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AV: From analog to digital to IP

Penetration rates are low, but the potential is significant for the adoption of IP-based audio-video systems supported by high-performance twisted-pair cabling.

BY PATRICK MCLAUGHLIN

If you haven't yet watched the online seminar titled "Cabling and Connectivity Requirements for Reliable AV," you can find it on-demand at cablinginstall.com through November 30, 2018. During the seminar, which aired live on May 31, Panduit's product manager for audio-video (AV) solutions Amy Hacker, and the company's product manager for copper cable products Steve Kwasiborski, describe AV distribution technologies and the physical-layer system performance needed to support them.

During the seminar, Hacker pointed out, "AV systems have evolved from analog to digital to IP," setting up a discussion about the cabling specification, design and installation methods that can best position an end-user organization to navigate this evolution. This article takes information from that online seminar, as well as additional information from Panduit and from other cabling-system solution providers. It intends to illustrate and give examples of the analog-digital-IP evolution of AV systems.

HDMI and beyond

Panduit's Hacker elaborated that the introduction of HDMI—High-Definition Multimedia Interface—in 2002 marked the transition from analog to digital. "Before HDMI, 4K video wasn't possible," she explained. "The highest resolution was 720p. The HDMI connector and cable, with 16 pins and 16 pieces of copper wire, respectively, allowed more data transmission."

The evolution to IP started a few years later, with the introduction of technology that allowed the extension of HDMI over twisted-pair cabling. 2010 marked another turning point with the introduction of HDBase-T, "which brought control, Ethernet, and power functions" she noted.

In a recent blog post, Belden broadcast and AV sales manager Bob Ferguson described the relationship between HDMI and HDBase-T. "The HDMI connector has become the industry standard for AV applications," he says. "It's estimated that there are more than 4 billion HDMI devices currently in use … HDMI cables, however, have some distance limitations … This is where HDBase-T steps in. It can take the HDMI input, along with the other 5Play technology signals, and transport it 330 feet over a field-terminable, four-pair twisted copper cable. Not only can you achieve longer distances, but with the use of a switch, you can use multiple inputs and outputs."

Both Belden's Ferguson and Panduit's Hacker turned the conversation to cabling performance and specifically the need to support speeds higher than 1-Gbit/sec. "The first AV-over-IP systems were 1-Gbit/sec," Hacker noted. "They had latency. At 1-Gig, a user always will have to compress their video."

Ferguson adds, "Although HDBase-T was originally intended to work with standard category cabling, there have been some issues. As a result, we recommend that you choose a cable designed for the HDBase-T system you're running. Belden has performed several cabling tests to analyze bundling, power and 4K performance among different cabling systems. These tests have identified the cabling that can reliably support HDBase-T technology." Belden subsequently developed and introduced the 4K Ultra-High Definition Media Cables, twisted-pair cables available with plenum and riser ratings.

"This new cable is specifically made to support the increased requirements of 4K signals in the commercial environment," Ferguson says. "However, there are still a large number of installations that only require a 1080p signal to be supported. Here, you have several cable choices. Our testing shows that it's still critical to eliminate electrical noise outside the cable for the HDBase-T signal."

He further notes, "The HDMI 1.4 specification requires bandwidth of

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almost 10 Gbits/sec. The HDMI 2.0 specification requires 18 Gbits/sec, and the new HDMI 2.1 specification requires 48 Gbits/sec. It's clear we're seeing a rapid increase in bandwidth demand."

A number of products and systems are available to meet HDMI-compatible AV transmission needs. RapidRun from Legrand, for example, is a modular cabling solution for AV applications. Initially available with copper media, Rapid Run more recently became available as an optical cabling system as well to support HDMI's rising speeds.

SDVoE

Hacker points to SDVoE—Software-Defined Video over Ethernet—as a next-generation video-transmission technology that improves the user experience and ratchets up the requirements on the system's cabling infrastructure. SDVoE incorporates 10-Gbit speeds in the form of 10GBase-T.

In May Anixter joined the SDVoE Alliance. Around that same time the company's vice president of technology, Andrew Jimenez, recorded an informative video on SDVoE. Jimenez explained, "SDVoE is the leading system for low-latency transmission of AV over IP. By leveraging the existing OSI Layer model established for network communications systems, SDVoE builds on the suite of 802.3 and 802.11 standards, and offers solutions for the full seven-layer OSI stack.

"This includes physical layer media such as structured cabling, an Ethernet data link layer, IP and IGMP [Internet Group Management Protocol] network layer, TCP [Transmission Control Protocol] and UDP [User Datagram Protocol] transport layer, SDVoE session management layer, SDVoE adaptive clock resynchronization presentation layer, and SDVoE API [Application Programming Interface] application layer."

Jimenez further explained three advantages SDVoE holds over traditional AV distribution systems.

Cost: "Ethernet-based switches are widely available and do not require custom hardware configurations, which drive device port costs dramatically lower than traditional AV switching platforms."

Futureproofing: "IEEE 802.3 standards support 10-Gbit/sec data rates over structured cabling that facilitates a transmission of uncompressed 4K video streams."

Density: "Increased port counts due to converged applications are limiting available space within telecommunications rooms. With SDVoE, port densities of up to 48 per 1RU are achievable on many Ethernet switch platforms."

Upgrade uptake

The promise of AV-over-IP systems has so far has been met by an uptake rate that is generally believed to be about 8 percent of the market.

Users of AV systems in different verticals tend to have different refresh rates for AV equipment, providing a laddered opportunity for migration from digital to IP. Many corporate users and higher-education facilities commonly refresh on two- to four-year cycles. Other user types, like K-12 schools, have longer cycles that can result in five to ten years between AV upgrades.

As such, many AV systems accommodate retrofit applications, both physically and technologically. For example, Panduit's Hacker points out, "Many products will come with mounting brackets so they can be put under a conference table or behind a monitor. Some run on the infrastructure that's in place." Many HDBase-T users, for example, can accommodate the new system with their existing Category 5e cabling.

She adds that many active components also build backward-compatibility into their specifications. For example, EDID—Extended Display Identification Data—is a format that dates back to the 1990s and has been updated as recently as the mid-2000s. "As that specification evolves, it remains backward-compatible, allowing for the use of existing equipment," Hacker said. There's an entire market segment of products that enable users to keep older-generation devices operating and interacting with newer-generation equipment.

While the refresh cycle will provide opportunities for upgrades to AV-over-IP systems, proponents of the technology may have to overcome some level of corporate inertia among user organizations. The situation can be compared to the shift of an organization's video-surveillance system from analog to IP. The change raises questions about which internal department is responsible for the system. Such red tape can kill or at least delay ambitions for a technology upgrade.

Additionally, many organizations have invested in knowledge that could be obviated if technologies like SDVoE are more widely deployed. "With SDVoE, control systems are embedded in active equipment," Panduit's Hacker said. Traditionally, programming the active systems can be a lengthy process—and one that requires investment in the training to do so.

Perhaps with that dynamic and others in mind, Anixter's Jimenez concluded, "SDVoE promises to be very disruptive to the AV industry, and will offer challenges for legacy and new vendors."

Add designers, installers, integrators, and users to that list as well. ◆

Patrick McLaughlin *is our chief editor.*