get a Sony F3 with S-Log for € 13,900 in Europe (without external recorder – full set incl. Ki Pro recorder costs you € 14,400)

Theater Release

Bitrate and codec

Issues related with frequencies?

Countries in 60 Hertz (USA, Canada, Japon…):
More easy when editing and mixing with 23.98, 29.97, 59,94 fps

Countries in 50 Hertz (Europe…):
More easy when editing and mixing with 24, 25, 50 fps

Before choosing frequency:
Better to know the country where postproduction will be done

In Europe, better shooting and postproducing in 25 fps,
or in 24 fps if you have to send deliveries to USA, Canada, Japon

Playtime of programmes depends on contracts and depends on frequency.
Better to anticipate safeties during editing for all foreign deliveries.

When shooting abroad, the choice of shutter speed depends on country-specific frequency

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**
- **Definition/ sharpness / MTF**
- **Recording format**
- **Exhibition format**

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

FINAL DEFINITION

Marketing stories

The fact that a camera can deliver a 4 K image doesn't mean that it has the required numbers of photosites to deliver a real 4K definition.

Whitout carefully paying attention, all these matched informations can lead to wrong decisions and to wrong process (during post: SFX, keying).

Sensor types

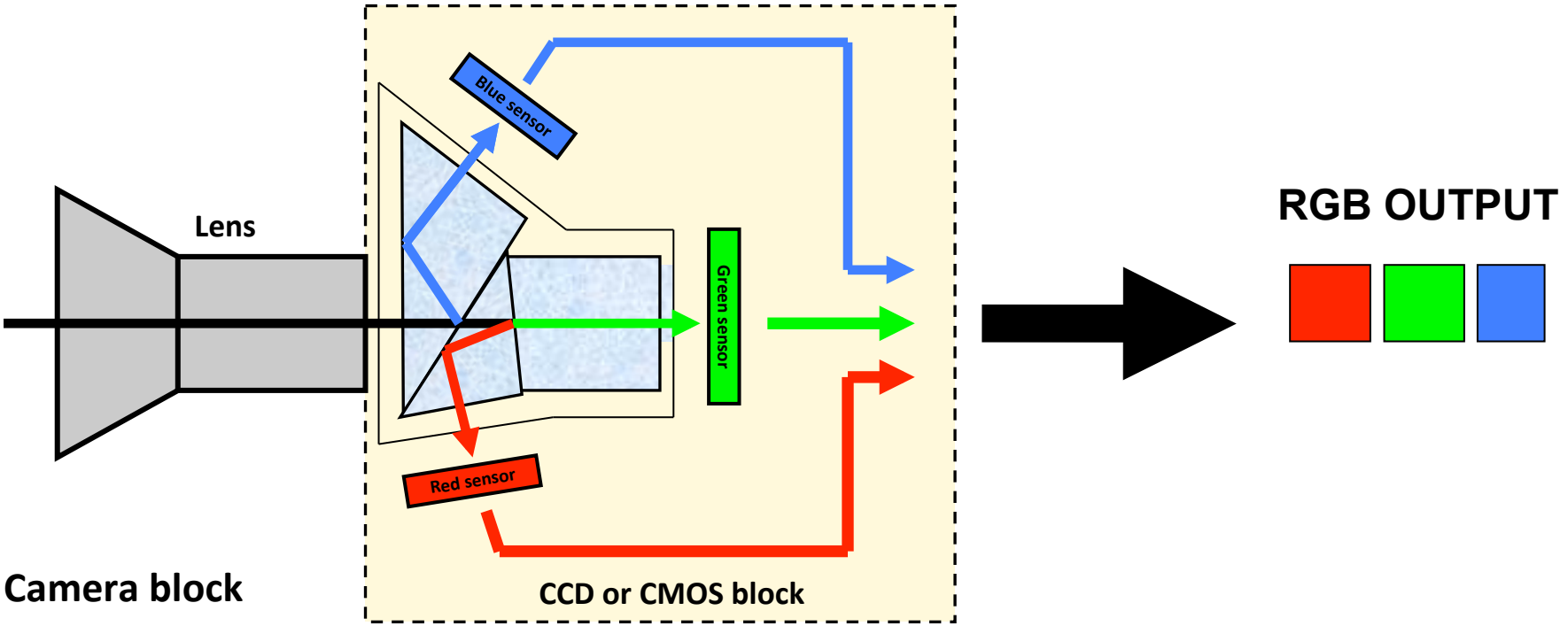
▪ The 3 Sensors cameras (examples)

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

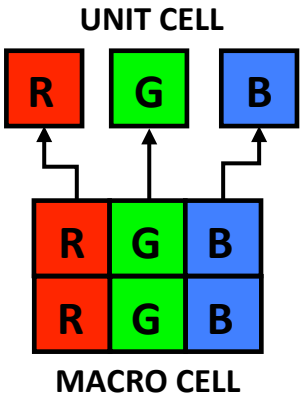
AJ-HPX 3700 Panasonic
2/3" 3-*CCD sensor*
1920 x 1080 x 3 photosites

EX-3 (Sony)
3 x ½ -*CMOS sensor*
1920 x 1080 x 3 photosites



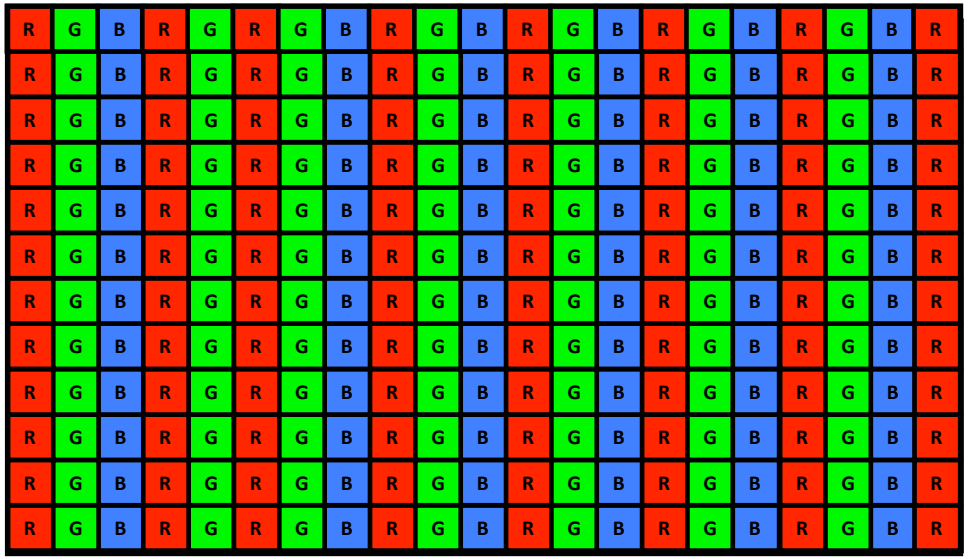
Sensor types

▪ The 1 Sensor cameras - The Striped pattern (examples)

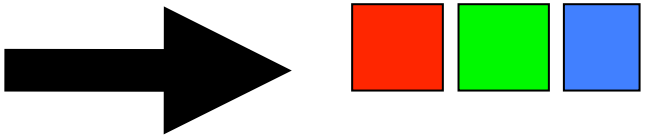


Genesis
(Panavision)
Mono CCD sensor Sriped pattern
5760 x 2160 photosites

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



RGB OUTPUT



The 1 Sensor cameras - The Bayer pattern

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.

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.

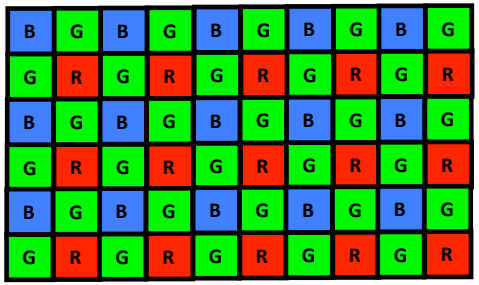
Luminance contains important spatial information, and we would like to preserve as much spatial detail as possible during the process.

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 (Irridas, Glue Tools, Phantom, Red, Arri, etc



Debayering

RGB OUTPUT

Sensor types

▪ The 1 Sensor cameras - The Bayer pattern (examples)

F65
(Sony)

Alexa
(Arri)

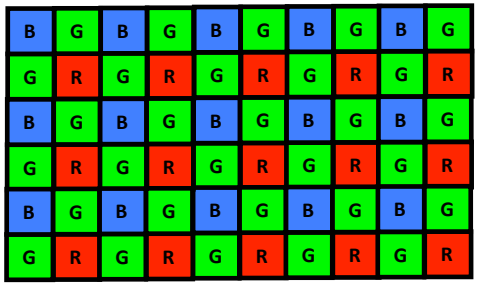
Epic
(Red Digital Cinema)

F55
(Sony)

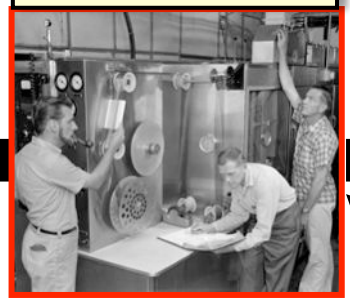
Delta
Pénélope
(Aaton)

F3
(Sony)

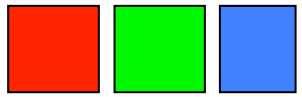
C500
(Canon)

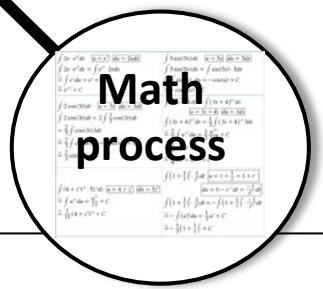


Debayering



RGB OUTPUT

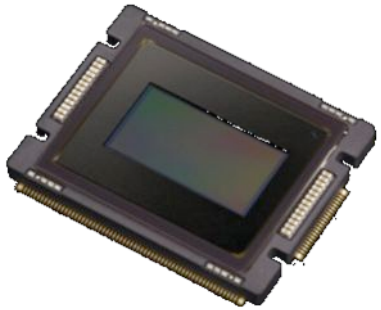


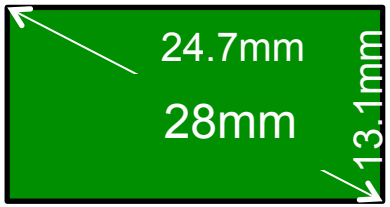


Debayering is not only a mathematic process but also an artistic process.

Pixels vs Photosites

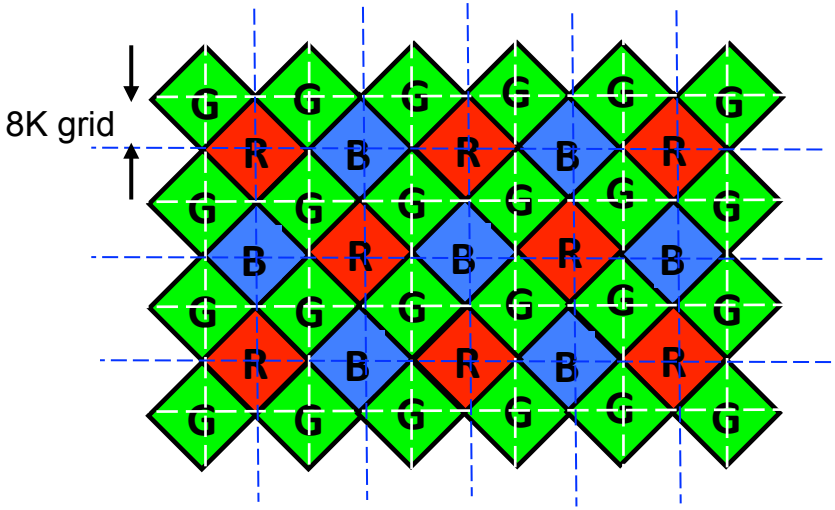
▪ The 1 Sensor cameras - The F65 pattern



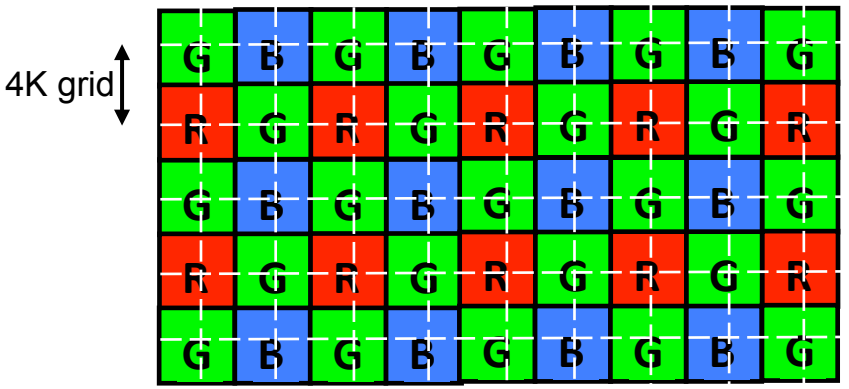


- Super 35mm 3-perf.
- Total Pixel Count: 20.0M
- 8K CMOS Image Sensor

F65 Sensor



Conventional 4K Bayer Sensor

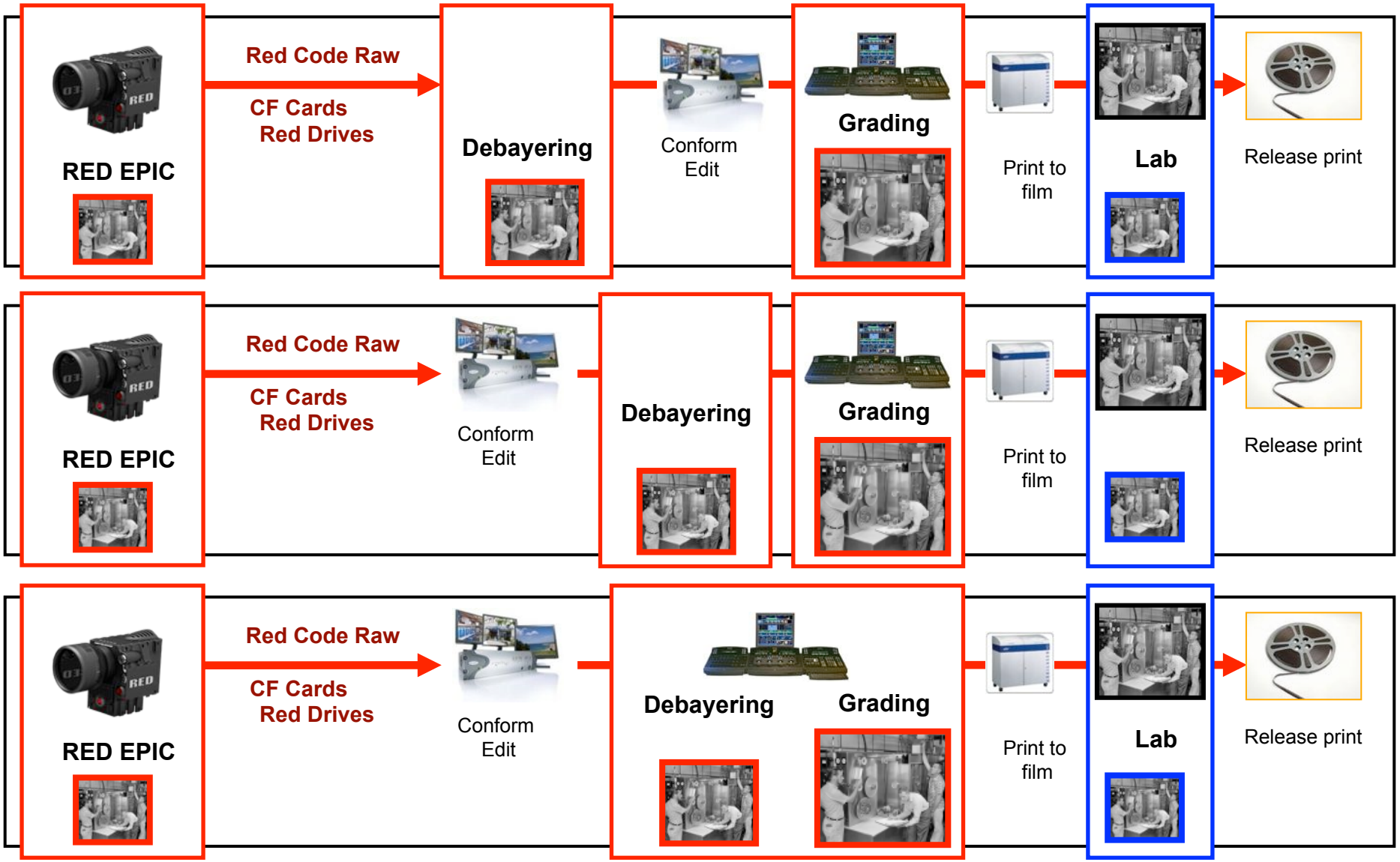


Photosites arrayed on 45-degree diagonals allow to lower the aliasing issues

Essential features of a digital workflow

Digital shooting **Red digital cameras (One, MX, Epic) - 3 ways of Debayering after shoot.**

This features can be applied to all cameras using bayer pattern



Production: Les Films d'Ici - Michael Kohlhaas

Workflow by DIGIMAGE

Shoot

Editing

DVD PAL
For producers & co-producers

Synch dailies by assistant

DIGIMAGE Postproduction

R & D
Creation of customized LUT's & Look

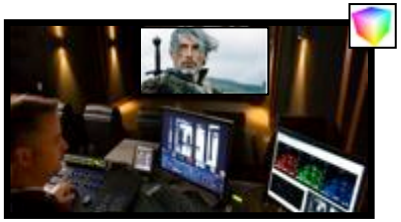
Back up
SAN-Sync

Quantum LTO IV drives

Conform DPX files
2K 10-Bit Log

Dailies
DNx HD 36 with preview LUTs

Resolve



Grading

VFX Titles

Mapping in Rec 709 (Lut w / Gamma)

DCDM

DCP

BROADCAST MASTER

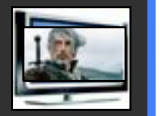
Legal Range

Fulll Range

Film Screening

Digital Screening

Broadcasting



Blu-ray

Internet

Red Epic camera workflow – Feature film – Kodak Cinelabs Romania

Shoot

Epic

Video Assist

Real time debayering

DVD

Dit Monitor

Real time debayering

ProRes

RAW RAID 5

RAW + dailies RAID 0

RAW + dailies External rugged drive

Editing

EDL XML / AAF

LUT & Look

Kodak Cinelabs Postproduction

R & D
Creation of customized LUT's & Look

Control of Dailies
24' LCD Cine-Tall DLP projector

Transfer to film

Real time debayering

RAW Ingest
RAW Conforming (EDL, XML, AAF)
Color management

SAN

DCP

DCDM

Clipster Finishing & mastering

XSERVE (Ingest station)

DSM

The End
Adobe Production Premium
Titles & credits

SAN-Sync

Quantum LTO IV drives
Back up

Grading

Baselight / Truelight network

Film Screening

Digital Screening

Broadcasting

Blu-ray

Internet

Workflow: TV commercials workflow with the Red Epic

Shoot

Epic

Video Assist

Real time debayering

Dit Monitor

RAW RAID 5

RAW + dailies RAID 0

RAW + dailies External rugged drive

Editing

Postproduction

R & D

Creation of customized LUT's & Look

SAN

Back up

SAN-Sync

Quantum LTO IV drives

ScratchLab

Debayering with metadata

Conform

DPX files

HD 2.5K or 5K

10 bits log or 16 bits fp

Dailies

DNx HD or ProRes with Rec 709 preview LUT

Nucoda FilmMaster

VFX Titles

Grading for TV

Re-grading in Rec 709

(Lut w / Gamma)

BROADCAST MASTER

Legal Range

Fulll Range

EPIC

(Red Digital)

Files Recording

OnLine postproduction Zürich Switzerland

GRADING FOR BROADCASTING

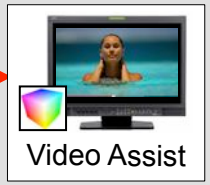
Broadcasting

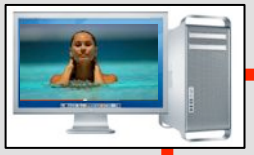
Blu-ray

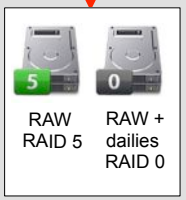
Internet

Workflow: TV commercials - Workflow with the Arri Alexa

Shoot







Editing

Postproduction

R & D
Creation of customized LUT's & Look

Back up
SAN-Sync

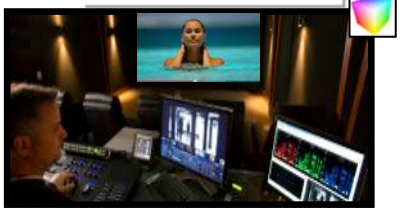
Quantum LTO IV drives

Conform DPX files
HD, 2K or 2.8K
10 bits log or 16 bits fp

Dailies
DNx HD or ProRes with Rec 709 preview LUT

VFX
Titles

Nucoda FilmMaster



Grading for TV
Re-grading in Rec 709
(Lut w / Gamma)

BROADCAST MASTER
Legal Range
Fulll Range

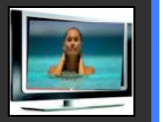
ALEXA

(Arri Digital)
SxS Recording

OnLine postproduction Zürich Switzerland

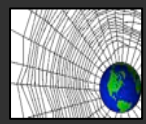
GRADING FOR BROADCASTING

Broadcasting



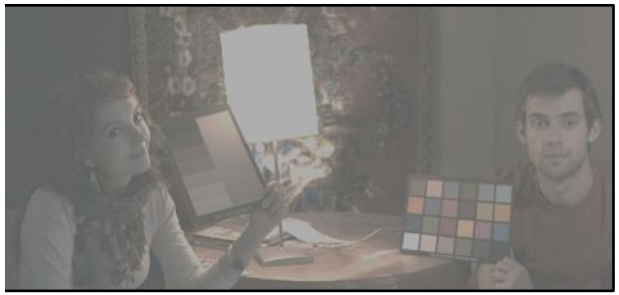
Blu-ray

Internet



Previsualization

With new cameras using log curves, it is impossible to show to producers and directors the flat, low, desaturated image without pre-grading. A table of conversion (Lut: Look-up table) is used to correct the image and/or to simulate a space colour of final destination (example: Kodak or Fuji film lut for a film out).



Lut

How to see the same image all the way through the workflow?

Monitoring / shoot

Monitoring / editing

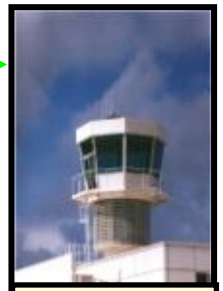
Grading

Previsualization

Manufacturers

Tests

Rental house



Lab

- The lab's knowledge about cameras and codecs
- The preparation of the cameras by the rental house under the supervision of the lab
- Artistic & technical control of the image through luts
- Involvements of DPs, DITs and colourists

Luts **Monitoring / shoot**

Luts **Monitoring / editing**

Luts **Grading**

Digital dailies checks

Digital shoot on file Example SxS card

Digital shoot

Check

Check

Two types of control

Data control

Means:

Checksum, good migration
0101101 >> 0101101

Quality control

Means:

Technical control, focus, exposure, etc.
Need of reference monitor or DCI / ISO projection

Sensor types

SHOOT

Alexa

Internal process in the camera

Viewfinder

External recorders via HDSDI video output

Monitoring on set

What WYSIWYG?

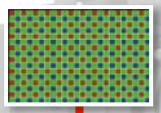
WYSIWYG: What You Seels What You Get

Sensor types

SHOOT

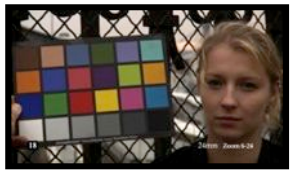
POST-PRODUCTION

Alexa



Role of Luts

Internal real time deBayering

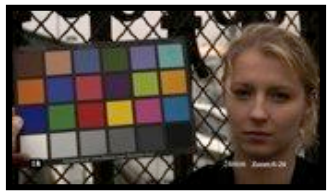


Monitoring editing

Luts

SxS ProCard

Luts Recording



Luts Monitoring Previsualization

Luts Confo / Grading

Sensor types

SHOOT

POST-PRODUCTION

Alexa

Same image all along the workflow

Monitoring editing

Recording

Monitoring Previsualization

Confo / Grading

Sensor types

SHOOT

Alexa XT

XR Capture Drive

Viewfinder

What WYSIWYG?

WYSIWYG: What You Seels What You Get

Internal raw recording

Internal process in the camera

External recorders via HDSDI video output

Monitoring on set

Codex on deck recorder

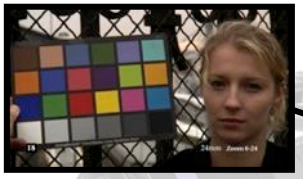
External Raw recoder

Sensor types

SHOOT

POST-PRODUCTION

Alexa XT



ARRIRAW

Internal real time deBayering

DeBayering

Color Space

Contrast Encoding

Image reconstruction RGB

Monitor. editing

Recording

Monitoring Previsualization

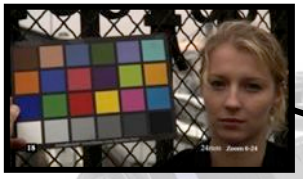
Confo / Grading

Sensor types

SHOOT

POST-PRODUCTION

Alexa XT



ARRIRAW

Internal real time deBayering

Role of Luts

DeBayering

Color Space

Contrast Encoding

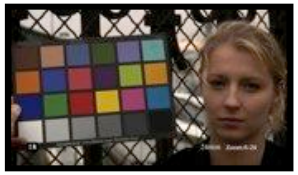
Image reconstruction RGB

Luts

Monitor. editing

Luts

Recording



Luts

Monitoring Previsualization

Luts

Confo / Grading

Sensor types

SHOOT

POST-PRODUCTION

Alexa XT

Quality of

ARRIRAW recording

Same image all along the workflow

Monitor. editing

Recording

Monitoring
Previsualization

Confo / Grading

Recording options

Alexa

Alexa Plus

2 x REC OUT

1 x MON OUT

2 x SxS Cards

1920 x 1080 - 10 bit 4:2:2 YCbCr
Information overlay

HD-SDI

HD 16:9

External recording

Sony SRW-1

1920 x 1080 - **10-bit 4:4:4** RGB

1920 x 1080 - **10-bit 4:2:2** YCbCr

HD-SDI

HD 16:9

T-Link

Codex on board recorder

2880 x 1620 12-bit uncompressed

ARRIRAW 16:9

Alexa

Internal recording

QuickTime

HD 16:9

- 1920 x 1080 **ProRes** - **12-bit 4:4:4:4**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2** (HQ)
- 1920 x 1080 **ProRes** - **10-bit 4:2:2**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2 (LT)**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2** (Proxy)

2K 16:9

- 2048 x 1152 **ProRes** - **12-bit 4:4:4:4**
- 2048 x 1152 **ProRes** - **10-bit 4:2:2** (HQ)
- 2048 x 1152 **ProRes** - **10-bit 4:2:2**
- 2048 x 1152 **ProRes** - **10-bit 4:2:2 (LT)**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2** (Proxy)

MXF

HD16:9

- 1920 x 1080 **DnxHD 145** - **8-bit 4:2:2**
- 1920 x 1080 **DnxHD 220x** - **10-bit 4:2:2**
- 1920 x 1080 **DnxHD 440** - **10 bit 4:4:4**

NO 4:3 >>
NO REAL 2 x ANAMORPHIC

Recording options

Alexa

Alexa Studio

Alexa M

Alexa Plus 4:3

2 x REC OUT

1 x MON OUT

2 x SxS Cards

1920 x 1080 - 10 bit 4:2:2 YCbCr
Information overlay

HD-SDI

HD 16:9

External recording

Sony SRW-1

1920 x 1080 - **10-bit 4:4:4** RGB

1920 x 1080 - **10-bit 4:2:2** YCbCr

HD-SDI

HD 16:9

Codex on board recorder

2880 x 2160 12-bit uncompressed

2880 x 1620 12-bit uncompressed

T-Link

ARRIRAW 4:3

ARRIRAW 16:9

Internal recording

4:3 >> REAL 2 x ANAMORPHIC

QuickTime

HD 16:9

- 1920 x 1080 **ProRes** - **12-bit 4:4:4:4**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2** (HQ)
- 1920 x 1080 **ProRes** - **10-bit 4:2:2**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2 (LT)**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2** (Proxy)

2K 16:9

- 2048 x 1152 **ProRes** - **12-bit 4:4:4:4**
- 2048 x 1152 **ProRes** - **10-bit 4:2:2** (HQ)
- 2048 x 1152 **ProRes** - **10-bit 4:2:2**
- 2048 x 1152 **ProRes** - **10-bit 4:2:2 (LT)**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2** (Proxy)

MXF

2K 4:3

- 2048 x 1536 **ProRes** - **12-bit 4:4:4:4**
- 2048 x 1536 **ProRes** - **10-bit 4:2:2** (HQ)
- 2048 x 1536 **ProRes** - **10-bit 4:2:2**
- 2048 x 1536 **ProRes** - **10-bit 4:2:2 (LT)**
- 1920 x 1536 **ProRes** - **10-bit 4:2:2** (Proxy)

HD16:9

- 1920 x 1080 **DnxHD 145** - **8-bit 4:2:2**
- 1920 x 1080 **DnxHD 220x** - **10-bit 4:2:2**
- 1920 x 1080 **DnxHD 440** - **10 bit 4:4:4**

Recording options

Alexa XT

nov.2013

4:3 >> REAL 2 x ANAMORPHIC

External recording Live output

- 2 x REC OUT → HD-SDI 16:9 Clean image
  - 1920 x 1080 - **10-bit 4:4:4** RGB
  - 1920 x 1080 - **10-bit 4:2:2** YCbCr
- 1 x MON OUT → HD-SDI 16:9
  - 1920 x 1080 - 10 bit 4:2:2 YCbCr
    Information overlay

Internal recording

HD 16:9

- 1920 x 1080 **ProRes** - **12-bit 4:4:4:4**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2** (HQ)
- 1920 x 1080 **ProRes** - **10-bit 4:2:2**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2 (LT)**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2** (Proxy)

2K 16:9

- 2048 x 1152 **ProRes** - **12-bit 4:4:4:4**
- 2048 x 1152 **ProRes** - **10-bit 4:2:2** (HQ)
- 2048 x 1152 **ProRes** - **10-bit 4:2:2**
- 2048 x 1152 **ProRes** - **10-bit 4:2:2 (LT)**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2** (Proxy)

2K 4:3

- 2048 x 1536 **ProRes** - **12-bit 4:4:4:4**
- 2048 x 1536 **ProRes** - **10-bit 4:2:2** (HQ)
- 2048 x 1536 **ProRes** - **10-bit 4:2:2**
- 2048 x 1536 **ProRes** - **10-bit 4:2:2 (LT)**
- 1920 x 1536 **ProRes** - **10-bit 4:2:2** (Proxy)

Quick Time

HD 16:9

- 1920 x 1080 **DnxHD 145** - **8-bit 4:2:2**
- 1920 x 1080 **DnxHD 220x** - **10-bit 4:2:2**
- 1920 x 1080 **DnxHD 440** - **10 bit** 4:4:4

MXF

1 x XR Capture Drive

Quick Time

- ARRIRAW 16:9 → 2880 x 1620 12-bit uncompressed
- ARRIRAW 4:3 → 2880 x 2160 12-bit uncompressed

MXF

XT

ALEXA XT

ALEXA XT M

ALEXA XT Plus

ALEXA XT Studio

1 x SxS Adapter with 1 x SxS PRO Card

HD 16:9

- 1920 x 1080 **ProRes** - **12-bit 4:4:4:4**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2** (HQ)
- 1920 x 1080 **ProRes** - **10-bit 4:2:2**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2 (LT)**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2** (Proxy)

2K 16:9

- 2048 x 1152 **ProRes** - **12-bit 4:4:4:4**
- 2048 x 1152 **ProRes** - **10-bit 4:2:2** (HQ)
- 2048 x 1152 **ProRes** - **10-bit 4:2:2**
- 2048 x 1152 **ProRes** - **10-bit 4:2:2 (LT)**
- 1920 x 1080 **ProRes** - **10-bit 4:2:2** (Proxy)

2K 4:3

- 2048 x 1536 **ProRes** - **12-bit 4:4:4:4**
- 2048 x 1536 **ProRes** - **10-bit 4:2:2** (HQ)
- 2048 x 1536 **ProRes** - **10-bit 4:2:2**
- 2048 x 1536 **ProRes** - **10-bit 4:2:2 (LT)**
- 1920 x 1536 **ProRes** - **10-bit 4:2:2** (Proxy)

HD 16:9

- 1920 x 1080 **DnxHD 145** - **8-bit 4:2:2**
- 1920 x 1080 **DnxHD 220x** - **10-bit 4:2:2**
- 1920 x 1080 **DnxHD 440** - **10 bit** 4:4:4

Sensor types

SHOOT

POST-PRODUCTION

F55 (Sony)

Sony 4K XAVC recording

What WYSIWYG?

WYSIWYG: What You Seels What You Get

What do we see all along the workflow?

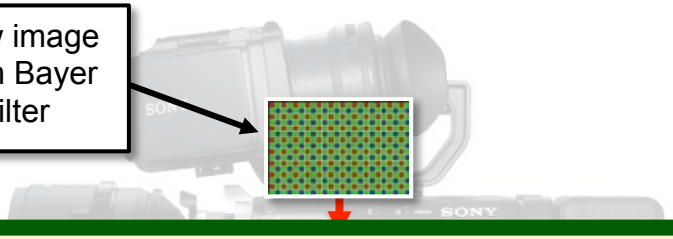
Sensor types

SHOOT

POST-PRODUCTION

F55

Raw image from Bayer filter



Good quality of internal deBayering

Recording from HDSDI output

Electronic viewfinder

Limitation of quality due to size / cost of viewfinder

Monitoring editing

SxS Pro+ Card

Confo / Grading

Sensor types

SHOOT

POST-PRODUCTION

F55

Good quality of internal deBayering

Internal real time deBayering

Monitoring editing

SxS Pro+ Card

Recording

Good quality

Monitoring
Previsualization

Good restitution

WYSIWIG

What you see is what you get

Confo / Grading

Sensor types

SHOOT

POST-PRODUCTION

F55

Same image all along the workflow

Monitoring editing

Recording

Monitoring Previsualization

Confo / Grading

Sensor types

SHOOT

POST-PRODUCTION

F55 + AXS-R5 (Sony)

Sony 4K Raw recording

What WYSIWYG?

WYSIWYG: What You Seels What You Get

What do we see all along the workflow?

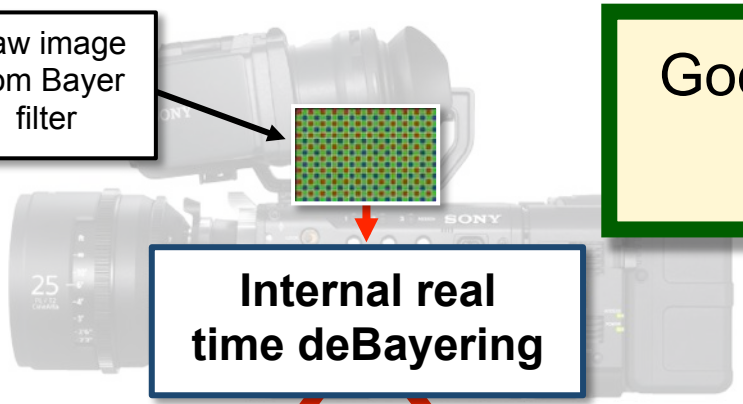
Sensor types

SHOOT

POST-PRODUCTION

F55 + AXS-R5

Raw image from Bayer filter



Internal real time deBayering

Good quality of internal deBayering

Limitation of quality due to size / cost of viewfinder

Recording from HDSDI output

Good quality

Electronic viewfinder

Monitoring on set

Monitoring Previsualization

Good restitution

WYSIWIG

What you see is what you get

Sensor types

SHOOT

POST-PRODUCTION

F55 + AXS-R5

SONY RAW

Internal real time deBayering

DeBayering

Color Space

Contrast Encoding

Image reconstruction RGB

Monitor. editing

Recording

Monitoring Previsualization

Confo / Grading

Sensor types

SHOOT

POST-PRODUCTION

F55 + AXS-R5

Same image all along the workflow

Monitor. editing

Recording

Monitoring Previsualization

Confo / Grading

Codec

MULTI CODEC CAMERAS

Mainstream 4K TV
SxS Pro +
64GB/128GB

300 Mb/s

Codec
XAVC 4K
10 bit 4:2:2

SxS Pro +
64GB/128GB

440, RGB
220 Mb/s

Codec
SStP 2K
10 bit 4:4:4 End 2013 - 4:2:2

SxS-1 / SxS Pro
32GB/64GB

100 Mb/s
@30 fps

Codec
XAVC HD
10 bit 4:2:2

SxS-1// SxS Pro
32GB/64GB

50 Mb/s
@30 fps

Codec
MPEG2 HD422
8 bit 4:2:2

Internal recording

Sony PMW-F55

8,9 M photosites

External recording AXS-R5

Codec
RAW F65
16 bit

Sensor types

SHOOT

POST-PRODUCTION

Red Epic

Internal process in the camera

Epic RedRaw recording

What WYSIWYG?

WYSIWYG: What You Seels What You Get

What do we see all along the workflow?

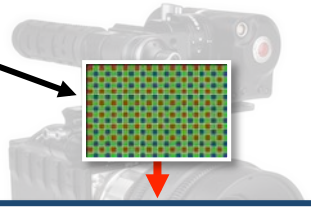
Sensor types

SHOOT

POST-PRODUCTION

Red Epic

Raw image from Bayer filter



Internal real time deBayering

Recording from HDSDI output

Electronic viewfinder

Monitoring on set

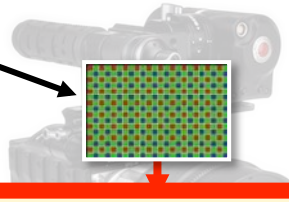
Sensor types

SHOOT

POST-PRODUCTION

Red Epic

Raw image from Bayer filter



Medium quality of internal deBayering

On the other side the size of the camera can be a great asset

Limitation of quality due to deBayering & size / cost of viewfinder

Recording from HDSDI output

Bad quality

Through HDSDI output

Electronic viewfinder

Monitoring on set

Monitoring Previsualization

Medium quality

Bad WYSIWIG

Sensor types

SHOOT

POST-PRODUCTION

Red Epic

REDCODE RAW

Internal real time deBayering

DeBayering

Color Space

Contrast Encoding

Image reconstruction RGB

Monitor. editing

Recording

Monitoring Previsualization

Confo / Grading

Sensor types

SHOOT

POST-PRODUCTION

Red Epic

REDCODE RAW

Internal real time deBayering

Role of Luts

DeBayering

Color Space

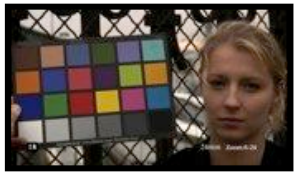
Contrast Encoding

Image reconstruction RGB

Luts

Monitor. editing

Recording



Luts

Monitoring Previsualization

Luts

Confo / Grading

Sensor types

SHOOT

POST-PRODUCTION

Red Epic

Not the same image all along the workflow

Monitor. editing

Recording

Monitoring Previsualization

Confo / Grading