RAVENNA (Part 1)

The Scalable Audio Network Solution

RAVENNA is a network audio distribution technology promoted by a strong group of companies. Its technical implementation is handled by ALC NetworX, based in Munich, Germany. As officially described, RAVENNA is a phase-accurate synchronized solution for real-time distribution of audio and other media content in IP-based network environments, using standardized network protocols and technologies. Most importantly, RAVENNA is now the first AES67-compatible solution available on the market.

Andreas Hildebrand is Senior Product Manager at ALC NetworX, the Munich company that leads the technology development, R&D, and promotional efforts for the RAVENNA technology.

By
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In 2010, a consortium of companies announced a new technology cooperation effort under the name RAVENNA. It was formed the same year the Audio Video Bridging (AVB) set of technical standards was developed under the auspices of the Institute of Electrical and Electronics Engineers (IEEE) and several commercially successful audio network implementations were available.

RAVENNA was intended to create a technology for real-time distribution of audio and other media content in IP-based network environments using standardized network protocols and technologies (i.e., running on existing network infrastructures). A key focus was on precise media clock distribution—with no requirement for a separate house clock distribution—and sample-accurate playout alignment across all nodes on the network. RAVENNA features concurrent supports for multiple media clocks. This enables streaming with different sample rates across the network without sample rate conversion and supports different data formats (16-, 24-, and 32-bit data) running anywhere in the network.

The RAVENNA technology is suitable for audio, video, and other media data as well as for control protocols. It supports unicast and multicast modes on a per-stream basis and it operates with full bit transparency—signals are not changed by the transport mechanism (e.g., Dolby E signals stay intact). The RAVENNA specification states that, depending on network infrastructure, traffic patterns, and stream configuration, sub-milliseconds latency is achievable. Meanwhile QoS support is based on the widely supported DiffServ scheme enabling resource sharing with other traffic. Full redundancy is optionally supported with dual-network interfaces and streams may be individually configured in terms of data format, number of channels, and bandwidth utilization.

Effectively, RAVENNA is an IP-based solution, based on protocol levels on or above Layer 3 of the OSI reference model using real-time transport protocol (RTP) for streaming of media content. IP can

be transported on virtually any LAN and is used as the base layer for communication across wide area network (WAN) connections (including the Internet). In most cases, Ethernet will be deployed as an underlying data link layer. IP is, in general, infrastructure-agnostic and can be used on virtually any network technology and topology. The choice of RTP—as defined by the Internet Engineering Task Force (IETF)—enables the support of a large number of standardized payload formats for different applications. RAVENNA specifically uses RTP/audio video profile (AVP) over User Datagram Protocol (UDP) together with the real-time transport control protocol (RTCP) according to Request for Comments (RFC) 3550, providing the possibility to transport any RAVENNA stream across IP-based WAN connections.

The RAVENNA initiative was introduced at IBC 2010 in Amsterdam with several public demonstrations where companies such as Genelec, DirectOut, and Lawo provided the first working solutions.

A Different Focus

Different from similar industry efforts and solutions, RAVENNA focuses on low-latency, full-signal transparency and high reliability. Its primary target is the professional broadcast and recording markets—even if the companies involved never discard potential applications in other pro audio market segments (e.g., live sound and the installation market) where other industry efforts were primarily focused.

RAVENNA applications include in-house broadcast signal distribution, outside broadcast (OB) van support, interfacility links across WAN connections, and production and recording uses. One of the first implementations RAVENNA demonstrated was a capacity for nearly eight times multichannel audio digital interface (MADI) streams over a single gigabit Ethernet link. RAVENNA was also the first Layer-3-based IP audio protocol implementation to provide full support for high-channel count high-resolution audio signals such as Digital eXtreme Definition (DXD) and Direct-Stream Digital (DSD).

The RAVENNA consortium's founding companies, which were initially all European-based companies, included Genelec, which provided the first working demonstration of a working solution; Lawo, the broadcast powerhouse from Germany and the originator of the initiative; Merging Technologies, the high-end Swiss company devoted to the most demanding recording applications; Innovason (now a part of Lawo); DirectOut (an important MADI solutions provider); and Schoeps, the microphone manufacturer and one of the promoters of the Audio Engineering Society's AES42 standard as a digital link to microphones. Other important manufacturers, such as Neumann (also a pioneer in AES42 digital microphone solutions) quickly joined the list of partner companies, adding important contributions in those same core application areas. Among those companies was the French Digigram and the American group Axia/Telos Systems. Both companies were involved in successful examples of audio networking protocols over switched Ethernet, the former with EtherSound and the latter with Livewire.

With the accession of those two companies, the RAVENNA effort certainly gained momentum, especially since those same companies held the

The first working demonstration of the new audio-over IP (AoIP) was tested in the RAVENNA booth during the International Broadcasting Convention (IBC) 2010.

Just before the National Association of Broadcasters (NAB) Show opened on April 15, 2012 in Las Vegas, NV, ALC NetworX and the Telos Alliance's Axia Audio division, developers of Livewire, announced interoperability between Livewire and RAVENNA. Philipp Lawo, CEO of ALC NetworX; Frank Foti, CEO of The Telos Alliance; and Michael "Catfish" Dosch, President of Axia Audio, are pictured.

largest installed based of networked audio solutions in the broadcast market (mainly on radio).

Most of RAVENNA's initial support came from the Lawo Group. Not surprisingly, Philipp Lawo himself is not only Lawo's CEO but also the CEO of ALC NetworX, RAVENNA's technology promoter. Describing the effort, Lawo said, "Within the last years, IP-based solutions have become a serious option for the transfer of control and audio signals." RAVENNA opens new horizons for stretching Lawo's networking technology for mixing consoles and routing systems onto an IP-based platform."

ALC NetworX and its Munich-based engineering team assumes the leading role in the technology development, R&D and promotional efforts are lead by Andreas Hildebrand, as Senior Product Manager for the RAVENNA technology.

Hildebrand is an experienced professional with a diploma in computer science who worked as a software engineer and former head of development for several companies in Germany and the US. He had large system implementation responsibilities in the pro audio/broadcast market.

Open Approach

According to Hildebrand, "All RAVENNA supporting manufacturers get the value of having an open standards based technology they can use, control and enhance. Merging Technologies is a perfect example of that, because they easily identified the potential of having a Layer-3 solution, which is open to others as well, since they were previously involved in developing a proprietary Layer-2 scheme. Immediately they got the potential of having the RAVENNA framework and adding payloads and functionalities they need in their specific application environment, without harming the whole RAVENNA specification. They added DSD/DXD payload format support at 384 kHz and that lives in total harmony with other RAVENNA generic streams, for example. There is a large strategic potential for those willing to place their own network capabilities at the core of their products."

In July 2011, RAVENNA was introduced to the Audio Engineering Society (AES) and European Broadcasting Union (EBU) standardization bodies, following the public release of the first RAVENNA

In 2014, RAVENNA promoted demonstrations of AES67 interoperability (a) showing solutions from Merging Technologies, Axia xNodes, and other manufacturers (b).

Specification Draft. From the beginning, RAVENNA was an open-technology standard for the pro-audio community, without a proprietary licensing policy. Thus, it was just a consecutive step to present the intermediate achievements of the RAVENNA technology to the most important standardization bodies related to professional audio and broadcasting.

During the European AES convention in London, RAVENNA's open-technology approach was introduced and elucidated to AES WG SC-02-12 and to the Technical Committee on Networked Audio Systems (TC NAS). Consequently, ALC NetworX and its RAVENNA partners also participated in the Task Group for audio interoperability over high-performance IP networks (X192), which resulted in the recently published AES67-2013 standard on high-performance streaming audio-over-IP (AoIP) interoperability.

Subsequent development efforts led to the convergence of the AES67-2013 standard on high-performance AoIP interoperability within the RAVENNA framework, with Axia/Telos Alliance and ALC NetworX being major contributors for the X192 work group. Currently, RAVENNA is being presented as an open standard for real-time IP media networking. It is already AES67-compatible, extending the application scope into other markets, especially in the fixed installation/integrated AV sector.

When Digigram joined RAVENNA in 2011, its President and CEO Philippe Delacroix stated, "IP audio has been a key component of our strategy and is embedded in our audio networking solutions since 2007 with full compatibility with EBU N/ACIP recommendations for AoIP contributions over WANs.

The RAVENNA protocol offers a host of neat features for synchronous AoIP distribution, (particularly for large-scale broadcast production facilities) based on open, existing standards. It was, therefore, a logical step for Digigram, and entirely in keeping with our own in-house IP audio developments, to offer bridges to/from the RAVENNA ecosystem. Broadcasters and audio professionals opting for RAVENNA networking for their IP audio deployments will be able to integrate Digigram equipment into their system to create the best possible infrastructure."

But it was probably the support from Telos Alliance to RAVENNA that projected this IP-based media networking technology to new horizons. With more than 25,000 Axia Livewire devices in more than 3,000 installations, the Telos Alliance's Axia Audio division, which are the developers of Livewire, proved the limited interoperability claims to the global market arena. Livewire and RAVENNA used a common IETF RTP L24 audio stream packet format. Livewire defines all the contents of the audio packets that Axia and ALC NetworX worked on into a fully synchronized stream operation as defined within RAVENNA, and according to the IEEE 1588-2008 synchronization standard and implementation of the initial RAVENNA Interoperability Profile. RAVENNA-enabled products could then be added to a large number of existing Livewire installations.

Quite possibly the largest RAVENNA implementation so far, in 2013 Lawo introduced its own RAVENNA-based Commentary Unit, a fully digital and networked system, enabling the use of standard IP networks for interconnecting venues and devices. The solution was developed in conjunction with Host Broadcast Services (HBS) and will be used during this year's Fédération Internationale de Football Association (FIFA) World Cup in Brazil.

In 2014, Neumann demonstrated a dual-port RAVENNA interface option for its AES42 microphones' DMI-8 interface. DirectOut introduced a RAVENNA-to-MADI converter featuring four MADI and two RAVENNA ports. Axia also announced that its xNode family of Axia IP-Audio interfaces—basically the building blocks of Axia Livewire AoIP networks—will be compliant with the new AES67 standard with a simple software upgrade.

RAVENNA and Livewire

Detailing the contribution from Axia/Telos Systems, Hildebrand told *audioXpress*, "RAVENNA is being adopted by manufacturers, because it is open and based on standards. Livewire had a very early IP-based scheme called Livewire legacy or Livewire 1.0 now, which was not fully based on standards because those standards were not available at that time. So they were really pioneers in that field. When they joined us at NAB 2012, they told us that if they had invented Livewire now they would probably come up with the same scheme."

"So, why not join forces and make the devices RAVENNA compatible, maintaining Livewire 2.0 as a

separate brand? Which is fine. It's a clever scheme, assembling the old framework out of our available technology, which does not require specific gear, like AVB requires specific switches. So, naturally they adopted RAVENNA for Livewire 2.0 systems," Hildebrand added.

As Axia directly states, it has worked together with RAVENNA to shape the new protocol Livewire 2.0, to combine the best ideas of RAVENNA and Livewire. That way, Axia is able to continue Livewire support on future products. Livewire and RAVENNA will co-exist on the same network and interoperate in RAVENNA-compatible mode.

Detailing the differences between Livewire and RAVENNA, Axia states that "RAVENNA uses a different clocking scheme than Livewire and it requires a different hardware interface design. You must have an IEEE-1588 clock master for the RAVENNA devices. And you must have a RAVENNA/Livewire device on the network that can synchronize to the 1588 clock and then offer a synchronized clock to the Livewire devices. Axia's new xNodes interfaces can provide both functions. One xNode placed on a Livewire network can provide the clock to RAVENNA devices and also to Livewire devices on the same network."

Naturally, all the Livewire partners (more than 30) started supporting RAVENNA indirectly. This includes radio broadcast market leaders such as Broadcast Electronics, Dalet Digital Media Systems, D.A.V.I.D. Systems, Digigram, RCS Sound Software, and Studer.

As Hildebrand explains, "All RAVENNA partners were working toward different application areas, with different priorities, latency being one of them. RAVENNA is meeting all those requirements."

"Since RAVENNA is based on standards you need to make sure that devices can easily exchange the streams. Not all RAVENNA implementers will work with DSD/DXD streams, for instance. But if they want, they can, because it's open," he continues.

"Now, to ensure interoperability we defined operational profiles. RAVENNA currently has a set of operational profiles being defined and one of those is the generic profile, which apparently is very close to what AES67 has been defined as an interoperability standard. So, in other words, all the nodes are supporting the Generic Profile—so that a speaker can receive a stereo channel or eight-channel stream and just extract the one channel they need to playback; a microphone can generate a two-channel stream but also, the big consoles can work with stereo or eight channel streams, despite the fact that they can also replace MADI connections using RAVENNA.

"For those operational profiles we have some mandatory requirements, so we tell a manufacturer 'if you support the generic profile, or the high performance, or the ultra-low latency profile, or the AES67 profile you need to obey certain rules.' And they need to comply with this or that payload format, or number or channels per stream. So, like AES67, this is basically a set of guidelines and rules, which define 'if you support a certain profile, you need to comply with certain formats.' This also allows manufacturers to support multiple formats at the same time. Even if a device is running a 384 kHz stream on a network it can also generate or receive stereo streams at 48 kHz, for example. That's the benefit of RAVENNA. Being open and being able to support different formats for different streams at the same time."

RAVENNA
http://ravenna.alcnetworx.com

Resources

Axia, "Livewire and RAVENNA: Why Are RAVENNA and Livewire Becoming Partners?" http://axiaaudio.com/Ravenna.

——, "Technical Papers and Presentations from Axia," www.axiaaudio.com/tech.

Ravena, AES67 now!, "Technological Overview," http://ravenna.alcnetworx.com/technology/technology-overview.html.