



Digital Film Center

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Digital Intermediate Format Choices Or How Many K's Do I Need?

By Jim James, Chief Engineer, IVC

Resolution: The Battle of the K's

Few things are more used and less understood than the terms 4K and 2K. In the world of digital film they describe the resolution of a digital image. Simply put 4K has 4,098 pixels across the image (horizontal resolution), and 2K has 2,048 pixels across the image. However, the vertical resolution of the K's can vary by quite a bit. A 4K scan of the entire 35mm film frame will be 4096x3112. A 4K image for a 1.85:1 output will be 4096x2214. A 4K 2.39:1 output could be 4096x3112 or 4096x1714 depending on whether it is anamorphic or not. To simplify things just remember this, 4K has four times the number of pixels as 2K for the same aspect ratio. 2K has 13% more pixels than HD. In all other areas, such as bit depth and color format, 4K, 2K, and HD RGB are identical.



4K, 2K and HD sizes compared

So how many K's are enough?

What do all these numbers mean to a filmmaker? Four times as many pixels means four times as much detail in the image, but also four times as much data to store and move through the DI process. All that extra data adds extra time and extra cost to the project. So how much resolution is enough?

In theory a 4K scan is capable of capturing all the resolution available in a 35mm negative. In actual practice this can vary anywhere from 2 to 6K, depending on film stock, processing, and other factors. By scanning in 4K you can be reasonably certain that no detail on your film will be lost or distorted by the film scanner. Having all those extra pixels to work with offers several



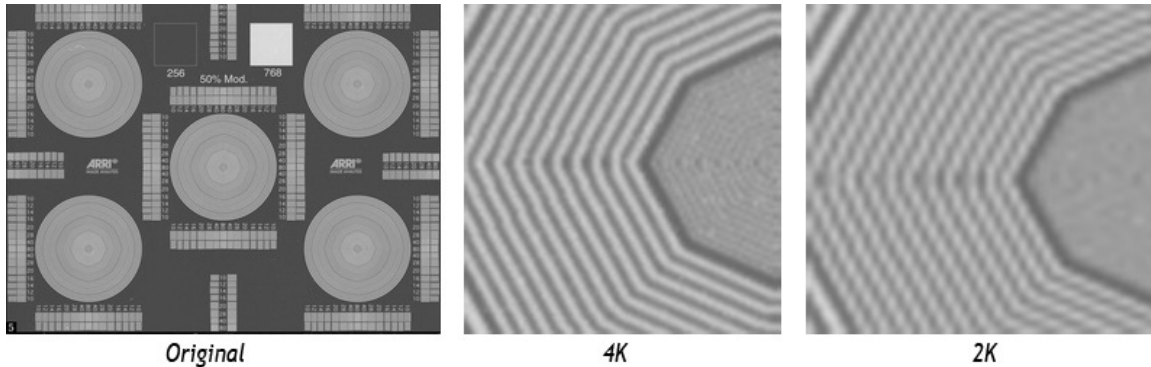
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advantages. If you have to resize the image (zoom in to loose a boom mike or an airplane that shouldn't be there) the extra resolution allows you to resize the shot without the image going soft or developing scaling artifacts (jagged edges, etc.). 4K also allows you to have the highest quality archive, whether on film or in a digital format. But all this comes at a price. Literally. All those extra pixels require more storage space. Moving all those pixels requires more expensive hardware and software. 4K simply costs more.



Original 4K 2K
Detail of 4K vs. 2K scan. Blowups are taken from the center circle.

It is important to note that a 4K scan does not always guarantee a sharper image. Your choice of lenses has much more impact on the perceived sharpness of the image than the scan. Processing and lighting can also effect how sharp the scene appears. To the viewer a shot with lower resolution but higher contrast may appear sharper. A high resolution scan of a soft image will still be soft.

The audience will never see the full 4K resolution of your images. By the time a film has gone through the processes of high volume release printing, there is less than 2K worth of resolution left on the print. Even Digital Cinema's are only 2K or less. (Someday there will be 4K Digital Cinemas, but in today's world 2K is the norm.) Home video and broadcast masters are all HD. 2K more closely matches the resolution of your final delivery, whether it is a film print, a digital cinema projector, or a HDTV master. This can be both good and bad. If you will not need to zoom any of your shots, and the sizing is handled carefully from scanning to output, a 2K scan can be more than adequate. Because it has one quarter the data of 4K, 2K uses less storage, hardware, and time, resulting in lower costs. In Hollywood's never ending battle between cost and quality 2K represents a nice compromise.

Where's the K in HD?

HD has a horizontal resolution of 1920 pixels, or 1.9K. The ground glass lines in the viewfinders of most cameras are at least 10% in from the edge of the exposed image, which itself may not reach the edge of the film frame. Because of this Digital Intermediates using HD usually extract the 1920 pixels from the usable part of the negative, discarding the rest. This gives it a usable resolution matching 2K. However if a shot needs to be repositioned during the DI it will have to be rescanned from the film. The biggest advantage to HD is the ability to record it to real-time tape formats. This can lead to significant cost savings. However it is important to remember that most HD tape formats involve considerable compression, which can seriously degrade the



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image. To be considered comparable to 2K HD must be RGB, and recorded uncompressed to disk. (HDCAM-SR is a close alternative with its very low compression and RGB capability.)



Viewfinder markings compared to a full frame Super 35mm film scan

Mixing the Ks

A popular option in Digital Intermediates is to mix the Ks. The film can be scanned in 4K to capture all the available resolution. 2K files are then made from the 4K originals and are used for the rest of the DI process. Many of the cost savings of 2K are preserved, as are the 4K files should any zooming or other manipulations be required in specific scenes. Aliasing and other artifacts can often be minimized using this method. In some cases it makes sense to scan some scenes in 2K and others in 4K. In this way shots that could benefit from the extra resolution have it, while the overall cost is kept down. Most Digital Intermediate systems have no problem handling the mixed resolutions.

Finding the right K's

4K has many advantages, and may someday become the standard for digital intermediate work, but with today's technology the costs of working in 4K often exceed the benefits. Whether a project should be done in 4K, 2K, HD, or a mixture is a decision that should be made based on the project's content, distribution, and budget. An anamorphic 35mm epic will most certainly benefit from 4K, while a HD is a more logical choice for 16mm. It should always be remembered that no amount of resolution can compensate for a cheap lens or a poor cinematographer. Before deciding on a DI resolution call us to discuss your project. Together we can find the options that best work for you.

