

JPEG XS: Grass Valley's Standardized Approach

July 2021

Why Compression?

Production in today's world has become increasingly complex and expensive. While the cost of media rights has soared to record highs, the demand for new content has also increased. Producing this content has also become more expensive. UHD and HDR formats have become a requirement for premiere content, while concerns over ecological sustainability and health measures have made remote production more and more commonplace. As a result, broadcasters have been driven to lower the cost of productions, and make more content available at a lower price, often using a remote production crew.

Underlying infrastructure must enable the flexibility and scalability required for efficient and safe workforce management as well as an increased demand for content. IP-based workflows using compressed video enable the growth and accessibility that broadcasters need to meet today's demands for a remote production crew as well as the ability to seamlessly change the setup based on the size or format of the production. One of the key enablers of scalable and flexible production over IP is the JPEG XS codec, which allows broadcasters to more effectively transfer high-bandwidth video, UHD in particular, over an IP network.

Grass Valley's Commitment to Standards

A broadcaster's entire workflow, from the camera in the arena to the display in the remote control room, is critical and should be reconsidered as we design for today's requirements of a larger number of diverse and remote productions. Using a standardized 10-bit codec in the complete workflow fulfills the promise of IP, increasing flexibility and scalability while reducing complexity. Broadcasters are empowered to maximize savings while simultaneously fostering creativity and artistry to deliver more diverse content and increase their yield per asset. Grass Valley's implementation of the standardized 10-bit codec helps customers maintain interoperability within this ecosystem.

The main business benefit of using any compression technology is to reduce the bandwidth used across a network. This allows a broadcaster to increase production capabilities (more and/or better productions), improve delivery, reduce costs and allow other innovations which will maximize monetization of their content. With any codec, however, there is an increased risk of poorer picture quality or increased latency.

Grass Valley has found that the JPEG XS standard has negligible latency, with no quality sacrifice at a fraction of the bandwidth. Grass Valley's encoding and decoding latency of 4 milliseconds are well below the 13 millisecond latency threshold that MIT researchers have indicated humans are able

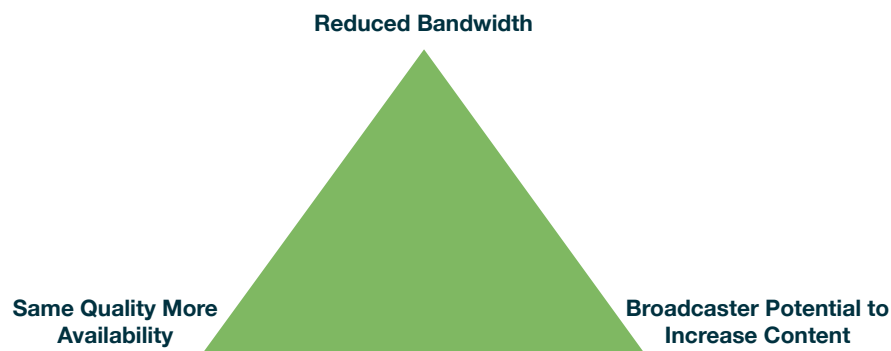


Figure 1: Business benefit of JPEG XS.

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For the XIP-3901-JPEG-XS application, there are three operating modes:

Mode	Encoder Paths	Decoder Paths	Uncompressed Output Type	Codec/Card	Codec/RU (Densité 3+ FR4)	Codec/RU (Densité 3+ FR1)
1	2 UHD	2 UHD	12G SDI + SMPTE ST 2110	4 UHD	12 UHD	8 UHD
2	8 HD	0 UHD	SMPTE ST 2110	8 HD	24 HD	16 HD
3	0 UHD	8 HD	3G + SMPTE ST 2110	8 HD	24 HD	16 HD

Table 1: Three operating modes, for HD (8 channels) to UHD (2 channels).

to detect. Research also indicates that at a 10:1 compression ratio using JPEG XS provides visually lossless quality. Grass Valley's modular JPEG XS decoder/encoder supports compression ratios from 6:1 to 36:1 allowing each customer to select between visual quality and bandwidth efficiency.

Encoding to SMPTE ST 2110-22 is ultra-low latency for sub-millisecond transmission. For decoding, the uncompressed output of the XIP-3901 can be realigned to "top of frame" with other video signals feeding the typical production center, or in minimum delay to keep total video latency to minimum.

In a customer's recent transatlantic trial, Grass Valley equipment was shown to display signals in Los Angeles that had originated in Berlin with uncompressed quality. By considering the entire broadcast workflow from camera to final display, Grass Valley is proud to say that we are the only supplier that can offer a full end-to-end standardized solution with negligible latency — and no loss of quality — at a fraction of the bandwidth. This creates the best-in-class experience based on our market research, for both the broadcaster and the viewer while providing the ability to scale the network with additional tools and more content.

The Grass Valley End-to-End Workflow Solution

A typical end-to-end JPEG XS-based remote production signal flow is shown in Figure 2.

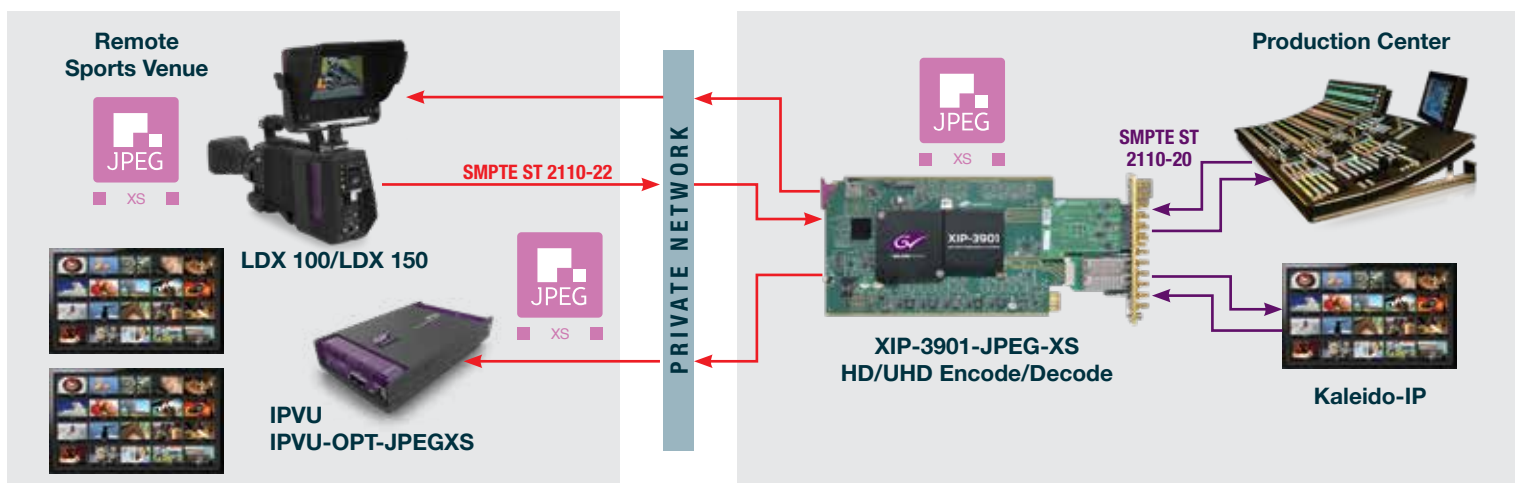


Figure 2: Grass Valley JPEG XS Solution Overview

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The Grass Valley LDX 100 and LDX 150 cameras with NativeIP technology output JPEG XS encoded video and transmit it directly to a private network over SMPTE ST 2110-22. This SMPTE ST 2110-22 stream is decoded at super low latency levels at the production center by the XIP-3901-JPEG-XS application. These decompressed streams feed the production switcher and Kaleido IP multiviewers allowing the technical director to switch the show with no delay — as if they were sitting at the venue. The output from the multiviewers is again encoded by the XIP-3901-JPEG-XS application and retransmitted out to the private network so that it can be displayed in the remote control rooms using the IPVU JPEG XS application, which translates the SMPTE ST 2110-22 into HDMI for the 4K displays — which can range from consumer models to professional models.

The IPVU has a mounting unit so it can be mounted on the back of displays in remote control rooms; essentially it's a zero rackspace unit. The output from the multiviewer is in JPEG XS, so low-cost 10G SFPs can be used in the IPVU. This allows for a reduction in the amount and cost of cabling in the control room, making for a cleaner and more efficient workspace.



Figure 3: Zero Rackspace IPVU using Vesa-Mounting Kit

The high-quality compression and low latency of JPEG XS and SMPTE ST 2110-22 allow the production to take place remotely. The fact that the entire workflow is using JPEG XS natively simplifies the equipment that needs to be brought on site and the entire workflow can be quickly reconfigured for any size production in any format at any location on the network.

Solution-Oriented Approach

A Grass Valley JPEG XS solution is a true end-to-end ecosystem allowing a broadcaster to reap the full benefits of scalability, flexibility and efficiency of JPEG XS in an IP infrastructure. Broadcasters looking for a simple, standards-compliant, end-to-end solution will find that Grass Valley is the only vendor to address the complete workflow. Broadcasters who require multivendor systems will benefit from Grass Valley's adherence to standardized technologies and the fact that all Grass Valley solutions are fully NMOS compliant and are extensively tested for interoperability.

Some early implementations of JPEG XS in broadcast environments use an 8-bit codec that was never standardized. These 8-bit islands now face costly and delayed upgrades that will prevent them from being compatible with the current 10-bit JPEG XS codec standard. Having two incompatible implementations in the market creates problems not only for the early adopters — but is an impediment to creating the open, standardized ecosystem critical to achieving a broadcaster's goal of increased flexibility and reduced complexity.

A New World

As the cost of acquiring new content continues to rise and the revenue it generates continues to decline, broadcasters must continuously innovate to increase not only the amount of content produced, but the utilization of the resources and investments they have made into creating that content.

Grass Valley's JPEG XS workflow enables broadcasters to have much more freedom to generate content for remote production safely, and to get greater usage out of their infrastructure investments. A standardized IP-based compressed workflow gives the broadcaster the ability to scale their productions easily, quickly switch between formats and effectively increase the quality and quantity of their productions at a reduced cost.

Grass Valley will bring this open standards-based solution to the market in July 2021, helping content creators, broadcasters and media organizations to produce brilliant content and build successful media businesses.