harmonic

Exploring the IP Evolution for Media Workflows

harmonicinc.com

Table of Contents

Introduction

Compressed video signals transported via IP are now an essential element of broadcast infrastructure. This paradigm originated more than a decade ago in distribution applications, where underlying connectivity challenges could be improved with techniques imported from IT networking environments. For uncompressed workflows, however, there remained islands of broadcast-specific, SDI-based functionality alongside IP, creating complexity and inflexibility.

A simplified broadcast infrastructure that seamlessly combines light and heavy compression techniques with uncompressed signal flows over IP simply wasn't possible… until now.

Recent developments in network technology are leading to the replacement of SDI-dependent systems with IP solutions capable of moving high-bitrate, uncompressed signals alongside compressed ones. SDI still has its place, and will for some time, but predominantly when legacy systems, surrounding infrastructure or specific workflows demand its use.

In the 2016 Big Broadcast Survey Market Report, 68% of respondents identified IP networking and content delivery as important to the future of their business. The primary catalyst for their interest is the ability to create a more agile and flexible technology infrastructure that can be repurposed for future services.[1] Greater solution agility allows operators to deal with rapidly changing market dynamics. When systems are no longer commissioned for specific formats, core areas of media functionality can then embrace enterprise techniques like virtualization and software-defined networking (SDN). Live broadcast workflows are the main beneficiaries of these advancements, with improved bandwidth and processing leading to the availability of all-IP delivery chains for all video formats, including Ultra HD.

The efficiencies and CAPEX and OPEX benefits of IP-based workflows hold an obvious attraction for broadcasters. To realize these benefits requires technical clarity on the issues fundamental to adopting media-over-IP workflows, and that is the principle aim of this ebook: provide a common-sense look at the available technologies for migrating to an all-IP workflow.

1. The Big Broadcast Survey 2016 Global Market Report, Devoncroft Partners, pg. 8

Tracking the IP Evolution

The application of compressed video over IP networks began in distribution and is now actively employed throughout ingest and content creation workflows.

Before IP, a form of SDI known as ASI (asynchronous serial interface) dominated compressed video distribution. This format for carrying MPEG transport streams was very much a compromise solution between the synchronous world of video and the asynchronous domain of IP networking, yet the shift from ASI to IP transport was one of the first major transitions towards adoption of IP network-based solutions in video infrastructure. This revolutionary step required that IP networks possess the same redundancy, resilience and non-blocking behavior of legacy broadcast products and solutions. The use of multiprotocol label switching (MPLS) networks, seamless packet switching and robust error protection were also vital elements to guarantee the quality of service (QoS) demanded for professional video transmission.

The early incarnations of broadcast IP headends sowed the seeds for the standardization of compressed video protocols, and triggered the development of forward error correction (FEC) schemes like SMPTE 2022-1/-5 to enable the reliable carriage of media data over IP. There have since been concerted efforts to extend the scope of IP workflows to lightly compressed and uncompressed video transport. Hardware-based codecs such as JPEG 2000 and AVC-I offer light compression performance and the ability to edit encoded content, leading to their adoption in many IP-centric production environments.

While uncompressed IP as an alternate to SDI is a logical next step, the cost of deploying the required high-performance IP networks to accommodate uncompressed video delivery workflows remains prohibitive. That reality has led to the introduction of light-compression mezzanine codecs such as VC-2 and TICO® as potential enablers of low-latency, increased density all-IP broadcast and production workflows.

The way forward, however, increasingly appears to depend on a set of common standards from SMPTE for transporting uncompressed video over IP: SMPTE ST 2022-6 and SMPTE ST 2110 (the latter having some parts of the standard approved at the time of writing). Driven by the Alliance for IP Media Solutions (AIMS), the industry is now aligning around both specifications.

With SMPTE ST 2022-6 and SMPTE ST 2110, broadcasters can operate within a mixed environment consisting of both compressed and uncompressed video, one in which all-IP interconnectivity provides the same operational efficiencies found throughout the larger enterprise sector. Synchronous video switching goes a long way to the deployment of this all-IP infrastructure, as well as high-performance media storage, but timing, control, metadata and the ability of the network to function according to the requirements of live media are the wider ambitions for broadcasters and service providers alike.

Reliable carriage of live media also necessitates buffering, error correction and synchronization schemes to overcome the inherent weakness of packet-based IP networks. Virtualized IP networks address this issue; more specifically, SDN approaches in which the network control layer is decoupled from bespoke hardware to optimize the entire network for the demands of video.

As with any evolutionary process, the speed of IP adoption is not consistent across global markets. Some operators are simply more ready than others to embrace advanced IP video workflows. In addition, some solutions that feature IP connectivity are merely a reworking of SDI techniques. Harmonic takes the approach that to fully exploit the benefits of IP for the full spectrum of media and entertainment applications, SDI and IP transport must coexist in a simplified, hybrid environment that allows operators to move forward at a pace that meets their technical and financial requirements.

SDI and IP transport must coexist in a simplified, hybrid environment that allows operators to move forward at a pace that meets their technical and financial requirements.

Migrating from Coax: Why Now?

"IP is the only way to have a flexible, friendly and economically sustainable video ecosystem with reduced equipment demands, standards conversions, cabling, space and power."

- Massimo Bertolotti, head of engineering, Sky Italia

SDI VS. IP FEATURE COMPARISON

SDI	IP
	
Guaranteed bandwidth	Best effort/prioritized
Deterministic	Probabilistic
Static circuit connections	Dynamic/routed
Single signal	Multi-signal
Synchronous timing	Asynchronous timing
Real time	Non real-time/jitter reorder
Low latency	Variable latency/utilization
Error-free	Packet loss/retransmission/FEC
Point to point	Any to any

No 24/7 broadcaster is going to move from traditional coax-based SDI infrastructure to IP overnight. SDI is simply too embedded — especially for production and playout applications — so the transition will be gradual. The industry has made similar transitions before; for instance, when moving from analog to digital and from SD to HD. In each case, most broadcasters constructed islands of the new technology and routed appropriate workflows into and out of them. Media over IP will be no exception.

What has happened recently to drive the adoption of IP throughout the delivery chain?

1

The increased use of standard IT networking technologies, solutions and practices in media environments. As programmers and service providers have realized the benefits of employing technologies previously found primarily in data centers — IP switches and routers, for instance — they've looked for opportunities for these systems to enhance baseband video ecosystems. Transporting large files or live streams without the need to encode and decode them multiple times to accommodate SDI islands offers clear workflow efficiencies, but requires an SDI-to-IP bridge. Several technologies provide this capability, including SMPTE ST 2022-6 and SMPTE ST 2110. Moving lightly compressed streams over an IP network via proprietary codecs, such as TICO and VC-2, is also viable, but may not be suitable for all applications — or provide long-term ROI.

2

The growing demand to reduce total cost of ownership (TCO) of broadcast infrastructure. Software-based media processing applications running on commercial off-the-shelf (COTS) servers delivers on this front. Function integration — the ability to combine previously discrete functions on a single platform — is a key benefit of software-based media processors, resulting in lower overall business costs through significant CAPEX and/or OPEX savings.

3

Flexible, scalable workflows are now a key requirement for most programmers and content providers. Broadcast, cable, satellite and IPTV services must co-exist with video on demand (VOD) and over-the-top (OTT) services to allow customers to watch content on any device at any time. New, more-efficient codecs such as HEVC and compression technologies such as Harmonic's EyeQ™ video optimization solution both enable this capability — without the need for a forklift upgrade of the headend. And, of course, Ultra HD content distribution is building momentum, prompting a growing number of programmers and service providers to enhance their infrastructure to efficiently transport real-time, high-bitrate signals. High-performance, Ethernet-based media storage with the ability to accommodate both compressed and uncompressed content plays a key role in enabling these flexible, scalable workflows.

THE BENEFITS OF UNCOMPRESSED WORKFLOWS

Enhanced flexibility and agility of the broadcast plant	Cable reduction via statistical multiplexing of multiple signals
Reduced CAPEX through increased use of COTS hardware	Easier monitoring of video signals
Support for transmission of richer metadata	Flexible distribution via private and public cloud
Simplified infrastructure via a single Ethernet fabric for all media formats and codecs	A single multiresolution fabric for SD, HD, compressed and uncompressed content, with an easy upgrade path to UHD

Adapted from "Demonstration of COTS Hardware for Capture, Playback and Processing of SMPTE ST 2022-6 Media Streams" by Thomas Edwards, VP Engineering & Development, FOX Network Engineering & Operations

IP-Enabling Media Technologies

For media over IP to become viable industry-wide, adherence to standards is essential. Proprietary or in-house protocols may work on a limited basis, but do not provide the overall flexibility and security required to serve the full spectrum of video playout and distribution applications. Here's a quick look at some of the pivotal standards and specifications enabling the migration to all-IP infrastructure.

Timing

SMPTE ST 2059-x – The SMPTE ST 2059 family of standards addresses the timing of systems (and devices) based upon IEEE 1588 PTP. The move to PTP permits operators to circumvent the need for genlock synchronization and timecode wiring in IP-centric facilities, and to begin a coherent migration from SD/HD-SDI to IP for media transfer (often using SMPTE ST 2022-5/-6 and now possible with SMPTE ST 2110).

Production Codecs

AVC-I – AVC-I is a light-compression variant of the MPEG-4/AVC codec. It was standardized in 2005, emerging from the MPEG-4 AVC production standard as a low-latency option for video contribution applications. Intra-only codecs such as AVC-I are more efficient than long-GOP options when enough bitrate is available, low end-to-end latency is a decisive requirement, streams have to be edited, or the application is sensitive to transmission errors.[2]

JPEG 2000 – JPEG 2000 is a light-compression codec created by the Joint Photographic Experts Group to improve the performance of the original JPEG standard. Based on wavelet compression technology, a JPEG 2000 architecture lends itself to a wide range of uses, from portable digital cameras to advanced pre-press, medical imaging and other key sectors. At high bitrates, artifacts become nearly imperceptible with JPEG 2000, leading to its wide acceptance in production applications.

Visually Lossless Mezzanine Codecs

TICO – TICO compression was developed for HD and UHD infrastructure by the TICO Alliance, a consortium of industry manufacturers, OEM providers, broadcasters, electronics brands and technology companies. Announced at the 2015 NAB Show, it provides visually lossless compression up to 4:1 and enables UHD and HD content to be transported over legacy SDI infrastructure and modern IP production and contribution networks. The TICO SMPTE RDD35 with new extended capabilities has been selected as the baseline for the JPEG-XS international standard, which is expected to be published in 2018.

VC-2 – SMPTE ST 2042-1 (VC-2), also known as Dirac Pro, is an intra-frame family of codecs that spans contribution to UHD distribution to post production. Developed by the BBC, VC-2 is non-proprietary and royalty-free, and offers high quality with low complexity and latency. A lossless compression ratio of 2:1 is available, and bitrates are configurable from 10-200 Mbps for transport over ASI and IP.

LLVC – LLVC (Low Latency Video Codec) is a light-compression technology developed by Sony to support the requirements of 4K 60p transmission over 10-Gbps Ethernet. With visually lossless 3:1 compression, this format is expected to enhance Sony's IP Live Production system, making live studio and sports broadcasts more efficient and less expensive.[3]

2. http://ateme.com/IMG/pdf/avc-i_for_broadcast_contribution_by_pierre_larbier_ateme_cto_-_october_2011-2.pdf
3. https://blog.sony.com/press/sony-collaborates-with-evertz-on-ip-interoperability-and-development-of-its-networked-media-interface/

Uncompressed IP Transport

SMPTE ST 2022-x – The SMPTE ST 2022 family of standards deals with the transport of various types of media signals over IP, along with optional FEC. Only parts 5 and 6 are applicable for uncompressed media; the others (except for Part 7) address MPEG-2 TS-based media, which implies compressed. Each part was drafted for long-haul service; as a result, switching is a challenge and needs supplementary timing and control standards to work within an IP ecosystem.

SMPTE ST 2110 – With the first three parts of the standard having been approved at the time of this writing, SMPTE ST 2110 is intended to address the complexities of live and as-live production environments, in which independent video and audio sources may need to be managed, split, recombined, mixed and routed. Promoted by AIMS as the preferred protocol for complex IP workflows, it combines VSF's TR-03 and TR-04 specifications with AES67 audio and SMPTE ST 2059 timing, making it possible to implement more elegant and sophisticated all-IP workflows than are possible with SDI today.

Network Infrastructure

SDN – SDN is an emerging architecture that decouples the network control from hardware-level packet-forwarding functions. One of its key aspects is that switching decisions can be made at the switch level to allow the network to be controlled and optimized for non-blocking carriage of video.

NFV – NFV decouples the network functions, such as network address translation, firewalling, intrusion detection, domain name service and caching, from proprietary hardware appliances so they can run in software. It utilizes standard IT technologies that run on high-volume service, switch and storage hardware to virtualize network functions, and is applicable to any data plane processing or control plane function in both wired and wireless network infrastructures.[4]

4. https://www.sdxcentral.com/resources/nfv/whats-network-functions-virtualization-nfv/

Professional Interfacing

A look at some of the interface and format options for migrating from SDI to IP.

SDI: Single (6G/12G) or Quad SDI:
Baseband or lightly compressed HD & UHD/4K

IP: 10/25/40/100 G
Compressed TS, mezzanine & baseband HD & UHD/4K

I-Frame (Editable)
XAVC
JPEG 2000
AVC ULTRA

Visually Lossless
TICO
VC-2
LLVC

Long GOP
H.264 MPEG-4/AVC
HEVC High Efficiency Video Coding

For media over IP to become viable industry-wide, **adherence to standards** is essential.

Video Processing over IP

All-IP workflows offer the promise of more efficient, less-expensive media processing for everything from OTT to UHD content, making it a better option than SDI for future-proof infrastructure investment. The available bandwidth for the different SDI formats are outlined below:

Format	Standard	Name	Bitrate (Gbps)
720p, 1080i	SMPTE ST 292	HD-SDI	1.485
1080p	SMPTE ST 372	Dual Link HD-SDI	2.970
1080p	SMPTE ST 424	3G-SDI	2.970
UHD1 30 fps	SMPTE ST 2082	6G-SDI	6
UHD1 60 fps	SMPTE ST 2082	12G-SDI	12
UHD1 120 fps	SMPTE ST 2036	24G-SDI	24

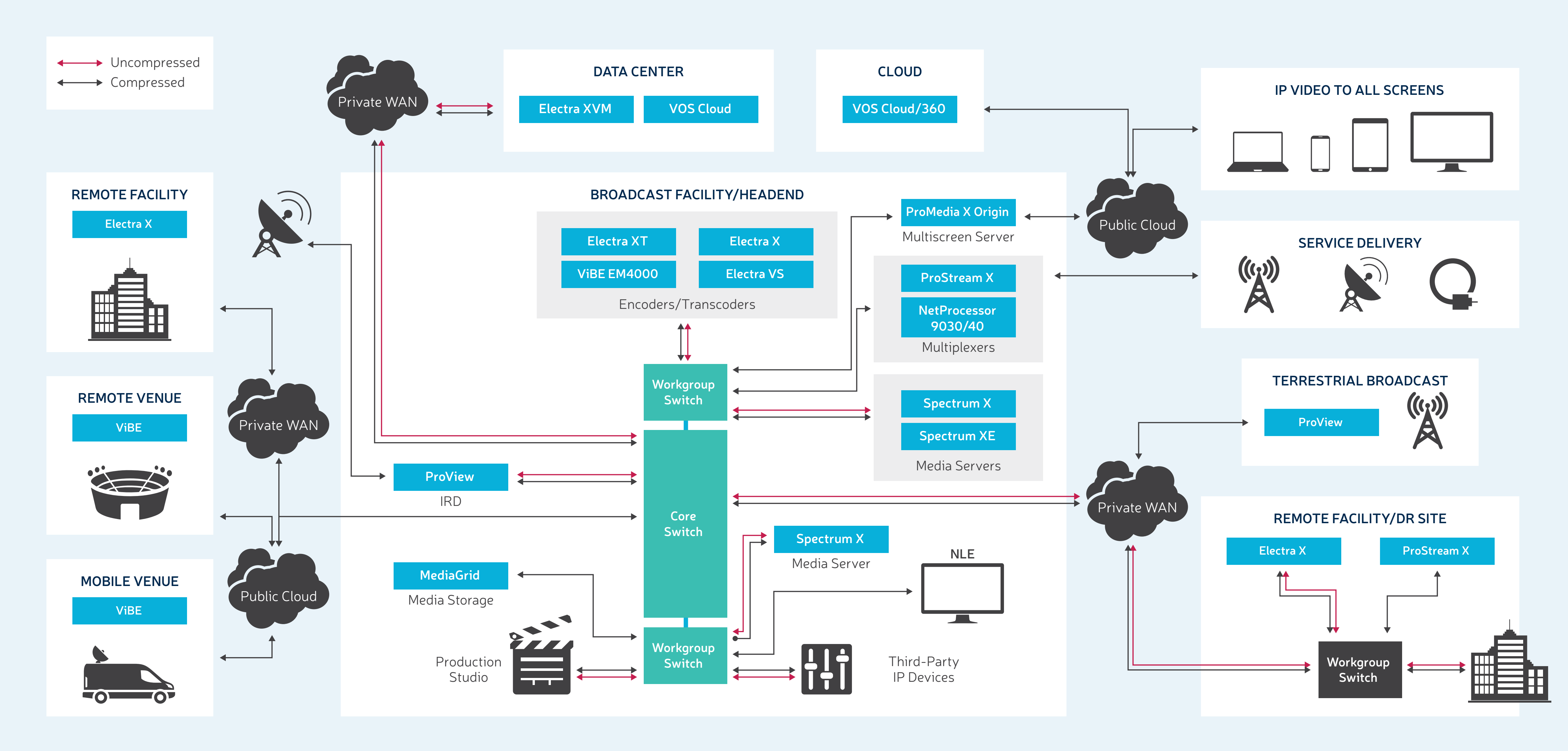
Based on this table, we can see that the carriage of UHD 60-fps content requires 12G-SDI connectivity and therefore cannot be carried over a 10-GbE link; light compression is required to make this possible.

Formal SMPTE Standards for IP Networks

SMPTE has certified a range of standards for transporting media over IP networks. Here's a closer look at them.

SMPTE ST 2022-1	Forward Error Correction for Real-Time Video/Audio Transport over IP Networks
SMPTE ST 2022-2	Unidirectional Transport of Constant Bit Rate MPEG-2 Transport Streams on IP Networks
SMPTE ST 2022-3	Unidirectional Transport of Variable Bit Rate MPEG-2 Transport Streams on IP Networks
SMPTE ST 2022-4	Unidirectional Transport of Non-Piecewise Constant Variable Bit Rate MPEG-2 Streams on IP Networks
SMPTE ST 2022-5	Forward Error Correction for High Bit Rate Media Transport over IP Networks
SMPTE ST 2022-6	Transport of High Bit Rate Media Signals over IP Networks (HBRMT)
SMPTE ST 2022-7	Seamless Protection Switching of SMPTE ST 2022 IP Datagrams
SMPTE ST 2059-1	Generation and Alignment of Interface Signals to the SMPTE Epoch
SMPTE ST 2059-2	SMPTE Profile for use of IEEE-1588 Precision Time Protocol in Professional Broadcast Applications
SMPTE ST 2071-1	Media Device Control — Framework (MDCF)
SMPTE ST 2071-2	Media Device Control — Protocol (MDCP)
SMPTE ST 2071-3	Media Device Control — Discovery (MDCD)
SMPTE ST 2071-4	Media Device Control — Interface Repository (not published yet)
SMPTE ST 2110-10	Timing and definitions – SMPTE ST 2059 aka PTP
SMPTE ST 2110-20	Uncompressed active video - RFC-4175 transport of video
SMPTE ST 2110-30	Uncompressed PCM audio - AES-67 transport of audio
SMPTE ST 2110-40	Ancillary data - IETF ANC 291
SMPTE ST 2110-21	Video Sender Traffic Shaping for uncompressed video Being Considered
SMPTE ST 2110-31	Full AES3 transport
SMPTE ST 2110-50	Embedded essence - SMPTE ST 2022-6 for video and AES-67 for audio

The Harmonic Media Over IP Solution



Components of the Harmonic Media-over-IP Solution

IP network design needs to account for security and performance, as well as convenience. The Harmonic media-over-IP solution addresses these concerns with an integrated architecture that allows customers to bridge the gap between baseband and compressed workflows with simultaneous SDI and IP functionality. The principal Harmonic products that contribute to this hybrid solution are outlined below.

Electra XVM

The Harmonic Electra XVM virtualized media processor is a software-based, fully converged, broadcast-ready platform designed exclusively for virtualized video infratructure (VVI). Operating on common hardware platforms in IT data center environments, Electra XVM optimizes the computing power of contemporary Intel-based servers to host a robust set of dynamically deployable media processing applications, including SD/HD MPEG-2/AVC/HEVC encoding, video graphics and branding, and statistical multiplexing over IP. The platform natively supports compressed and ST 2022-6 IP transport stream input and is upgradeable to SMPTE ST 2110.

For more information on Electra XVM, click here.

Electra X2

The Harmonic Electra™ X2 advanced media processor is the industry's first fully converged platform for broadcast and OTT delivery. At its heart is the Harmonic PURE Compression Engine™, an advanced encoding technology that supports SD and HD formats and MPEG-2, MPEG-4 AVC and HEVC codecs. Users can also employ EyeQ™ real-time video optimization, Harmonic's enhancement for PURE Compression that ensures delivery of the highest video quality across OTT delivery networks while reducing bandwidth consumption by up to 50%. Uncompressed video over IP workflows are supported via optional SMPTE ST 2022-6 ingest and is upgradeable to SMPTE ST 2110.

For more information on Electra X2, click here.

Spectrum X

The Harmonic Spectrum™ X advanced media server system combines file, baseband and transport stream ingest with comprehensive integrated channel playout (ICP) capabilities, including graphics, branding, DVE, and live switching of baseband and compressed IP sources. The software-based system supports a broad range of SD, HD and UHD formats. By providing SDI and ST 2022-6 I/O on the same chassis, and supports SMPTE ST 2110, Spectrum X eases the migration to IP playout workflows,allowing users to transition away from SDI at their own pace.

For more information on Spectrum X, click here.

ProStream X

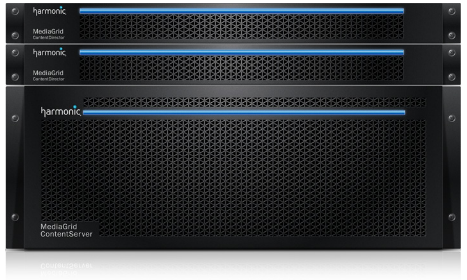
The Harmonic ProStream® X video stream processor and gateway leverages advances in IT infrastructure to provide best-in-class, high-performance stream processing for mission-critical broadcast, cable, satellite, IPTV and OTT delivery applications. The platform integrates 10-Gbps throughput with a variety of advanced video processing applications, including multiplexing, splicing, blackout switching and DVB CSA3 encryption. ProStream X also serves as a high-throughput video gateway featuring socket address flipping and ASI-to-IP conversion. The optional FlextreamIP™ technology integrates statistical multiplexing and IP switching by connecting ProStream X systems with remote Electra X2 encoders across a LAN or WAN.

For more information on ProStream X, click here.

ProMedia X Origin

The ProMedia® X Origin multiscreen media server is used to prepare and deliver broadcast-quality video to consumers anywhere, at any time. The software-based system fully integrates with Harmonic's IP video encoding and transcoding systems for live and file-based workflows, enabling a complete ecosystem for launching new revenue-generating multiscreen services. Integrated packaging-on-the-fly functionality allows multiple streams of H.264 and H.265 video to be selectively combined for any of the most popular HTTP adaptive bitrate protocols.

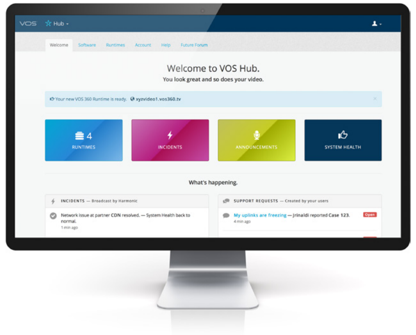
For more information on ProMedia X Origin, click here.



Harmonic MediaGrid

Harmonic MediaGrid is a highly scalable, Ethernet-based shared storage system optimized for digital media workflows. Purpose-built to deliver high bandwidth and consistent low latency, MediaGrid systems can seamlessly scale to petabytes of capacity and tens of gigabytes per second of throughput. An industry-leading, high-density storage option — up to 504 TB of raw capacity in 5 RU — can reduce rack space by up to 60%, and all compressed and uncompressed file types are supported.

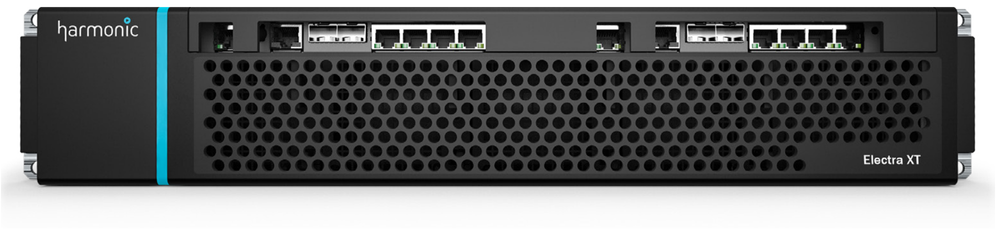
For more information on MediaGrid, click here.



VOS™ Cloud

VOS Cloud from Harmonic is a comprehensive software application that transforms traditional video preparation and delivery architectures into a fully integrated set of cloud-native microservices, accelerating time to market for new broadcast and OTT services.

For more information on VOS Cloud, click here.



Electra XT

Possessing the highest real-time transcoding density on the market and any-to-any format support, the Harmonic Electra XT Xtream™ transcoder (formerly ViBE® XT1000) delivers significant CAPEX and OPEX savings and accelerates time to market for operators faced with fast channel lineup growth and a rise in multiscreen applications.

For more information on Electra XT, click here.

NetProcessor 9030/40

The NetProcessor 9030/40 is an advanced MPEG-2/MPEG-4 AVC SD/HD transport stream multiplexer and processor possessing powerful function integration capabilities. It is ideal for broadcasters, content owners and network operators looking to migrate from DVB ASI legacy environments to IP-based infrastructures, as well as for localizing or remodeling content.

For more information on NetProcessor, click here.

Spectrum XE

Combining a full channel-in-a-box system with a premium-quality software encoder, the Harmonic Spectrum XE (formerly FUZE-1) defines a new breed of IT-based solution for HD/SD broadcast and multiscreen channel origination, manipulation and delivery. The platform is available as a virtual machine running on customer-provided hardware or as an appliance. It delivers emission-ready transport streams and OTT outputs, and can be controlled through Spectrum XE's clustering technology to manage resiliency and load balancing of its services.

For more information on Spectrum XE, click here.

Electra VS

The Electra VS convergent video system (formerly ViBE VS7000) is a next generation compression platform for all-IP environments, encompassing mission-critical applications including live broadcast-quality HD and UHD encoding and faster-than-real-time file transcoding.

For more information on Electra VS, click here.

ViBE CP9000

The ViBE CP9000 HD/UHD contribution encoder addresses the call for preserving video quality at the front of the broadcast chain with the ability to process uncompressed UHD signals at up to 160 Mbps. The platform encodes content in a single slice in real-time via HEVC. SDI and all-IP contribution and primary distribution use cases are both supported, with SMPTE ST 2022-6 and TICO capability available via software upgrade

For more information on ViBE CP9000, click here.

ProView 7100/8100

ProView IRDs assure delivery of pristine video for all content reception applications. With RF, ASI and IP inputs, and ASI and IP outputs, the ProView 7100 and 8100-series receivers simplify the migration to an all-IP headend solution and power the launch of added-value services. Support for advanced content delivery redundancy schemes includes the ability to provide simultaneous primary satellite and backup IP network feeds. Distribution over unmanaged IP networks is available on the ProView 8100.

For more information on ProView IRDs, click here.

Harmonic Media Over IP Product Summary

	COMPRESSED		UNCOMPRESSED	
	In	Out	In	Out
Spectrum X Advanced Media Server	X		X	X
Spectrum XE Playout System	X	X	X	
Electra X2 Advanced Media Processor	X	X	X	
Electra XVM Virtualized Media Processor	X	X	X	X
ProStream X Stream Processors	X	X		
VOS Cloud Cloud-Native Media Applications	X	X		
MediaGrid Shared Media Storage	X	X	X	X
ViBE CP9000 Contribution Encoder	X	X	X	
ProView 7100/8100 IRDs	X	X		

Available Today   Under Consideration

The Challenges Ahead

The topology of a media infrastructure is complex, and when users who are accustomed to SDI with genlock-based timing begin to think about migration to IP networks, they often fail to understand some of the key architectural differences. While the bi-directional nature of IP may be obvious, the need to segregate traffic may not be. Network security is also a key consideration, particularly when that network extends beyond the studio environment.

Even with the construction of IP islands, traditional SDI-oriented users will need to learn several new concepts and terminology. One of these is QoS, an important metric for guaranteeing IP network performance. Since multiple signals share a single IP cable, QoS ensures that media flows get through and less important traffic can be held, when necessary. IP network design also needs to account for security and convenience.

As mentioned earlier, real-time, frame-accurate switching is a particular challenge in IP workflows. SMPTE ST 2022-6, for instance, was written with long-haul applications in mind, not studio applications; thus, frame-accurate switching of uncompressed IP video streams is only now coming into focus. The advent of SMPTE ST 2110 brings much-needed clarity to the situation.

The ultimate goal is for COTS-based core and workgroup switches to replace bespoke video routers, a paradigm that is currently cost-prohibitive and lacks the performance required for real-time media processing. There are other methods, known as packet stitching of AV streams, which can accomplish the goal of frame-accurate switching at the cost of additional devices and/or subsystems, including:

Source Timed Control

- Performed like SDI switching
- Frame-accurate effect
- Buffering at the end point (to cover the transmission time delta between two sources)
- Synchronization required at both sources

Switched Timed Control

- Performed like SDI switching, with the stream switch during VBI
- Frame accurate
- Buffering in the Ethernet switch (to cover the transmission delta from sources to switch)

Destination Timed Control

- Not like SDI switching — the destination assists in “splicing” two streams
- Frame accurate
- Buffering at the end point
- Additional bandwidth required during splice period

Each of these methods requires cooperative resources and sometimes extra bandwidth on the network.

Once content is in the IP domain, many of the techniques used in conjunction with SDI workflows are redundant, and consequently need to be reworked to improve processing efficiency. Specifically, timing and control approaches are being re-evaluated to facilitate the separation of these functions as layers, apart from the signal flow. This approach is consistent with the structure of virtualized enterprise deployments.

Conclusion

The media industry is making great strides to adopt IP techniques and infrastructure within the video domain. While IP-based networking has been around for more than a decade, new approaches for transporting lightly compressed or baseband video over IP are simplifying infrastructures and opening the door to the deployment of new services, such as UHD.

Many of the uncertainties that previously hindered adoption of all-IP workflows have now been resolved. SMPTE ST 2022 is a good starting point, covering not only encapsulation of existing video formats but also FEC and seamless switching of IP datagrams — both essential elements for reliable video carriage over redundant IP networks. The latest standards, specifically SMPTE ST 2110, enable us to move beyond the constraints of SDI to more flexible options in our workflows.

The development of SDN architectures shows great promise for enabling high-performance processing and switching of video in an IP network. SDN may well be the catalyst for the adoption of a layered approach to the separation of media, control and timing — a necessary step if video media is to emulate the structure of enterprise networks, where there is a clear separation of applications from underlying processing capability. The move to VVI (virtualized video infrastructure) will lead to even more logical partitioning of processing resource allocation, allowing broadcasters to fully embrace the benefits of running video applications on servers.

While the drive to deploy uncompressed IP workflows began with the implementation of what are essentially SDI techniques, SMPTE ST 2110 demonstrates a committed effort to approach media carriage and processing from a fresh perspective, and to explore video in a new light. This and other related initiatives are expected to yield key efficiency gains in terms of ease of use, processing and bandwidth, but raise the question: How far from existing SDI-based processing can a facility go and still be compatible with installed infrastructure? Put another way, how long will it be before workflows are fully freed from the legacy constraints of SDI? For IP techniques to be used over a wider footprint, compression techniques must meet the traditional needs of content production, where quality, editability and image manipulation place very different demands on the codecs used for contribution and distribution.

Harmonic is leading the way with an infrastructure for the efficient transport of baseband and IP signals. Adherence to industry standards assures that components in this architecture are interoperable with standard IP networking systems, and paves the way to VVI. The move to realize core functionality in a software-based VVI is already under way with the Harmonic VOS media processing platform.

With its legacy of IP innovation and support for emerging standards, Harmonic is the ideal partner for implementing a complete media-over-IP workflow.

FULL ALLIANCE MEMBER

AIMS
Alliance for IP Media Solutions

harmonic®

12.21.17