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HDR and the Broadcast Environment

Better Pixels Create Better Content

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WHITE PAPER

Consumers have long judged video content by the visible quality of the image on the screen, and are always pursuing the next breakthrough in display technology. Over the years, we've witnessed the shift from black-and-white to color, from SD to HD, the failed introduction of consumer 3D for the home and now we are seeing simultaneous interest in both 4K UHD and HDR. Content producers are embracing both technologies, while early adopter consumers are investing in new displays that can support the latest formats.

Initial reactions to 4K UHD and HDR content indicate that consumers are impressed with the noticeable difference they see in HDR programming as the colors pop and details stand out in a wider variety of scenes. 4K UHD increases the number of pixels, resulting in a larger field of view for long shots or increased detail in close-ups. Because HDR works by improving the quality of the pixels, the impact is readily discernible to the human eye. HDR is generally recognized as the next big thing in content delivery with an immediate perceivable benefit for the consumer. The ability to produce HDR content in HD removes the significant bandwidth requirements needed for HDR in 4K UHD and can be more quickly deployed.

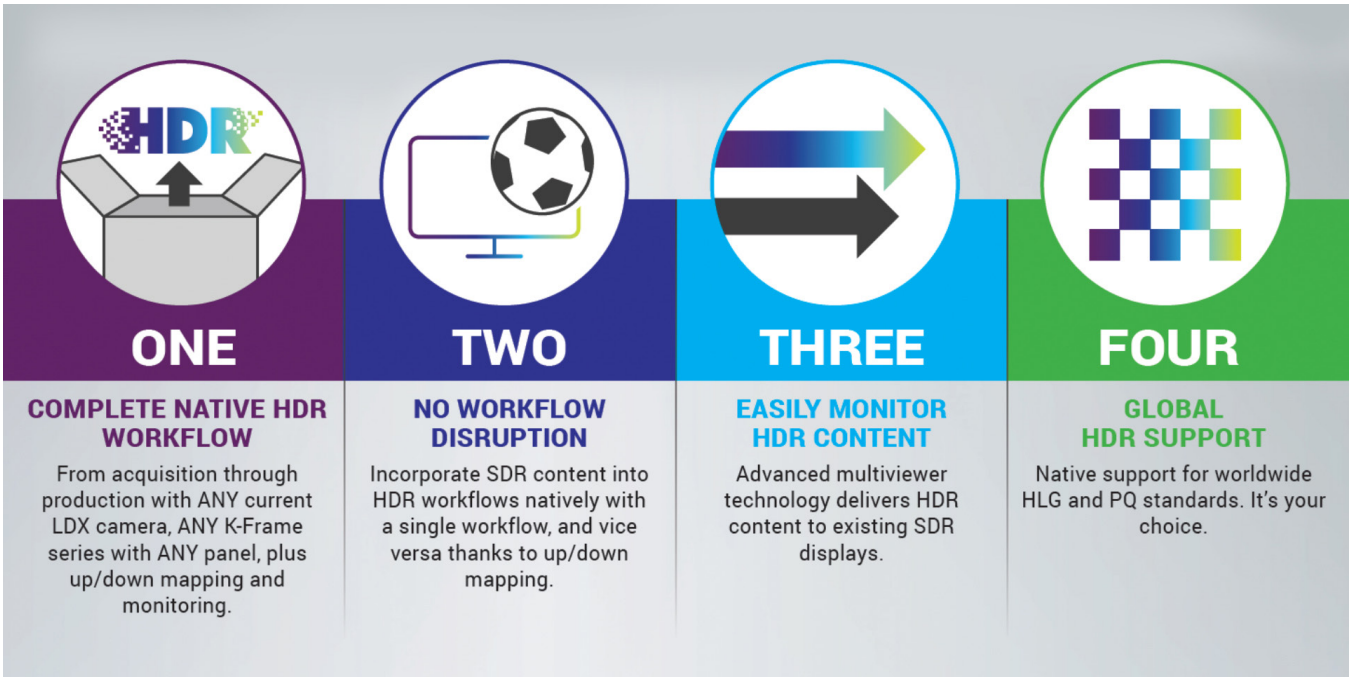
What is HDR?

4K UHD seems to have captured more headlines recently, and is indeed a significant advancement for content delivery, but HDR is winning over consumers today because of its ability to deliver visibly wider range of highlights and shadows as well as more realistic color and detail. Thanks to its contrast ratio, which is much closer to the conditions found in real life, HDR allows image reproduction that is much closer to reality. Furthermore, HDR also allows more dependable results under difficult shooting conditions — such as irregular lighting or partial shade — found at many outside broadcast productions. An additional advantage of HDR is that it is fully format independent, and does not need any specialized viewing conditions (such as the minimum screen size and proper viewing distances required for 4K UHD) to show its advantages.

Embracing HDR

For broadcasters and content creators, embracing an HDR workflow process raises a number of questions and poses some challenges. Most notable is the need for a parallel SDR/HDR production workflow, one where the signal can be adapted with up/down mapping as required to mix and match incoming content formats and output signals without sacrificing any quality. For example, operators may need to integrate existing SDR content into new HDR productions, or may need to send HDR content to SDR multiviewing screens in the studio. In either case, the producer's intent for each individual signal must be maintained.

Grass Valley, a Belden Brand, offers a portfolio of HDR-enabled solutions that includes cameras, switcher frames, servers, routers, up/down mapping cards and multiviewers. With these devices, broadcasters are able to produce native 10-bit HDR in either HD or 4K UHD and deliver that content in HDR and SDR simultaneously, as necessary, thanks to the high-quality conversion that can be done with a down mapping process. Additionally, these solutions provide native support for both of today's worldwide standards: Hybrid-Log Gamma (HLG) and Perceptual Quantization (PQ).

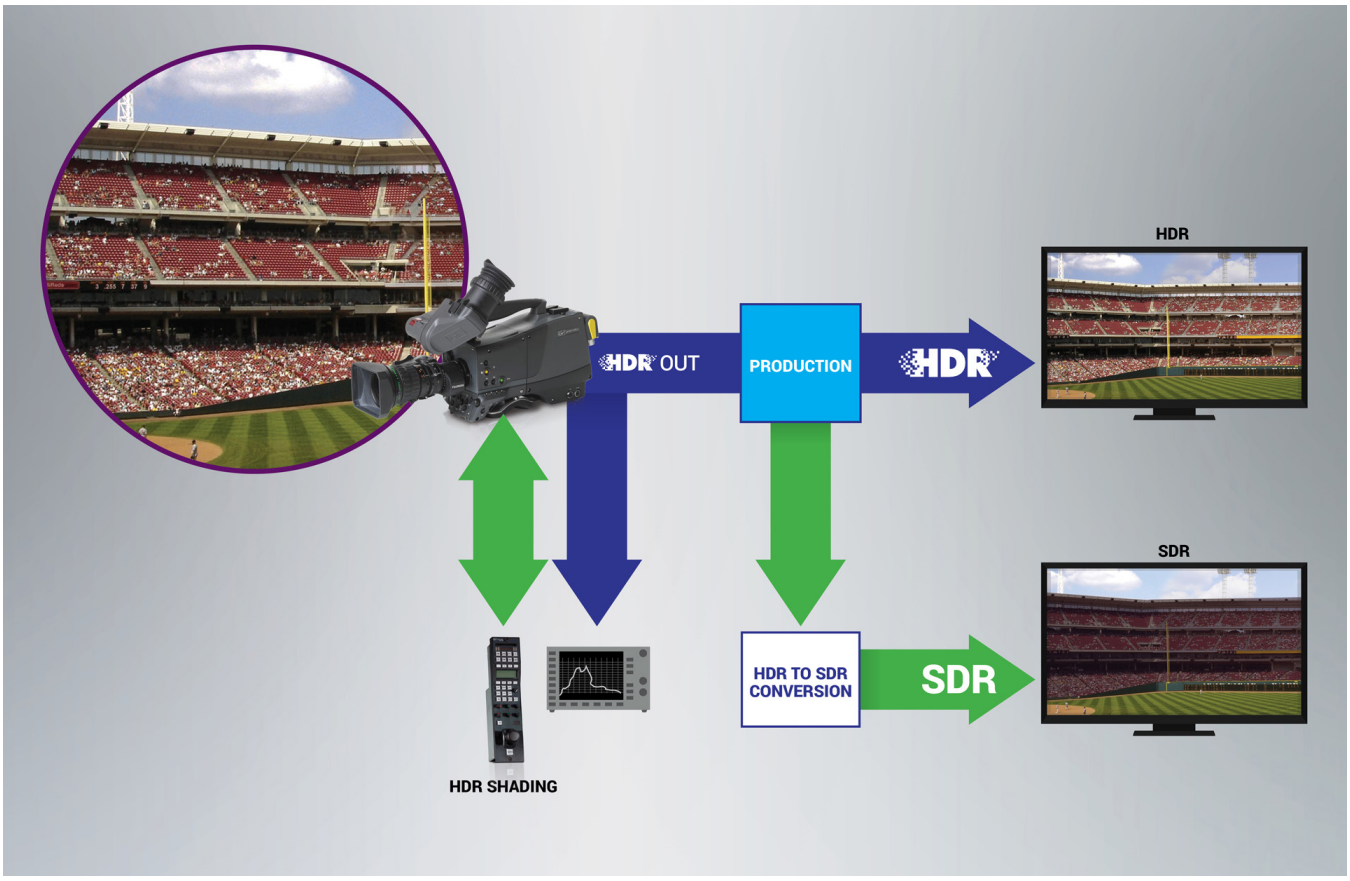


Workflows

A full parallel HDR and SDR workflow is the easiest way to produce both HDR and SDR at the same time, from a single camera system through the full production chain.

In a full parallel scenario, the camera delivers two simultaneous signals, one HDR and one SDR. In this simultaneous HDR and SDR production workflow, the camera lens iris is set to HDR output and the SDR gain is used to control the SDR output to the required level. As long as the scene lighting does not change significantly, the lens iris will not need to be changed and a moderate variation of the lighting condition will be well inside the headroom of the HDR output.

In comparison, SDR does not offer this additional headroom, so a much more precise adaptation of the sensitivity will be required. Challenges in this workflow include the simultaneous shading of HDR (which requires less work due to the higher dynamic range) and SDR signals (which requires more work due to the limited dynamic range) as well as the handling of both signals separately through the full production chain. This translates into a more complex and expensive workflow, which might be accepted for certain applications and/or for an intermediate period of time, but might not be acceptable in the long term. It's akin to the early days of HD, when remote sports productions would use separate SD and HD trucks and crews.



An alternative to the full parallel HDR/SDR workflow is to use only native HDR signals from the camera and then perform an HDR-to-SDR conversion somewhere during the production. While this simplifies the workflow and reduces the amount of resources required, in contrast to the parallel HDR/SDR workflow, there is no separate control for the SDR and HDR outputs, and the SDR gain cannot be independently controlled from the HDR signal. As a result, the success depends on the quality of the HDR-to-SDR conversion under all types of lighting conditions.

For the best results under the widest range of production environments, Grass Valley recommends a native HDR workflow where SDR is derived by conversion.

Static Conversions and Dynamic Conversion

Broadcasters and content creators planning to add HDR to their workflows have two kinds of HDR-to-SDR conversions to consider: Static conversions with a fixed LUT or a selectable LUT (the "look up table" that is the template for the conversion), and dynamic conversions that analyze the picture content and apply content-based settings.

Dynamic conversion appears to offer a larger capability of processing inside the production chain, although automatically adopting the look of the image might not be acceptable for all users or in all cases. Early versions of both types of converters are available today and initial testing in live environments continues to deliver very promising results. No doubt a variety of solutions will become commercially available in the near future covering a wider range of typical live applications.

Conclusion

HDR is shaping up to be the next major advancement in the viewing experience, with consumers praising the image improvements and broadcasters working to find the best options for delivery. Grass Valley's HDR solutions allow its customers to choose the best approach for their specific production needs today, whether that be HD, 4K UHD or both, plus an easy upgrade path for tomorrow's demands with GV-eLicenses as production requirements change.

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