

Audio Network Development (Part 4)

Developing Products Based on RAVENNA



In this article, we continue to explore the options for audio networking development and implementation in new audio products. We already explored the most popular of the options currently in the market, which is Audinate's Dante. Now, we will look at RAVENNA and what differentiates this powerful media network technology, which is also at the forefront of the interoperability efforts with AES67.

By
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audioXpress already published two articles describing RAVENNA in detail (both articles are now available online—see Resources) so we will focus on RAVENNA's development and implementation.

But first there's something important to mention—very important. Since *audioXpress* published those two articles on RAVENNA, the new AES67 standard for high-performance streaming audio-over-IP (AoIP) interoperability is now a practical reality. Together with Livewire+ from The Telos Alliance, RAVENNA is probably the closest networking protocol implementation to the AES67 specifications, which is why RAVENNA is being promoted as RAVENNA/AES67. But for the purpose of this article, we are focusing on RAVENNA, understanding that this is an open technology, without a proprietary licensing policy and fully compatible with the AES67-2013 standard (now updated to AES67-2015).

RAVENNA Tools for Manufacturers

In the world of professional audio, where software has an increasingly important role and computers are now at the center of most operations, implementing

audio networking is a question of running the available applications depending on the operating system. The advantage here is that the connectivity is provided as standard on available Ethernet interfaces, which are common on any current computer.

For more powerful and critical workstation-type systems, there are also different vendors offering OEM solutions. For example, Digigram, a French company, has been a key supplier of audio-networking cards for PC since the days of CobraNet and EtherSound. Digigram currently offers its LX-IP PCIe card for Windows and Linux PCs, a high-performance solution for RAVENNA with streaming for up to 256 channels. The Digigram LX-IP card provides manufacturers with a ready-to-go RAVENNA and AES67 streaming solution ideal for audio systems that support the PCIe interface.

The Digigram LX-IP RAVENNA PCIe sound card, features ultra-low latency—down to one audio sample per IP packet—or round-trip latency down to 3 ms and is ideal for high-density audio production or automation applications in radio and TV broadcast studios, using multichannel audio digital interface

(MADI) as an option. The Digigram solution also leverages the embedded 128x128 switching matrix, Grandmaster PTP clock abilities, and high redundancy assured by two Gigabit Ethernet connections, with control provided through web pages and EMBER+ remote protocol.

For manufacturers looking for a high-performance integration into existing hardware products (e.g., mixing consoles, cross-point switching), ALC NetworX offers a high-performance SoM (SoC System on Module) evaluation board—the COMi.MX. This board features 256 input/output (I/O) channels (128x128 at 44.1/48 kHz), MADI and time-division multiplexing (TDM) connectivity (64 channels), 8x I²S channels, AES3 I/O (2x XLR), built-in four-tier 256x256 audio matrix and also two Gigabit Ethernet ports (2x RJ45/2 x SFP) for redundancy. This is a self-contained RAVENNA implementation solution with support for up to 192 kHz sampling rate, full AES/EBU bit-transparent operation and full AES67 support with the lowest latency, down to 1 sample per packet.

The COMi.MX evaluation board uses a single voltage power input (4.75 to 15 VDC) and also features Word Clock I/O (2 x BNC) and one UART system console (RS-232 SubD-9), JTAG Debug Port, USB 2.0 (A/B), serial peripheral interface (SPI), and general purpose input output (GPIO).

For small channel applications, Archwave Technologies from Switzerland offers multiple hardware SoM solutions, including the UNet Standard board for up to 32 channels, the UNet Compact for up to 16 channels (44.1 kHz to 96 kHz), the UNet Mini for up to four channels (44.1 kHz to 96 kHz), and the more sophisticated UNet Centre (to be introduced in 2016) for up to 128 channels. All solutions support 44.1 kHz, 48 kHz, 88.2 kHz, and 96 kHz sampling rates.

Of particular interest for two-channel applications, which enable audio networking implementations in a larger number of products, from input modules and interfaces to network-connected speakers, Archwave Technologies introduced its uNET Mini module, which delivers AES67/RAVENNA for end-point applications. The new small low-cost subsystem is part of Archwave Technologies' AudioLan product family of modules. Archwave AudioLan is a completely integrated hardware and software package for professional grade audio through an AES67 compliant network. Before the introduction of the UNet Mini, the Swiss company focused on multichannel (16, 32, and 64x64) development platforms on its uNET series.

The uNET MINI module accepts two digital audio streams in I²S format and converts these to the AES67/RAVENNA standard for streaming over



Ethernet cable. The module includes the Ethernet PHY and also has a number of I/O signals for control, including an SPI-bus interface, two UARTs (for MIDI), and eight GPIOs. It supports sample rates of 44.1 kHz, 48 kHz, 88.2 kHz, and 96 kHz and has a small form-factor of 40 mm x 44 mm. For ease of setup, it also incorporates Archwave Technologies' uLink technology, which uses a simple button and combination of LEDs to set up or confirm connection to other devices in the network.

As well as the uNET Mini module, Archwave Technologies can supply the uNET Mini Evaluation Kit, which comprises two uNET Mini modules plus two uNET Mini Base Boards. The uNET Mini Base Board has been designed to demonstrate the capabilities of the uNET Mini module. It provides a complete evaluation system for RAVENNA-compliant audio streaming over AES67 Ethernet, with optional CopperLan support. It has a connector for mounting the uNET Mini module and includes the Ethernet transformer plus RJ45 connector, two unbalanced analog inputs, two unbalanced analog outputs, a MIDI input and output, an RS-232 debug port, a push-button rotary encoder, and various buttons and LEDs for manual set-up and control.

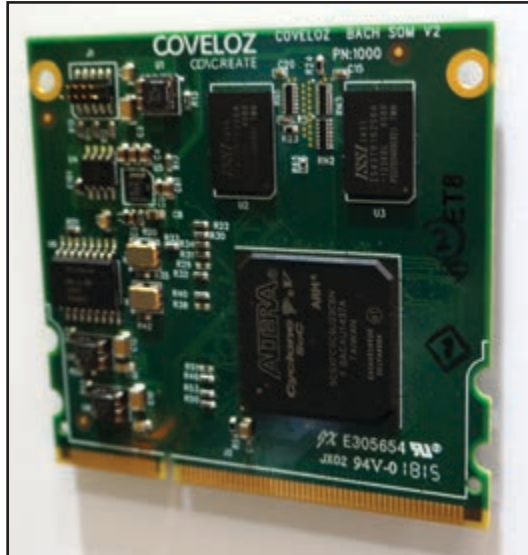
Like the existing uNET Compact (16 audio channels) and uNET Standard (32 audio channels) modules, the uNET Mini can be set up and controlled by web browser using Archwave Technologies' intuitive user interface. The modules all make use of Archwave Technologies' uConnect software,

A high-performance SoM (SoC System on Module) from ALC NetworX, the inventors of the RAVENNA protocol is demonstrated at the 139th Audio Engineering Society (AES) convention.



This is Digigram's RAVENNA/AES67 LX-IP PCIe card.

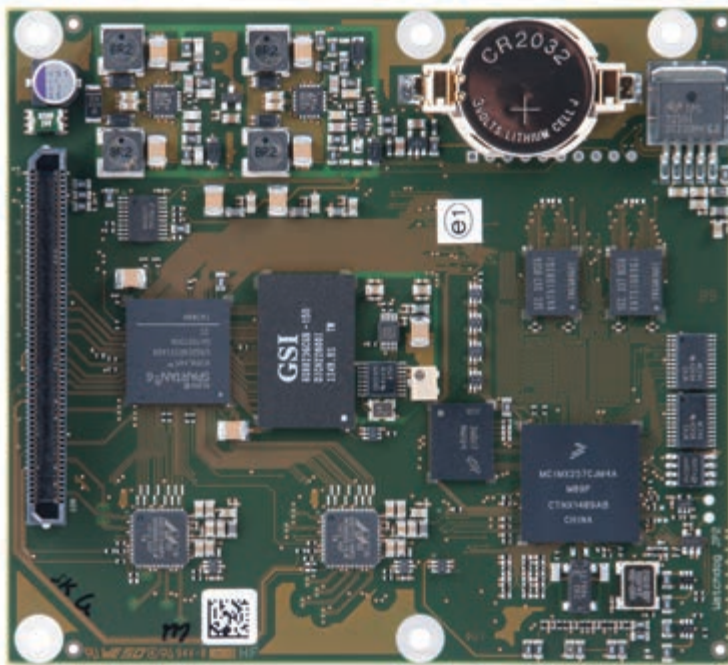
The CoveloZ BACH series comprises three dedicated hardware boards, a development kit, and an API platform, available either on a per-unit basis or as licensed hardware/IP.



which is based on the CopperLan network protocol to further simplify setup.

A more recent technology provider, offering a sophisticated implementation, is CoveloZ from Canada. CoveloZ provides collaborative FPGA-based embedded solutions focusing on time-sensitive networking and transport of audio, video and control signals, which enable manufacturers looking into both Ethernet-based AVB and IP connectivity to utilize the same platform.

The CoveloZ BACH platform series is the only available solution supporting RAVENNA/AES67 and AVB. The range comprises three dedicated hardware boards, a development kit, and an API platform, available either on a per-unit basis or as licensed hardware/IP. The CoveloZ BACH-minuet SoC solution supports up to 16x16 channels, the BACH-allegro SoM expands up to 128x128 and the BACH-canon SoM goes to 512 x 512 channels—all platforms supporting 44.1 kHz, 48 kHz, 96 kHz, 192 kHz, and 384 kHz sampling.



RAVENNA Software Tools

There are also building blocks available for companies that want to implement software-based processing and embedded systems. RAVENNA is supported on any standard PC with an Ethernet port and RAVENNA-compatible software. Solutions include the ALC NetworkX RAVENNA Virtual Sound Card, free software for Windows 7, 8.1, and 10, with support for 8x16 channels (44.1/48 kHz), and the Lawo Jade Virtual Sound Card (VSC) with support for 64x64 channels (44.1/48 kHz), for Windows 7, 8.1, and 10 and Windows Server systems. Lawo also offers the Jade Engine and Jade Engine Pro applications for Windows 7 and 8, available in 8x8 and 64x64 applications (44.1/48 kHz), respectively.

The ACL NetworkX COMi.MX evaluation board is a fully self-contained RAVENNA implementation solution.

Lawo's virtual sound card application enables Windows-based audio applications to fully integrate with AoIP networks without any external hardware interfaces. It delivers 64 channels bi-directional RAVENNA and true AES67 streaming in the Microsoft Windows environment and provides multiple WDM drivers and an ASIO driver that can be loaded by more than one application at the same time. It also features advanced real-time broadcast-quality sample rate conversion for transparent playback of content sampled at a different rate than the network.



Merging Technologies offers a range of software solutions, including Core Audio and ASIO drivers to support its hardware interfaces in Windows and Mac OSX. Merging Technologies is also the company behind the Pyramix DAW solution—a complete multi-track recorder and editor with support for up to 384 channels at 44.1 kHz and for pulse-code modulation

The three Archwave uNET series development modules range from 2 to 32 audio channels.

A Network Attached DAC Based on RAVENNA

Derived from its highly successful Horus and Hapi family of RAVENNA-enabled networked audio interfaces, Merging Technologies has taken its expertise into the consumer market with the launch of its revolutionary high-end audiophile digital-to-analog converter, the NADAC, which stands for Network Attached Digital to Analog Converter. With NADAC, high-end audio enthusiasts are able to experience the full advantage of Merging's network approach, particularly suited to DSD source files and high-resolution formats.

NADAC is available in two versions—stereo or eight-channel—and is the first device to bring the power of RAVENNA networking into the home, thus removing traditional limitations to boost performance to levels never yet experienced in a consumer setting.

So why a networked DAC, and why use RAVENNA? Merging Technologies marketing manager Chris Hollebhone explains: "The modern world has become increasingly dependent on networks, both at home and in our professional environments. As network capacities have increased, more and more people are turning to IT networks for carrying both audio and video. Gigabit Ethernet clearly had sufficient capacity for high quality audio, but still was far from ideal without an additional protocol to add the required precision and management. We looked at alternatives that could offer sufficient accuracy and reliability with high channel counts and high-res audio data rates. The only choice that made sense to us was RAVENNA."

Thanks to Merging Technologies, RAVENNA is now the first and only Layer 3-based IP audio protocol to offer full support for high channel-count DXD and DSD signals. It is also fully AES67-compatible. According to Merging Technologies, RAVENNA "remains the only logical choice for the professional and the audiophile." The added benefit of using an advanced networking solution such as RAVENNA is being able to send and receive control information as well as audio data. This has already opened up exciting possibilities in the studio, which can now be enjoyed at home.



During the High End 2015 show in Munich, Claude Cellier, the company's CEO and founder, demonstrated its Network Attached DAC (NADAC) solution



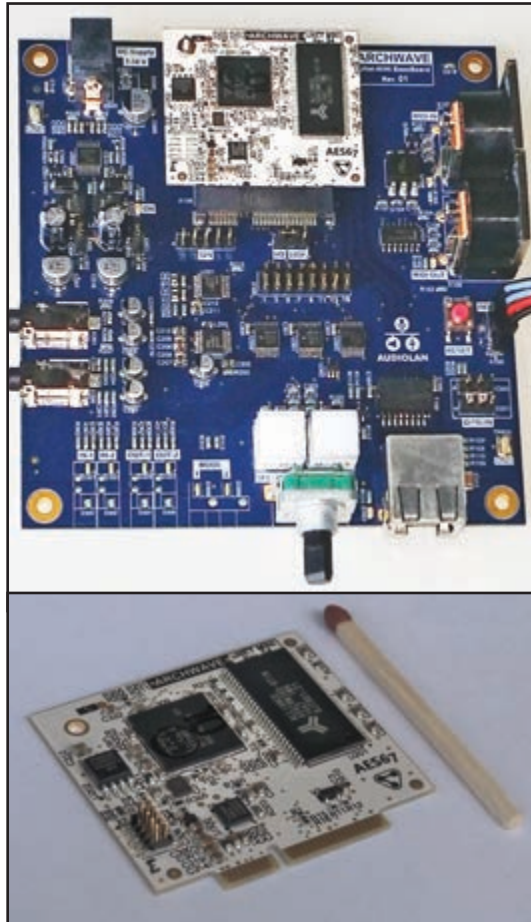
Network Attached DAC (NADAC) covers pulse-code modulation (PCM) formats up to 24-bit/384 kHz and DSD up to DSD256. It has AES/EBU and SPDIF digital inputs for use with CD players, CD transports or other devices up to 192 kHz. The provided Ethernet interface enables computer-based digital audio systems to carry through any resolution up to 384 kHz, DXD and DSD256, using the RAVENNA protocol that Merging Technologies helped to develop for high sampling rate applications and enables robust and accurate transfer of the digital audio data from the computer to NADAC.

Because Merging Technologies has already developed standard RAVENNA drivers for any computer operating system, it is possible to connect a NADAC to any music server, player, or streamer supporting ASIO on Windows or CoreAudio/DoP on MacOSX, using only CAT5e or CAT6 cable. Hollebhone adds, "any connected device in the home can be routed to NADAC, and multiple NADACs can listen to any device, zone, or playlist. A built-in web browser means that you can remotely control NADAC from any mobile device, giving you control of the listening level and the source selection. You can even control multiple NADACs remotely from the same mobile device."

Claude Cellier, the company's CEO and founder explained, NADAC can be considered the missing link between the world of DSD or high-resolution audio files—which are increasingly available online—and the consumer high-end market, which wants as close to the quality of the original recordings as possible. And no company other than Merging Technologies can claim what it is offering is as close to what the producers, the audio engineers, and the musicians have heard when those recordings were originally created. NADAC uses the same components and professional DACs currently used by Merging Technologies' Hapi and Horus professional audio interfaces, which are also based on RAVENNA/AES67 AoIP technology.

Because of the connection between Merging Technologies and the world of multichannel SACD and DSD/DXD production, NADAC is delivered in stereo and eight-channel versions. Both variants have 0.25" and mini-jack headphone outputs and the monitoring-grade headphone outputs can be configured to carry a different signal to the main output, which can be analog balanced and unbalanced line outputs. For more information visit, <http://nadac.merging.com>.

Archwave's uNET Mini module and the uNET MINI Base Board are part of the uNET Mini Evaluation Kit, a complete evaluation system for RAVENNA-compliant audio streaming, with optional CopperLan support. The Base Board has a connector for mounting the uNET MINI module and includes the Ethernet transformer plus RJ45 connector, two unbalanced analog inputs, two unbalanced analog outputs, a MIDI input and output, an RS-232 debug port, a push-button rotary encoder, and various buttons and LEDs for manual set-up and control.



(PCM) recording up to 384 kHz and DXD recording for DSD format productions.

In a positive development, Merging Technologies has announced the release of a new CoreAudio driver that is available for free to the entire AES67 community. This driver, dubbed RAVENNA/AES67 Virtual Audio Device, is fully compliant with RAVENNA and other AES67 compatible devices and provides an easy way for Mac users to connect to the majority of available networked audio devices. The Virtual



German pro audio connectivity specialists DirectOut Technologies and Merging Technologies have demonstrated high-performance interoperability of RAVENNA audio network cores with DirectOut's MONTONE.42 MADI bridge to support 256 low-latency streaming audio channels to and from Merging's Pyramix Virtual Studio DAW.

Audio Device is a free download from the Merging Technology website and supports full operation of up to 64 channels in and out at 44.1/48 kHz. It can be expanded to the fully featured premium licensed version with support for sampling frequencies up to 384 kHz and DSD256.

Since RAVENNA is an open technology, all the

Resources

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

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Source

Jade VSC demo software

Lawo | www.lawo.com/services/service-support/software-registration-demo-licences.html

required documentation to create any type of implementation is publicly available on the RAVENNA Network dedicated website and there are API options from ALC NetworX with a one-time fee.

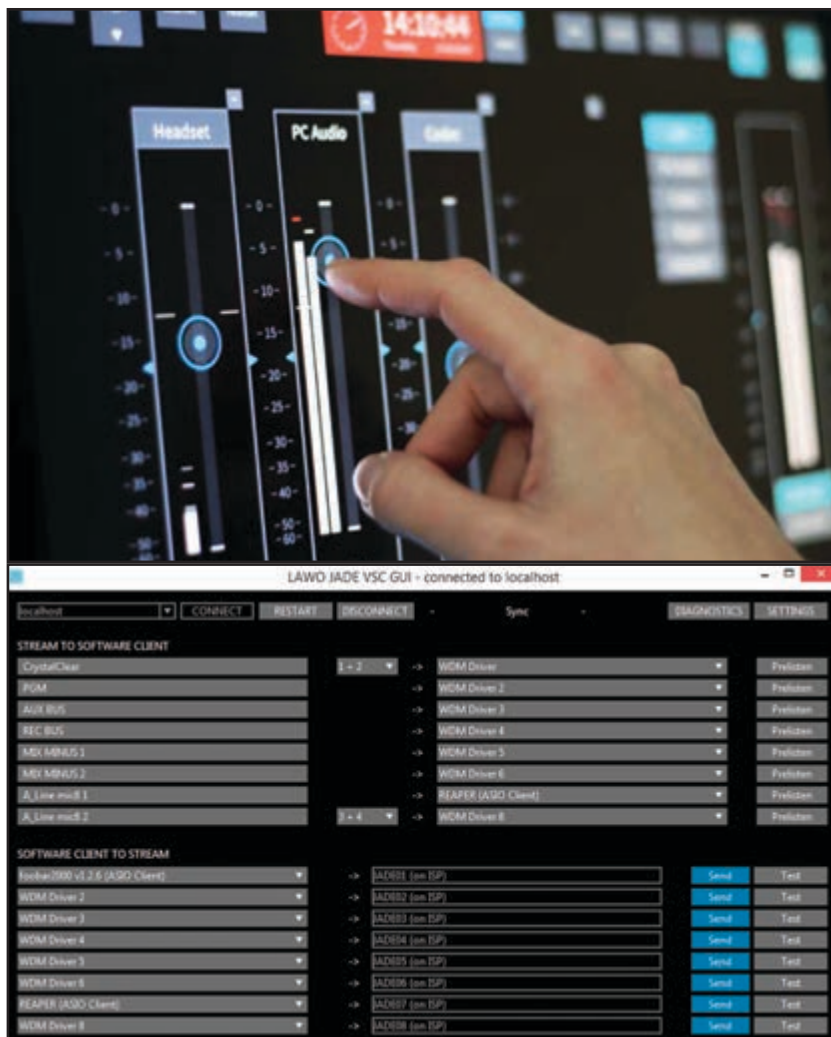
For companies who want to own their design or create a specific implementation, ALC NetworX, CoveloZ, and Archwave Technologies are able to provide engineering support. There are fully documented reference designs available from those companies, including full VHDL Hardware Description Language (VHDL) source code for FPGA and the full C++ source code available for building specific design and port the implementation into new products, according to the performance requirements. This reference design also includes complete Linux environment and development tools.

Why Use RAVENNA?

Similar to how Dante originated from Audinate, the RAVENNA networking technology was originally promoted by Lawo and ALC NetworX, which was established in October 2007 in Munich, Germany, as a competence center with its own R&D department. But it differs from Dante because RAVENNA is currently an open technology based on existing standards, supported by multiple partner companies, even though ALC NetworX continues to keep the lead role with respect to technology definition. Implementation guidelines ensuring interoperability among devices of different manufacturers are jointly worked out and published.

The solution uses standardized network protocols and technologies, can operate in existing network infrastructures and leverages all the characteristics of an AoIP transport solution, featuring low latency, full signal transparency, and high reliability. Current applications already cover in-house signal distribution for broadcasting houses, fixed installations, live events, studio recording, and even high-end audio products. In that regard, RAVENNA's technology framework is the most extensive and flexible audio networking solution in the market. So far, it is the only solution to support formats other than PCM (e.g., DSD), and higher frequency sampling rates up to 384 kHz. RAVENNA is also the easiest and most cost-effective route for manufacturers to offer AES67 compatibility.

The RAVENNA Partner Network is comprised of a variety of developers and manufacturers committed to implementing RAVENNA technology in their own products and there are implementation solutions with no ongoing license fees. This means that any company or manufacturer is free to develop their own solutions without having to rely on ALC NetworX as the exclusive solution provider.



Lawo has Windows software-based drivers and commercial applications available for RAVENNA under the name Jade, supporting up to 64x64 channels, integrated sample rate conversion and a VST plug-in interface.

Naturally, anyone considering implementing audio networking on new products will question why they should go to RAVENNA, especially when almost 300 manufacturers already support Dante and that technology clearly dominates the pro audio market.

As Arie van den Broek, Archwave Technologies' Chief Executive Officer describes it, "RAVENNA is an open solution. The strategic decision is so much easier. They can start working with us because we have a very good business proposition today. But maybe next year we are no longer here, our value proposition is no longer valid because volumes go up, or some other reason. Either way, there's always somebody else who could do it, or they can do it themselves. The strategy is very easy to implement. The flexibility is there. That's what senior managers like. They don't like to be locked in."

As Nestor Amaya, CEO of CoveloZ, states, "CoveloZ is in the business of providing technology solutions, and we believe that these solutions should not lock our customers inside of a proprietary box. Ecosystems built on open standards, such as RAVENNA, align with our vision of how best to serve our customers."

Another reason has to do with the fact that RAVENNA not only offers more flexibility in terms of audio formats and sampling rates, but it also offers more flexibility in the way it deals with different types of real-time audio and IT network configurations. This was certainly demonstrated in the AES67 implementation efforts, which will be the focus of the next article in this series. 📺