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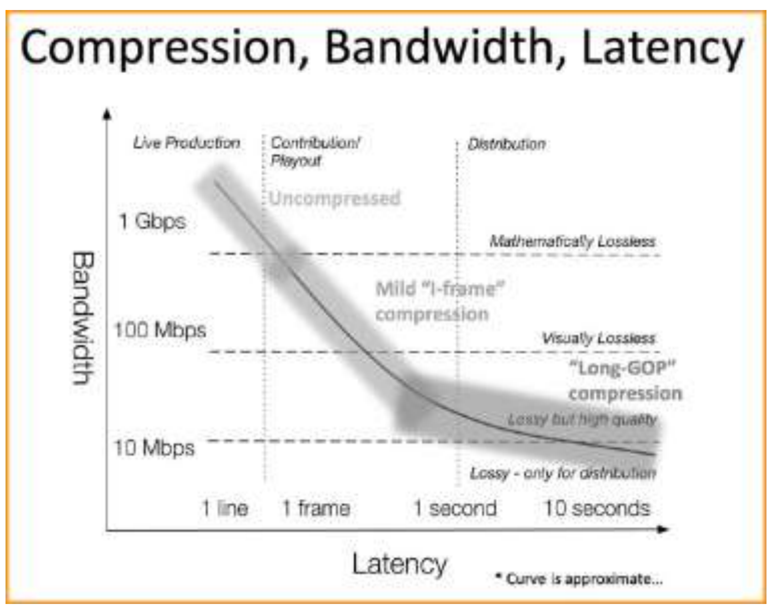
TV TechCheck

The Weekly NAB Newsletter for TV Broadcast Engineers

The State of Professional Media Networking

The broadcast industry is considering a move to converge professional quality audio, video, data, and production communications to a common networked infrastructure. The business drivers behind this revolution include: enhancing the agility and flexibility of the broadcast plant; reducing the amount of cabling through aggregating multiple signals onto Ethernet connections; expanding the use of common off-the-shelf (COTS) PC and networking hardware that have economies of scale beyond just the broadcast industry; making the broadcast plant more easily monitorable; distributing video processing in an efficient fashion over private or possibly public cloud infrastructures; and providing an efficient unified fabric for multi-resolution media.. A session at this year's NAB Broadcast Engineering Conference (BEC, April 5-10, 2014, Las Vegas, NV) entitled *Broadcast Facilities (Part 2)* included a paper, excerpted here, discussing this converged infrastructure. This paper is entitled *The State of Professional Media Networking,* and was authored by Thomas Edwards, VP Engineering and Development, Fox Network Engineering and Operations, Los Angeles, CA.

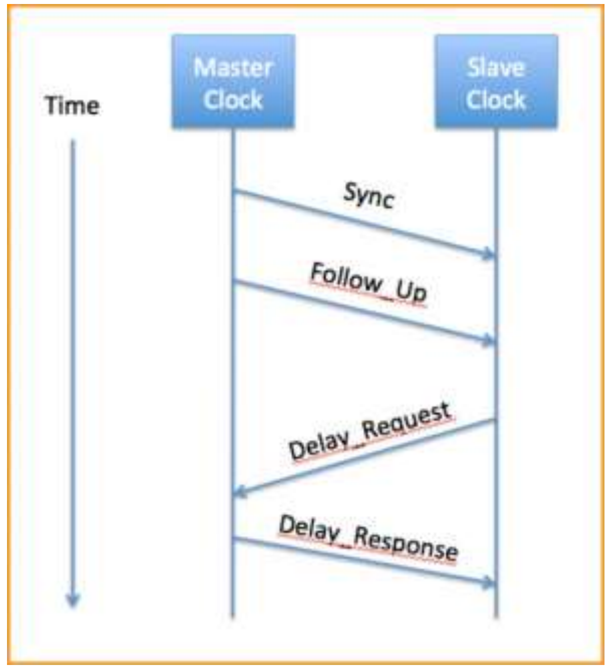
INTRODUCTION – Professional media networking is the use by professionals of a networked infrastructure to process media. Although the broad definition includes file-based workflows, the greatest challenge of professional media networking today is the processing of real-time audio and video flows. These flows have strict "isochronous requirements" that certain atomic elements of the flows must arrive to decoding devices within specified time windows, or else undesirable artifacts will be introduced. To successfully network live video streams in the broadcast plant, the industry will need to identify the standards for transmission and synchronization, enhancements to the Quality of Service (QoS) of networks, methods for synchronous switching, and realizable architectures that can make networked live video practical.



NETWORKED VIDEO TRANSMISSION STANDARDS – When considering networked video transmission, it is important to keep in mind the use cases for the video. These cases tend to break down into three main types: live production, contribution/playout, and distribution. Live production requires the lowest latency so that producers can immediately visualize the results of camera switches, transitions, and graphics insertion. Latency per device needs to be low because there may be many devices in a chain. Live production may call for per-device latency of 1 line to 1 frame.

Contribution/playout generally has lower latency requirements, ranging from 1 frame to 1 second. These kinds of streams are not being switched rapidly, and often the switching is scheduled significantly ahead of time. Distribution to end-users has the lowest latency requirements, and some very efficient distribution video compressors have several seconds of latency. Some distribution streams may almost never be switched.

As latency requirements are reduced, higher levels of compression can be used, which decrease the total amount of bandwidth required. Live production may require uncompressed video of 1.5 Gbps or more. Contribution and playout may use an I-frame compression in the tens of Mbps. Distribution may use a long-GOP compression of just a few Mbps. The graph in the figure above shows a curve that is a useful way of thinking of the trade-offs between latency and bandwidth.



TIMING & SYNCHRONIZATION – Most broadcast plants operate in a synchronized fashion today to allow for low-latency serial digital interface (SDI) synchronous switching. A centralized synchronization signal is distributed across the plant either using “black burst” or “tri-level sync,” often distributed as analog signals. In an “All-IP” broadcast plant, it is likely that timing and synchronization will be provided by the IEEE 1588 Precision Time Protocol (PTP).

PTP is a protocol to synchronize clocks throughout a computer network. Its accuracy depends on implementation, but can range from a microsecond to nanoseconds. The figure at right shows the messaging of clock synchronization in PTP. There are “master clocks” that are assumed to be accurate (from GPS or other methods), and “slave clocks” that become synchronized to the masters.

A master clock first sends out a “sync” message over the network to the slave clock. The slave clock notes the time of arrival of the sync message according to its internal clock. The master then sends a “follow_up” message that contains the precise time that the master sent its “sync” message (it is easier to determine the precise time of emission of a network packet by a NIC after it has been sent than before). Based on this information, the slave clock can achieve a basic level of synchronization with the master, however the slave time is offset from the master due to the latency of the network delay between the master and the slave.

CONCLUSIONS – The year 2013 has shown significant progress in professional networked media. There now are a number of interoperable products that carry SDI over SMPTE 2022-6, and there are some products carrying SDI video over Ethernet audio video bridging (AVB). The synchronous switching of 2022-6 flows has been shown using field-programmable gate array (FPGA) techniques as well as software-defined networking (SDN) techniques. Ethernet-connected video processing (such as compositing, graphics insertion, scaling, etc.) has been shown, giving a hint of future CPU-based and FPGA-based flexible video processing “private clouds.”

However there still remains some significant challenges ahead. Lab experiments and products with limited number of video streams need to prove that they can scale up to 100 to 1000 or more video streams while delivering the kind of reliability that broadcasters expect. There needs to be an industry consensus about whether Ethernet AVB, IP-based SDN, or some other kind of overall architecture is optimal for broadcast needs. And finally it remains to be proven that professional networked media can deliver on its promise of enhanced flexibility at a reasonable price. The rest of 2014 should be an exciting year in this area.

This paper is included in its entirety in the 2014 NAB BEC Proceedings, available on-line from the NAB Store (www.nabstore.com). For additional conference information visit the NAB Show web page at www.nabshow.com.

Important Dates and Upcoming Events

NAB/SBE Satellite Uplink Operators Training Workshop

September 29 – October 2, 2014 – Washington, DC.

137th International AES Convention

October 9 – October 12, 2014 – Los Angeles, CA.

2014 IEEE Broadcast Symposium

October 15 – October 17 – San Antonio, TX.

SMPTE Annual Technical Conference and Exhibition

20 October – 23 October, 2014 – Hollywood, CA.

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