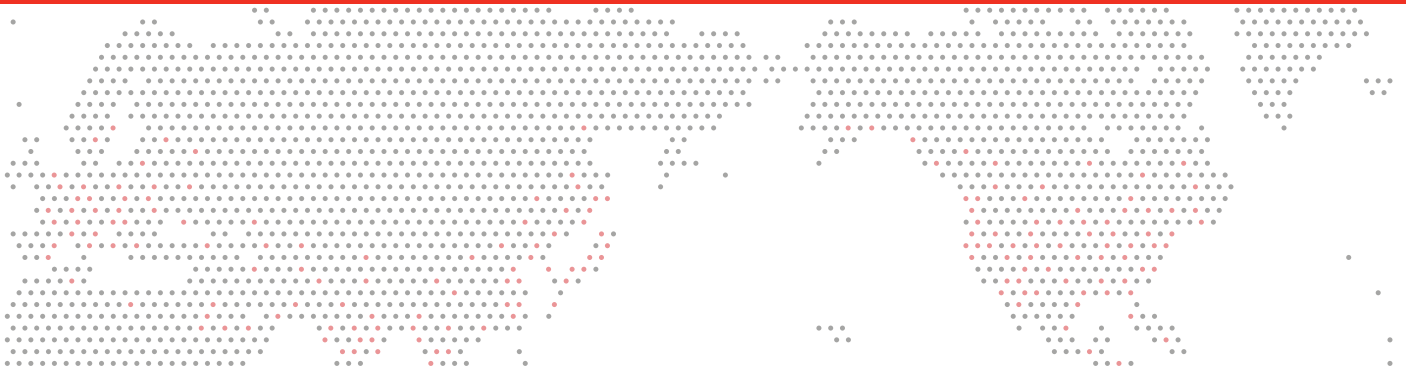


AVB RESOURCE GUIDE

Covering the Basics of AVB



B I A M P[®]

S Y S T E M S

Table of Contents

AVB Brings AV and IT Together	3
AVB for IT Professionals.....	4
What is AVB and What Does It Do?	4
The AVB-Related IEEE Standards	4
Industry-Supported and Future-Proofed Solutions	4
How Does AVB Work?	5
Clocks: Accurate, Synchronized Communications	5
Endpoints: Talking and Listening	5
Key Features of AVB	6
Why AVB?	8
Streamlined	8
Efficient	8
Simple	8
Innovative	9
AVB Questions and Answers	10
AVB Glossary	16

AVB Brings AV and IT Together

The AV industry has experienced exponential growth in the last 10 years and shows no signs of slowing down. The development of Digital Signal Processing (DSP) has required a number of protocol innovations both in telephony and in transporting digital media around a facility. Traditionally this has been handled by the use of licensed or proprietary audio or video protocols. More recently the development of the Audio Video Bridging (AVB) Protocol from the IEEE allows standards to be used that deliver low latency, high channel count media content.

These technological breakthroughs have also heralded the biggest and most important change of all: the convergence of AV and IT. This change means adopting new ways of doing business and reinventing the ways we create value for our customers. We've met this latest challenge with the industry's first truly scalable media system for digital audio networking using AVB: Biamp Tesira®.

In order to enable our customers to do more with their AV systems—scale larger and faster, facilitate more signals and send signals further—we had to develop a hardware platform that incorporated cutting-edge technology and training and support that expanded the Biamp legacy for product innovation. Tesira is that product, and AVB is its specialty.

This guide is a comprehensive support resource about the basics of AVB, how end users can benefit from it, and what we can expect from AVB in the future.



Using AVB,
an IT manager can
have a mixed data
network, making their
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**AV systems much
more time- and
cost-effective.**



AVB for IT Professionals

What is AVB and What Does It Do?

AVB is a collection of IEEE 802.1 standards that have increased the capacity for information exchange, support and AV product standardization. Commonly referred to as a switch, the purpose of an audio video bridge is to provide time-synchronized, low latency streaming capabilities for audio and video data that guarantees bandwidth reservation.

The promise of AVB is a single network to transmit audio, video and other forms of data via “smart” switches that can process AVB traffic without compromising network integrity. Using AVB, an IT manager can have a mixed data network, making their responsibilities as the manager of AV systems much more time- and cost-effective than parallel systems. Integrating AVB technology into their current IT systems would be a giant step forward and a radical shift in design philosophy most IT and AV administrators.

The AVB-Related IEEE Standards are as Follows:

- **802.1AS:** Timing and Synchronization for Time-Sensitive Applications
- **802.1Qat:** Stream Reservation Protocol (SRP)
- **802.1Qav:** Forwarding and Queuing for Time-Sensitive Streams
- **802.1BA:** Audio Video Bridging Systems
- **1722** is a Layer 2 transport protocol for time sensitive applications in bridged LANs. Relates to media talker and listener endpoints only.
- **1733** is a Layer 3 transport protocol for time sensitive applications in LANs that leverage Real-Time Transport Protocols (RTP) and RTP Control Protocols (RTCP), two protocols commonly used in VoIP.
- **P1722.1** is responsible for AVB device discovery, enumeration, connection management and control for 1722-based devices. It is currently going through the balloting process prior to acceptance.

Industry-Supported and Future-Proofed Solutions

AV equipment connections have historically been analog one-way, single-purpose and point-to-point. Even digital AV standards were often point-to-point and one-way, such as S/PDIF for audio and the serial digital interface (SDI) for video. This connection model resulted in large, confusing masses of cables, especially in professional and high-end consumer applications.

With the increase in larger scale project installations in recent years, AV integrators are looking for system solutions that can accommodate their clients' growing needs for more flexible and scalable options in their AV systems. Our answer is to provide customers with an industry-supported and future-proofed solution for their AV systems. As Biamp's newest networked media system, Tesira incorporates features and functionality that we've been developing since the launch of AudiaFLEX. The biggest difference in Tesira, as compared with other similar systems, is the level of scalability it provides.

How Does AVB Work?

Clocks: Accurate, Synchronized Communications

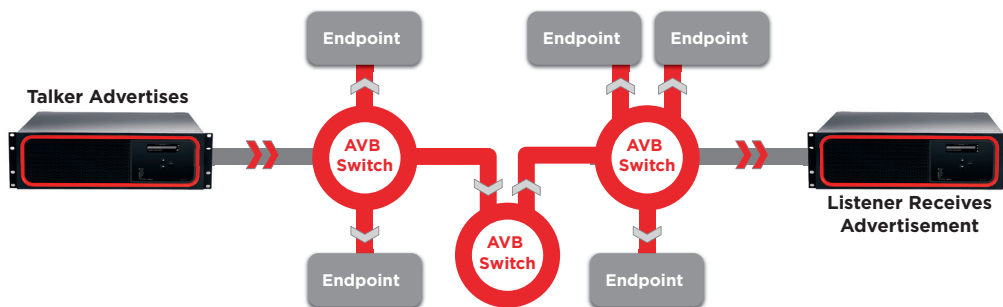
The commonly referenced network clock in every AVB-enabled device on a network ensures that every device will have a very close representation of what the precise time is in any given instance. After the devices communicate with each other, one AVB device is selected as the best master clock and communications proceed from talker endpoint to listener endpoint.

Endpoints: Talking and Listening

When an AVB talker endpoint device transmits one or more media streams to the network, an AVB listener endpoint device receives one or more of those streams from the network. The AVB bridge/switch acts as a conduit between the two. Both the talker and listener endpoints request stream reservations and the bridge between them fulfills those reservations, regulating the data streams between both endpoints so they are receiving the correct data streams.

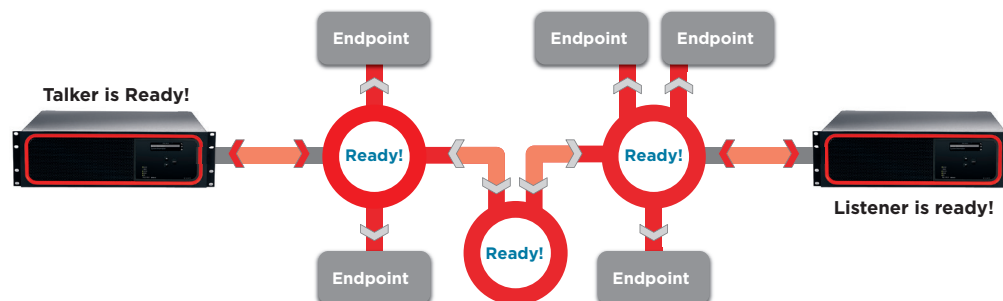
Step 1:

Talker endpoint advertises and listener endpoint receives the advertisement.



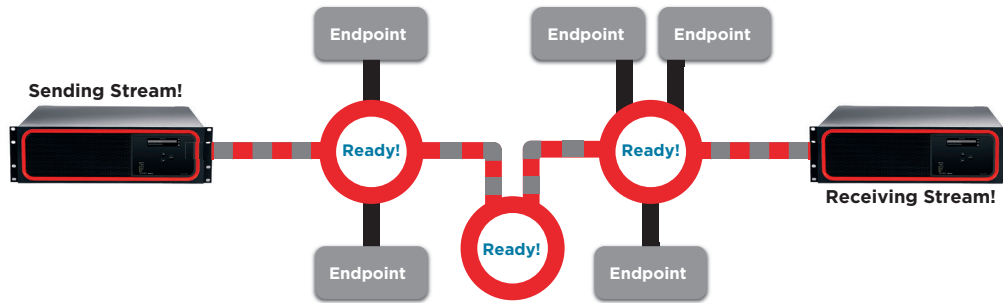
Step 2:

Talker endpoint is ready to send data and listener endpoint is ready to receive it.



Step 3:

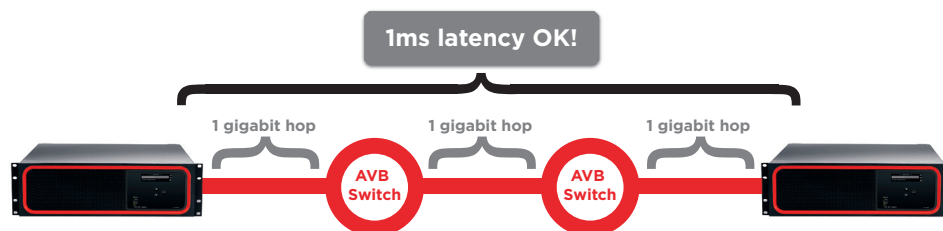
Talker endpoint sends stream and listener endpoint receives it.



The AVB bridge/switch guarantees time-sensitive, loss-sensitive, real-time AV data transmission while allowing audio and video data to seamlessly share the same network. The switches will only allow up to 75% of each network port to be used for AVB traffic, preventing other forms of data from being delayed or lost.

Key Features of AVB

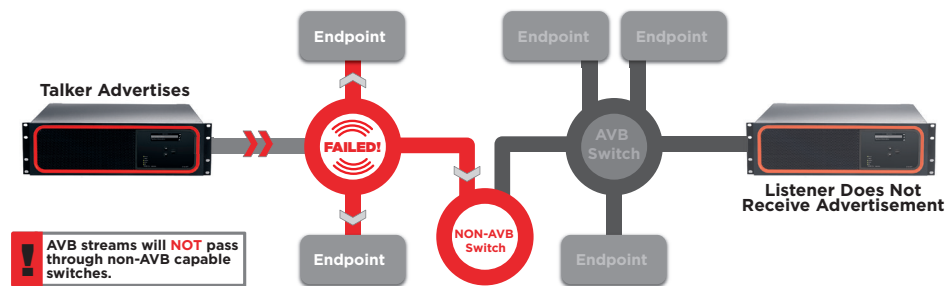
- Transports media data faster and simultaneously by referencing a network master clock.
- AVB devices periodically exchange timing information that allows both ends of the link to synchronize their time base reference clock very precisely across an AVB-aware LAN. This precise synchronization has two purposes:
 1. To allow accurate synchronization of multiple streams.
 2. To provide a common time base for sampling/receiving data streams at a source device, and presenting those streams at the destination device with the same relative timing.
- Guarantees bounded, low and constant media latency. Low latency is important in live situations where the receipt of audio needs to arrive within milliseconds of the original transmission. Bounded/constant latency prevents the timing from changing by guaranteeing a specific, known latency between endpoints. The latency of AVB provides 2ms over 7 switch hops in a 100Mbit Ethernet network. With one gigabit hops, 1ms latency becomes possible.



- Provides higher channel count capabilities than are possible using

CobraNet®.

- Works over existing Ethernet infrastructure with proper switches.
- Stream reservation protocol (SRP) defends bandwidth against oversubscription and ensures quality of service (QoS) through the use of admission control and traffic shaping. It also prevents information from being lost in cases of oversubscription.
- Queuing and forwarding rules ensure AV streams pass through the network with the delay specified.
- Allows synchronization of multiple flows of media/streams from different sources, and arrive at their endpoint simultaneously. AVB allows you to not only transfer data at the same time from point-to-point, but also from point-to-many different points.
- AVB devices can identify and communicate with non-AVB devices using standard 802 frames, but cannot send AVB data streams through non-AVB switches.



- Open network standard provides market stability and consistency for end users, integrators and manufacturers alike.
- Modularity allows for the creation of different system configurations between centralized, hybrid and distributed systems. The system designs can be easily expanded and reconfigured to meet the facility's needs without having to install a completely new system.

Why AVB?

Streamlined

For AV integrators and IT managers, AVB means end-to-end digital networks that are simple to design and easy to manage. AVB follows the IEEE 802.1 standards, which are open, industry-accepted standards for transporting audio over networks.

These standards were created to address shortcomings in existing proprietary audio visual networking systems such as synchronizing multiple streams of audio and video, eliminating the buffering delay through the network, and creating resource reservation. AVB fully addresses the shortcomings in networked AV, and makes highly flexible and affordable networking of professional Ethernet-based AV products a reality

Efficient

This form of digital networking allows IT managers to reduce costs by sharing equipment between rooms and locations. For example, a company can use a single AVB network to transport all media between rooms, such as a boardroom, the CEO's private conference room, a training room and a marketing conference room. By comparison, a siloed four-room environment would require four sets of equipment because each room would need its own digital signal processing (DSP) hardware. AVB eliminates the need for room silos and makes it easier for IT professionals to remotely manage and troubleshoot their network. And as every IT manager knows, every minute spent troubleshooting a system is time lost and company dollars wasted.

By continuing to facilitate a relationship between AV and IT, Biamp will be able to support a vast ecosystem of AVB-compatible products that will lower industry prices, drive innovation and secure future investments all along the sales channel from the manufacturers to the integrators to the end users.

“AVB eliminates the need for room siloes and makes it easier for IT professionals to remotely manage and troubleshoot their network.”

Simple

To use, AVB is as easy as analog, but with next generation functionality and scalability. Here are some of the key benefits of AVB technology to IT managers and AV integrators:

- Simplifies maintenance
- Ethernet-based
- Eliminates interoperability challenges
- Creates a future-proof system
- Large channel capacity enables flexibility and scalability
- Smart switches do the heavy lifting
- Open standard
- IEEE and AVnu Alliance standards
- Single network for all media
- Delivers high quality audio and a better user experience

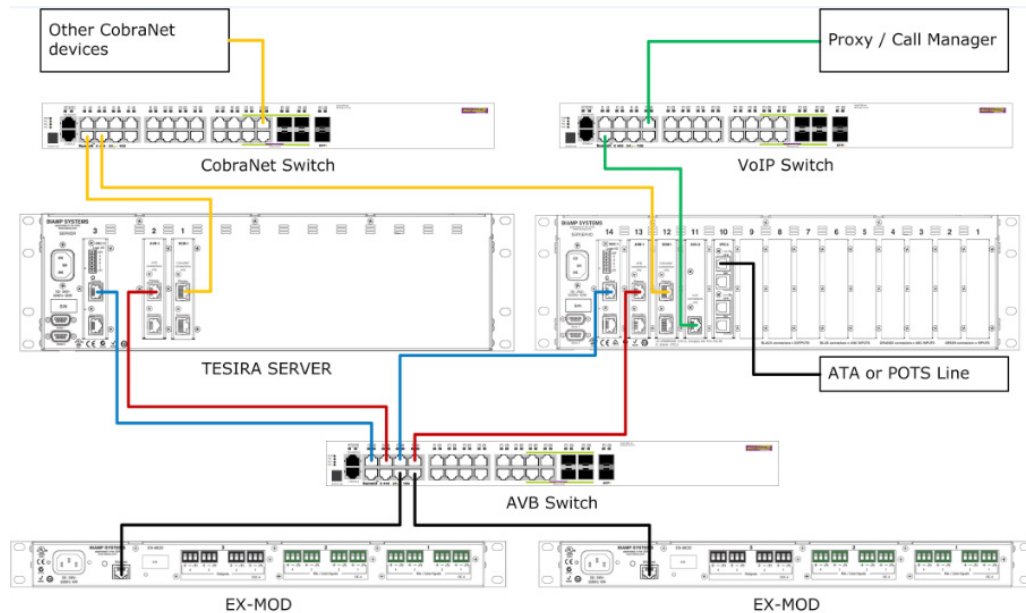
Innovative

As more and more IT managers become responsible for managing corporate AV systems, it is increasingly important that Biamp Systems is there to bridge the gap between IT needs and AV technologies. The AV industry continues to grow and shift, and the functionality and widespread use of AVB will grow and shift with it. Using AVB is a way to future-proof AV systems and protect customer investments over the long-term. As an industry leader in AV innovation, Biamp is meeting this challenge head-on.

AVB Questions and Answers

Q: How does AVB fit with other technology like CobraNet® and VoIP?

A: See diagram below:



Q: Why do I need different switches to use AVB?

A: The most important enabler for AVB technology is the AVB bridge/switch. Unlike current Ethernet switches, AVB switches have additional CPU processing to handle the additional traffic shaping, time synchronization and QoS requirements inherent in AVB-aware networks.

The AVB bridges/switches provide guarantees for time-sensitive, loss-sensitive, real-time AV data transmission while allowing data, audio and video to share the same network. The switches will only allow up to 75% of each network port to be used for AVB traffic.

With AVB, VLANs and separate physical networks are options instead of necessity. The bridge/switch automatically creates a VLAN for AVB traffic, allowing AVB data packets to reach ports with non-AVB aware devices. Therefore, AVB traffic will not pass through non-AVB switches.

Q: Is there a list of approved AVB switches for Tesira systems?

A: There are several AVB-capable switches currently available:

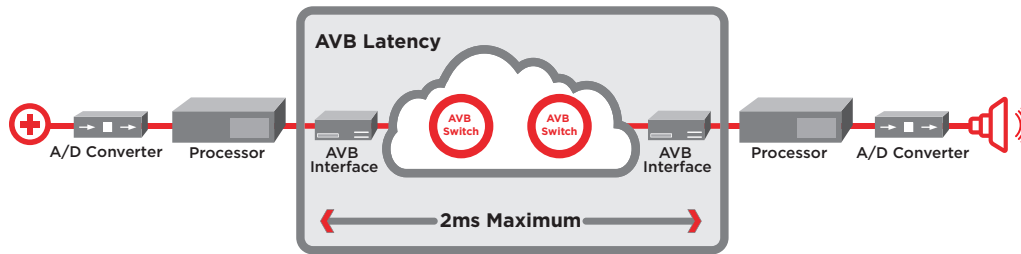
1. Lab X Technologies Titanium 411 AVB SwitchAudio 24 Port Ethernet
2. NETGEAR GS724T AVB Switch
3. Extreme Networks X440, X460, X670, Ethernet AVB Switches

Q: Can I use AVB with a mixed network?

A: Yes.

Q: What is the latency of AVB?

A: The latency for AVB is very low. Stream Reservation Protocol (SRP) and the IEEE 802.1Qav Protocol together ensure end-to-end timely delivery of all reserved media streams. Without these protocols, there is no way to know how much intervening non-media traffic, or how many media packets, the switches may queue up.



With AVB on a wired Ethernet network, the worst-case travel time is known throughout the entire network. As a result, only a small amount of buffering is required and very low latencies – 2ms over 7 switch hops in a 100Mbit Ethernet network – can be achieved, and even better at gigabit speeds.

Q: What are the network diameter limitations?

A: This is variable and dependent upon forwarding delay of the switches used. The network must support a round-trip delay within the AVB latency setting. As Tesira uses Class A latency, this is either 1 or 2ms.

For example, if a switch has a forwarding delay of 150 microseconds (150µs), nine switches will take 1.350ms to move an AVB data stream. Once you then factor in the endpoint processing delay, you are at the 2ms network limit. This sample switch would support 10 switch hops. The use of “faster” switches or uplinks will increase the network diameter. So moving to a 10 Gigabit uplink, or using a switch with a quicker throughput, will mean more switch hops are supported.

Q: How will my bandwidth be utilized?

A: The IEEE 802.1Qat Stream Reservation Protocol (SRP) provides mechanisms for reserving stream bandwidth that allows endpoint applications to configure the routes, eliminating the need for this type of infrastructure network engineering. SRP checks end-to-end bandwidth availability before an AV stream starts. If bandwidth is available, it is “locked down” along the entire path until explicitly released. SRP works hand-in-hand with the IEEE 802.1Qav Queuing and Forwarding Protocol.

Qav schedules time-sensitive AV streaming data, ensuring timeliness through the network. Regular non-streaming traffic is treated in such a way that it cannot interfere with reserved AVB traffic. Utilizing the AVB protocols, intelligent devices communicate with the network to provide reliable AV streaming without the need for the integrator to perform extensive hand-tuning of the network.

Q: What are switch manufacturers doing with AVB?

A: In order to leverage the use of AVB, the switching network is used to perform the heavy lifting items such as traffic shaping and stream reservation. In order to do this, there is a requirement for updated features in the switch chipsets. Many switches already have the hardware built-in and it's simply a matter of upgrading the software to enable the AVB feature set. Typically this is enabled with a software license on the switch.

Q: What layers of technology are available with AVB?

A: While an IEEE working group has recently ratified an AVB transport protocol for use at Layer 3, it currently only operates as a Layer 2 protocol.

Q: What are the product channel capacities?

A: There are variable stream sizes. Each stream can support between 1-60 channels. Hardware endpoints will dictate the local hardware input or output channel capabilities or requirements.

Q: Are media converters available?

A: AVB bridges/switches are aware of the AVB data packets they are handling and will provide QoS based on the data they are receiving. The switch will be aware of AVB talkers and listeners on the network and any active streams. In order to move AVB data around a network, bridges/switches will need to know how to handle any AVB data. Some media converters act as bridges/switches, which, if not AVB capable, will not adjust the timing information appropriately in the protocols and, therefore, will act as an AVB boundary. Other media converters act as "true" converters and the latencies incurred are typically within the tolerance allowed by the AVB devices. These will allow the AVB boundary to be extended to another AVB-aware bridge/switch.

Q: How many channels can I send through AVB?

A: AVB uses the concept of streams and channels. A stream is a connection from one talker to one or more listeners. One stream can be made up of 1-60 channels. Up to 64 streams in and 64 streams out of an (Tesoris) AVB interface are supported.

Stream Channel Count	Gigabit Ethernet link utilization	Total channels
7 x 60 channels (Max Bandwidth)	68.45%	420
14x 30 channels (Max Bandwidth)	71.77%	420
20x 20 channels (Max Bandwidth)	71.54%	400
32 x 12 channels (Max Bandwidth)	74.76%	384
43 x 8 channels (Max Bandwidth)	73.83%	352
64 x 4 channels (Max Streams)	69.17%	256
64 x 2 channels (Max Streams)	49.82%	128

Q: What are the bandwidth requirements of AVB?

A: There are two factors used to calculate AVB bandwidth requirements, which means the calculation is not linear. The first is the stream overhead, which is a fixed requirement and is used to assist in the traffic shaping requirements of the AVB data streams. There is also a calculation for the number of channels of audio the stream contains.

Example channel streams:

Stream Channel Count	Gigabit Ethernet link utilization
1	0.63%
2	0.78%
4	1.09%
8	1.70%
12	2.32%
20	3.55%
30	5.08%
40	6.62%
50	8.15%
60	9.69%

Stream Channel Count	Gigabit Ethernet link utilization
2 x 1 channel streams	1.25%
2 x 2 channel streams	1.56%

Q: What is the resolution and bit-depth of audio through AVB?

A: This is dependent on the endpoints. Tesira supports 48kHz 24-bit analog-to-digital and digital-to-analog conversion.

Q: Is AVB a routable protocol?

A: AVB is currently supported at Layer 2 and is not routable at the moment.

Q: Can I send AVB over a wireless link?

A: Class B traffic (which is not supported by Tesira) would be used here.

Q: Can you mix AVB and non-AVB switches in the same network?

A: Yes. Non-AVB switches will act as a boundary to the AVB traffic.

Q: Is Dante™ compatible with AVB?

A: According to Audinate®, AVB standards are well-aligned with existing Dante technology. Audinate has announced that Dante will be AVB-compliant as these standards are ratified. However, you will still need to use AVB-enabled switches for true AVB transmissions.

Q: Can CobraNet be in the same network as AVB?

A: It's certainly possible to mix CobraNet and non-CobraNet traffic on the same network with no perceived problems. However, this is highly topology and usage dependent. There's no guarantee that artifacts wouldn't occur in different use cases. The CobraNet conductor assumes control and provides scheduling for all traffic on the network. When other traffic is present, it may delay delivery of CobraNet audio packets to the extent that the isochronous (beat) interval is exceeded. In this case, audio artifacts would likely be heard. For this reason we strongly discourage our customers from doing so. Segregating AVB traffic to VLAN 2 and placing CobraNet traffic on a separate VLAN or bridge/switch is recommended.

Q: How can I send AVB data between Tesira and third party products?

A: This is dependent on some final ratification of the interoperability standards.

Q: Can I make my existing infrastructure AVB-compliant?

A: AVB is enabled on existing infrastructure with the addition of AVB bridges/switches and endpoints.

Q: Why is your Netgear® switch so much more expensive than on Amazon®?

A: The Netgear switch available from Amazon or other retailers is the same model number, but is not AVB-enabled. The Netgear GS724T switch supplied by Biamp has an AVB software license loaded and enabled on the device. This is a paid upgrade provided by Netgear to Biamp. This software license is not available from Netgear to other users.

Q: When is there going to be a video device that uses AVB?

A: AVB data is purely that and is technically video-ready now. There is a requirement for hardware-based video endpoints. Manufacturers are still developing hardware to bring to market.

Q: How do I set up VLANs with AVB?

A: AVB traffic is sent between AVB devices using VLAN-tagged packets and the endpoints and bridges act to automatically create and join the appropriate VLAN.

Q: What form does AVB traffic take on my system?

A: By default AVB traffic between the talker and listener is tagged traffic with a VLAN ID number of 2.

Q: What cable do I need for AVB?

A: AVB switches work at Gigabit speeds or better. Cat-5e or better cable is required.

Q: How do I know if AVB is working properly in my system?

A: This can be done via the switch console by monitoring the Multiple Stream Reservation Protocol. Tesira devices also have alarm indicators viewable in software, and the front panel of the device shows alarms due to AVB streams not operating as expected.

Q: Is AVB traffic unicast or multicast?

A: AVB data traffic is 100% Layer 2 multicast. The standard allows for the use of unicast, but only if locally administered MAC addresses are used.

Q: Is AVB CPU-intensive for the AVB bridge/switch?

A: Yes, AVB control traffic is CPU-intensive. The key factors relate to the numbers of ports and how many MSRP streams they will be using.

AVB Glossary

AVB Endpoints

A device used at the edge of the network that has correct hardware to receive or send signals into or out of an AVB network. These will then be configured as talkers or listeners on the network. A common application will be to have a talker transmitting a microphone audio signal to a listener elsewhere on the AVB network.

AVB Timing Domain

The boundary between an AVB-capable bridge/switch and non-AVB-capable bridge/switch.

Bridge

Ethernet appliance with the AVB standards implemented. Acts as a conduit between talkers and listeners. Also referred to as a switch.

Switch

Commonly used to refer to an AVB bridge.

BMC Algorithm

The Best Master Clock Algorithm is used as part of the Grandmaster election process.

Clock Synchronization

AVB devices each contain a time-of-day clock, and these clocks are synchronized to the clock of the chosen grandmaster clock in the system. Each AVB source device is master-capable. This master is either dynamically chosen, or can be statically configured. This clock synchronization allows multiple data streams to be synchronized, and provides a common time base for the sampling (at a stream talker) and presenting (at the stream listener) of stream data.

gPTP

Generalized Precision Time Protocol

Grandmaster

Refers to the network wall-clock time provided by the 802.1AS protocol.

Talker

An AVB endpoint capable of transmitting one or more streams to the network.

Listener

An AVB endpoint capable of receiving one or more streams from the network.

Multiple Stream Reservation Protocol (MSRP)

Allows various devices to communicate their network resource requirements (from a stream talker to a stream listener) for their audio and video streams.

Multiple VLAN Registration Protocol (MVRP)

A standards-based Layer 2 network protocol, for automatic configuration of VLAN information on switches. Without using MVRP, either a manual configuration of VLAN trunks or use of a manufacturer's proprietary method is necessary.

Port VLAN ID (PVID)

A default VLAN ID that is assigned to an Ethernet bridge/switch access port to designate the virtual LAN segment to which this port is connected. The PVID places the port into the set of ports that are connected under the designated VLAN ID. Also, if a trunk port has not been configured with any VLAN memberships, the virtual switch's PVID becomes the default VLAN ID for the port connection.

Stream

A virtual container, identified by a unique 64-bit value, of one or more AVB data channels sent from a talker to one or more listeners.

Traffic Shaping

A process performed by talkers and a bridge/switch to "smooth" out the traffic for a stream, distributing its packets evenly in time. Stops bursts of AVB data that can overwhelm the buffers in subsequent bridges/switches.

Pilot Stream

Method used by some manufacturers to facilitate audio synchronization. Tesira uses a separate pilot stream currently for inter-device synchronization of AVB traffic. 1722.1 will be used to define rules around inter-device compatibility.



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