



**ALPHADOGS** IN ASSOCIATION WITH **DIGITAL SERVICE STATION™** PRESENTS AN **EDITORS' LOUNGE** EXCLUSIVE EVENT

# "HANDLING RED ONE IN POST-PRODUCTION"

FEATURING PRODUCTS BY **APPLE ASSIMILATE AVID** AND **RED** RED ONE™ CAMERA DEMONSTRATION BY **JAMES MATHERS**

**AVID®** DEMONSTRATION BY **BOB RUSSO** **FINAL CUT PRO®** DEMO BY **KEITH HATOUNIAN** **COLOR** DEMO BY **ROLAND WOOD**

**SCRATCH®** DEMO BY **LUCAS WILSON TONY CACCIARELLI** **REDCODE™** PRESENTATIONS BY **DIGITAL SERVICE STATION**

**LEADER OF THE REBELLION (RED GURU) TED SCHILOWITZ** **TECHNICAL CONSULTANT BRIAN HUTCHINGS** **HOSTED BY ALPHADOGS**

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# HANDLING RED ONE IN POST-PRODUCTION

February 2008



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## ADDITIONAL RESOURCES

- For the latest information on RED technologies and solutions, visit ..... [www.red.com](http://www.red.com) and [www.reduser.net](http://www.reduser.net) and [www.redhax.net](http://www.redhax.net)
- For the latest information on Apple Final Cut Studio support, visit ..... [www.apple.com](http://www.apple.com)
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- For the latest information on Assimilate SCRATCH support, visit ..... [www.assimilate.com](http://www.assimilate.com)
- To download XMIL Sequencer or MetaCheater, visit ..... [www.xmil.biz](http://www.xmil.biz) or [www.staticpictures.com/metacheater](http://www.staticpictures.com/metacheater)
- For more information on eCinema's FX-class of on-set capable LCD monitors, visit ..... [www.ecinemasystems.com](http://www.ecinemasystems.com)
- For more information or to arrange a consultation on your next RED project, contact AlphaDogs at ..... [www.alphadogs.tv](http://www.alphadogs.tv)
- For RED Alert! and REDCINE file preparation services, contact Digital Service Station at ..... [www.digitalservicestation.com](http://www.digitalservicestation.com)

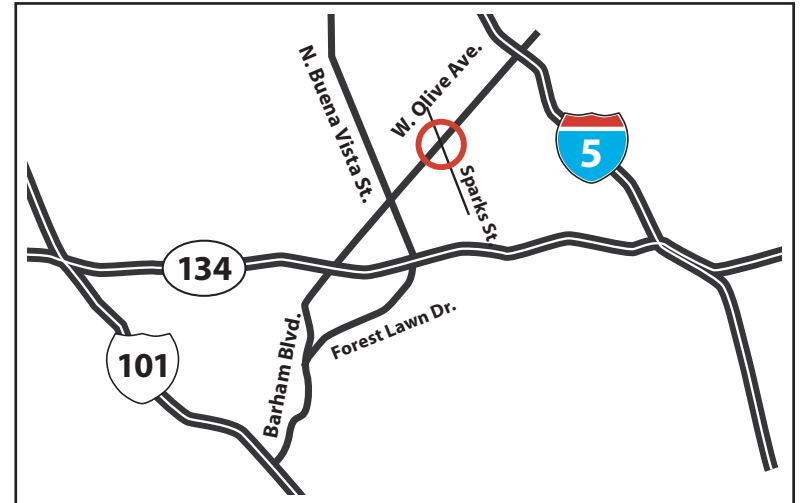
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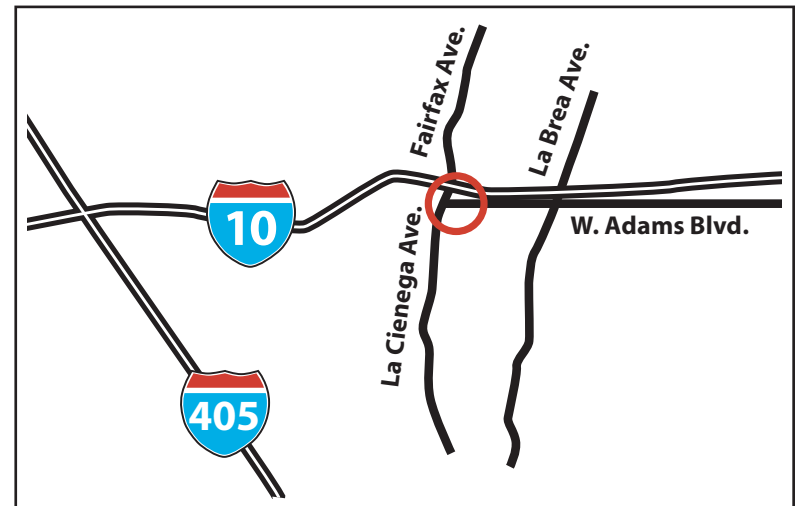
(818) 729-9262 p  
(818) 729-8537 f  
burbank@digitalservice  
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### West L.A. Location

Secret HQ, Inc.  
5767 W. Adams Blvd.  
Los Angeles, CA 90016

(323) 677-2092 p  
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culver@digitalservice  
station.com

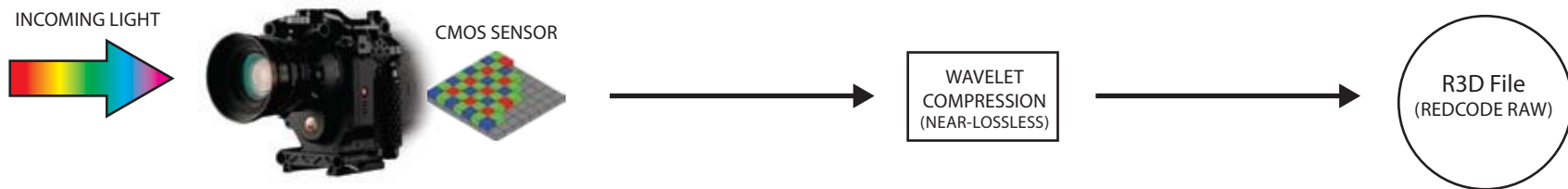


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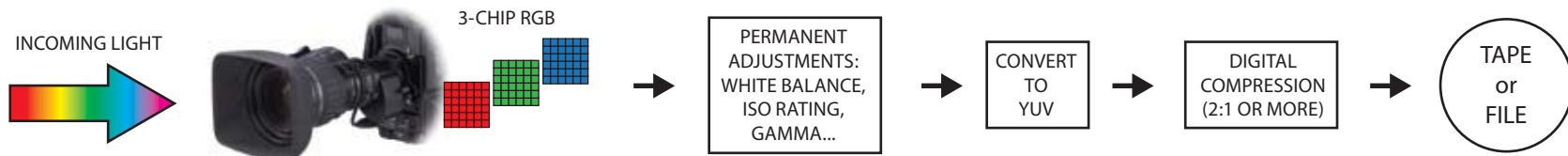
# REDCODE RAW Codec vs. Digital RGB Capture

The RED ONE camera records a RAW file (R3D), which is simply the uninterpreted data that comes straight off of the camera sensor after undergoing visually-lossless wavelet compression (*fig. 1*). Standard in-camera adjustments like white balance and ISO, are stored as metadata rather than permanently baked into the image.



*fig. 1 - RED ONE camera signal processing*

A traditional 3-chip RGB camera reinterprets the data from the sensor in several steps before sending it out to tape or file, losing significant image data along the way (*fig. 2*). In-camera adjustments are permanent; the original image caught-on-chip cannot be recovered.



*fig. 2 - Digital RGB camera signal processing*

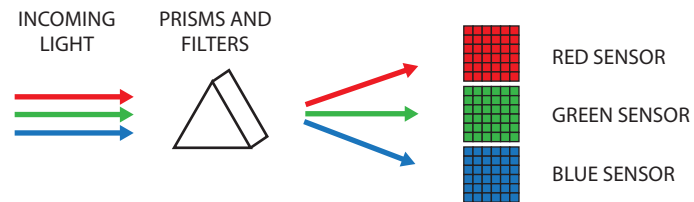
The REDCODE RAW codec allows 4K sensor data to be recorded at 24 frames per second with a data throughput of around 27 MB/second (or 220 megabits per second), roughly half the data rate of HDCAMSR. An even higher throughput of 36 MB/second is also available.

The file needs to be debayered (*see page 4*) before it can be used. This is done during the file-processing stage in preparation for post. Using RED Alert! or REDCINE, you can establish the initial white point, ISO rating, and color correction settings, as the R3D is virgin in those areas. The original R3D file is never manipulated, allowing you to always return to the camera original. This is a workflow that is similar to what a dailies colorist does in a film-to-tape transfer. After setting these parameters, you can create files of any needed flavor to use throughout the rest of your post-production process (*see pages 7-11*).

# Bayer Filters and Debayering

## WHAT IS A BAYER FILTER?

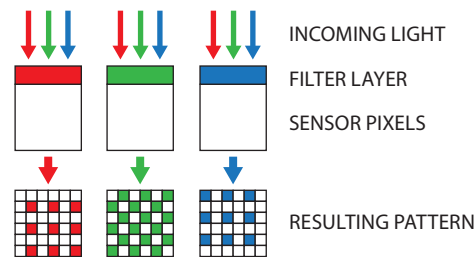
Most digital sensors are monochrome, meaning each light detecting pixel does not have the ability to discern multiple channels of color. Many video cameras determine color using three separate image sensors. Light entering these cameras is split into three directions using a series of prisms and filters such that red, green, and blue light selectively reaches each sensor (*fig. 3*).



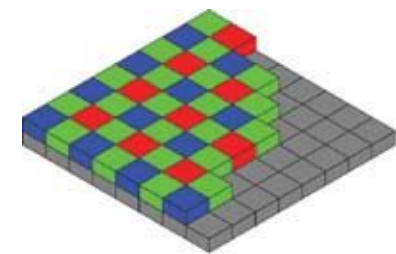
*fig. 3 - RGB camera (three sensors)*

Digital cinema cameras use one single large sensor and must use a different technique to determine the color of each pixel. There are exceptions, but for the most part these cameras use a technique called a Bayer filter.

A Bayer filter selectively blocks certain wavelengths of light before reaching the sensor so that each pixel is sensitive to either red, green or blue light (*fig. 4*). These selective color filters are arranged in a pattern called a 'Bayer pattern' which allows a computer to later guess the value of the two blocked colors of a pixel based on the value of its neighbors (*fig. 5*). This process of educated guessing is referred to as demosaicing, bayer interpolation, or debayering. Images that are recorded as a Bayer pattern are sometimes called RAW.



*fig. 4 - Bayer filter (single sensor)*



*fig. 5 - Bayer pattern*

## WHAT ARE THE ADVANTAGES OF BAYER FILTERING?

In addition to being a solution to the single chip color problem a Bayer pattern is also considered a kind of natural image compression. Since each pixel contains only one color channel, a Bayer pattern image is exactly one third the size of its three-channel RGB equivalent.

## HOW DOES DEBAYERING WORK?

Digital images are often represented as RGB. In an RGB image each pixel is represented by three values that determine the intensity of light in the red, green, and blue parts of the spectrum. In order to display a Bayer pattern image or manipulate it must first be converted to RGB. In order to do this a computer can use one of many different strategies to fill in the blanks for each pixel. These strategies are demosaicing algorithms.

*Continues on Next Page*

### EXAMPLE OF A DEBAYERING ALGORITHM — BILINEAR INTERPOLATION

Bilinear interpolation is a simple example of a demosaicing algorithm that can be used to help explain the process. As seen in the diagram (fig. 6) the pixel G5 does not have green information. It is possible to give the pixel a green value by averaging the neighboring pixels. So:

$$G5 = (G2 + G4 + G6 + G8)/4$$

The pixels missing their red information can be calculated in a similar way:

$$R2 = (R1 + R3)/2$$

$$R4 = (R1 + R7)/2$$

$$R5 = (R1 + R3 + R7 + R9)/4$$

The pixels missing their blue information can be calculated in a similar fashion. In practice this algorithm is too simple, not sharp, and introduces many color artifacts. Therefore, bilinear interpolation is never used.

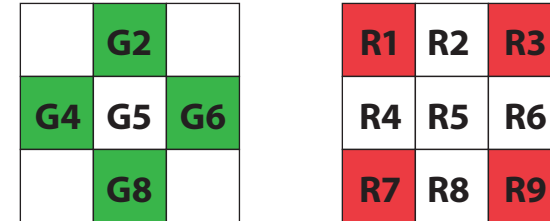


fig. 6 - Bilinear interpolation

One of the main problems with the Bilinear interpolation method is that it treats each color channel completely separately from one another. In fact it is possible to take clues from neighboring pixels even though they represent different color channels. This is possible because the hues in a natural image usually change much less rapidly than the corresponding luminance.

In an RGB image hue is determined by the ratio between all three color channels for a given pixel. Because the hue of two neighboring pixels is likely to be similar it is possible to predict the value of the missing color channels if the ratio is known. Because the green channel of a Bayer image contains twice the samples of the red and blue channels, an algorithm can start by interpolating the green channel independently. Once this is done ratios between blue and red and green and red can be used to calculate more accurate values for all pixels.

### MORE COMPLICATED ALGORITHMS

Using hue ratios is just the beginning of the possible methods for creating accurate and eye pleasing RGB images from a Bayer Pattern source. Complex algorithms use known properties of natural images and other tricks to create sharp and accurately colored images. Some of these algorithms are documented while others are proprietary. While the differences between the algorithms is often very subtle, it is the case that their results vary depending on the content of the source image. In most cases a standard high quality algorithm will work well, in other cases one might want to choose the appropriate algorithm for their specific content.

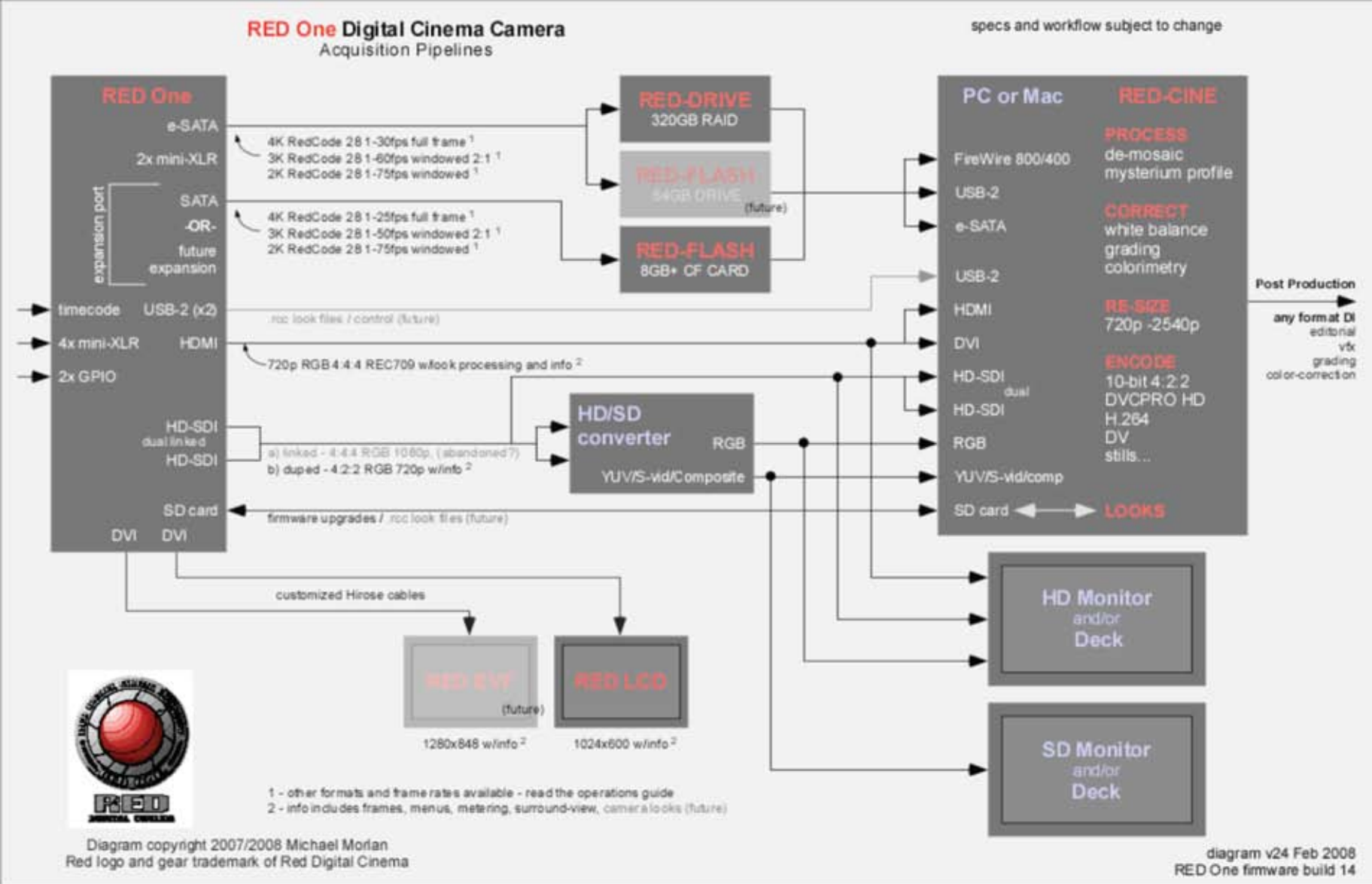
### HOW MUCH RESOLUTION DOES A BAYER FILTER SENSOR HAVE?

The Bayer filter technique works well because it exploits a common trait of most natural images: hue changes more gradually than intensity. Even though each pixel does not contain all color information, the single channel it does contain is an excellent predictor of the overall intensity of the image at that point.

The human eye exploits the same phenomenon — the eye contains many more intensity resolving cones than color differentiating rods, making it much better at resolving changes in intensity than color. When a Bayer pattern is demosaiced with a very effective algorithm the overall detail in the intensity of the image will come close to the original. For this reason it is not correct to say that a Bayer filter reduces the effective resolution of an image. It is more accurate to say that the system is not as accurate as an RGB equivalent would be, but that it comes close in terms of the perception of sharpness and detail.

Adapted from the Redhax Wiki article "Bayer Demosaicing" ([www.redhax.net/wiki/Bayer\\_Demosaicing](http://www.redhax.net/wiki/Bayer_Demosaicing))

# Diagram of RED ONE Acquisition Pipelines



# RED Alert! and REDCINE Demystified



## HOW AND WHEN TO USE RED Alert!

RED Alert! was initially designed for use on-set and therefore has color-grading tools emphasizing simple and powerful functions that a cinematographer could use to set the look of a shot. By its very nature, this interface was designed for working one shot at a time. By simply writing new QuickTime reference files that point to the original R3D file, this application is suited for MacBook and MacBook Pro laptops.

## HOW AND WHEN TO USE REDCINE

REDCINE was designed to prepare R3D images for the post-production pipeline. As such, its toolset emphasizes basic color grading and shot framing, processing multiple clips, batch rendering, and the generation of new QuickTime files that don't need to refer back to the R3D master. REDCINE was developed with Assimilate and is, in essence, a streamlined set of tools derived from SCRATCH. This application requires beefier desktop hardware for effective use.

## COMMON TO RED Alert! AND REDCINE

RED Alert! and REDCINE share many tools and features, but geared towards different workflows (see *At A Glance* below). When rendering, neither RED Alert! nor REDCINE currently pass along the R3D audio. In addition, when RED Alert! currently writes new QuickTime Reference files, they overwrite the camera-originals and blow away QuickTime access to the audio tracks. Special care should be taken to copy the camera-original QT References before using RED Alert! (if audio is recorded with the camera).

See page 11 for important notes on the R3D file/folder structure.

### AT A GLANCE: RED ALERT! VS. REDCINE

	Mac	Windows	Best-light Grading	Framing / Scaling	Render QT Reference	Render New QuickTime	Limited QT Codecs	All System QT Codecs	Batch Processing	Window Burns	Build Timelines	External Monitoring	Audio Support
RED Alert!	✓	✓	✓		✓	✓	✓						
REDCINE		✓	✓	✓		✓		✓	✓	✓	✓		

# Final Cut Studio Post-Production Overview



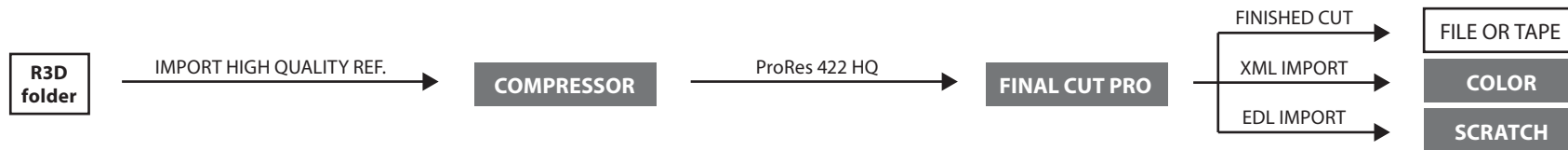
## FINAL CUT OFFLINE WORKFLOW

Import the camera-original Low quality Proxy QuickTime Reference movie files into Final Cut Pro (see page 11 regarding proper file handling). Edit until picture is locked. Export to QuickTime file/Output to tape/Send to DVD Studio Pro via Compressor. This workflow sacrifices quality for speed.



## FINAL CUT 2K PRORES 422 HQ WORKFLOW

Convert the camera-original High quality 2K QuickTime Reference movie files to ProRes 422 High Quality codec via Compressor. Import into Final Cut Pro and edit until picture is locked. Export to QuickTime/Output to tape/Send to Color/Export EDL to SCRATCH for advanced grading.



## FINAL CUT 2K DPX WORKFLOW

Use RED Alert! or REDCINE to make best light versions of shots and export 2K DPX sequences. Use AJA DPXtoQTTranslator utility to wrap DPX sequences into QuickTime files. Import into Final Cut Pro and edit until locked. Export to QuickTime/Output to tape/Send to Color/Export EDL to SCRATCH for advanced grading.



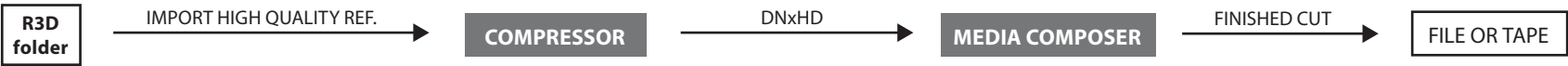
## FINAL CUT VIA LOG AND TRANSFER WORKFLOW

A RED plugin for the *Log and Transfer* window in Final Cut Pro will be **Available Soon**. It will allow easy ingest of RED footage while rendering it to ProRes 422 HQ on the way in. If you've worked with P2 footage in Final Cut Pro, you will be familiar with this streamlined workflow.

# Media Composer Post-Production Overview

## FILE-BASED WORKFLOW: HD FINISH IN MEDIA COMPOSER

Use Compressor to convert QuickTime Reference movies to DNxHD or Uncompressed files. Import into Media Composer and edit. When finished, output to tape.



## FILE-BASED WORKFLOW: 4K FINISH IN SCRATCH

Use Compressor to convert QuickTime Reference movies to DNxHD files. Export XML from Final Cut timeline and use MetaCheater to generate an ALE to import DNxHD into Media Composer. Export final EDL from Media Composer for 4K conform in SCRATCH from R3D files.



## TAPE-BASED WORKFLOW: HD FINISH IN MEDIA COMPOSER

Use REDCINE to make best light versions of shots and render to desired codec. Import and quickly string out in a Final Cut Pro timeline, then output to HDCAMSR tapes. Make downconversions and capture into Media Composer for traditional offline / online Avid workflow.



## TAPE-BASED WORKFLOW: 4K FINISH IN SCRATCH

Import Low quality Proxy reference movies into Final Cut Pro, string out in timeline, and output to DV tapes or other tape format. Export XML from Final Cut timeline and use XMIL Sequencer to generate an ALE to capture tapes into Media Composer. Export final Media Composer EDL for 4K conform in SCRATCH from R3D files.



# SCRATCH Post-Production Overview

## REDCODE DAILIES WORKFLOW

Import R3D files directly into SCRATCH from RED media. Perform basic color grading, shot management, scaling / framing, or conform from offline cut. Record to tape with metadata burn-in, or export to media files for use in post, or generate LUTs to pass on to the edit facility, vfx house, or film lab. Play out to a digital projector for client review.



## 4K FINISH WORKFLOW

Conform from Final Cut Pro or Media Composer using EDL for direct R3D import. Perform final assembly, advanced color grading, manage LUTs, and screen for clients (including Stereoptic/3D material). Output to film or digital cinema media. This is the only option currently available to deliver a true 4K finish from REDCODE 36 (the highest recordable data rate on the RED ONE).



## Some Useful Facts

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### MEDIA STORAGE REQUIREMENTS

(APPROXIMATE VALUES. YOUR RESULTS MAY VARY.)

REDCODE 36 (R3D @ 36 MB/s) 2.1 GB/min

REDCODE 27 (R3D @ 27 MB/s) 1.6 GB/min

#### FRAME RATE 23.98

4K DPX 45 GB/min

2K DPX 11.25 GB/min

Uncompressed 1080p (10 bit 4:2:2) 7.41 GB/min

DNxHD 175X (10 bit 4:2:2) 1.35 GB/min

ProRes 422 HQ 1080p (10 bit) 1.38 GB/min

#### FRAME RATE 59.94

4K DPX 56.25 GB/min

2K DPX 14.1 GB/min

Uncompressed 1080i (10 bit 4:2:2) 9.26 GB/min

DNxHD 2205X (10 bit 4:2:2) 1.67 GB/min

ProRes 422 HQ (10 bit) 1.73 GB/min

### R3D FILE AND FOLDER STRUCTURE

The name of the R3D file uses the following convention - which is set from the camera:

**A002\_C010\_080229**  
CAMERA REEL CLIP YEAR/MONTH/DAY

Each shot resides in its own folder (with matching name) consisting of the R3D file, three QuickTime Reference files in High (2K), Medium (1K), and Proxy (1/2 K) resolutions, and a metadata file (if you've made settings in RED Alert! or REDCINE). To avoid unlinking the reference movies from their R3D sources, RED strongly recommends that none of these files be moved from the folder.

### RED @ DIGITAL SERVICE STATION

The Digital Service Station offers a wide range of media transfer services. Numerous locations around the country can assist your RED post-production pipeline by:

- backing-up your R3D assets to LTO archival tape
- offering overnight REDCINE dailies to tape or DVD
- generating ALEs and tapes for Avid tape-workflows
- rendering QT files for Final Cut Pro editing

[www.digitalservicestation.com](http://www.digitalservicestation.com)

### RED @ ALPHADOGS

AlphaDogs offers RED-tailored editing and DI services for Final Cut Studio and Avid workflows, as well as 5.1 surround audio mixing and resolution-independent graphics and effects. We can also interface with the other links in your pipeline (VFX houses, film labs, SCRATCH DI, etc).

[www.alphadogs.tv](http://www.alphadogs.tv)

ALPHADOGS WOULD LIKE TO THANK THE FOLLOWING PEOPLE FOR MAKING THIS EVENT POSSIBLE

Brenda Bergin, Tony Cacciarelli, Martin Euredjian, Keith Hatounian, Brian Hutchings, Greg Huson, James Mathers, Bob Russo, Ted Schilowitz, Rainer Standke, Kevin Stanley, and Lucas Wilson