

SOLUTION BRIEF

Broadcast and Cloud Content Delivery Networks (CDNs)
Playout, Encoding/Decoding, Production, Distribution, Archiving



Solving HDR to SDR Video Conversion Challenges



Executive Summary

Video standard transitions such as the one from standard definition (SD) video to High Definition (HD) combined with new video technologies such as high dynamic range (HDR) have left a myriad of legacy equipment in homes and the field. Broadcasters and video content providers are therefore required to provide multi-format video playout capabilities to satisfy legacy equipment, usually by storing multiple versions of content at multiple resolutions, with consequent increase in equipment compute and memory.

Bcom's SDR<>HDR conversion solution in Intel® FPGAs implements a real-time conversion engine to re-format live or recorded video reducing the amount of files that need to be stored in servers and other video equipment.



Solution

The HDR-SDR intellectual property (IP) developed by bcom provides an intelligent and lightweight solution that allows for multi-platform compatibility so that original video content can be served simultaneously in HDR and SDR formats. This same technology also up scales video from SDR to HDR with an outstanding visual reciprocity. The upscale-downscale solution can be applied not only to stored or archived content, but also live video so that a live HDR stream can be pushed in both HDR and SDR formats. This setup requires less equipment to carry (less cameras, less cables, less power). The patented technology from bcom analyzes each video frame and adapts the conversion in real time without the need of a look-up-table (LUT), which may not always produce the best representation of the source. Furthermore, bcom HDR-to-SDR is available as a verified acceleration function (AFU) within the Intel Acceleration Stack for Intel Xeon® CPU with FPGAs. The solution can be deployed in a virtualized FPGA environment today in all qualified servers with Intel Programmable Acceleration Card with Intel Arria® 10 GX FPGA (Intel PAC with Intel Arria 10 GX FPGA).

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Proof Point

The b<>com HDR-to-SDR IP core was validated on an Intel Arria 10 GX FPGA with Bitec FMC HDMI daughtercard. Video source from a Phabrix-Qx serial digital interface (SDI) generator converts the HDMI using AJA Hi5-4K-Plus; the HD video output is converted to SD Input using the AJA HA5-4K and analyzed by the Phabrix-Qx.

The test setup on PAC board plays the same test vectors as the IP HDL simulation testbench. A second test setup measures the output values of a generic pattern bar and compares the output to a reference algorithm model developed by b<>com engineers. Videos comparing the output of the b<>com converter and standard fixed look-up algorithms are available or can be created from customer video data. This allows side-by-side comparison of the output, which is really the best way to assess the quality of the results.

Use Case

The accelerator function converts HDR content (without the need for input metadata) from BT.2100 (PQ/Perceptual Quantizer, HLG/Hybrid Log Gamma) or S-log3 HDR format into a legacy or UHD Phase 1 (BT.709) format.

Full HD and UHD (4K/8K) can be supported. Example use cases include:

- Conversion of HDR video content to legacy format. For pre-recorded live and on-demand service modes, extensive libraries of HDR content can be pre-converted to SDR.
- Mixing of SDR and HDR live sources
Broadcasting of live events (typically sports) in HDR, using a number of cameras where not all cameras are necessarily HDR-capable, is not feasible without an SDR-to-HDR converter.
- Monitoring and quality control in production environment

Solution Value

This type of solution is usually integrated into video broadcast equipment, but in this case it can be integrated into enterprise or on-prem cloud or server systems. It could complement a video functions suite that could include features such as H264, MPEG2 encoding or decoding. With this solution media content owners can still feed their video catalog with SDR content even if they are producing the video in HDR. It allows them, at a very low cost, or, if their infrastructure can support it, to deliver both legacy contents and HDR contents to their customers bases (not all houses are equipped with HDR-compatible TV sets). This enables the broadcaster, or media provider to offer a consistent viewing experience to their end customers even if they do not have any native HDR TV sets.

The HDR-SDR IP helps not only to manage files, but can also lead to massively reduced storage requirements because it reduces the need to store multiple versions of the same file.

Solution Architecture

The b<>com HDR-to-SDR AFU solution is available on qualified servers with Intel PAC with Intel Arria 10 GX FPGA. The HDR-SDR Converter IP is validated to run on industry-standard hardware with the Intel Arria 10 GX FPGA.

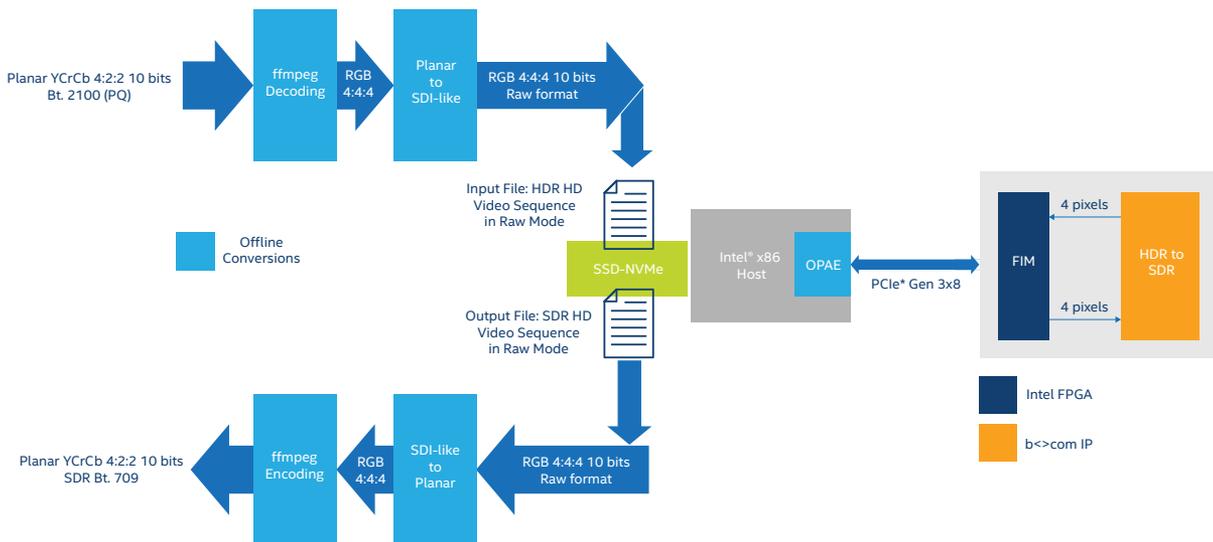


Figure 1. b<>com solution enables FPGA acceleration of HDR conversions in a virtualized environment using the Intel® Acceleration Stack for Intel Xeon® CPU with FPGAs. The stack is integrated by the host Open Programmable Acceleration Engine (OPAE) and the FPGA Interface Manager (FIM) driver

Performance

NUMBER OF LANES = NUMBER OF IP INSTANCES	4 ^a
Useful byte rate	3 GBps
Useful bit rate	24 Gbps
FPGA design clock	200 MHz
Bit number / pixel	30 bits
Aligned bit number /pixel	32 bits
Full HD acceleration 1 stream	x 8
Full HD acceleration 2 streams	x 4
UHD acceleration 1 stream	x 2
UHD acceleration 2 streams	x 1

^a The maximum performance (maximum amount of lanes of uncompressed video that can be processed) is limited by the PCI Express* (PCIe) bandwidth in Intel PAC with Intel Arria 10 GX FPGA and not limited by the compute capabilities of the Intel Arria 10 FPGA. Newer versions of acceleration cards significantly increase the PCIe bandwidth.

Table 1. Acceleration Performances



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Conclusion

B<>com's solution in Intel Arria FPGA offers a real time and highly efficient HDR to SDR conversion solution that can help reduce total cost of ownership(TCO) derived from reduced file storage and enables high quality offline and live conversions. The HDR-SDR Converter IP is available for purchase directly from b<>com.

Learn More

You can find more information at the following websites:

- b<>com
<http://b-com.com>
- Intel FPGA Video Solutions
www.intel.com/fpga-broadcast