

# Audio Network Development (Part 5)

## Developing Products Featuring AES67 Network Connectivity



*audioXpress* continues to explore the options for audio networking development and implementation in new audio products, one of the most exciting technology developments this industry has seen in many years. Following Audinate’s Dante and RAVENNA, we will now focus on AES67 implementation, the high-performance streaming Audio-over-IP (AoIP) interoperability standard.

By  
**João Martins**  
(Editor-in-Chief)

The RAVENNA Partner Network is one of the strongest promoters of the new AES67 AoIP interoperability standard.

As stated in last month’s article, RAVENNA, together with Livewire+ from The Telos Alliance, is probably the closest networking protocol implementation to the AES67 specifications, which is why RAVENNA is being promoted as RAVENNA/AES67. Audinate also adopted an AES67-compatible profile in Dante, and QSC now also supports an AES67-compatible mode in its proprietary Q-LAN technology. No doubt others will follow, but we can say that with those four, most of the options are covered and all the most important audio networking solutions in the market are now able to exchange audio and have a common basic audio transport interoperability level.

The only missing piece is AVB/TSN, but since most AVB solutions in the market already offer a hardware bridge to Dante or RAVENNA (e.g., Avid, Biamp, and PreSonus) that might not be such a big problem in real applications, even though direct AES67 support on AVB systems still needs to be implemented. The important thing to remember is that AES67 is just another basic operational profile for all audio-networking technologies.

As Ethan Wetzell, (Platform Strategist Bosch Communications Systems and an active participant in the AES67 and the AES70 standards efforts, AVnu Alliance, Media Networking Alliance, and OCA Alliance) explains, “It is important to consider what AES67 is intended to do and what it is not. For example, AES67 is not intended to be used instead of Dante (or RAVENNA, Livewire, etc.) but rather inside of and in conjunction with those solutions. Dante and the rest are architected solutions that add many things beyond transport and clock (discovery and connection management being important components). AES67 is intended to create a common foundation for these solutions to be able to communicate and interoperate with each other, which is a positive thing. This was highlighted when Audinate released AES67-compatible firmware for its Dante devices. It is not an either-or situation. And that is a good thing.”

This same perspective is perfectly illustrated by The Telos Alliance and Livewire+ implementation. The audio networking technology was introduced as Livewire in 2003, and today’s Livewire+ is AES67-

compliant. That means that it complies fully with the AES67 Interoperability Standard, enabling AES67 devices to directly connect to Livewire+ networks and exchange audio streams. Livewire+ is also backward-compatible with RAVENNA.

In this same article series, *audioXpress* has already published an article explaining the basics of AES67 (see References), so we are not going to repeat a description of the standard.

## Interoperability Plugfest

Meanwhile, a maintenance revision to AES67-2013 has been issued. The revision, called AES67-2015, clarifies some of the interoperability requirements, based on general implementation and “plugfest” experience.

The ability to incorporate these revisions was identified during the first Audio Engineering Society (AES) “Plugfest” testing, carried out in cooperation with the European Broadcast Union (EBU) in October 2015, and held at the Institut für Rundfunktechnik (IRT), in Munich, Germany. During these tests, 10 companies tested 16 currently available networked audio products with AES67-specific extensions against each other to confirm interoperability.

The participating manufacturers were ALC NetworX, Archwave, Axia Audio (The Telos Alliance), Digigram, DirectOut, Georg Neumann, Lawo, Merging Technologies, SOUND4, and technical personnel from IRT, Swedish Radio, and the BBC assisted in the tests and observed the outcomes on behalf of the EBU. The tests were a resounding success and proved the proposed functionality of AES67 to be real and robust.

The Media Networking Alliance (MNA), an industry alliance established to promote awareness and uptake of AES67, promotes those efforts. Several products, which support AES67, were already released to the market and allow for the industry to gain confidence about the compatibility between dominant audio networking technologies, while allowing manufacturers of products that do not require the full set of audio networking functionalities (e.g., speakers) to introduce network connectivity options in their newest products, with total confidence.

At the 139<sup>th</sup> Audio Engineering Society (AES) Convention in New York, the MNA held its first public display of audio networking based on the new AES67 interoperability standard. The demonstration showed interconnectivity between 22 currently available products from 18 different companies, all streaming live audio over the same network via AES67 specific extensions to the different network platforms utilized by each manufacturer.



The demonstration also served to illustrate AES67 support for both unicast (one-to-one) and multicast (one-to-many) audio transmissions. The technology on display was primarily a multicast configuration and enabled visitors to see how some of the manufacturer-specific discovery, control, and monitoring functions can augment AES67 audio interoperability and coexist on the same network. Apart from companies already mentioned, digital audio signals were also seamlessly interchanged among devices from Focusrite, Genelec, QSC, Solid State Logic, and Yamaha. All devices were connected to a standard network through a single Ethernet switch and appeared as available sources for monitoring on a Lawo console.

At the Integrated Systems Europe (ISE) 2016 show, MNA members and member manufacturers repeated the public interoperability demonstration, this time featuring 22 commercially available networked audio products from 12 different manufacturers, employing Dante, Ravenna, Livewire+, and Q-LAN.

Those demonstrations also featured new products from Archwave/Cymatic Audio and Yamaha, with a mixture of hardware devices,

Dante is now AES67-capable, following Audinate's release of a firmware update for products based on the Dante Brooklyn II card. The addition of AES67 allows baseline connectivity between the growing ecosystem of Dante-enabled devices and networked devices from other vendors who support AES67 bridging.



The Media Networking Alliance promoted the first public AES67 interoperability PlugFest at the 139<sup>th</sup> AES in New York. AES67-specific extensions to the different network platforms provided interoperability between devices employing Dante, Livewire, Q-LAN and RAVENNA.





Twenty-two devices supporting AES67—from ALC NetworX, Archwave, Axia Audio, Digigram, DirectOut, Focusrite, Genelec, Lawo, Merging Technologies, QSC, Solid State Logic, Telos Systems and Yamaha—can be connected to a simple network with a single Ethernet switch.

software products, and hardware development kits, serving to illustrate how different companies in the professional audio space handled their own audio-networking implementations. (For more information, see the side text on Merging’s NADAC in the previous article about RAVENNA).

For anyone following those demonstrations and many system engineers currently deploying new IP-based infrastructures in television, radio, recording studios, or outside broadcast units, an AES67 profile is now an available option anytime it becomes necessary to exchange audio channels between different networking protocols. Now, manufacturers can confidently start planning their development efforts, considering the available



Andreas Hildebrand, Senior Product Manager at ALC NetworX, coordinates interoperability tests during the MNA PlugFest at the 139<sup>th</sup> AES Convention.

options for their products and knowing that many potential users will expect AES67 as part of the toolset at their disposal. This will be important in many market segments where only basic functionality is required, such as speakers.

## How to Proceed

To better illustrate what’s next for the industry, we have asked some of the development platform and engineering support providers in this field to explain their views on and experience with network implementation for manufacturers.

We started with Andreas Hildebrand, Senior Product Manager at ALC NetworX, whom we asked to describe the procedure for an audio manufacturer (from pro audio to consumer) that intends to implement and test a new product featuring RAVENNA /AES67 connectivity.

According to Hildebrand, there are three principal ways of implementing AES67 (and RAVENNA) into new or existing products. “Manufacturers may search for commercially available building boards (SoMs, chips or driver software) and decide to integrate them into existing or new products. This certainly has the advantage that the manufacturer does not need to engage with the networking technology in deep detail and saves the time-consuming and costly core development. He usually just would have to adopt his existing design to match the mechanical/electrical interface of the selected building block (usually a well-known audio interface like I<sup>2</sup>S, TDM, or MADI). Besides the aspect of low development effort, this direction usually also comes with the benefit of receiving a good interoperability guarantee, as the building blocks already provide this, per se. The disadvantage is that he does not “own the technology” and usually has no means for modifying any characteristics or performance features. For any number of products, he will be limited by the corresponding number of boards (and potentially, any related licenses). This may be the preferable way for low-volume products or manufacturers without ample R&D resources.”

“Product designers may also decide to develop an individual implementation from scratch. This would certainly require not just an ample amount of time and appropriate development resources, but also a sound background on networking fundamentals. The development may be accelerated by reaching out for free or commercially available reference code or designs. The clear advantage is that the product designer owns the design and can add or change any features to better match his product and application requirements. Usually, no further licenses apply (except for any purchased technology



ALC NetworkX's COMi.MX board is a complete SoM solution for quick and easy OEM RAVENNA/AES67 integration, complemented by a C/C++ software framework and reference design including a full source code package.

blocks, depending on the business model). Also, the development can serve as basis for further products. This model most probably matches best for high quantity and cost-sensitive products, but also for product designers seeking ownership of the technology and deep technology integration into core areas of their products," explained Hildebrand.

He added, "Technology providers or product designers with access to the underlying AoIP technology may also decide to expand an already existing networking technology or product to add the requirements of AES67. Companies like Audinate, Telos Axia, QSC, Wheatstone or all RAVENNA partners building/providing their own RAVENNA OEM implementations fall into this category."

## Genelec 8430 IP Network AES67 Compatible SAM Studio Monitor

In a nice example of the impact AES67 connectivity has had in the audio industry, at the 2016 Integrated Systems Europe (ISE) show, Finish manufacturer Genelec announced "A Giant Step in Audio over IP" with the introduction of its new 8430 IP Network Compatible SAM Studio Monitor, effectively, the company's first commercially available "IP speaker" and the first AES67-connected speaker in the world.

The company revealed its ambitions in this domain when it was one of the first manufacturers to demonstrate a complete audio-over-IP (AoIP) showcase system at Integrated Systems Europe (ISE) 2010, and to support the RAVENNA AoIP initiative at the International Broadcasting Convention (IBC) that same year, in cooperation with Lawo, DirectOut, and several other companies. Since then, Genelec invested continuously in the IP speaker concept, following the industry consortium's standard efforts, and investing internally in its own R&D.



An industry first, Genelec believes the 8430 is set to become an indispensable tool in IP-networked audio systems in music studios, post-production houses, digital edit suites, radio, TV, and outside broadcasting applications.

As Genelec explains, "Using LAN networks to replace dedicated audio cabling can deliver significant cost savings and make audio system setup flexible and fast as complex multi-room audio systems can be configured with ease, often as "plug-and-play." Ongoing maintenance and remote monitoring are also simplified, as device health, power status, and settings can all be controlled via the LAN network."

Genelec participated in the recent AES67 interoperability demonstrations and plug-fests, promoted by the Media Networking Alliance (MNA) with the only existing "network-connected" speaker.

The new Genelec 8430 monitor combines multiple connectivity options, first using an AES67 signal via the XLR-housed RJ45 connector, and then using a standard analog signal via a balanced XLR connector. As part of Genelec SAM Series, the 8430 shares identical electro-acoustic features such as Genelec MDE and DCW technologies, a flow optimized reflex port, low distortion, high SPL, and wide uncolored response in a compact enclosure.

Also, as member of the SAM Series, the 8430 uses the highly intuitive Genelec Loudspeaker Manager (GLM 2.0) control network and software, which enables adjustments of all aspects of monitor settings and full system control. As a central part of GLM, Genelec AutoCal automatically ensures every monitor on the network is aligned for level, timing, as well as compensation of room response anomalies.

The culmination of many years of intense research and development into AoIP by Genelec, the company believes the time is now right to launch this advanced solution. "At Genelec, we believe that audio-over-IP networking, using systems fully compatible with open and global standards, is the right, reliable and robust way to address the future needs of the audio market. By launching 8430 we are a significant step closer to this reality" said Siamäk Naghian, Genelec's Managing Director.

"Audio over IP is no longer the future of monitoring, it is here now," he adds.

For more information, visit [www.genelec.com](http://www.genelec.com).





Nestor Amaya, Coveloz President and CEO, says his company is in a unique position to deliver AES67 running over AVB networks, addressing the network management “gap” seen in current AES67 implementations.

Regardless of the approach, manufacturers are encouraged to engage in a community, such as the RAVENNA partnership offered by ALC NetworX. RAVENNA partners have access to an online repository and Wiki, containing several implementation hints and additional information on RAVENNA technology, in general. The partnership also includes the opportunity to directly talk with the ALC R&D team members and participate in RAVENNA workshops and plug-fests or engage in trade shows and other educational activities.

As a first stop for information on RAVENNA and AES67, we recommend visiting the RAVENNA website ([www.ravenna-network.com](http://www.ravenna-network.com)). Along with the “RAVENNA Draft on Operational Principles,” several white papers, and other resources on RAVENNA/AES67 can be found there. An entire section of the website is dedicated to “Adopting RAVENNA” where various options for implementing RAVENNA into existing products or new designs are described. This also includes information on available building blocks from RAVENNA partners, such as Archwave, Coveloz, Lawo and Digigram (just to name a few). The range of available options ranges from a variety of available SoMs over software drivers to full source code and IP packages.

While ALC NetworX, as the inventors of the RAVENNA protocol can be contacted at any time, interested manufacturers may also directly contact any of the RAVENNA OEM partners.

### Testing the Limits

Another follow-up question is how manufacturers can tailor their RAVENNA/AES67 implementation to the specific needs of an application/market and maybe even contribute with suggestions or improvements to the technology. According to Hildebrand, RAVENNA as a technology is powerful enough to meet the most demanding requirements of the professional broadcast market, but also flexible enough to suit all needs—down to simple stereo I/O applications. “RAVENNA as a technology does not demand any specific channel number, data format, or sample rate. So, it is completely up to the manufacturer to individually tailor the performance features to his specific application needs. However, to achieve interoperability among RAVENNA devices, operational profiles have been defined for certain application areas. Profiles define mandatory requirements to be supported by all RAVENNA implementations adhering to these profiles (i.e., there is a generic profile that calls for L16/L24 support at 48 kHz with 1 to 8 channels (which is mostly identical to what AES67 requires). Other profiles define requirements for low-latency (MADI-like) or high-speed backbone interconnectivity,” said Hildebrand.

“Manufacturers working on their implementations have the freedom to add features as required by their applications (i.e., Merging Technologies uses RAVENNA technology to interconnect their high-end recording devices with DXD/DSD at 384 kHz). Everybody interested in adopting the DSD/DXD processing capabilities may of course get in touch with Merging and check for business opportunities. Other suppliers of RAVENNA IP may also be able to help interested manufacturers in adopting these capabilities (i.e., Coveloz with its BACH design).

“Within the RAVENNA manufacturers community, every partner is encouraged to add suggestions to improve the performance and applicational stretch of



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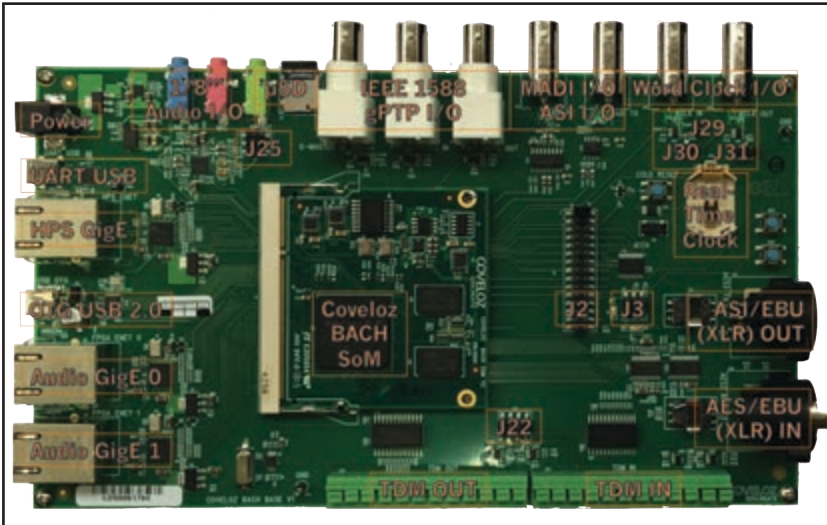
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The CoveloZ BACH fully customizable platform family for professional audio networking and processing can be implemented either as a PCIe-based FPGA, or as a System-on-Chip (SoC).

RAVENNA. The RAVENNA technology is constantly being evolved with feature enhancements and technology updates. In preparation for the recent AES67 plug-demos, we have added SAP (Session Announcement Protocol) support to allow connectivity with Dante-based AES67 implementations [since Dante-AES67 devices offered no means for manually reading/entering the required SDP data]. This is a perfect example for the open and modular approach of RAVENNA. Other enhancements relate to common configuration and control by adopting Ember+ as control protocol. We are constantly monitoring technology evolution and upcoming standards for potential adoption within the RAVENNA technology framework. Examples are the expected AES70 standard for device control (OCA

or the current IEEE activities with respect to PTPv3 (Precision Time Protocol). In the video field, we are watching SMPTE activities (i.e. the SMPTE 2059 PTP profile), VSF (i.e., the just recently published VSF TR-03) and other related organizations' to make sure that RAVENNA technology is fully applicable in these areas as well. But the major advantage of RAVENNA is that it can be used and enhanced by any manufacturer to match his individual requirements," added Hildebrand.

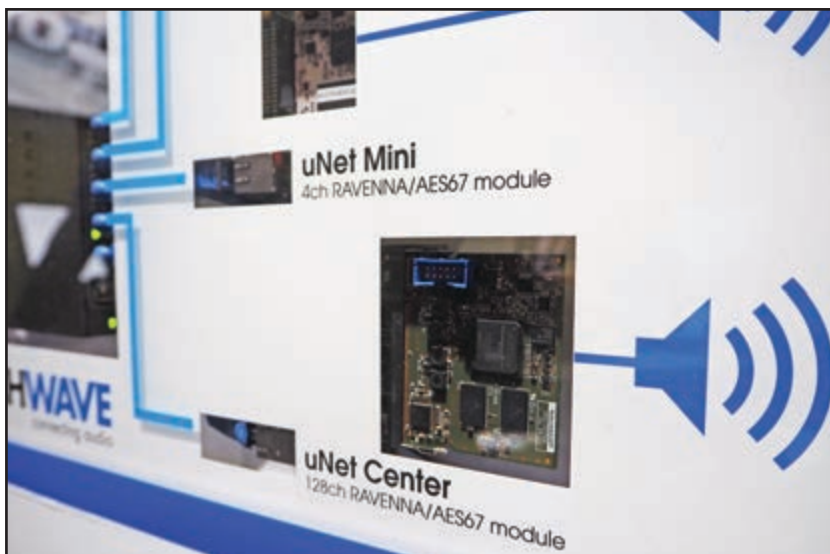
We also asked Hildebrand about validation or certification procedures manufacturers should consider. We learned that, with RAVENNA/AES67, there is no official certification procedure in place. "Since all manufacturers engaged in RAVENNA implementation have a superior interest in interoperability with other RAVENNA devices, we simply promote plugfests as well as individual testing. Reference implementations from ALC NetworX are available for operational verification," confirmed Hildebrand.

## The CoveloZ Perspective

With a much broader perspective in audio networking implementation, Canada-based specialist technology firm CoveloZ is also providing complete solutions for AES67, after initially being focused on applications for AVB/TSN. All CoveloZ solutions in this domain are based on its BACH fully customizable platform family for professional audio networking and processing, featuring AVnu-certified Ethernet AVB/TSN audio talker and listener, AES67/RAVENNA audio talker and listeners, and embedded audio signal processing, implemented either as a PCIe-based FPGA, or as a System-on-Chip (SoC). As Nestor Amaya, CoveloZ President and CEO proudly confirmed, his company is in a unique position to deliver AES67 running over AVB networks, which addresses the network management "gap" seen in current AES67 implementations.

For the moment, Amaya states, "CoveloZ' mission is to make the network look like a plain old tip-and-ring cable. And we do so, not just by offering complete hardware and software solutions, but also by working within open standards-based organizations such as AES, SMPTE, VSF, AVnu, and RAVENNA. My advice to any audio manufacturer is to look at ecosystems where open standards are at play, and find that competition is alive and well, which in the end works to serve their needs. I welcome them to get involved in AVnu and/or relevant industry alliances, and stay away from closed/proprietary solutions."

CoveloZ offers hardware reference designs, modules, development kit, user guides, reference



Archwave Technologies offers a uNET Mini four-channel low-cost sub-system module and the more sophisticated UNet Centre (to be introduced in Summer 2016) for up to 128 channels.





Arie van den Broek, Archwave's Chief Executive Officer, is shown at the ISE 2016 MNA demonstration pointing to the new Cymatic Audio uNode M42 devices, which are remote-controllable microphone preamps and simple audio and MIDI interfaces for Ravenna/AES67 networks.

guides, and application software, including a web-based user interface for connection and device management and monitoring.

"I believe that CoveloZ is unique in offering both AES67/RAVENNA and Ethernet AVB on the same hardware platform. A product can be commissioned for one or the other application with a simple change of configuration, which can even be done remotely. Our customer support site, <http://coveloZ.com/bach-dev-kit>, contains all documentation, wikis and user forums," says Amaya.

"Central to our value proposition is to offer our clients the ability to customize BACH hardware as well as its software. As an engineering services firm equipped with a rich toolbox of intellectual property, CoveloZ is in the business of bringing our customer's products to market faster and more cost-effectively, all while enabling differentiation. We bring the network to play for our clients, so that they can focus on what makes their products great. It might seem odd for me to say this, but I believe that the network interface is not what makes a great audio product; it just happens to have become a staple technology that great audio products now have to build upon, and CoveloZ' role is to make that easy, effective and robust.

## The Archwave Perspective

Another interesting perspective is that of Swiss-based Archwave, which offers the broadest portfolio of audio networking development solutions. We reached out to Arie van den Broek, Archwave's Chief Executive Officer and the mastermind behind Cymatic Audio. Cymatic is the creator of an affordable range of multitrack recorders, which are able to directly record from Ethernet connections and are affordable multitrack USB audio interfaces. Cymatic is releasing an affordable range of remote controllable uNode M42 AudioLan mic preamps, combining four microphone and line inputs plus two line outputs and MIDI. The uNode M42 can be used as an interface to add microphones, line-level sources, and MIDI devices to any AES67 or Ravenna equipped audio mixing console or sound installation.

We were interested to hear from someone with a unique perspective on audio networking, both from a technology and engineering services provider perspective, as well as a product implementer (using their own platforms).

According to van den Broek, companies developing low-channel count solutions supporting AES67 connectivity should typically reach out to Archwave, the only company with a 2x2 solution on the Unet Mini board. Archwave also provides the UNet Compact with 16 channels and the UNet Standard with 32 channels. "There are two routes for implementing AES67. One is you do it yourself, or you buy complete solutions like these. The 2x2 solution is one of them, and is literally plug-and-play with I<sup>2</sup>S, SPI, UART, and USB. Add it to a board and we can make it work within days. No problem," says van den Broek.

Archwave also has something that so far no one has done in chip solutions, which is bridging USB and networking on the uNET Mini and the Standard

## Resources

"1733-2011 - IEEE Standard for Layer 3 Transport Protocol for Time-Sensitive Applications in Local Area Networks," Institute of Electrical and Electronics Engineers, <https://standards.ieee.org/findstds/standard/1733-2011.html>.

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——, "Audio Network Development (Part 4): Developing Products Based on RAVENNA," April 2016.

boards. "The uNET Standard can take eight channels of USB, eight channels of local I/O, microphones or input level, eight channels of network and matrix them back and forth. So, from this board, we can do 32 channels, but if USB and network are not related and we need cycles to basically line them up, we go back to 8x8x8, instead of 32, with 48 kHz," added van den Broek.

"The uNET Mini is exactly the same with two USB, two local I/O and two on the network. So far I haven't seen anybody capable of doing that on a chip base. Of course, if you have a very big FPGA, that's a different story. That makes it pretty unique, for instance, in broadcast where we need small dongles for a reporter using a microphone—mixing something already pre-recorded on a computer and stream it over a network. We can do it with the uNET using the USB as well," he adds.

"We focus on lower channel counts and lower nodes—all pro audio level. What we advise our customers, if they go to bigger systems, in either high channel count or high sampling rates, then you need dedicated solutions on FPGA," states van den Broek.


He adds, "That is where the Coveloz or ALC NetworX solutions make sense. They are very specifically targeted to that application. We see that as a distinct different business. They make very high-end applications and specific solutions. We are about covering the broad endpoints kind of products."

Typically, a company in the installation market, looking to build a speaker with AES67 benefits from Archwave's solutions and expertise. As van den Broek puts it, "How much time and how much resources, does a company have to build something like this, or basically buy it and bring it straight to market?"

If a company decides to do its own product development in-house with a tight integration on the board level, and they need just services, Archwave also provides hardware integration. "We have done that for many companies already, it becomes a non-recurring engineering (NRE) agreement, where we basically do the complete design for them, or we integrate our chip on their motherboard. There's a whole array of possibilities. But in the end, for many of the applications that we can see in this particular area, the modular approach is the easiest one.

Because not many audio companies have the volumes. This is not mobile phone business. Then condensing volumes together in a module makes sense. It can be 5,000 for product X and 5000 for product Y, but for us, in the end, it represents 10,000 modules. That's how we can become competitive in price. Companies individually could not have done it if they nailed it down on a board," van den Broek explains.

With extensive experience on different audio networking implementations based on their existing development platforms, Archwave is in a unique position to provide a reference of time to market—assuming a company has a product ready and just wants to add a networking audio module.

"We have examples of six weeks, from first handshake to a working prototype on a trade-show. If a company knows what they want, implementing these modules for RAVENNA, AES67, MIDI, DMX, with or without a dedicated web page, for us it doesn't make much difference, because it's all there already," van den Broek concludes. 



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