Panasonic

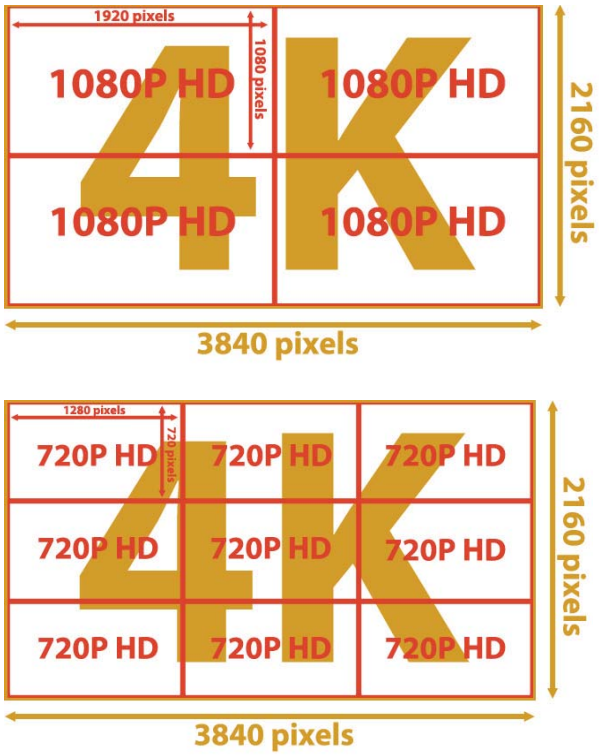
AG-DVX200
TECH BRIEF

The Benefits of Shooting in 4K

By Barry Green, a producer/writer who has authored many books on the operations of Panasonic professional camcorders.

4K PROFESSIONAL

Benefits Of Shooting In 4K



Originating footage in 4K/UHD brings a host of benefits to the video shooter, not the least of which is that your source footage is literally four times sharper and more detailed than 1080p HD footage would have been, or nine times more detailed than 720p HD footage. It's really rather remarkable; you would need to set up nine 720p HD cameras, each pointing at different sections of the scene, to capture as much image detail as a single 4K camera could!

All that additional detail can be used in many different ways and provides many potential benefits to the video shooter. First and foremost, shooting in 4K (or Ultra HD / UHD) means that your footage can be displayed on larger displays or projected on larger screens without losing detail. For movie screens, digital signage, large-screen 4K televisions, or other environments where the largest displays will be used, 4K origination means the sharpest images for those displays.

But what if you're not delivering your footage in 4K (or UHD)? What if you're producing footage that's intended to be broadcast in HDTV (in 1080 or even 720 resolution) -- or, perhaps, even in standard definition? What if you're delivering content for web streaming in HD (or lower) resolution? Are there still benefits from, and reasons for, shooting 4K/UHD in the first place? Most definitely!

Shooting 4K For 1080 (or 720) HD Delivery

When your final delivered footage is going to be mastered in 1080p, 1080i, or 720p, there are still substantial and significant benefits that can be derived from shooting your source footage in 4K/UHD. Some of these may or may not apply to your particular scenarios, but it's still interesting to explore the implications of all of them.

Future Proofing: How many times have you seen a good, vintage television series, and bemoaned that it looks lousy on your HDTV because it was shot and mastered in 4:3 standard-definition television? Many older television series were shot on standard-definition video cameras, but some were shot on film. Those film-shot series are sometimes "remastered" into high-definition versions -- and they look so much better! When the series were produced, standard-definition television broadcast (and perhaps VHS video or maybe, at best, DVD) were the anticipated delivery mediums, so mastering the series and distributing in standard-def were practical decisions at the time. But with the advent of HDTV and Blu-ray discs and

HD streaming, it opened new markets for remastered high-definition versions -- which created new opportunities and new revenue streams for those producers. Unfortunately for those who shot their projects on standard-definition TV cameras, there is no higher-definition master footage to go back to. Accordingly, while you may not necessarily see a need or even an opportunity to deliver a 4K or UHD version of your projects, wouldn't it be nice to have the higher-resolution master copies of the footage to go back to in case such an opportunity were to arise?

Sharper HD Footage: When you have a much larger source image to work from, shrinking it down to HD size can make for the sharpest, clearest HD images possible. A super-sampled ultra-high-definition image, when resized down to HD frame sizes, can result in images that hold as much detail as the HD frame size is capable of retaining. This means that it is possible to get sharper HD images from a 4K/UHD camera, by resizing the images in post, than you would get from even a very high-performance HD camera.

Reduced Noise: Another benefit to downconverting 4K/UHD footage to HD in post production is that you'll see a significant reduction in visible noise in the image. When converting UHD/4K footage down into 1080p footage, each 2x2 group of UHD pixels are used to create a single pixel in HD. Combining the 2x2 group of UHD pixels can result in "averaging" the noise from each pixel together, resulting in smoothing out the noise and greatly reducing its visibility.

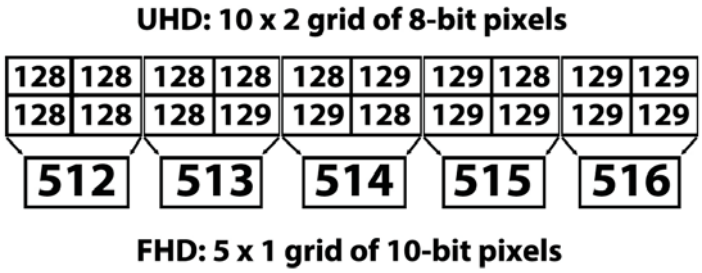
Increased Color Resolution And Bit Depth: One excellent benefit of downconverting UHD/4K footage to 1080 HD in post is that you can realize an increase in proportional color resolution and a notable increase in bit depth. The AG-DVX200 records 4K or UHD footage at 8 bits per pixel and utilizes 4:2:0 color sampling. After downconversion, the resulting footage has 10 bits per pixel and 4:4:4 color sampling! Yes, you can convert 3840x2160 8-bit 4:2:0 recorded footage into 1920x1080 10-bit 4:4:4 footage in post.

To understand the color sampling advantage, you'd have to first understand that the camera records its footage in 4:2:0 color sampling. That means (simply put) that there is one color sample for every 2x2 block of pixels. In any given 2x2 block of pixels there are four different "brightness" samples, but they all share one "color" sample. Effectively, within the 3840 x 2160 frame, there is a 1920 x 1080 matrix of color samples, one for every 2x2 block of pixels. During the downconversion to HD, each block of 2x2 brightness samples are converted into one HD pixel, creating a 1920 x 1080 matrix of brightness pixels. This 1920 x 1080 "brightness" (luminance) matrix can be effectively married to the originally-recorded 1920 x 1080 "color" matrix, resulting in one individual and unique color sample for each and every brightness pixel. The result is 4:4:4 color sampling at high-definition resolution.

In terms of pixel depth, the original recorded footage is quantized and recorded at an 8-bit depth, providing for up to 256 shades per pixel. Other formats, like Panasonic's own AVC-Intra, quantizes and records at a 10-bit depth, for up to 1,024 shades per pixel. Having deeper bit depth provides the ability for finer shading and more subtle transitions, especially apparent on smooth gradients (such as in a clear blue sky). Generally 8-bit cameras perform fine for most

images, but extensive image manipulation in post can reveal the limitations of 8-bit encoding and cause "banding" and "stair-stepping" from one shade to the next. 10-bit footage minimizes those effects because there are up to four shades for every one shade in 8-bit footage. When downconverting UHD/4K footage to 1080p HD, you also get the benefit of converting 8-bit pixel depth into 10-bit pixel depth! Since each 2x2 block of UHD/4K pixels will be summed together to create a single 1x1 pixel in 1080p HD, the individual pixel values and gradations from the source footage can be retained in the downconverted footage.

Imagine a smooth gradient of medium gray, gradually getting brighter from left to right. In 8-bit pixel data, a medium gray might be represented by a pixel value of 128, and the next brighter shade might be 129. In 10-bit pixel data, that same medium gray (128) might be represented by a pixel value of 512 (128 x 4) and that brighter shade (129) might be represented in 10-bit by a value of 516 (129 x 4). The obvious difference here is that an 8-bit camera can't represent any difference between 128 and 129, but the 10-bit camera (looking at the exact same gradient) could represent a smoother transition between 512, to 513, 514, 515, and then eventually 516. Having 10 bits of data provides for the ability to retain and discern between finer shades of gray (or color). So what happens when we downconvert our 8-bit UHD footage to 10-bit 1080p HD footage? As each 2x2 block of pixels is summed together, those subtle differences in shade are retained, and we end up being able to represent shades that the 8-bit footage couldn't have.



Extended Zoom Range (in post): The AG-DVX200 has a 13x optical zoom, providing for the 35mm photography camera equivalent of 364mm of telephoto reach -- but sometimes, you just need more. If you're delivering in 1080 HD, you can crop in post into the central 1/4 of the UHD frame and use that crop as your full 1920 x 1080 frame, effectively "zooming" in post for a total magnification equivalent to 728mm. If your final delivery is going to be 720p footage, you can zoom in post even further, to the central 1/9th of the screen, while still retaining full resolved detail; that would mean a total "effective" zoom equivalent of 1,092 mm.

Full optical zoom

Post crop of center of image, for 2x "post zoom"

Reframing And Post-Production Camera Movement: Sometimes when you frame up a shot, you think you've got it perfect, only to get to the editing suite and realize that there's a microphone in the shot, or something ugly in the background, or perhaps your composition wasn't quite level, or maybe you really wish that you'd zoomed in just a little tighter. When you're shooting in 4K/UHD and finishing in HD, you've got quite a bit of flexibility in resizing, trim-

ming, cropping, rotating, or otherwise adjusting your footage in post. In fact, you can even turn a locked-down stationary tripod shot into a simulated pan, tilt, or even zoom, by cropping into the UHD frame and then moving that cropped portion across the UHD frame during the shot. You can also turn a wide shot into a close-up, perhaps giving you more editing flexibility in post.

Image Stabilization: The AG-DVX200 has excellent image stabilization capabilities, including the 5-axis Hybrid Optical Image Stabilization when shooting in HD. When in 4K or UHD, it doesn't get the benefit of the Hybrid OIS, it uses standard optical image stabilization, which -- while good on its own, may not be sufficient for more extreme shooting scenarios. Maybe you decide you need more stable footage than you were able to get when using the camera handheld (or on a boat, or from a car window, or wherever you were shooting from). Most modern non-linear editing programs include excellent image stabilization capabilities, but taking advantage of these programs usually means cropping off a notable chunk of your footage (to give the stabilizing software "room to work.") The more unstable your footage is, the more that would need to be cropped off; the remaining footage then gets magnified to fill the full frame, and that normally might lead to soft, low-res-looking footage. The nice thing about originating your footage in 4K or UHD is that you'll start with so much resolution in the image, that you could devote a large percentage to the post-production image stabilizing software and still retain plenty of resolution for the resulting stabilized image. Knowing this beforehand, and knowing that you may need to stabilize the footage in post, you would be best served to consciously shoot your footage at a wider angle than you might otherwise have done, with the express intent of allowing that wider field of view to be cropped off as the "buffer zone" that the image stabilizing software will need. The resulting footage can be substantially stabilized in post, while still retaining plenty of resolution to be suitable for use in your Full HD project. Used judiciously, this could even mean that you could occasionally leave your tripod at home and work lighter, while still being able to deliver tripod-stable shots in post.

To see examples of some of the techniques described in this article, I recommend this excellent video produced by Park Camera in the United Kingdom.

Summary: The advantages of shooting in UHD/4K are numerous, even if your final project is destined for only an HD or even standard-definition finish and delivery. The AG-DVX200 is flexible enough to provide for the ability to record in standard definition, high definition, and ultra high definition (and also 4K). Whenever possible and practical, I recommend shooting in UHD (or 4K) for the flexibility, future-proofing, and post-production advantages that UHD/4K acquisition provides. You may or may not need it, but if you ever do need to do some of the tasks outlined in this article, you'll be very glad you had that high-resolution source footage to work from.

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