Considerations for AV over IP Deployment in Educational Institutions:

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Classroom AV technology has historically been driven by local in-room distribution. Whether a matrix switcher box type solution, or an assemblage of extenders and splitters, key asks for in-room technology can be distilled to a single word, “simple.” The demands for classroom technology were historically not all that high, and the expectation of technology was not either: Centralize and share AV content in the room. Each classroom having an independent system is resilient and easy to troubleshoot: If you cannot get video in Classroom A, then it *must* be that assemblage of little black boxes in Classroom A causing the problem.

As years have passed, it is important to understand that “simple” can take on many different meanings.

Technologically rigid or non-networked solutions are no longer being understood as simple.

As educational institutions continue to make upgrades with ever-constricting budgets, how technology investments are chosen is critical. So, in rethinking of classroom technology, making the investment into AV over IP systems should be met with careful consideration. This article will endeavor to help guide that decision making.

From a manufacturer’s point-of-view, fixed architecture is going away in favor of more scalable modular, and flexible solutions. The ease of IP connectivity and ever lower network latency has even begun to reduce “expandable” card-based offerings, including Crestron’s blade chassis/card system being discontinued. Familiar I/O on a box is fading as control, audio and video shift onto an ethernet protocol. From an institution’s point-of-view, instructors are demanding more of their classrooms; schools and instructors alike look to technology as a means of efficiency and improving learning outcomes, allowing technology to enhance in-classroom instructor capabilities.

Add the right I/O where you need it
Image Credit: Qsys

Note: I/O to the edge removes the need for large centralized controllers

There have been a few key shifts that have changed technology's role in the classroom dramatically:

- COVID has demanded a more connected and hybridized education experience
- The role of the Technology Manager has changed as AV and IT continue to merge
- Smartphones, at-home technology adoption, and a continuing pressure for technology investment has instructors and students becoming more comfortable having access to and using technology tools in and behind the classroom

We will review how the transition to an IP-based, or AV over IP, AV system can streamline EdTech management, simplify infrastructure upgrades and deployments, and hopefully redefine "simple." We will also briefly touch on how peripherals to AV, such as LMS, gamification, and asynchronous learning have changed learning forever.

For the purposes of this paper, AV over IP concerns the transport of audio, video, and control signals over the network using an IP protocol. While this includes the typical consideration of encode/decode device-type boxes, also considered under this assessment are the transport of any peripheral system over the network, including IP-based loudspeakers, microphones, and USB transport.

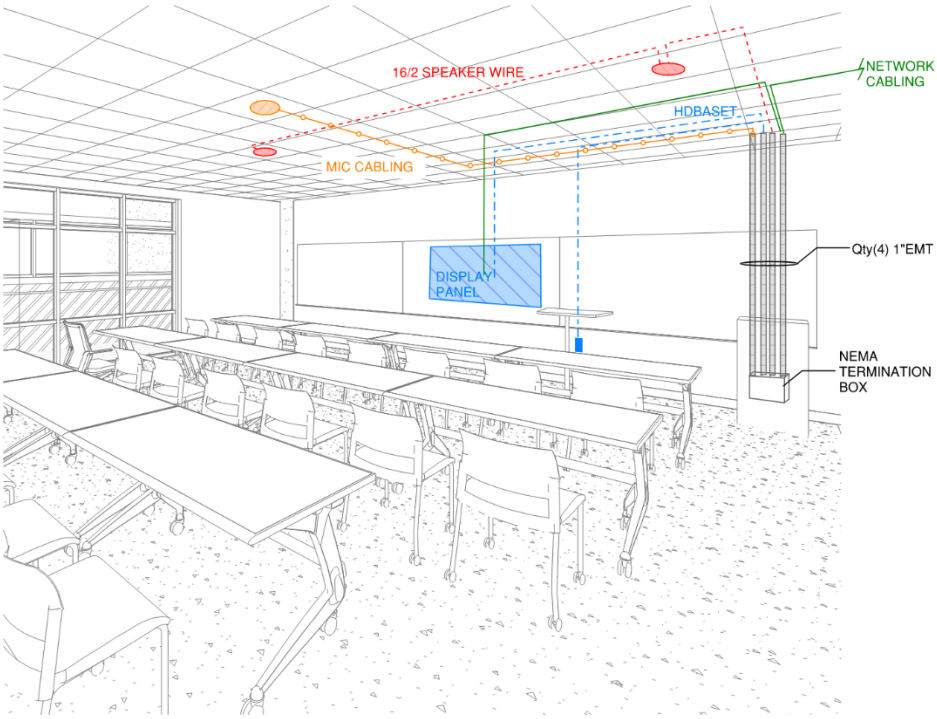
SARS-CoV-2 completely transformed education

For anyone even tangentially around schools during the pandemic, there is no way to overstate the degree to which the COVID19 pandemic impacted learning. In AV, we created almost an entirely new vocabulary. Words like Hyflex and meeting-equity were in most conversations, and Zoom became a household name. For educational institutions, even basic hybrid or "Hyflex" set-ups introduced complexity. Technology managers and others trying to plan classroom upgrades to support these changes may be intimidated by the dizzying array of infrastructure to support a Hyflex system: various levels of audio signals and distributions, USB peripherals passing audio and video, video cabling and video extension over category cable, AV networks, loudspeakers, and more.

Considering an approach based upon AV over IP greatly simplifies design infrastructure. By placing devices on the network, it is one cable to rule them all: UTP. A single category 6A cable may transmit audio, video, USB2.0 & HID, IP communication, and even charge/power devices. There are two primary considerations in this assessment of a streamlined infrastructure.

First, in contrasting the deployment of new systems, analog systems, consisting of: microphone, USB, and video cabling not only creates a web of various signal types to be managed, but also may confuse problems when they arise. Transmitting all of these signals over ethernet allows for a simpler

cabling deployment, and troubleshooting. Second, when considering technology upgrades during a renovation, institutions can capitalize on the re-use of an existing network infrastructure. Most classrooms and learning spaces are already equipped with network drops. Tech Managers can save on costly renovations by simply hanging AV over IP endpoints at those locations and connect them over the network.



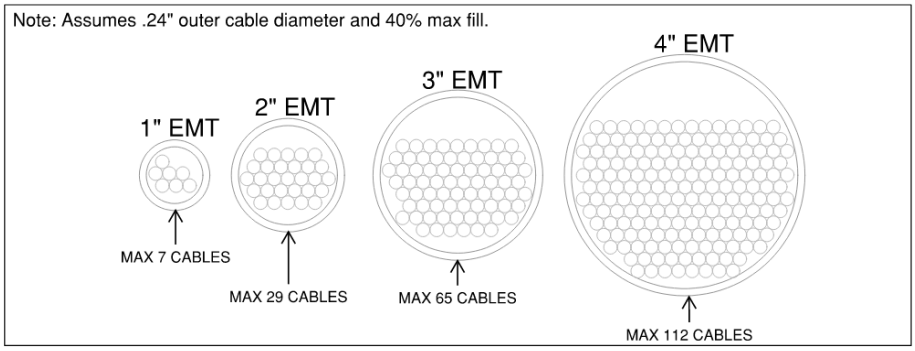
Note: Adding hybrid-learning capabilities requires not only multiple signal types, but also specialized wiring. Note how multiple conduits support various signal types and protect from cross-talk.

The other side of this infrastructure deployment regards conduit, conveyance, and scalability. Analog systems with their various voltages and cable types demand dedicated pathways to mitigate induced interference (EMI). To reduce cross-talk, firm separation of cable-types based upon voltages is paramount in a successful deployment. What this means in practice, is more penetrations, a larger conveyance footprint, and when you wish to plan for future scalability, where that scaling exactly happens is not immediately clear.

Simplifying infrastructure may yield multiple benefits well after deployment

Converging these signal types into an ethernet protocol allows owners to reduce the overall amount of conduit and/or conveyance footprint. Scaling is also simplified: Tech managers are now working with a standard cable type with a predictable outside diameter. Thus, if institutional stakeholders require 25% headroom for future growth, technology designers can reliably size conduits and/or cable trays and ensure the future success of those deployments.

Note: View predictable growth of structured cabling plant. Conduit fill is measured via inner diameter of conduit and outer diameter of cable jacket. Conduit can house cabling for a variety of purposes.



AV over IP systems may offer simplified infrastructure, but an ethernet protocol may also bring natural order to the continued convergence of AV and IT in the technology manager role. More than ever, EdTech managers are being asked not only to fix projectors, but monitor network health, troubleshoot WiFi, and provide vision and input on the future of technology as "tech SMEs" at their respective institutions. AV management tools such as Crestron's XIO Cloud, Extron's GlobalViewer, or QSYS Reflect give a pane of glass for EdTech managers to monitor AV devices. With the addition of AV over IP, you can now provide a granularity of device health and control like never before. Importantly, this also allows institutions to centralize AV/IT support. "Sneakerware" will go the way of the dinosaurs, and Tech managers can now focus specifically on problem devices, doing so from the comfort of an AV helpdesk.

When parts do fail, this also means that replacement may be cheaper and easier. Institutions standardizing on particular products may benefit from "batching" or keeping extras of these devices, and can save time: reducing down-time while defective devices are sent away. Instead of replacing what is ostensibly the entire room system, EdTech managers can quickly swap just one piece in the system, and utilize AV management tools to quickly bring this room back to full operation. As a rule, 5% batched stock is typically sufficient for institutions to protect from outages resulting from component device failures.

Technology adoption among classroom users and support staff has heavily driven classroom changes. For learning professionals (and everyone else):

we live in a world where the WiFi password is a QR code, and casting videos from your phone to the TV is commonplace.

We enter our classrooms and our places of work when suddenly, you cannot share information or communicate in as effective a medium.

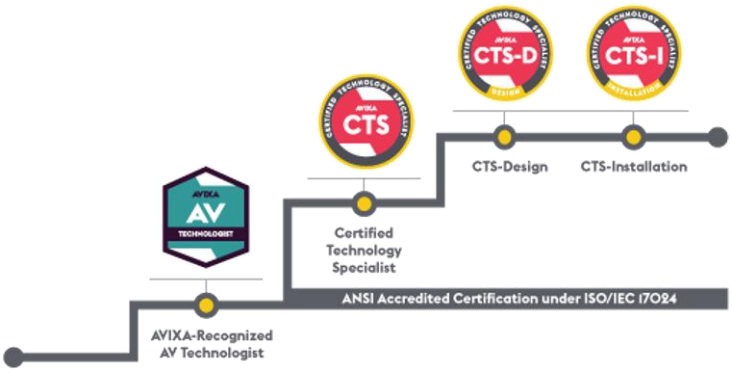
The expectation for technology has risen among practically all stakeholders in any given institution, as well. Despite words like "AI Slop" and "Clunker" entering our lexicon, we are currently living in a technologically optimistic period of time with most people utilizing AI in their everyday lives, even if they are not necessarily aware of it.

Classroom technology adoption at its simplest: iPad lockers and websites like Kahoot! in K-12 have digitized and gamified learning. However, this now means placing a dozen-plus wireless devices on an education system's network. In the world of installed AV, clearly labeled touchpanels and 2-way IP control allow instructors to easily and reliably switch between source inputs in a room. Integration of Chromecast or Airplay into commercial-ready wireless sharing platforms maintains a user-friendly format with enterprise-level cyber security for easily sharing work or content in class. Even more advanced, AI-enabled cameras combined with advanced algorithmic tools like Audio Camera Preset Recall (ACPR), or specialty Career and Technical Education (CTE) spaces often demand network connectivity not only to the WAN, but require the transmission of specific protocols such as multi-cast, Dante, NDI and others. Hands-on learning in a hybrid environment may call for camera switching systems. These advancements in classroom technology are a direct answer to optimistic wishful-thinking statements such as, "I should be able to just choose what I'm showing on the TV" or "The camera should just know where I am."

Leveraging an AV over IP system as your classroom AV infrastructure solution is not without its risks and learning curves. The kinds of traffic and network requirements to successfully facilitate these upgrades demand EdTech managers that are ready and willing to learn, and take a proactive approach to network management.

One of the first questions any institution needs to ask itself is, "how critical is latency in my network," or "How much compression am I willing to live with?" Primarily, AV over IP systems are based upon a 1Gbps network (compressed) or a 10Gbps network (uncompressed). The bandwidth-savvy of you may be already realizing that even at 10Gbps HD content must still be at least a *little* compressed. You would be right. 10Gbps AV over IP systems such as those on SDVOE are perhaps better called "lossless" than truly uncompressed. For the vast majority of applications, institutions are utilizing a 1Gbps network to collate and distribute AV signals. With ever better compression algorithms and low-latency solutions from manufacturers, AV over IP deployments over 1Gbps networks will likely suffice for all but the most demanding environments.

Even with a robust institutional IT network, AV traffic on ethernet usually requires multicast and IGMP capabilities on network switches which may drastically increase complexities, requiring new tools like IGMP snooping and QoS. Institutions must consider strategies to manage these kinds of traffic. At minimum, dedicating virtual space in the form of a VLAN will allow a partition of network traffic and more predictable management of bandwidth. As AV network deployments scale, EdTech managers and institutional stakeholders must consider backplane and bottlenecks in more advanced AV distributions. A separate physical AV LAN may become necessary. A separate physical AV LAN offers a couple of advantages. Achieving an unthrottled network backbone may be simpler in a dedicated deployment where technology managers can predict overall throughput of the network switch. This is especially true in larger deployments or many-to-one distributions where multiple HD video feeds may be feeding downstream into a single network switch. Additionally, institutional stakeholders must think about servicing of equipment. It may be policy or preference to isolate access to IT or AV-Technology networks, sometimes providing dedicated closets for each system when security is a factor. A VLAN gives all service technicians equal access to both IT and AV ports. Educational institutions must consider who they want having access to what equipment.



A successful implementation of any new audiovisual system will certainly rely on the experience and qualifications of the integrators, and in the consideration of an AV over IP deployment, careful integrator vetting is paramount. Industry organizations such as HETMA and AVIXA may already be familiar to the EdTech managers in your institution. They offer opportunities for AV professionals to learn and connect. The CTS certification pathway through AVIXA is considered the gold standard for audiovisual design and integration excellence. As a hub for thought leadership and professional certification, AVIXA has created the new ANP (Audiovisual Network Professional) certification. This networking-focused certification is in direct response to the continued convergence of IT and AV and placing AV distribution on the network, in particular.

Manufacturers are also recognizing the growth of network-enabled AV devices, with Netgear releasing the wildly popular M4250-series AV-Line network switches. These Layer 3 switches take a lot of the guess-work out of the AV over IP compatibility over 1Gbps, and are pre-configured to optimize AV over IP network traffic.

Aside from network considerations and qualified vendors, institutions should consider how to support a system after it's installed, and may reference a telecom standard, TIA-606. Now that devices are on the network, cabling must be properly labeled, documented, and documentation must be easily shareable to anyone that needs to service or work with this segment of an institution's IP network. You may also consider local standards including cable colors and jacks to easily differentiate AV systems from other networks and proper labelling of conduits, pull-boxes and other infrastructure. Once complete, Institutions require careful documentation, including as-built drawing documents, network/device IP addresses and MACs, maps, or specialized Automated Infrastructure Management Systems (AIMS). This consideration means that not all contractors are capable of delivering the quality of work required for headache-free service in the years to come. Looking carefully at not only industry qualifications, but recent project experience and references may mean the difference between a successful deployment, and one fraught with buyer's remorse.

There is no panacea in the world of technology.

We are constantly adapting as our uses evolve, conditions change, and cultures shift. As we have shown, key changes that often took place outside the classroom have pushed institutions and EdTech managers to change their approaches to AV deployment. Given what we have learned, a few key considerations stand out:

Conversations about AV deployments should be led from two points of view: infrastructure, both new and existing, and desired functionality. The adage is as true in technology as it is in architecture: form should follow function. By leading conversations from a capabilities and performance point-of-view, technology decision-makers can then back into a fitting solution. Stakeholders in technology deployment projects should also review what kind of investment new infrastructure will

require while also assessing the usability of what they already have. Bringing in experts and/or qualified consultants early in these conversations may help guide decision-making and place guardrails around scope-creep. Neutral advisors and consultants can offer ideas, frame thought and strategy without the incentive of selling new equipment to institutions focused on the careful balance of performance, quality, and budget.

Data-driven decision-making already drives learning outcomes in the form of Learning Management Systems. Today, accelerating IoT is allowing institutional stakeholders to bring KPIs and data to audiovisual devices and building management, as well. Institutions should review their comfort with technology or network connectivity as a direct counter-weight to their interest in gleaning new data and possible consolidations of service and support. Institutions craving new insights and data may be more willing to take advantage of an AV system on a network where tech managers can control multiple buildings or campuses and gain actionable intelligence: from better understanding classroom usage, to catching problematic device drop-outs, and take a proactive approach in their maintenance.

AV over IP shines in asymmetrical, dynamic environments that demand flexibility.

If your institution or classrooms are looking at “many-to-one” or “one-to-many” AV distributions, AV over IP should be on the table. In particular, 1Gbs AV over IP deployments were built with the reuse of existing network infrastructure in mind. Schools, like many institutions, are unique in that they are very often working through legacy systems and infrastructure. The incorporation of encoders and decoders through the existing network allows a relatively pain-free path to AV modernization.

Finally, no matter how educational environments deploy AV technology, EdTech managers and institutional decision-makers should think through any deployment’s impact on an IT network. IT and EdTech managers should review networking capabilities such as layer 2 and 3 switching, IGMP querying and snooping, Multicast, and understand the limits and vulnerabilities of their network architecture. The investment in a robust and reliable network will not only allow for high-bandwidth applications such as AV over IP video distribution, but future-proof institutions for a world of wireless devices, more IT intelligence, and applications we have not yet dreamed of.

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