How TesiraLUX Addresses Networked Media Pain Points

Most integrators and end users are not shy about sharing their opinion of AV solutions, good or bad. Many AV professionals remember five years later if a technology was difficult to work with (and they may still hold a grudge).

As Biamp's sales team has discussed TesiraLUX with their customers, they naturally received a lot of candid feedback regarding integrators' past experiences and the pain points encountered in previous installations. Here are some of the common issues we've heard:

- Commissioning multiple hardware/software packages is difficult
- I ran into control/management/configuration issues
- The audio and video were out of sync
- There was too much latency for in-room use
- There were noticeable latency differences between longer/shorter system routes
- HDCP truly is a four-letter word
- I was surprised by some of the challenges I encountered when configuring IGMP
- The non-deterministic network behavior made AV latency unpredictable
- Dealing with the "customized," separate AV infrastructure was a hassle
- Conversations with the customer regarding why they had to pay for switch capacity that they might never use were painful
- Different end users had dramatically different user experiences
- Moving away from iron matrices and onto the network introduced new stakeholders to the conversation that we hadn't worked with previously
- We didn't have the necessary networking expertise, so we got in over our heads and lost money on projects that used networked video
- We had challenges with localized media mixing (local presenter mics, switching between camera and content, etc.)
- As soon as we called something a "server," IT got involved
- It's a non-starter if the streams aren't encrypted
- Our enterprise customers don't allow any switches on the network that they don't provide, own, and manage

We'll be honest and say that while TesiraLUX addresses most of these pain points, there are a few that require additional maturation/advancements in the industry, such as broadening the adoption of 10Gb switch infrastructure. That said, let's dive into each pain point.

Commissioning multiple hardware/software packages is difficult

One of TesiraLUX's key differentiators is that it's completely integrated with the rest of the Tesira platform, allowing system designers to use a single software environment for both their audio and video installations. There are no breakout boxes, no time-consuming workarounds, and no third-party controllers.

Video I/O blocks and partition connectors similar to their audio counterparts are available, and they behave just like their audio cousins, allowing a modular approach to system design and commissioning. Our unique compilation engine then translates your design from processing and I/O needs into a shopping list of physical hardware, saving you time, headaches, and money.

I ran into control/management/configuration issues

"One system to rule them all..."

This is exactly what Tesira offers: a centralized design and system management/configuration platform for both audio and video projects. Here are some of the ways programming in Tesira can help mitigate these issues:

- In Tesira software, implicit AVB streams are created and managed automatically by the Tesira compilation engine, which determines the best allocation of channels and streams within the Tesira AVB network. There is no need for users to define talkers and listeners, as they are defined as part of a valid compilation process. In essence, the compilation engine automates the time-consuming process of wiring up the matrix mixer. Implicit AVB also means you do not need to manually configure network stream routing or multicast addresses in the switches or endpoint devices.
- A Tesira system has a single global configuration process, so there's no need to configure each endpoint individually.
- Our robust TTP API makes it easy to control Tesira from third party systems, reducing your programming and troubleshooting time. In addition, control systems do not need to communicate individually with each Tesira device — simply make a single control connection to the system, and Tesira will route the control commands as needed.

TesiraLUX-specific highlights:

- "It's Tesira, just with video now" — TesiraLUX video is simply an extension of the audio programming environment that system integrators already know quite well.
- TesiraLUX devices do not require any special addressing or handling — you add video I/O blocks to our video partitions and compile the system in the same manner as Tesira audio devices.
- The simplicity of the audio and video integration means that fewer hours need to be spent on system configuration during the design stage.
- Signal flow diagrams, shop drawings, and as-built sets are more concise and straightforward.
- Bandwidth management can be dynamic and granular. For instance, when a control system initiates a signal routing change (over an uplink, for example), the bandwidth settings can also be changed easily to accommodate the new routing.

In a nutshell, Tesira provides significant aggregate of time savings resulting in less time for you in the shop and the field, thus increasing your margins.

The audio and video were out of sync

Another important differentiator is that Tesira automatically syncs your audio and video streams.

AVB/TSN is at the heart of Tesira and serves as the basis for automated lip sync. AVB/TSN's deterministic nature allows networked media systems such as Tesira to provide guaranteed network transit latency — even during times of peak network activity — and precise time synchronization for both audio and video content. These characteristics ensure dependable performance, as well as superior handling of audio and video signal synchronization.

Since Tesira manages the entire audio and video signal path, Tesira DSP recognizes how long it takes for each signal to pass over the network, allowing it to synchronize everything accurately. You can embed/de-embed the audio from the video stream (or route it) as often as you'd like without needing to add manual delays.

There was too much latency for in-room use

As discussed in a previous section, AVB/TSN provides guaranteed network transit latency and precise time synchronization for both audio and video content (the standard indicates 2ms over seven 100 Mbps switch hops, but AVB latency is generally much faster than 2ms with enterprise-grade Gigabit switching, measuring total network transit in microseconds across several switch hops). The plug-to-plug video latency of TesiraLUX, which we sometimes refer to as the system transit latency, is 1 frame (16ms at 60 fps) if no compression is applied, or less than 1.5 frames with compression (25ms at 60 fps). This measurement includes encoding, scaling, network transit, and decoding.

Realistically, signal transport plays only a minor role in the glass-to-glass (camera lens to monitor) latency aggregate. Display lag usually adds about 1 frame of latency, and 4K cameras can easily introduce 3-4 frames of latency (51-66ms at 60fps) before the video signal even reaches the input port of the encoder.

There were noticeable latency differences between longer/shorter system routes

Since Tesira manages the entire audio and video signal path, Tesira DSP recognizes how long it takes for each signal to pass over the network, allowing it to accurately synchronize everything for you. This is a huge advantage compared to re-routing signal paths in an iron matrix and having to manually adjust delays.

In addition, Tesira software contains a feature called Delay Equalization Groups, which provides a way to group signal paths that are sensitive to small offsets in delay. System latencies through the system will be equalized for all paths within a defined group. Most of our AV input and output blocks are assigned by default to a Delay Equalization Group, although user-defined Delay Equalization Groups can also be created.

Delay EQ also tracks dynamic changes in video processing time, depending on active routing, scaling, and/or compression settings. Changing video parameters while a stream is actively transmitting will not de-sync the audio and video.

HDCP truly is a four-letter word

Copy protection isn't inherently evil, but the user-friendliness of copy protection schemes varies tremendously. This contributes to an ongoing challenge in Pro AV: equipment interoperability. As an example, there are multiple opportunities for the HDCP "handshake" to fail in systems where consumer sources and displays are used for commercial AV deployments. In some products, HDCP is not deployed correctly. For instance, some laptops/media players apply HDCP protection to all content by default — even if the content has not asserted the content protection flag (i.e. personal videos).

The initial release of TesiraLUX will not transmit HDCP content. HDCP support via firmware upgrade is planned for our first major release after launch. In other words, you will not need to purchase different hardware to play HDCP content. Realistically, that means only "Type 1" content — primarily Hollywood television shows and movies — will be temporarily blocked. There are several use cases that typically involve only locally- or user-created content. Check out our blog posts on HDCP and HDCP Pro for more information.

I was surprised by some of the challenges I encountered when configuring IGMP

IGMP requires careful configuration of multicast, snooping, and queriers on each switch, because misconfigurations can cause network traffic flooding and crash the entire network. IGMP also does not protect against uplink overprovisioning, which can result in disruption of all AV media, control, and data traffic. Some video-over-IP implementations always have network multicast streams active on uplinks, even if there is no receiver active. Network topology changes such as adding or replacing switches may completely break IGMP until it is manually reconfigured.

AVB/TSN doesn't suffer from these issues, and in fact prevents them from happening. Bandwidth reservation is one of its core tenets; at the time of transmission, if there is not sufficient bandwidth available between the talker and listener — regardless of the number of switch hops — then the stream will not be allowed. In addition, AVB/TSN has a default (albeit user-adjustable) bandwidth reservation per port, which helps ensure that control, voice, and standard data traffic on the port will not be interrupted when a media stream is transmitting.

To be clear, AVB/TSN streams are constantly advertised ("I have a media stream to share"), but until a listener requests the stream from the talker, bandwidth is not reserved and the stream is not transmitted. The traffic is also multicast instead of unicast, so a single stream does not get replicated multiple times across the uplink for each listener requesting it. In other words, if the talker is on one switch, and there are multiple listeners attached to a different switch, there is only one bandwidth reservation made between the switches for the media stream.

The non-deterministic network behavior made AV latency unpredictable

By definition, standard Ethernet is non-deterministic, meaning that the arrival time of data packets cannot be predicted with a high degree of accuracy because there are multiple possible pathways for each transmission (and network traffic congestion is typically not spread evenly). Non-deterministic network behavior works just fine for most network use cases. For example, if an email takes a while longer — even several minutes — to arrive at its destination, few people notice, and it doesn't disrupt their experience.

However, some network workloads — such as real-time professional audio and video communications — are highly sensitive to delays. In the case of a phone conversation, a delay of even just a few hundredths of a second can make communication with another person very difficult, as each person tends to wait awkwardly, then attempt to speak, and both parties inevitably speak over one another. Non-deterministic packet reconstruction also impacts signal delay; if packets arrive out of order, additional time is needed to re-organize them into a human-usable form.

AVB/TSN's pillars of guaranteed system transit latency and precise time synchronization enable accurate prediction of packet arrival. Referencing a network master clock enables AVB/TSN to transport media data faster (and concurrently), while bounded/constant latency prevents the timing from changing by guaranteeing a specific, known latency between endpoints. Quality of Service (QoS) and traffic shaping — another pillar of AVB/TSN — help ensure an even flow of Ethernet traffic (no packet bursting), which is crucial for real-time video transmission.

Dealing with the "customized," separate AV infrastructure was a hassle

Traditionally, systems on the network that had specific operational requirements, such as networked AV systems, have been implemented using dedicated equipment (either physical hardware or virtual) that is separate from "general use" infrastructure. This was a simple way to ensure that the system operated as intended, but this model often results in higher costs to install, manage, and operate the system. Worse, this model impedes flexibility, since integration and interoperation with other systems and/or evolving business needs is limited to the capabilities of the original implementation.

Today, many companies don't allow a dedicated network for AV media traffic to be installed separately from the corporate network. Instead, an integrated, common-use network infrastructure is mandatory. The flexibility of common-use network infrastructure provides significantly more value to IT and their customers, whether it be capacity utilization, systems monitoring, or maintenance. From an AV perspective, having a platform approach (i.e. Tesira) that supports both audio and video installations greatly simplifies solutions and enables an incredible amount of flexibility in adapting the system to future technologies and business needs.

Conversations with the customer regarding why they had to pay for switch capacity that they might never use were painful

Enterprises are often faced with highly volatile and unpredictable business conditions. Sound familiar? Optimizing investments in resources is a significant concern. No one wants to pay for capacity they will never use, but they must also be prepared to add capacity as needs demand. Many systems — both AV and not — do not scale particularly well. Although some additional resources can be added over time, the entire system must be replaced with a solution designed for larger capacity at some point.

Tesira and AVB/TSN address this problem by being designed from the beginning to allow endpoints to share the same digital channel on the network without consuming additional network capacity; in this manner, they support a great level of scalability to adapt the infrastructure to evolving business needs. Further, they enable additional flexibility in repurposing existing capacity on demand. Endpoints can be dynamically reassigned to support large corporate-wide communications tasks or numerous distinct "local" tasks — all without needlessly over-provisioning network capacity. It is important to consider that scalability in this sense refers to the ability to not just grow resources within a system, but also to shrink and/or repurpose resources to address new use cases.

Different end users had dramatically different user experiences

User experience can be subjective; even if the system is operating as expected, some users are challenged or overwhelmed by the control interface. If the technology isn't working correctly, then everyone will have a challenging in-room experience. In addition, user expectations are constantly increasing — what was a cutting-edge feature yesterday is now a base expectation. Only a few years ago, Full HD (1080p) video was considered a "premium" offering. Today it's the bare minimum in many cases.

TesiraLUX's feature set has been designed with the future in mind, and is capable of meeting the ever-growing video needs of even the most complex facilities. TesiraLUX can accept up to 4K60, 16-bit color depth, and 4:4:4 chroma subsampling, and supports the Rec. 2020 color space. It also supports 8-channel PCM audio for embedding and de-embedding, as well as managing EDID automatically between the TesiraLUX device and the input source/output display thanks to scaling in both the encoder and decoder.

TesiraLUX allows the integrator to make intelligent decisions about what to send over the network and helps them treat content types appropriately. Multiple software-based options are available for managing bandwidth over the network, including setting maximum resolution, frame rate floor, and/or a rate of compression. Furthermore, routing and bandwidth constraints can be dynamically changed via presets, hot plug detect, or control automation. As an added benefit, TesiraLUX offers both a 1Gb (RJ-45) and a 10Gb (SFP+) media port, so end users won't have to switch out their video endpoints when they upgrade to a 10 Gigabit switch infrastructure.

To help facilitate third party control programming for UX design, Tesira offers a rich and easy-to-use API called Tesira Text Protocol, or TTP. Most of our software blocks and settings are programmatically accessible/controllable, and we've prioritized making our control language intuitive to programmers of all skill levels.

Moving away from iron matrices and onto the network introduced new stakeholders to the conversation that we hadn't worked with previously

IT owns the network and everything running on/over it, and that's not likely to change. When asked to add something to the network — say for instance an AV system — the first question an IT professional will ask is, "what's this going to do to my network," or even, "how is this going to break my network?" You have to be able to speak the lingua franca and defend your requests. Treat it like a court case, and you're the defendant.

Biamp has two CTS-accredited courses — "How to Speak Intelligently to IT Customers" and "Communicating with Your IT Customer" — that can help you understand the IT perspective better. By entering the conversation prepared to answer questions, you'll likely have a greater chance for success. Contact your Biamp sales rep to set up a lunch-and-learn.

One thing that may help set IT at ease is the fact AVB/TSN is an open set of standards published by IEEE, the same organization that created the standards for Ethernet and Wi-Fi. AVB/TSN was designed from the ground up to exist in an IT-managed environment and share the same infrastructure as traditional non-deterministic traffic. AVB can be monitored and managed via many of the dashboards already being used for monitoring the overall health of the network.

We didn't have the necessary networking expertise, so we got in over our heads and lost money on projects that used networked video

For some integrators, networking introduces complexities that they may not be comfortable dealing with. However, AV systems are moving rapidly towards (or are already) transmitting over standard Ethernet infrastructure, requiring integrators to adapt and become proficient with network design and troubleshooting. This is becoming a "must have" skill for most integrators. We have a number of articles posted on our technical support website regarding networks and networking principles.

AVB/TSN (and, by association, Tesira) offers automation to the AV network setup process, greatly reducing the amount of network configuration required when deploying a system. There is no need to manually configure multicast addresses or IGMP snooping querier VLANs. Once AVB is enabled on the switch, dynamic VLANs, QoS, traffic shaping, and stream bandwidth reservations are all automated under AVB/TSN.

We had challenges with localized media mixing (local presenter mics, switching between camera and content, etc.)

This challenge often appears in rooms requiring real-time video and audio of the presenter and, at times, two-way audio for Q&A sessions in large/overflow rooms. Many solutions don't provide seamless ways of de-embedding audio. Instead, they process it with other localized sources like local presenter mics, and then re-embed the audio, in sync with the video, for the overflow room.

As mentioned previously, Tesira manages the entire audio and video signal path, allowing our DSP to determine how long it takes for each signal to pass over the network, enabling it to accurately synchronize everything. You can be embed/de-embed the audio from the video stream (or route it) as often as you'd like without needing to add manual delays. For content switching, EDID is managed automatically between the TesiraLUX device and the input source/output display thanks to broadcast-quality scalers in every encoder and decoder.

As soon as we called something a “server,” IT got involved

We’re guilty of this one. Mea culpa.

AV and IT dictionaries are different, so problems arise due to misconceptions about how many endpoints actually reside on the network. Terms like SERVER, SERVER-IO, and “server-class devices” trigger administrative and ownership conversations regarding maintenance and update schedules.

While we’re not promising *anything*, we’re open to making changes to our naming conventions and descriptions to help facilitate improved conversations with customers. For example, we changed the product category of our Vocia® MS-1e & TTS-1e to “processors” to alleviate misunderstandings. Perhaps in the future we’ll do something similar for Tesira, but again, we’re not making any promises. In fact, *we never even had this conversation*.

You may want to talk your Biamp sales representative about our CTS-accredited How to Speak Intelligently to IT Customers course for more IT-friendly euphemisms like “Embedded Media Processing Appliances.”

It’s a non-starter if the streams aren’t encrypted

Network security is a primary responsibility of every IT organization, and there are times when AV streams may carry sensitive or confidential information. Thus, IT is highly motivated to keep the stream content secure, and a common way to achieve this is by encrypting the streams. If the network is breached and the data is captured by an outside party, the hacker won’t be able to decrypt the information without the magic decoder ring, and the decryption key is very large (128, 192 and 256 bits are common). While Tesira video streams are not currently encrypted in the traditional sense, the Tesira platform has a number of attributes that make those streams difficult — if not impossible — to access:

- AVB streams are not sent to ports unless the device on that port is AVB "capable" and has indicated to the AVB talker that it's ready and expects to receive a stream. Therefore, AVB traffic would be “invisible” to hackers by default.
- The negotiation/handshake that occurs between AVB talkers and listeners for characteristics such as video stream parameters follows a precise protocol. If a non-AVB element is inserted into the transmission path — whether it's a non-AVB switch or "man in the middle" hack — the stream will not transmit.

In short, a hacker would require intimate knowledge about the installed Tesira system's configuration, and the hijacking device would need to actively participate in the protocols necessary to establish a connection masquerading as a Tesira AVB endpoint. Running a passive “network capture”, which is how most network capture tools operate, would be insufficient to gain access to Tesira's media streams.

Although unrelated to encryption, another favorable point is that AVB operates on Layer 2 of the OSI model — no IP addresses or related network services (e.g. DHCP) are necessary for an AVB switch port to pass media streams successfully. This provides an additional security benefit by reducing the number of services or ingress points a hacker can use to compromise or hijack the port — or the network.

Our enterprise customers don't allow any switches on the network that they don't provide, own, and manage

That makes sense. IT is responsible for the health and security of the network, so they need to be informed/involved whenever new endpoints and infrastructure are added. Leading the conversation with "here are all of the IT benefits that this AVB/TSN-enabled enterprise-class switch provides" tends to be an effective strategy. These benefits include:

- AVB/TSN is designed to exist on a single managed network, in conjunction with control, voice (VoIP), and traditional data traffic
- AVB/TSN requires minimal switch configuration (see below) and self protects against overprovisioning of bandwidth and network congestion, saving installation and downtime costs
- AVB/TSN automates the configuration of VLANs and QoS settings
- AVB/TSN also automates stream bandwidth reservations and traffic shaping, which smooths congestion and limits data bursting
- AVB/TSN switches are more leave/join tolerant to topology changes (adding /replacing switches or devices)

We want to emphasize that the AVB/TSN switches we're discussing are enterprise-class. They have remote administration and monitoring capabilities to self-report issues, and many models have redundant/backup schemes like their non-AVB counterparts.

In the last year, the AVB switch marketplace has picked up pace as manufacturers realize the benefits from the integration standpoint (quality-assured setup that is consistently easier and faster) and for the end user (cost-effective installation and enhanced reliability of data transmission). Extreme Networks' line of AVB-enabled switches have been available on the market for quite some time, as have Netgear, MOTU, and Control4/Pakedge.

We should also point out that Cisco has entered the market, which is a harbinger of how network infrastructure will be standardized in the future. Their incredibly popular Catalyst 3850 switch (among others) is AVB-enabled, so there's a decent chance that your customers are already using "special switches" [1] in-house.

If you have additional questions about Tesira and TesiraLUX, please contact your Biamp sales representative.

[1] We're pretty much over the whole "special switches" conversation. It's like continuing to lament the fact that VHS won out over Betamax. Move on, people. Move on.