RED, Raw and Beyond HD
Digital Cinema and the Digital Negative

Resolution
Colour Space
Bit Depth
RAW format
Exposure Histograms
Workflow options

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WHAT IS RED?

Camera + Format

- 4k Digital Cinema Camera
- RAW Digital Negative Format
- Low-Cost / Open Architecture
- Data Manipulation

Camera as ‘Data’ Acquisition Not ‘Image’ Acquisition
RESOLUTION

2k

*1.85:1 = 1998x1080
2.35:1 = 2048x858
RESOLUTION

4096x3112*

4k

*1.85:1 = 3996x2160
2.35:1 = 4096x1714
4k aint the whole story: three tiers of resolution

- **Acquisition Resolution**
  - 4k
  - 3k
  - 2k

- **Production Resolution**
  - 4k
  - 2k
  - HD 1080

- **Delivery Resolution**
  - HD 1080
  - HD 720
  - SD 576
COLOUR

YUV
(YCrCb)

Traditional video colour made of two colour values (U & V) and a luminance value (Y)

The human eye is less sensitive to colour than it is to brightness thus colour sub-sampling creates a perceptibly full colour image
Colour space for image acquisition and display made of 3 independent colour channels:

- RED
- GREEN
- BLUE

All screen images are displayed as RGB even if they come from a YUV format.

The YUV information is decoded into independent RGB channels by the TV or projector.
RGB > YUV

What usually happens with a camera...

Camera Acquires image in RGB

RGB image is encoded as YUV in camera

NLE system works with YUV footage using RGB processes

End product is delivered in a YUV format

Camera performs an RGB > YUV conversion

YUV image is compressed in-camera with a production codec.

White Balance, Colour Temp and ISO are applied and flattened into image

DV
HDV
DVCProHD
XDCAM etc
Native RGB

What happens in RED...

Camera Acquires image

RGB Bayer allows camera sensor to record separate Red Green and Blue channel info along with WB, Colour Temp and ISO values.

Red, Green, Blue information is encoded to a native RGB format with ‘lossless’ wavelet codec (RedCode).

WB, Colour Temp and ISO retained as independent Metadata and not ‘flattened’ into image.
IN POST YOU CAN...

- Select image settings ‘after’ shooting
- Utilize the full range of colour for correction
- Change the ISO to gain or reduce exposure
- Access the full dynamic range of the camera’s sensor
- Manipulate colour in 12bit space
- Freely select contrast and saturation from a neutral image
**BIT DEPTH**

*aka Colour Depth:*
the number of ‘bits’ of information dedicated to each colour channel.
The bit depth defines the precision and accuracy of colour reproduction.

8bit: Common shooting formats; DV, HDV, XDCAM, XDCAMEX, DVCProHD
- 256 shades per colour

10bit: Usually intermediate formats but also some hi-end shooting formats: Uncompressed (10bit), ProRes422, Cineform HD, DNxHD
- 1024 shades per colour

12bit: Very hi-end shooting and intermediate formats: REDCode, Cineform RAW
- 4096 shades per colour
BIT DEPTH

10-bit color

8-bit color

10bit colour spectrum

8bit colour spectrum

http://www.larryjordan.biz/articles/lj_video_bit_depth.html
READING EXPOSURE: the Histogram

Distribution of Exposure and Colour

- Under-exposed
- Balanced
- Over-exposed

Blacks/Shadows to Whites/Highlights
HISTOGRAM
HISTOGRAM
COLOUR BIAS

RED likes Daylight

Daylight balance (D65 - 6500k) is evenly spaced between primaries.

Tungsten Balance (3200k) is not.

Shooting with Tungsten balanced lighting results in not enough Blue light information in the image which can greatly impact upon options, flexibility and image quality in post.
SHOOTING FOR DATA

It helps to think of RED shooting as ‘Data’ Acquisition rather than ‘Image’ Acquisition

- Shoot for the Histogram rather than how it ‘looks’ in the viewfinder
- Aim to shoot balanced amounts of Red, Green and Blue light
- If you have good ‘data’ then you have full control in post to obtain any ‘look’ you want
- Use daylight balanced lighting to get even distribution of colour representation
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| 4k    | Proxy 1k      | 2k / 1080 HD  | Uses full RED sensor  
Overscan from HD allows for post reframing  
Can be off-line edited on most computers  
Retain RAW flexibility right through edit | Potential artifacts from image crunch-down from 4k to HD/SD  
No 1:1 image preview |
| 4k    | Uncompressed HD | 1080 HD       | Maximum HD quality  
Uses full RED sensor  
1:1 preview for colour correction | Can only be edited on 8-core AJA system  
Bakes-in colour space |
| 4k    | ProRes HD     | 1080 HD       | Good HD quality  
Uses full RED sensor  
Can be edited on most computers including laptops  
1:1 preview for colour correction | Slightly lower quality than Uncompressed  
Bakes-in colour space |
| 2k    | Proxy 1k      | 2k / 1080 HD  | Overscan from HD allows for post reframing  
Can be off-line edited on most computers  
Retain RAW flexibility right through edit | No 1:1 Preview |
| 2k    | Uncompressed HD | 1080 HD       | Maximum HD quality  
1:1 preview for colour correction | Can only be edited on 8-core AJA system  
Bakes-in colour space |
| 2k    | ProRes HD     | 1080 HD       | Good HD quality  
Can be edited on any computer including laptops  
1:1 preview for colour correction | Slightly lower quality than Uncompressed  
Bakes-in colour space |
‘More’ is not always ‘Better’

4k is ‘overkill’
  - Monstrous file sizes = storage problems
  - Impossible to on-line with anything but a very expensive dedicated hardware editing system
  - No viable monitoring options unless you have a 4k projector handy
  - Potential for artifacting from data-crush as 4k is downsized to HD or SD
  - 999 out 1000 people could never tell the difference between 4k and 2k with their eyes
  - Unless you’re screening on a 4k projector there’s no reason to finish in 4k

‘Baking-In’ is not the end of the world
  - Transcoding RAW (R3D) files to Uncompressed or ProRes HD makes more efficient data
  - The benefits of RAW are still exploited in the ‘one-light’ colour process before baking-in occurs
  - You can always go back to master R3D files and re-correct in RAW if you need to

Flexibility and Efficiency = Creativity
  - RED 2k transcoded to Uncompressed HD = Lossless precision in real-time on AJA hardware
  - RED 2k transcoded to ProRes HD = Superb Cinematic image you can cut on a Laptop..!
  - Efficiency means more freedom to experiment in post
SOFTWARE

Pre-Edit for ProRes or Uncompressed workflow: Red Alert and Clipfinder

- Open clips in Clipfinder

- From Clipfinder open files in RedAlert for ‘one-light’

- Manipulate and set Metadata (WB, ISO, Temp, Gamma, etc) to create desired ‘look’ or ‘looks’ (RSX files) or use DoP defined RSX in camera

- Batch process clips from Clipfinder to Uncompressed 10bit HD or ProRes HQ with RSX ‘look’ applied

- Import files in NLE to begin on-line post according to ProRes or Uncompressed project settings
SOFTWARE

Final Cut Pro

- Use ‘Log + Transfer’ utility to import and batch process R3D files from FCP

- 3 Options for FCP post:
  - Edit with Quicktime Proxy files at 1k (efficient but off-line only)
  - ReWrap native R3D files to MOV (max quality and res but no real-time performance)
  - Transcode to ProRes or Uncompressed HD (efficient and fast on-line)*

*FCP has only a handful of its FX and plugins that can render in 10bit -
Gaussian Blur, Broadcast Safe, Color Corrector, Color Corrector 3-Way,
Desaturate Highs, Desaturate Lows, RGB Limit, Proc Amp, Sepia Tint,
Chroma Keyer

Any others will truncate your image to 8bit and degrade quality
Premiere Pro CS4

- Premiere Pro CS4 natively supports R3D files

- 2 Options for Premiere post:
  - Transcode to ProRes or Uncompressed HD
  - Native edit 4k/2k with scaled res/quality preview

- Create new project using RED presets for 1k working resolution
- Import R3D files directly into project
- For Editing set RED working space to medium quality 1k preview
- For Finishing set RED working space to full quality 2k preview

Premiere Pro can natively scale the full res R3D files so even on a laptop you can put full-res 4K files on the timeline but selectively choose the resolution and quality you wish to edit in. Then when you’re ready to engage processes that require a full quality image rather than a real-time preview you turn the decoding quality back to full.
SOFTWARE

After Effects Finishing

Adobe After Effects CS4 Finishing and Grading system for both Final Cut Pro and Premiere Pro. The advantages of finishing a project in After Effects include:

- 16bit processing
- Native RGB colour space
- Synthetic Aperture colour correction system
- Native R3D file support
- Full resolution options including 2k and 4k
- Batch rendering

Workflow

FCP: Complete edit in FCP > Export XML > Import XML into Premiere Pro + save-as *pproj > Open *pproj directly in After Effects > swap proxy files for R3D originals > Finish project in, and export from, After Effects.

Premiere Pro CS4: Complete edit in Premiere Pro > Open *pproj file in After Effects > Finish and export
IFSS RED 2k on-line post-production workflow - Premiere Pro CS4

**Ingest and Prep**
- **RED ONE**
  - RED RAID HARD DRIVE
  - Dual System Sound Solid-State
- Transfer 2K Raw (R3D) files to computer / ext. HDD
- Import R3D files to CLIPFINDER
- Export R3D with Color LUTs
- One Light: Colour Connection + set metadata look in RED ALERT
- **Sb** (Clean Lable, Prep Audio)

**Editorial**
- Edit in Premiere CS4 on Octopod 8 Core MacPro Workstation
- Use 1K working res at medium quality for 2K source files
- **Pr**
- **AE** (Colour Grade / FX / Titles Export)
- Audio for Design / Mix
- Locked Picture

**Finishing**
- Open *Pr* into After Effects
- COLOURGRADE / FX / TITLES EXPORT
- **En**

**Sound**
- **OMF**
- **STP Project**
- **PROTOOLS**
- **SOUND EDIT/MIX PROTOOLS**
- **SOUND EDIT/MIX SOUNDTRACK PRO**
- Audio Mix Down

**Mastering and Delivery**
- **MASTER 10bit Uncompressed HD**
- **En**
- BluRay HD Authoring in Encore
- Author DVD with DVD Studio Pro or Encore
- In-House Screening (1024x576)
- Mobile
- Online (1920x1080)
Editing Native RED files in CS4

Native RedCode importing in Final Cut Pro

RED One Camera basics video
http://www.wonderhowto.com/community/member/mikegoedecke/playlists/learn-the-red-one-camera/

Shooting with RED
http://library.creativecow.net/articles/adcock_gary/red.php

Clipfinder: software for batch processing R3D's with direct integration to REDAlert
http://www.daun.ch/software/

All RED applications and utilities (inc REDAlert and the RED plugins for CS4 and FCP)
http://www.red.com/support/index

Free Apple Spotlight search plugin (allows spotlight searches on the Mac to read R3D files - must have REDAlert installed)
http://pomfort.com/spotlightredr3d/