Implementing Audio-over-IP from an IT Manager's Perspective

Presented by:

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A AVTECHNOLOGY Partner

IT managers increasingly expect AV systems to be integrated with enterprise data networks, but they may not be familiar with the specific requirements of audio-over-IP systems and common AV practices. Conversely, AV professionals may not be aware of the issues that concern IT managers or know how best to achieve their goals in this context. This white paper showcases lessons learned during implementations of AoIP networking on mixed-use IT infrastructures within individual buildings and across campuses.

NETWORKS CONVERGE AS IT MEETS AV

As increasing numbers of audio-visual systems are built on network technology, IT and AV departments are starting to learn how to work together. As AV experts come to grips with the terminology and technology of audio-over-IP, IT specialists—gatekeepers of enterprise networks—are beginning to appreciate the benefits that AV media bring to their enterprises.

This shift means that the IT department of any reasonably sized enterprise—commercial, educational, financial, governmental, or otherwise—is now ultimately responsible for the implementation and management of the AV systems within the environment. IT managers may even make purchasing decisions for that equipment, in consultation with AV experts.

While AV and IT professionals may understand each other's technologies well enough to interact and collaborate on a project or even on a daily basis, neither is expected to be an expert in the other's discipline. AV experts clearly benefit from having a basic working knowledge of IT, and many are availing themselves of training and certification opportunities from trade bodies such as CompTIA and InfoComm, as well as from manufacturers such as Cisco and Microsoft. AV experts do not need to become IT managers to do their jobs, as audio networking relies only on a subset of network capabilities, configurations, and issues.

Similarly, IT managers are beginning to acquaint themselves with the issues associated with the integration and implementation of one or more networked AV systems into enterprise-wide converged networks. Once armed with a clear understanding of the goals and uses of these systems, IT managers quickly discover that audio networking can be easily integrated with the LANs for which they are responsible.

AUDIO OVER IP: WHAT IT MANAGERS NEED TO KNOW

Early AoIP technologies were designed to overcome limitations in bandwidth and a lack of adequate standards for real-time media delivery, resulting in systems that were deliberately not compatible with data networks. Fortunately, those days are long past.

Modern AoIP systems such as Dante are based on common IT standards, enabling them to run alongside data traffic on networks comprised of readily available conventional switches and cables. To the other network members and components, these audio devices behave like any other node, making implementation, operation,

and management of such a network a familiar task to the IT staff.

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STANDARDS

While countless standards and common methods exist for many aspects of enterprise networking, AoIP generally relies on a small subset of standards that can easily be understood and utilized by IT managers.

Multicast, Unicast, and IGMP Snooping

Many network managers are wary of excessive use of multicast, and for good reason. Left unmanaged, multicast traffic will hit every node on a LAN all the time, potentially overloading devices on slower link speeds. Contrast this with unicast, in which network messages and data are simply sent from one device to another.

Multicast is absolutely necessary as a part of AoIP, as it is used to send sync, timing, and discovery messages to all devices at once. It may also be used to carry audio itself when that audio is going to multiple destinations simultaneously, and some protocols rely upon multicast exclusively for audio streams, such as the AES67-2015 high-performance interoperability protocol.

Knowing that multicast is required, an IT manager can easily configure IGMP Snooping on the switches connected to audio devices. IGMP Snooping ensures that only devices that request multicast traffic actually receive it, thus reducing unwanted traffic.

LANs and WANs

As the section above explains, real-time AoIP systems rely on standards and methods that restrict their operation for the most part to LANs, due to the use of multicast for synchronization and discovery. The IEEE 1588 Precision Time Protocol (PTP) is an example of a multicast-based standard that is widely used in AoIP solutions such as Dante. By themselves, multicast protocols are restricted to use within LANs and do not extend to wide area networks; fortunately, there is no functional reason for Dante multicast to be shared between subnets, and so this is easily managed.

TCP and UDP

An IT specialist observing an AoIP network will quickly find that large amounts of audio data are sent using UDP instead of the more common TCP. UDP differs from TCP in that it does not perform error checking or resend data, making it fast and ideal for real-time media. This helps the network to behave well and greatly reduces latency and error-correction traffic.

QoS (Quality of Service)

How do audio networking protocols ensure that time-sensitive data stays “on time” when a network is heavily loaded with competing traffic? Standards provide our solution with QoS enabled in switches. QoS, which uses priority flags to make sure that audio and timing data are always at the “front of the line,” is commonly implemented in AoIP systems. Note that time is generally only a problem when traffic loads are quite substantial.

It should also be noted that the AVB AoIP protocol requires special “AVB compliant” switches in lieu of using QoS.

IP Addressing

While early AoIP (or Audio over Ethernet) solutions sometimes required static IP addresses, this is no longer the case.

Modern AoIP solutions all respect DHCP, and most are designed to function perfectly well with self-assigned IP addresses as well, allowing the easy creation of "stand-alone" audio networks where no DHCP server is present.

Just as with other common network endpoints, DHCP is strongly recommended. Static IP addresses are rarely necessary in AoIP and are likely to cause problems due to human error.

VLANs

Virtual Local Area Networks (VLANs) are an easy way to keep traffic segregated while still allowing an AoIP network to share physical infrastructure with an existing IP network. An overload or error on one VLAN has no effect on the others on the same switch. As long as the VLAN has sufficient bandwidth and support for multicast traffic, there isn't a problem for most AoIP systems.

VLANs are often useful for delineating responsibilities. An AV manager may wish to keep traffic on a VLAN in order to clearly define which problems belong to the AV staff and which belong to the IT staff. The downside is this very lack of integration with the broader network, which may limit some uses of the audio network throughout a facility. Fortunately, this is easily addressed as requirements change.

BANDWIDTH

IT managers, of course, need to understand the real bandwidth requirements of AoIP, especially if they are new to the technology. This knowledge will help them to configure systems with adequate headroom in the most effective manner.

The majority of audio used in professional settings is PCM, sampled at 48 kHz and a bit depth (word length) of 24 bits. AoIP systems add some necessary overhead as this data is packetized into efficient streams. In a Dante network, audio is packaged into UDP audio "flows" of 4-channels each that consume approximately 6 Mbits/sec, leading to an easy "rule of thumb" for approximations. For example, a typical conference room might require as many as 16 audio channels, for a combined bandwidth requirement of ~24Mbits/sec, or 2.4% of the capacity of a gigabit link.

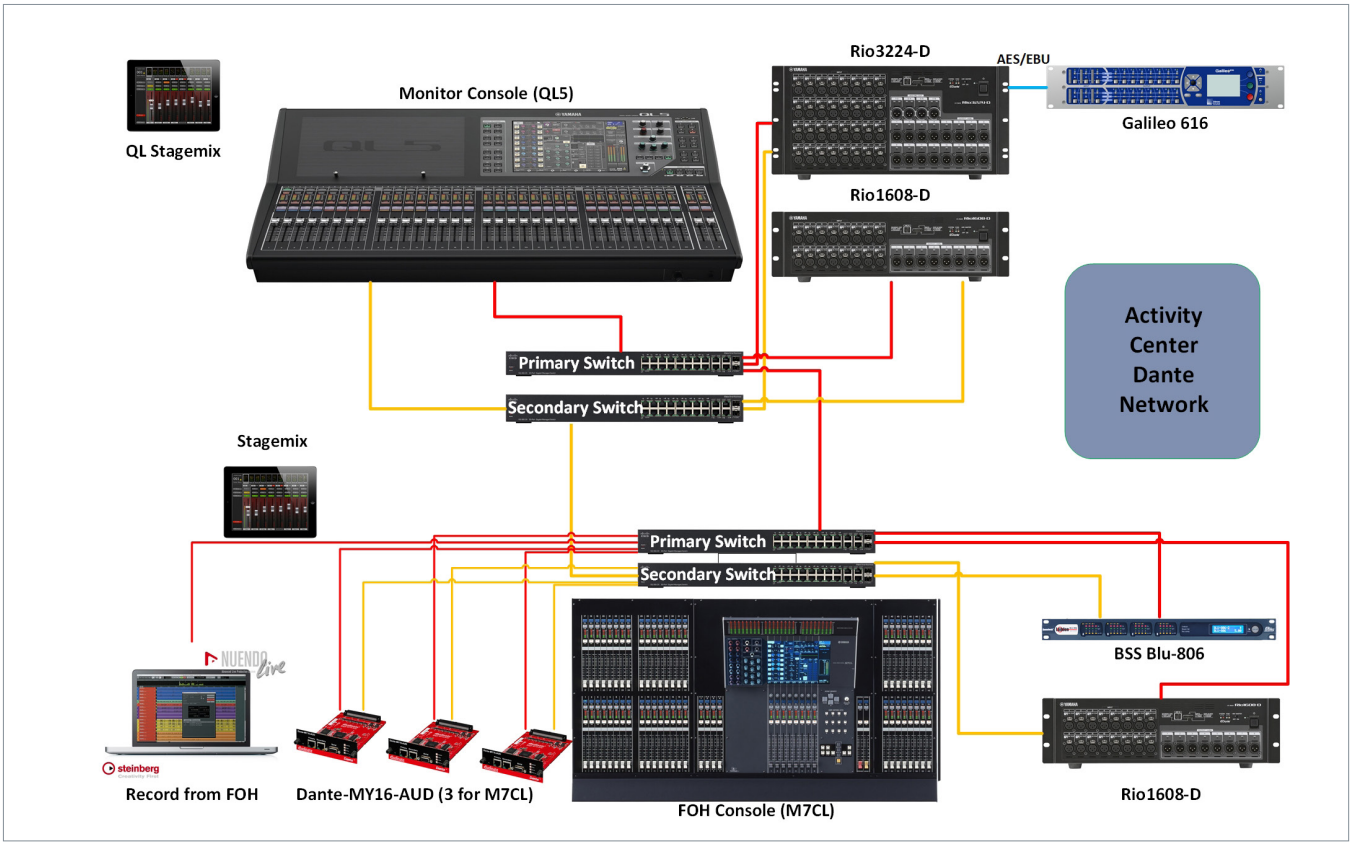
Bandwidth may also be managed with the selective use of multicast. AoIP solutions such as Dante use unicast UDP for audio flows by default, but when the same audio channels are being sent to multiple devices, unnecessary duplication of data is occurring. Dante allows audio channels to be placed into user-defined multicast flows, thus eliminating this duplication on a selective basis.

REAL-WORLD EXAMPLES AND BEST PRACTICES

The examples below illustrate some of the situations that different AV groups have encountered and explain how solutions were found, with the help of IT, using common tools and methods.

Using VLANs to Separate Venues at Willow Creek Community Church

Constraining AoIP traffic within VLANs can provide benefits in management and security for audio networks. According to Kurt Donnan, Infrastructure Manager at Willow Creek Community Church near Chicago, where the campus encompasses five venues, including a 7,200-seat main auditorium, "One of the issues that we had is that each of our multiple venues had to be on a separate VLAN … so that they weren't colliding." The problem was that the people running audio in one venue could "see" the audio devices at the



Kurt Donnan, Infrastructure Manager at Willow Creek Community Church, configured the VLANs in the Activity Center to enable wireless communication between the Yamaha mixing consoles and mobile devices running the StageMix controller app.

others, as they shared a common LAN for other purposes. The implementation of VLANs allowed the AoIP systems at different locations to remain hidden from one another.

Using VLANs to Allow Wireless Control at Willow Creek Community Church

Wireless control presents another common challenge. As Donnan explains, the centralized Aruba wireless LAN controller at Willow Creek Church initially ensured that someone connecting an iPad with a Wi-Fi access point to remotely control the soundboard would land on the same subnet as the board. But as the audio network expanded into the church's other venues, he says, "I had to start building VLANs, because we run wireless on different subnets than our wired audio equipment. I had to build a path to land that access point so that the iPad could talk to the board." Solutions of this type, combining robust security with specific types of access, are easily implemented once IT understands the needs of AV.

Using VLANs to Implement Security

At the University of Oxford's Blavatnik School of Government, AV data and AV control are distributed over two separate VLANs (of a total of 30), enabling strict control of access by users and devices. "We have a network access control system here, which means we can tag equipment into two separate networks, whether they are user networks, AV networks or whatever, and can also restrict access to the AV networks down to our IT and AV people," explains Matt Treavis, Head of Information and Communication

Technology. Robust data security is essential in a facility that has hosted conferences and events with the likes of the Duke of Cambridge, former UN Secretary-General Kofi Annan, and other major political figures, Treavis says.

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> ***– Matt Treavis, Head of Information and Communication Technology***

Using Existing Ports for Audio Everywhere

Anyone implementing an AV network as part of an enterprise-wide mixed-use infrastructure should consider the key benefits of a converged network, says Treavis. "We have about 2,000 ports, and every port in the building is live, so we have the flexibility to route AoIP data anywhere in the building." As a supplement to the installed AV systems, additional equipment can be set up and quickly configured in any space within the facility. "If you have data points flooded throughout the building, and all of your VLANs are presented on every switch cabinet, then you have that ultimate flexibility," he says. "We can go anywhere that there is a data point and we know we can make it work."

Best Practices: Planning around Differences between IT and AV

Treavis, who came to work at the school from a corporate IT environment shortly before the present AV system went live, stresses that thoughtful planning and conversations between IT and AV can go a long way toward making the final commissioning go smoothly and on schedule. "If anybody was talking to me about doing a converged network I would make sure that the AV people understand the specifications of the AoIP protocol and that they have access to them. Having those conversations quite early would be good."

In the case of the Blavatnik School of Government, the AV supplier built the network offsite because of restricted access during the building's construction, Treavis says. "If you're doing that then you can end up with a situation where, when you bring it into the live environment, you run into problems with access control lists and other bits and pieces that need some further diagnosis between the AV and the IT guys," he cautions. "People do need to think about the cultural differences between IT and AV and how they plan for it, and maybe get that sorted out up front."

CONCLUSION

While Oxford University and Willow Creek Community Church are quite different in terms of the scope of their IT and their work cultures, they share a common platform of tools and capabilities through IP networking standards that allow each to deploy AoIP in a manner that suits distinct needs and concerns.

As AV moves toward networking as a commonly accepted practice, AV professionals and IT specialists will find themselves working together more closely. People coming from AV will develop a toolkit of networking skills, and those in IT will become familiar with the needs of AV services Both parties have a vested interest in success for the enterprise. Fortunately, the development of audio networking on top of robust standards means that technical barriers are few in number, and only a mutual understanding of goals is required to overcome those obstacles. ■

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