EtherSound in a studio environment

Recent developments have made EtherSound, which is already an established technology in the live sound and fixed installation markets, an interesting alternative for studios dissatisfied with the cost and limited flexibility of traditional audio routing systems. An extended EtherSound specification along with its first implementation was recently released and this enables bi-directional audio distribution over the same cable and higher sample rate conversions at 88.2, 96, or 192kHz. Digigram's CARL CONRAD puts it all into context.

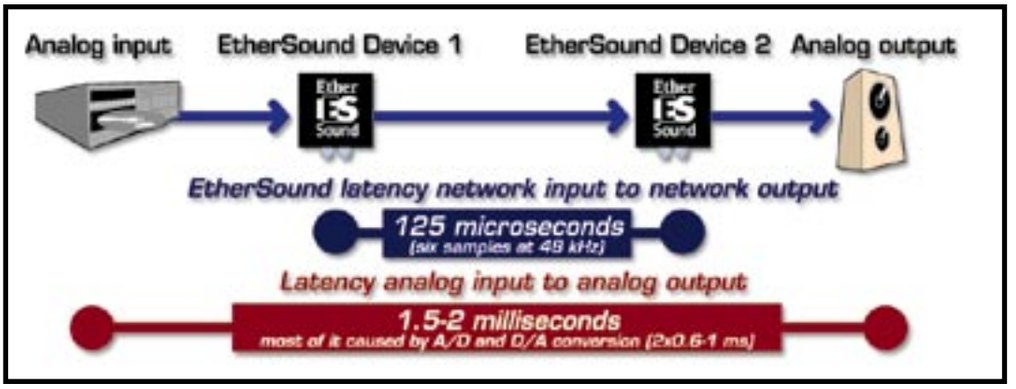
THE PATENTED ETHERSOUND protocol provides deterministic, real-time transmission of synchronised audio channels and control data over standard Ethernet. 64 channels of 24-bit/48kHz PCM audio, plus embedded control and monitoring data, are transported via a single cable. Thanks to built-in clock recovery, an ultra-low jitter ensures the audio quality. Developed by Digigram and introduced in 2001, EtherSound has developed into an industry standard as companies like Fostex (which has created a division dedicated to EtherSound products called NetCIRA), Nexo, Innovason, AuviTran, CAMCO, and Bouyer have adopted the technology. All these manufacturers produce their own EtherSound-compliant products that can be combined into multivendor networks.

Care has been taken to ensure Ethernet IEEE802.3x compliance. Only a technology featuring such compliance is able to leverage the huge R&D investments made by IT giants such as Cisco, 3Com, or Hewlett-Packard for the benefit of the pro audio industry. No specific and costly routing devices or convertors are needed. EtherSound networks support Layer 2 (physical) peripherals and can therefore use standard CAT5 or CAT6 cables, fibre optics, switches, media convertors, and other standard Ethernet components, that can be found at low cost at any IT supplier. As Ethernet technology evolves — for example, Gigabit Ethernet is on our doorstep, wireless technologies are developing apace while equipment prices continue to drop — EtherSound will be able to piggy-back on to these developments and constantly increase its capabilities.

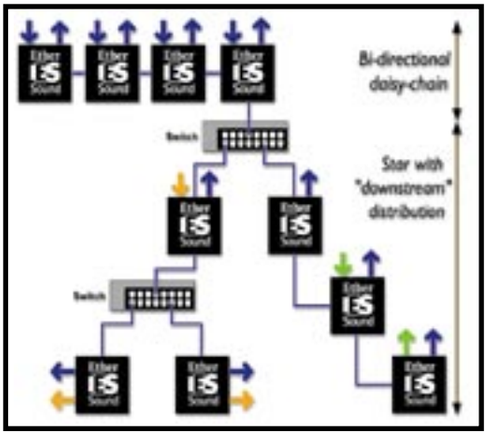
Today, EtherSound systems require a dedicated Ethernet network with a bandwidth of 100Mbps. EtherSound may also run within a VLAN (Virtual Local Area Network) and share the infrastructure of existing data or video networks. This means that if your IT department has scaled your internal LAN at a sufficient size, it is likely that you won't have to pull a single cable to build your EtherSound network.

Minimal latency was one of the key design requirements for EtherSound. No other technology offers such low latency with this many channels and at such high quality. The end-to-end transmission time between a network input and a network output is six samples, meaning 125 microseconds at 48kHz. Every device between the network input and network output, such as switches or other EtherSound devices, causes additional latency but only in miniscule amounts. Each module in a daisy-chain, for example, adds less than 1.5 microseconds, while switches contribute 2 to 20 microseconds. The latency is independent of the number of channels transmitted. Even complex digital networks feature a network latency of far under half a millisecond. In a system that include analogue devices, the biggest part of the overall system latency is due to the analogue to digital and digital to analogue conversion and that's completely independent from EtherSound technology.

EtherSound also offers great flexibility for system design. EtherSound networks replace traditional point-to-point connections by architectures that are easier to design, install, and maintain — daisy-chain, star, or a combination of both. The extended technology specification mentioned above, which enables bi-directional audio-distribution, has further improved system flexibility. Before the release, the EtherSound protocol was restricted to unidirectional audio distribution.



In unidirectional EtherSound all devices located 'downstream' from a source may playback audio from that source. Bi-directional EtherSound now allows the creation of a virtual bus between daisy-chained devices where a maximum of 64 channels of 24-bit/48kHz audio is available for inputs and outputs of all connected devices, be they 'upstream' or 'downstream' from the source. In both versions, control and monitoring data are bi-directional and use the same cable as the audio. Bi-directional EtherSound maintains the technology's very low and predictable latency (125 microseconds).



New generation EtherSound networks are able to combine uni and bi-directional sub-networks and new generation EtherSound devices will be able to operate in uni and bi-directional mode. All EtherSound licensees will autonomously determine their individual product plan to implement the new features into their products. As this text is written, AuviTran's AVY16-ES card already features bi-directionality. Furthermore, Digigram has announced an update for its ES8in, ES8out, ES220, and ES220-L audio bridges. The firmware of many EtherSound devices currently sold can be upgraded in the field to bi-directional EtherSound.

Bi-directionality makes system design much easier for one of the most important audio transport applications: signal exchange between studios. EtherSound breaks through the limitations of analogue audio or AES-EBU installation schemes. It eliminates the need to bring all of the audio to a central switching or routing location, reduces cable run and installation expenses, and greatly simplifies system reconfiguration as every input can be routed to every output. AuviTran's AVY16-ES card, with 16 EtherSound inputs and outputs, can directly interconnect to Yamaha mixing consoles, such as the DM2000, DM1000, or 02R96, as well as Yamaha signal processors (DME24N or DME64N), and all other professional products featuring the 'mini-YGDAI' interface.

To connect other analogue or digital devices to the network, Digigram and NetCIRA by Fostex offer product lines of EtherSound convertors with analogue (on XLR, Euroblock, or RCA), AES-EBU, and ADAT interfaces. Additionally, Digigram's ES8mic features eight built-in microphone preamplifiers and switchable mic/line inputs. In a bi-directional EtherSound network, the units are simply daisy-chained with a single Ethernet cable and thereby form a bus with all signals available to all studios. The number of EtherSound devices in the daisy-chain is only limited by the needs of the system as technically more than 60,000 devices can exist on the same network.

Obviously the advantages of such a system increase with the number of locations that need to be interconnected, but also with the distance between locations. Following the Ethernet standard, the maximum distance between two devices in an EtherSound network is 100m. Intermediate transceivers or fibre optic links might be used to increase this distance to 2km. As the audio signals travel as zeros and ones on the network, the audio quality stays the same from the first device to the last. And the properties of Ethernet cables (small diameter, no audible electromagnetic interference, etc.) allow for audio systems in areas where a traditional installation is difficult or impossible, as is frequently the case in retrofit projects.

Broadcast studios (radio and TV) are therefore

more likely to adopt EtherSound than recording or postproduction studios. But even there, EtherSound can make the life of owners and users much easier when one-off projects require additional signal paths because the existing infrastructure doesn't offer sufficient signal paths or because a new location, maybe a recording truck, needs to be connected. Rental companies could benefit from this technology by replacing their heavy, multicore cables with a single CAT5 cable.

With EtherSound input devices in a rack on one side and EtherSound output devices on the other side, you can connect the analogue or digital sources and destinations in a very timely and flexible manner. Monitoring distribution to studios and lounges can be added very easily. In many cases, it won't even be necessary to pull cables in between the devices as often the existing Ethernet infrastructure in the walls of the building can be used. Most EtherSound devices offer the possibility to configure the signal routing locally on the devices, so the system can work without the aid of a computer.

Another interesting development in broadcast environments is the move to ban noisy computers running radio automation software from on-air studios. EtherSound devices would be placed in the on-air studio, either in or near the console, and transfer the studio's microphone and line signals to EtherSound devices in the technical room, where the radio automation system server is located. Digigram's miXart 8 ES multichannel sound card with 8/8 EtherSound I-Os is an elegant and cost-effective way to integrate the EtherSound interface directly into the computer. Additional signals from the radio automation server travel in the opposite direction via the EtherSound network and are inserted into the on-air studio's console. Only the silent control interface of the radio automation system remains inside the studio. Other parts of the EtherSound network may connect the main control room as a link to the transmitter site or monitoring stations throughout the broadcast facility.

The second aspect of the aforementioned technology extension will make EtherSound even more interesting for the recording process itself. From its beginnings

restricted to 44.1 and 48kHz sampling frequencies, EtherSound now offers the possibility to implement sample rate conversions at 88.2, 96, or 192kHz. All multipliers of 44.1 and 48 kHz are possible. Depending on the sampling frequency the maximum channel count per cable may vary, i.e. 32 channels at 96kHz, but the very low and predictable latency (125 microseconds) remains unchanged. As for bi-directionality, all EtherSound licensees will develop their product plans autonomously as to how they implement this new feature.

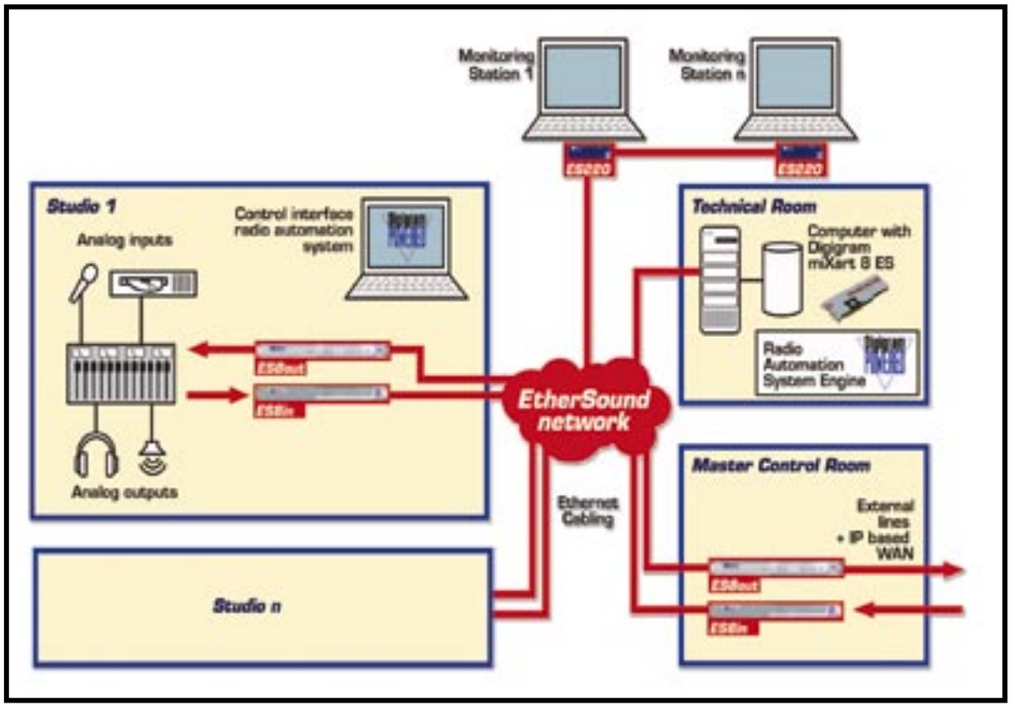
Microphone preamplifier manufacturers, for example, see EtherSound as a way to distinguish their products from the non-networked competition. EtherSound-enabled microphone preamps would replace massive amounts of high quality cable running from inside the studio to the console, especially in large facilities equipped for orchestral recording. As multiple microphone preamps can be daisy-chained, only one or very few Ethernet cables would be required to cover the distance between artists and console.

This is possible because the preamps would be remote controlled. EtherSound embeds control and monitoring data in the EtherSound frame and thus eliminates the need for separate cables for this information. The entire network can be configured, monitored, and controlled from a single point using PC software or microcontrollers located close to the console.

To facilitate the development of control applications, a Software Development Kit (SDK) that includes an Application Programming Interface provides simple control of the connected devices (including GPIO and RS232 management) via a vendor-independent set of commands. EtherSound licensees may extend this API with proprietary libraries to control advanced functions of their equipment.

AuviTran's ESMonitor Software is an impressive example of EtherSound's potential as it allows remote control of distant Yamaha devices using Yamaha's StudioManager through a virtual MIDI connection over the EtherSound network.

As EtherSound spreads, every new manufacturer adopting the technology will bring new tools to the overall system. Previous digital audio distribution concerns, like latency, audio quality, and interoperability, are no longer an issue and authorised EtherSound Implementors can help manufacturers speed up time to market. EtherSound is a technology that is now poised to embrace broadcast, recording, and postproduction. ■



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