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THE SUPERHEROES BEHIND THE BATMAN

FINISHING THE IP TRANSITION

John Mailhot, CTO of infrastructure and networking at Imagine Communications, looks at standards for television signals over packet-based (ethernet/IP) networks

Television production and distribution has been migrating towards IP infrastructure for more than 20 years. Control protocols for video servers moved from 9-pin serial RS422 onto VDCP (IP over ethernet). Routing control panels moved from bespoke coaxial loops onto IP connections. In most facilities, even the automation protocols for master control and routing control are now connected over IP networks rather than traditional serial ports.

Similarly, storage area networks (SANs) are moving away from application-specific connection technologies like Fibre Channel and InfiniBand, as ethernet speeds and capacities develop.

Another factor driving this change is economics. The IT industry is much larger (and richer in R&D resources), so it makes sense to take advantage of its standard technologies. Ethernet adapters, cabling, switches, and routers are more common, less expensive to own, and easier to wire and connect than their television-specific counterparts.

IP works for these applications, and as its line speed improved over the years, it took on more and more jobs as it surpassed other technologies. As far back as the early 2000s, some even contemplated using gigabit ethernet in place of 270 Mb/s SD SDI.

Almost ten years ago, to the surprise of no one, the decreasing cost and growing availability of 10-gigabit ethernet began to put pressure on 'traditional' 1.5G and 3G HD-SDI for pixel data. In anticipation of widespread adoption, standards bodies such as the Video Services Forum (VSF) and SMPTE took up the task of defining standards for moving studio signals over capable IP networks, leveraging work that had been done years earlier in the IETF and Pro-MPEG Forum. These standards (VSF TR-03, which led to SMPTE ST 2110) are the basis of most new designs for television facilities worldwide today.

These standards for media over IP – SMPTE ST 2110 in particular – go far beyond merely replicating SDI over IP. They break the rigid boundaries of SDI in two major ways:

- scalability to arbitrary picture shapes, sizes, and frame rates including UHD and 8K
- scalability to a wide and extensible variety of bit depths, sampling structures, colour representations, and transfer characteristics; including wide colour gamut (WCG) and high dynamic range (HDR) capabilities

Importantly, the SMPTE ST 2110 standards (unlike SDI) do not define the physical layer; they pack the signal into IP packets and allow the IP packets to be delivered over whatever network infrastructure is at hand. During the development and deployment of ST 2110 systems so far, we have seen the IT industry launch 25 gigabit and now 50 gigabit single-lane technologies into mass market, with port speeds of 25, 50, 100, 200, and 400 Gbps. Physical layer standards and technology developments for 800 Gbps and 1.6 Tbps ethernet interfaces are underway. The television industry has immediate access to all these new physical layer technologies without needing to develop any new television-specific standards.

This shift to packet-based IP technology for the interconnection of devices presents a change in how signal switching is done. Historically, SDI required every signal to connect back to a single crosspoint switch, and signals were switched by controlling this crosspoint; end devices simply consumed whatever came down the wire towards them.

In packet-based IP systems, the destination devices have a more active role in the process, where they need to request the right packet-flow from the network (typically using multicast joins). This requires the control system to have a management relationship with the endpoint devices, and in SMPTE ST 2110, we use the NMOS (Network Media Open Specification) specs from the Advanced Media Workflow Association (AMWA).

In parallel with the development of SMPTE ST 2110, AMWA developed the NMOS IS-04 and IS-05 specifications to allow control systems to have a universal device driver for endpoint devices, signalling not just which network streams to consume, but also the related metadata about the streams – the colorimetry, transfer characteristics, sampling structure, frame dimensions and rate, and more – ensuring the receiver can correctly interpret the stream it gets.

Through the careful coordination of the Joint Taskforce on Networked Media (JT-NM), the involved standards organisations – VSF, AMWA, SMPTE, AES, and the EBU – have delivered to the industry a set of standards and specifications that allow the construction of IP-based media systems that surpass the capabilities of SDI. The industry has responded by endorsing this effort and using these standards and specifications as the basis of design for new facilities worldwide. ■