Commercial INTEGRATOR PARTNER SERIES

WHY AV OVER IP TRUMPS TRADITIONAL AV MATRIX SWITCHES

MuxLab

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Today, connectivity is king, and nowhere is that more obvious then in the ubiquitous arrival of AV over IP. Today, AV content is delivered anywhere, and often everywhere.

AV over IP simply describes the delivery of AV content over a standard Ethernet network, including 4K/60 video, audio, peripherals and control signals. It offers flexible installations that deliver even ultra HD quality with nearly instantaneous results. Even better, it's relatively simple to integrate and operate once you learn the basics.

Because it is so versatile, AV over IP has quickly become the industry-standard for installations in both commercial and residential markets. Its adaptability allows integrators to expand systems on a port-by-port basis, with system size limited only by the network bandwidth. Virtual infrastructures

can be created and rearranged with signal delivery assigned to point-to-point, point-to-multipoint and multipoint-to-multipoint configurations.

There are virtually no distance limitations, making it convenient and cost-effective to connect and access AV across the home or around the world. Lossless video resolutions and ultra-low latency levels only improve performance. Integrators can utilize existing network infrastructures, pay for additional ports as they need them, and eliminate excessive extension cabling. All this makes for a cost-effective and highly nuanced installation environment that can be easily configured and controlled from a smartphone or tablet.

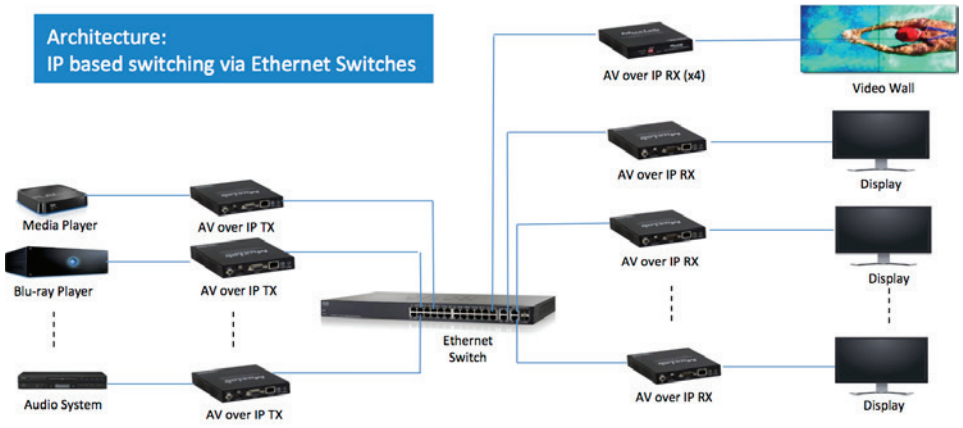
Today, it's readily apparent that AV over IP has officially arrived. This year, AV over IP installations saw a year-to-year increase of 138% according to Futuresource Consulting. Likewise, AV matrix switch installations fell 3.4%. Continuing that trend, Futuresource predicts a compound annual growth rate of nearly 65% until 2021, when most installations will, by default, rely on an AV over IP infrastructure. Certainly, AV over IP is expected to dominate installations involving more than a handful of AV sources and screens. Unless already hardwired, Matrix switch and splitter installations are expected to continue to slow.

All this has been firmly expected; especially since networking compression technologies have advanced along with the higher resolutions of video. You simply no longer need a high cost fiber optic cable to transmit 4K video with a visually lossless delivery. Today's networks have evolved to handle greater transmissions with nearly zero latency. Here, we'll examine the pros and cons of the two main methods for extending and switching AV: an IP-based switching architecture versus traditional matrix switching, a circuit based switching architecture.

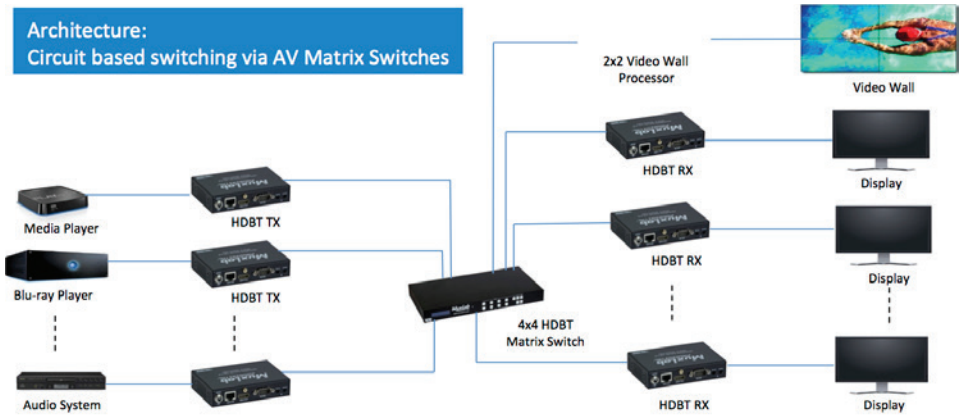
Backbone Architecture

The advantages of IP-based switching are many, the greatest of which is the ability to build a virtual system on a backbone architecture that is already in place. This eliminates the need to create short and long range cabling infrastructures that often cut into walls and ceilings and can be quite costly, depending on the application. Stacked Ethernet Switches can easily be expanded upon using a high-speed stack port. Switches can be stacked multiple times and any time, making the entire infrastructure easily expandable with the addition of a readily available and cost-effective Ethernet Switch. When using a traditional matrix switch backbone, you rely on the capabilities inherent in the matrix switch itself, which is determined at purchase, and can expand only to its maximum fixed size or to the maximum card count on a modular chassis-based model. Therefore, matrix switching becomes a fixed size solution that is fundamentally limited in its capabilities to easily expand.

Architecture: *IP based switching via Ethernet Switches*



Architecture: *Circuit based switching via AV Matrix Switches*



Maximum System Size

With a virtual matrix of sources and screens all connected on an Ethernet network, the ability to increase the amount of both sources and screens is almost unlimited. If you have a network that can handle maximum amounts of bandwidth, your matrix can include hundreds of sources and screens. Your port count is vastly improved as, for example, a typical 1080p resolution signal being transported on a 1Gig Ethernet network can support an average of about 250 transmitters with many more receivers. The reason for this is that only the transmitters generate large amounts of traffic and thus require sufficient bandwidth. If you are using a 1Gig Ethernet Switch stacked with a 10Gig fiber stack port, with each port supporting two directions, your system can handle 250 transmitters at 1080p, with a typical unit bandwidth requirement of 80Mbps (10000Mbps / 80Mbps x 2 directions). At 4K resolutions, that number drops to 40 transmitters units, and again with many more receivers, with a typical unit bandwidth requirement of 500Mbps (10000Mbps /

500Mbps x 2 directions). To extend 250 sources to many more displays would require a huge matrix switch or many switches stacked to accommodate this number, all with the requisite cabling to link them all together. Most traditional matrix switches in the AV realm are much smaller, encompassing 4x4, 8x8, 16x16, 32x32 and 64x64.

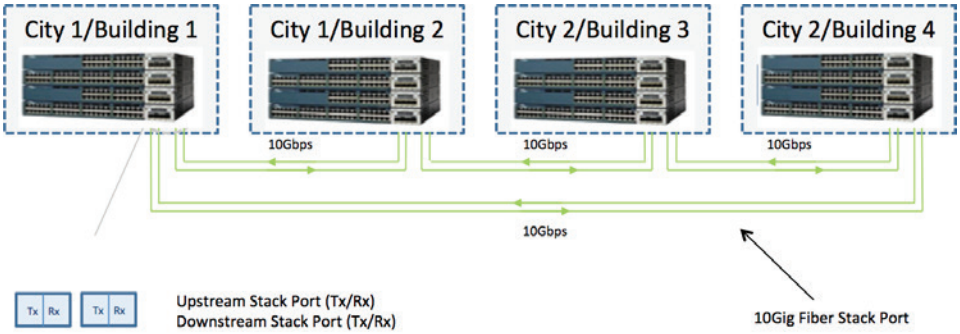
System Expansion

It's never been easier to expand a matrix of sources and screens on an AV over IP system. Cost-effective Ethernet switches are simply stacked as needed to expand the network. Each switch can be added or removed at any time without affecting the integrity of the system. Conversely, while removing ports from a matrix switch is easy, although expensive when not fully populated, adding ports to an already maxed out card count requires the purchase of another matrix switch or card. While modular matrixes can be accommodating, the cost can be prohibitive. Further, standalone matrix models are unable to expand to support additional ports in the same system.

Extended Distance

AV systems that encompass many different sources and screens often require unique placements as each source and screen may be in different rooms, buildings, etc. AV over IP systems allow the connection of sources and screens to up to 100m from the Ethernet Switch, and distributed Ethernet Switches may be stacked together using different types of cables depending on the distance desired. Thus, stacked Ethernet Switches can be distributed within the 100m limit of any source or display. Ethernet Switches may be stacked up to 100m from each other using CATX cable, up to 300m away using multi-mode fiber, or even up to 80km using single-mode fiber. This enables a diverse range of possibilities in which Ethernet Switches can be located in different buildings or even different cities. Even better, AV sources utilizing H.264/H.265 codecs at 4K resolutions can communicate over the Internet, supporting distances that truly span the globe. With a traditional AV matrix switch, you also have the ability to extend sources and screens, typically up to 40m, 70m or 100m using CATX cabling when using matrix switches enabled with HDBaseT technology. Distances are much more limited when this form of technology is being utilized.

Extending Ethernet Switches over a Region



Switching Flexibility

When it comes to flexible switching, AV over IP architectures really shine. Any transmitter can send content to any receiver using its unique IP address in an any-to-any as well as any-to-all scenario. Non-blocking switching is fully enabled when using a single Ethernet Switch or multiple stacked Ethernet Switches. Traditional matrix switches also support non-blocking switching when using a single switch. However, most matrix switches do not support non-blocking switching among multiple switches. As an example, one transmitter on one traditional matrix switch cannot connect to a compatible receiver on a different matrix switch since there is not one common switching platform across both matrix switches.

Resolution/Video Bandwidth versus Compression Requirements

One caveat to consider is the fact that AV over IP does require video compression when connecting through a 1Gig Ethernet Switch. For most applications, this is not a problem, given that current compression technologies are very effective and generally support visually lossless transmissions. However, some compression is eliminated when you utilize a 10Gig Ethernet Switch. AV over IP systems support uncompressed video on a 10Gig network up to 4K/30 (4:4:4) as well as 4K/60 (4:2:0), which is quite appropriate for many of today's commercial broadcast applications. HDBaseT technologies also support uncompressed video up to 4K/30 (4:4:4) or 4K/60 (4:2:0). For the current gold standard of 4K/60 (4:4:4) using either AV over IP on a 10Gig network or utilizing HDBaseT technology, both require some light video compression. Typical compression algorithms include motion JPEG, a video sequence composed of JPEG images. JPEG2000 will compress 30% more than M-JPEG. H.264 will compress 80% more than M-JPEG, and H.265 compresses 50% more than H.264. So, there are improvements in compression technology that likely will eliminate the concern over compression and its effects on visual acuity and performance. Today, these compression technologies are considered to most to be visually lossless when viewing video.

Video Resolution vs Bandwidth

Resolution	Color Sampling	Color Depth	Bandwidth	
1080/60p	4:4:4	8-bit	4.46 Gbps	
1080/60p	4:4:4	10-bit	5.58 Gbps	
1080/60p	4:4:4	12-bit	6.68 Gbps	
1080/60p	4:4:4	16-bit	8.91 Gbps	
2160/30p	4:2:2	8-, 10- or 12-bit	8.91 Gbps	
2160/30p	4:4:4	8-bit	8.91 Gbps	HDMI 1.4b
2160/60p	4:2:0	8-bit	8.91 Gbps	HDMI 2.0
2160/60p	4:2:0	10-bit	11.14 Gbps	
2160/60p	4:2:0	12-bit	13.37 Gbps	
2160/60p	4:2:0	16-bit	17.82 Gbps	
2160/60p	4:2:2	8-, 10- or 12-bit	17.82 Gbps	
2160/60p	4:4:4	8-bit	17.82 Gbps	
4320/60p	4:4:4	12-bit	~72 Gbps	

In light of the rapid, often astonishing rise of technological innovations in the Internet of Things arena, AV over IP is lined-up to become the status quo of most small and large-scale implementations in the AV world. It's flexible and expandable, a fact that is particularly desirable when building video walls and mosaics. System size is limited only by network bandwidth. Virtual splitter and matrix arrangements can be reconfigured easily and with zero hardware adjustments. Content can be delivered, locally, regionally and even globally, instantly. These types of expandable infrastructures are convenient and cost-effective, eliminating cable-heavy installations using an (often pre-existing) Ethernet LAN infrastructure. The ability to centrally manage the entire system from anywhere with a smart device or tablet is basically the cherry on a very effective, very accommodating cake.

JOE TEIXEIRA
Director of Product Management
MuxLab

Working in the connectivity business since 1982, Joe has held several prominent roles in data communications as well as the AV connectivity industry. Rising from the ranks of design engineer to executive leadership roles in research and development, strategic alliances and product management, he has held several key positions throughout his career. Currently, he has rejoined MuxLab as its Director of Product Management.