WHITEPAPER

JUNE 1, 2018

AUTHORS

Vicent Perales, Product Manager—d&b audiotechnik GmbH
Henning Kaltheuner, Head of Strategic Business Development and Market Intelligence—d&b audiotechnik GmbH

CONTRIBUTORS

Richard Gross, President—AudioScience
Genio Kronauer, Director of Electronics—L-Acoustics
John McMahon, Vice President of Solutions and Strategy —Meyer Sound
Jeff Rocha, Director of Product Management—L-Acoustics
Greg Schlechter, Technology Marketing Strategist—Intel

EXECUTIVE SUMMARY

Industry-leading manufacturers in the Pro AV market have worked together to develop Milan: a new network protocol built on top of IEEE AVB/TSN open standards with added technical requirements to provide a fully-realized solution that guarantees interoperable, reliable, deterministic and future-proof media networking.

INTRODUCTION TO MILAN

Leading Pro AV manufacturers, working together under the umbrella of Avnu Alliance, bring the Pro AV market a new network protocol built on top of IEEE Audio Video Bridging (AVB) / Time Sensitive Networking (TSN) open standards with added specifications to provide a fully realized solution that guarantees interoperable, reliable, deterministic and future-proof media networking.

Enter Milan: a thoughtfully designed and developed, user-driven protocol for professional media, built on open standards and with the guarantee that all Milan devices will work together at a new level of convenience, reliability and functionality.

WHY MILAN

The Pro AV market has unique requirements for moving time-sensitive video, audio, and data across the network – paramount as AV increasingly resides on the network.

When it comes to networked audio platforms, the professional industry has two major requirements. At the most basic level, it requires guaranteed delivery of high-quality audio, not subject to dropouts or latency. The industry also needs to solve this with a long-term, stable and viable platform. When making decisions on networking infrastructure, end users need to be confident that they've chosen an enduring standard and a network that can support as their media and data needs scale — today, tomorrow, and even years from now.

Many solutions today have been knit together using proprietary networking solutions, requiring extensive design, installation and support work from industry professionals and creating risky propositions that are not guaranteed for long-term viability. As the network has evolved and continues to scale, so has the opportunity for the industry.

Milan is the protocol that will enable fully realized standards -based networks for professional media with ensured reliability and determinism.

HISTORY OF MILAN

Milan is the result of 18 months of close collaboration amongst direct competitors including AudioScience, Avid, Biamp, d&b audiotechnik, L-Acoustics, Luminex and Meyer Sound. Milan was created by the technical experts designing the systems and driving product roadmaps to impress upon other manufacturers the importance of this technical transition for the future of their business.

Market leaders decided long ago that AVB is a technically superior network technology that guarantees deterministic delivery of audio, video and data, and offers a sustainable standard technology that is not limited by one company's vision and its future development and support decisions for its technology.

Avnu Alliance offers compliance testing and certification of the foundational standard called Pro A 1.0, which is ideal for network infrastructure switches, but does not outline specification requirements for media formats, media-clocking and other requirements specific for AV end devices, all of which are required for practical interoperability amongst AV end devices.

Today, major manufacturers in the Pro AV space have taken the lead with the first tangible solution to promise deterministic, reliable and future-proof delivery of networked media. Building on the technical benefits of the enduring open AVB standard, such as time synchronization and guaranteed quality of service, as well as risk-free coexistence of control and media data on one network, Milan provides defined device requirements at both the network and the application layer for media streams, formats, clocking and redundancy.

Milan will be supported within Avnu Alliance with the intention of deploying a simplified testing and certification program for implementation by Pro AV manufacturers. The Milan initiative is a long-term approach to bringing about change across the Pro Av market, and product certification will guarantee fool-proof interoperability of deterministic networked Pro AV devices.

BENEFITS OF MILAN

Building on the technical benefits of the enduring open standard AVB, such as time synchronization and guaranteed quality of service as well as risk-free coexistence of control and media data on one network, Milan takes the guesswork out of implementation and interoperability for manufacturers with defined device requirements.

Milan guarantees the interoperability of the network ecosystem by adding essential agreements about the implementation of AVB technology, including requirements for compatible and compliant media formats, media-clocking, redundancy, and controller software, while ensuring those requirements are implemented correctly through compliance testing and certification of end devices.

MILAN PROMISES A NETWORK SOLUTION THAT IS:

Guaranteed

- Deterministic network assures on-time delivery
- Co-exists with other Ethernet traffic without risk of drop-outs or degradation of media

Open

- Not a risky proprietary standard that is controlled by a single entity
- Choice of hardware implementation
- Development extension managed openly by a collaborative group of industry leaders
- Supports any type of media

Future-Proof

- Certification of compliance with standards and interoperability specifications through Avnu Alliance
- Assurance of long-term viability as part of the IEEE network/IT industry

Easy to Use

- Enhanced time alignment features
- No switch configuration required
- Scalable and flexible
- Does not require IT expertise to manage things like QoS configuration

KEY BENEFITS OF MILAN INCLUDE:

Seamless Interoperability Amongst Devices

- Every device will connect with any other device using a variety of agreed-upon formats and market-required definitions in the protocol.

For the Industry, by the Industry

- Manufacturers themselves are taking the initiative and driving the development of Milan with the same energy, drive and investment that make their companies successful leaders in the market.

Plug-n-Play and Deployable

- As the Milan protocol guarantees interoperability at both the device media interop and device management interop layers, end users can enjoy easy deployment of devices on a Milan network without the need for custom network configurations.

Agreed-Upon Specification for True Interoperability

- Milan is a market-defined protocol that provides a specific set of rules and directives for manufacturers to build products with the same requirements for media streams, formats, clocking and redundancy, and thus all work together as designed.

WHO BENEFITS FROM MILAN?

Manufacturers

- The new Avnu Milan certification program in development will lower the entry barrier for small and mid-sized manufacturers, open new business models for companies offering services for certification, and create a market for Milan modules.
- Milan offers a network ecosystem that scales into future requirements and businesses, and across a broad range of devices with any type of media content.

AV Managers

- With Milan, there's no guesswork for navigating network technology. With clearly defined features, functionality and requirements, Milan products will work with others in the market, as they are intended to, with no trial and error. AV managers are able to have their pick of certified devices mapped against needs for the network, with simple plug-and-play installation.

IT Managers

- AV tech managers can have the confidence that as an enduring protocol, their IT department will embrace Milan and AVB.
- Milan vastly simplifies the management of real-time media devices within local area networks.

AV System End users

- Milan fulfills expectations for real plug-and-play network setup and functionality. Network structures don't require setup or complicated switch configuration tasks.
- Networks as signal and control transport structures becomes easy, fast to set up and reliable. Users can concentrate on their creative tasks.

Business decision makers

- Due to their deterministic behavior, Milan network systems provide a higher degree of reliability and stability against user handling and errors. This makes them the first choice for critical system installations.

TECHNOLOGY OVERVIEW

Milan creates the endpoint solution layer for professional audio equipment based on the following AVB IEEE standards:

- IEEE 802.1BA-2011
- IEEE 802.1Q-2011
- IEEE 802.1AS-2011
- IEEE 1722-2016
- IEEE 1722.1-2013

Therefore, Milan defines a set of technical profiles for these IEEE standards dedicated to professional audio endpoints:

- Media Clocking Specification
- Stream Format Specification
- Redundancy Specification
- AVDECC Specification for Endpoints

MEDIA CLOCKING SPECIFICATION

There are a several methods that can be used for synchronizing media clocks on a local area network (LAN). Using an AVB stream to distribute the media clock allows for several media clock domains to coexist on the same network.

What devices have to support Media Clocking?

- Milan endpoint devices that incorporate a Media Talker
- Milan endpoint devices that incorporate a Media Listener with two or more streams

Devices that incorporate a Media Listener with only one stream and no talker do not need to have a dedicated Media Clock Input, and can just synchronize to their Media Stream.

What Format and Sample Rates are supported?

A number of stream formats can be used to distribute a media clock through an AVB network. For interoperability purposes, Milan defines a common format that shall be supported by all devices capable of transmitting/receiving a media clock through an AVB stream in a Pro Audio AVB network. This format is based on the CRF (Clock Reference Format) defined in IEEE 1722-2016.

Beside the media clock format, an agreed-upon sample rate needs to be defined so devices on the network are guaranteed to be interoperable. Milan devices must support a media clock domain at a sample rate of 48kHz. Media clock domains with 96kHz and 192kHz are also supported as optional sampling rates.

STREAM FORMAT SPECIFICATION

Milan defines three stream format profiles for professional audio devices based on the IEEE 1722-2016 Standard AAF Audio Format. The advantage of AAF is that it is less complex and more efficient than AM824. The three stream format profiles are:

AAF Standard Stream Format (32 bit)	Maximum 8 channels per stream, mandatory on all Milan endpoints
High Capacity 32 bit Format	Maximum 56 channels per stream, **optional**
High Capacity 24 bit Format	Maximum 64 channels per stream, **optional**

Talkers are free to use any channel count in their implemented formats, while listeners need to implement support for all channel counts within their supported formats.

REDUNDANCY SPECIFICATION

Milan redundancy works to give ProA AVB devices the ability to endure against a number of network failures.

Milan redundancy follows the concept of duplicating the network infrastructure into two independent logical networks and defines a mechanism that is capable of recovering seamlessly from the loss of connectivity in either the primary or secondary network (e.g. a broken cable or power loss of a bridge). By connecting endpoints to both networks, seamless redundancy can be achieved. Milan does not specify a particular implementation, but rather defines the general requirements that implementations must adhere to in order to achieve interoperability.

In Figure 1, we have the following elements:

- A primary network, composed of AVB switches and Ethernet cables
- A secondary network, composed of AVB switches and Ethernet cables.
- Controller 1 connected to both networks with two Ethernet interfaces.
- A second, independent, Controller 2 connected to the primary network only, with a single Ethernet interface.
- AVB Talker 1 and an AVB Listener 1, connected to both networks with two AVB interfaces.
- AVB Talker 2 and AVB Listener 2, connected to the Primary network only, with one AVB interface.

Deployment clarifications:

- The primary and secondary networks are not connected by any network links.
- Non-redundant end stations and controllers can be used without disturbing the normal of the redundant system. These devices are connected to the primary network.

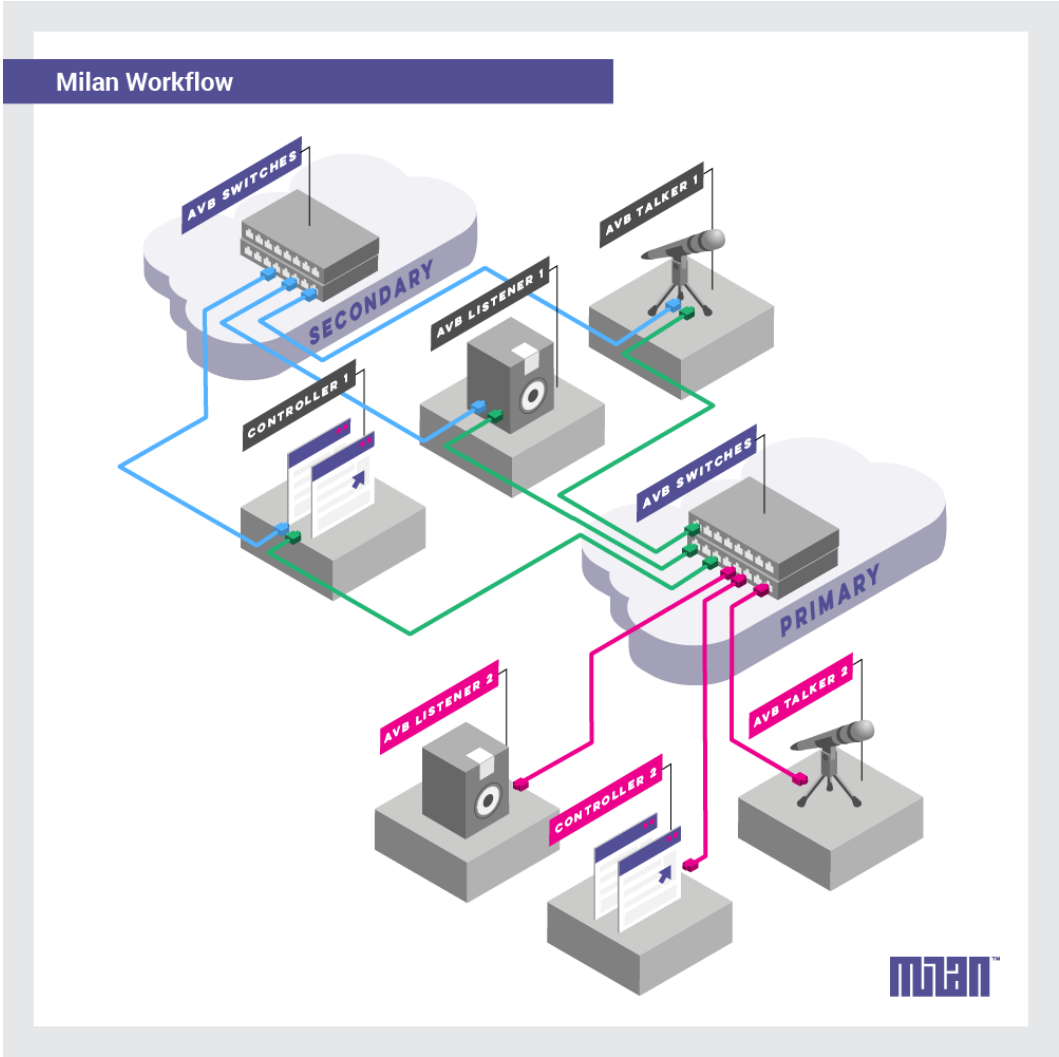

Figure 1

AVDECC SPECIFICATION

Milan relies on the IEEE1722.1-2013 Standard for Device Discovery, Connection Management and Control Protocol. This standard is very vast and allows many interpretations, including potentially contradictory ones. Therefore, Milan defines a profile for professional audio devices with a small subset of the standard, and tries to remove all ambiguities from this subset in order to achieve basic interoperability at the Control layer.

The Milan AVDECC specification provides a consistent set of requirements that provides the following features:

- Automatically discovers the addition and removal of pro audio devices on the network
- Retrieves the entity model of the discovered pro audio devices
- Connects and disconnects streams between the discovered pro audio devices
- Obtains status information about the discovered pro audio devices and their connections
- Controls the discovered pro audio devices

Milan specifications are available for download at www.avnu.org/specifications

USE CASE SCENARIO

Milan is a unique solution for local production systems. Here we shall view one such example system to illustrate how Milan can be implemented.

As the Milan application layer is built upon the base AVB network layer, interconnections within functional systems comprised of various endpoint devices are based upon reserved AV streams. With Milan being an open source solution, each manufacturer benefits by being able to implement its own network systems.

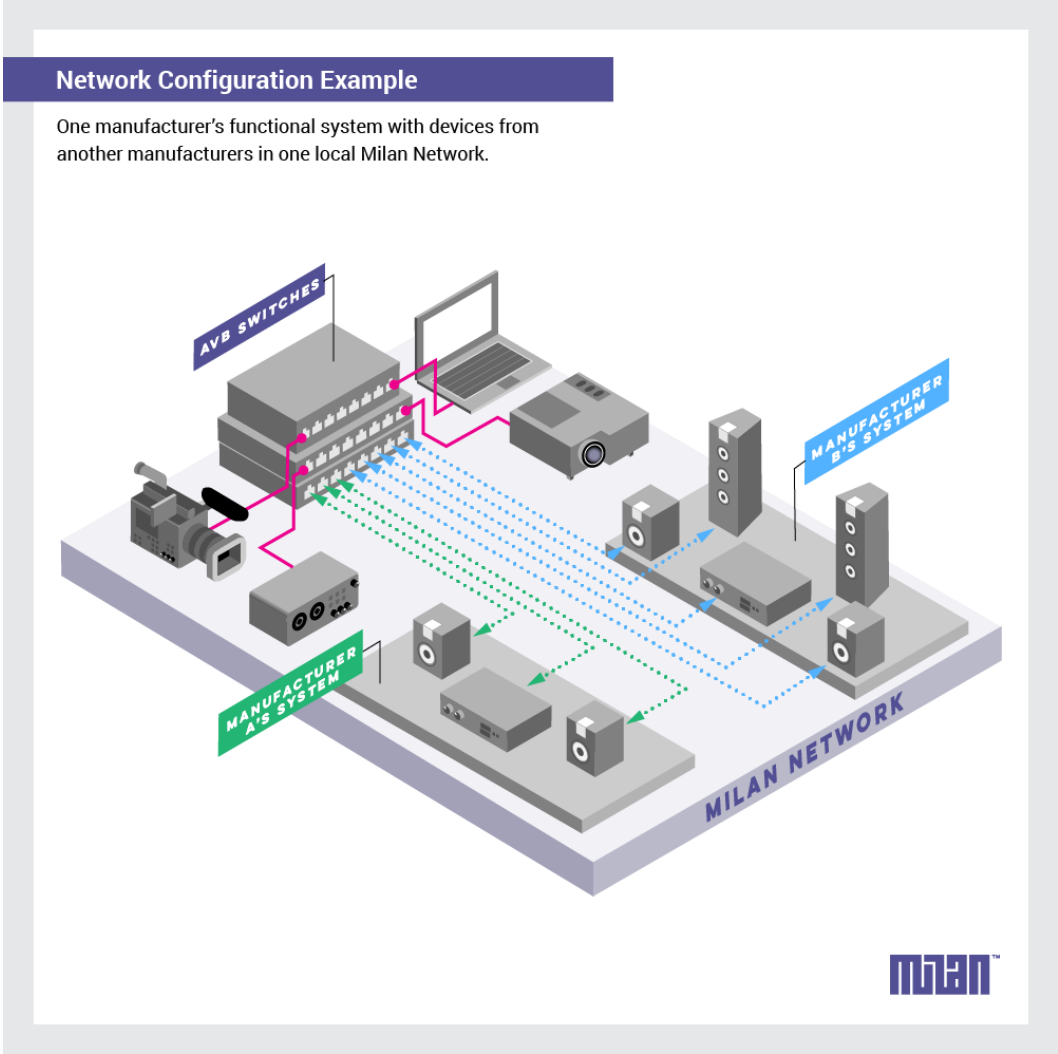

Figure 2

In Figure 2, we see Manufacturer A's functional system with three devices implemented on the Milan network, with connections from various AV devices as well as other endpoint devices from Manufacturer B all safely coexisting on the same network comprised of rather independent subsystems. Any non-media data can safely pass the structure without risks for congestion or drop-outs. Video devices and signals on the Milan network can easily be integrated with the same properties for low latency (1-2ms), deterministic transport and precise synchronization. Audio to and from video devices can also directly interact with audio devices. Media clocks of the various systems can be set up and managed completely independently.

CONCLUSION

Milan is the market-defined protocol for manufacturers created by industry leaders and experts that provides a specific set of rules and directives that allows manufacturers to build products with the same requirements for media streams, formats, clocking, and redundancy. Through the Avnu Alliance, Milan certified devices will be guaranteed to interoperate with one-another.

Milan removes the guesswork for manufacturers trying to navigate the complicated world of networking technology. With Milan, it is clearly defined what features, functionality and requirements are to be included in new products to make them work seamlessly with others in the market.

WHAT'S NEXT

The Avnu Alliance has been hard at work to develop a simplified specification and certification process that guarantees interoperability amongst Milan certified devices. Also, manufacturers involved in Milan will continue to develop the program to meet new and changing market demands.

GET INVOLVED

Avnu Alliance is a platform where strong competitors and like-minded companies can work together in a clear and defined environment. This kind of collaboration amongst competitors to develop Milan could not have been done without the framework provided by Avnu Alliance. Membership in Avnu Alliance gives manufacturers a voice to collectively define the market requirements to meet their unique development needs for a fully realized professional AV network solution.

Manufacturers that rely on the market's proprietary technology are limited by one company's vision and decisions on development and support for that technology. With Avnu Alliance, manufacturers benefit from having a say in the requirements and the refinement of standards, and they are not expected to share projections or product roadmaps with potential competitors to meet propriety suppliers' business forecasts.

Avnu Alliance provides a path to collaboration and knowledge sharing with other leading industry experts in a safe environment.

Join Avnu Alliance today to reap these member benefits and more:

- Participation in plugfests, face-to-face technical and marketing meetings, weekly and monthly marketing and technical segment workgroups
- Access to market requirement documents, compliance tools, testing plans and tools to expedite product certification depending on membership level
- Avnu Alliance members can submit products for certification testing including for the Milan solution.

Companies interested in learning more about Milan should get in touch at Milan@avnu.org

ABOUT AVNU ALLIANCE

Avnu Alliance is a community creating an interoperable ecosystem of low-latency, time-synchronized, highly reliable networked devices using open standards. Avnu creates comprehensive certification programs to ensure interoperability of networked devices. The foundational technology enables deterministic synchronized networking based on IEEE Audio Video Bridging (AVB) / Time Sensitive Networking (TSN) base standards. The Alliance, in conjunction with other complementary standards bodies and alliances, provides a united network foundation for use in professional AV, automotive, industrial control and consumer segments.