

## SHARING AUDIO – THE CONVERGENCE OF AUDIO AND COMPUTER NETWORKS

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The advent of programmable DSP systems has dramatically changed the way audio systems are installed. Tedious changeovers between sessions with large amounts of equipment to re-program and repatch are a thing of the past, and gone are the large racks full of audio processing gear and complicated multiway cabling between areas.

A programmable DSP system means that you can have virtually any audio system design.

It means that you can change what your audio system is doing according to the type of event you are holding, just by recalling a preset.

It means that you can easily and quickly add more processing to the system without increasing the hardware budget.

It means that any specification changes during the design phase can be easily implemented.

Typically, these systems are a set of audio processing units that can be linked by a digital communications network. The units are often completely flexible; you program the signal paths and block diagram of the processing using a PC choosing processing blocks from an extensive library. These units can often be fitted with microphone preamplifiers, so you can create almost any audio system, including all of the processing, all the way from microphone to power amplifier.

System Features would include:

- » Distributed processing, networking and DSP meaning that hardware can be installed where it's needed
- » A Network that carries both control data and 8 or more channels of bi-directional 48kHz digital audio for maximum audio performance throughout the system
- » A variety of control options and interfaces that you can give your client the exact level of control he needs
- » Systems can be easily expanded

### **What makes these systems attractive?**

Flexibility, easy expansion, digital audio networking over long distances, and control.

### ***Easy to Design***

All your audio system design is done offline (even while travelling!). Using the system design software, you can build your system, design the processing path, set initial gains, routing, equalisation and dynamics processing.

Most systems offer a library of DSP processing objects that contains most of the commonly used audio processing functions. These may include: automatic mic mixing, leveling, mixing, equalization, filtering, crossovers, delay, and dynamics processing, as well as utility functions such as tone generators and meters.

When you're ready, connect the PC to one device in the system, and upload. You can often design customized control panels that only allow access to the system parameters that you need controlled locally.

### ***Easy to Install***

Where an audio and control network runs over standard computer Cat 5 cable, installation is both low cost and simple.

Each Cat 5 cable carries 8 or more channels of bi-directional 48kHz digital audio, so arrives at each point in the chain with exactly the same performance, even over very long distances.

### ***Easy to Operate***

From untrained operators and staff to fully-trained engineers, you can leave a typical DSP system with whatever degree of local control you like, whether it's no control whatsoever, or simple volume and switches for waiters and bar staff, or more sophisticated programmable controls. The Soundweb 9010 'Jellyfish' provides customizable menu screens and a rotary encoder that can control virtually any system parameter that you choose to assign to it.

The most control obviously comes from leaving a PC on-line to the system with the original design file running. If you leave this PC for local control, you will probably have some kind of password protection offer your design the security you'll be happy with.

### ***Easy to Integrate***

Because they are essentially computers, these systems often have comprehensive RS-232 serial interfacing, so that you can control the audio from external multimedia systems such as AMX or Crestron panels. Creating the control scripts for these systems is made easy within Soundweb Designer, while a complete serial interface programmers development kit is readily available and supplied with every unit on CD.

Further integration is possible when video and audio are combined in a system. Video routing switchers can be controlled serially to allow sophisticated zoning under a single-source control.

## **A Proprietary Audio & Control Network**

The Soundweb network is based on a proprietary custom FPGA, which allows the transmission of 8 channels of 24 bit, 48 kHz audio in each direction, and also provides around 3 Mbit/s of bandwidth for control packets - these are used to send parameter changes, meter data, and various other control items. Soundweb was one of the first systems to offer both audio and control networking on a single cable, and remains one of the easiest to install and use. Designed to incur only a very low latency, Soundweb systems are ideal for use in delay-sensitive applications such as Theatre Sound and other live events, including use on monitor systems.

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The network uses standard category 5 cable, as used for most present-day computer networks and advanced telephony installations. Connection is made via readily available RJ-45 telephone-jack connectors, and a wide variety of off-the-shelf hardware items are available such as pre-made cables, patch bays and wall sockets. No IT management knowledge is required, or any external networking hardware.

The simplest Soundweb network is formed by connecting one RJ-45 cable between two Soundweb 9088*iis*'s. The cable can be up to 300 metres (1000 feet) long. This enables 8 channels of audio, plus a control path, to travel between the two units. The existence of the control path means, for example, that a potentiometer connected to the control inputs on one unit (see Section 4.1 Control Ports) can be used to control the output gain of a mixer in the other unit. The control path also allows a PC plugged into either one of the units to reload programs and adjust parameters on both devices.

Next up in complexity is a daisy chain of 9088*iis*'s. In this case the 'Out' jack of the first 9088 is connected to the 'In' jack of the second, then the 'Out' jack of this unit is connected to the 'In' jack of the third, and so on.

The 9088*iis*'s form an audio ring in which 8 channels travel round the ring from the first unit to the last and then back to the first. At each device a channel can either be passed on from the previous unit in the ring or, replaced by an audio signal from one of the inputs or processing objects. For this network, each network cable can be up to 300 metres long. The maximum size of the chain is a combination of total cable distance and number of units - under normal circumstances, a chain of at least 15 units should be possible.

To produce more complex networks, the Soundweb 9000*iis* hub is used. Each hub has six network jacks; each jack can generate the full 8 channels of audio in each direction. It is possible to hook a chain of 9088s to each hub jack, so that the hub forms the interlock point between the audio rings. Multiple hubs can be connected together, and multiple connections can be made between these hubs to increase the number of channels available. Working on this principle a 'web' of processing devices can be built up; so naming the product.

If a Soundweb unit should lose contact with the rest of the network (perhaps because of a cable fault or power failure), it will continue operating according to its current audio settings. If power is removed and reapplied, it will recover the settings which were in force at the time that the power failed. The reason that this is possible is because of Soundweb's distributed processing.

A dual redundant ring fault tolerant system has been developed for critical voice-evacuation situations using the 9000*ii* hubs. The system will detect a break in a network cable, and choose the routing of the audio signals accordingly.

### CobraNet™ – Ethernet-based audio

An alternate approach is to use existing computer network technology. An obvious advantage of this approach is economic. The market for computer networking arguably dwarfs the entire professional audio market. Due to the high volumes, off the shelf computer networking technology is much more affordable than any purpose built audio hardware. Additional advantages to using an established network technology include the availability of components from multiple sources and a general familiarity, acceptance and knowledge of the technology. The disadvantage is that computer networking technology is optimized for computer applications. An audio application as described has markedly different requirements when compared to computer applications. There are technical problems in applying computer networking technology to audio applications. Specifically, an audio distribution network, in addition to the audio data, needs to distribute a sample clock. Most computer networking technologies are essentially asynchronous in that each station uses its own local clock when transmitting. Receivers phase lock to the received data on a packet by packet basis. And, for successful real-time audio distribution, transmitting stations need timely and deterministic network access. Some network technologies yield solutions to these

requirements more readily than others. Fortunately there are quite a number of computer networking technologies to choose from. Choosing the most appropriate technology will have a profound effect on the success of any digital audio distribution system based on computer networking technology.

Peak Audio has developed a system for distributing audio over Standard and Fast Ethernet. This technology, called CobraNet™, achieves deterministic performance and accurate clock distribution over an Ethernet dedicated to audio distribution. We believe the best network for digital audio distribution is a CobraNet™. The datacomm industry is rushing to embrace Fast Ethernet at the expense of other networking technologies such as AnyLAN and ATM which may even be technically superior. Fast Ethernet has the bandwidth required for audio distribution in medium to large installations. In certain applications, where long distances, electrically noisy environments, and few channels are involved, Standard Ethernet will be viable. Standard Ethernet may also be viable for some paging and intercom applications where low duty cycle and lower audio quality requirements may allow reasonably large applications to fit on 10Mbps of bandwidth.

Due to its many advantages, digital multiple access networked audio distribution systems will become increasingly prevalent. Affordable computer network technology, with sufficient bandwidth for digital audio distribution applications are now available.

### An example - SALISBURY CATHEDRAL: THE DIGITAL HIGHWAY

BSS Soundwebs are at the heart of an installation at Salisbury Cathedral, designed to make audio preset distribution a simple task for members of the vestry. The brief handed out by audio designer John Del Nero to BSS Audio for the routing of sound around Salisbury Cathedral's digital highway was to make the system conform to the traditional style of presentation, in an operator-friendly fashion. This was achieved using nine Soundweb 9088s, a 9000 hub and a 9010 'Jellyfish' remote.

Since the Cathedral stages 900 services a year the audio control systems had to be both event-oriented and intuitive, maintaining the Cathedral's traditional terminology, which is obviously very important. In conjunction with BSS, John Del Nero evolved a network whereby the vergers could select the type of service required, whereupon the system will reconfigure and the desired touch screen control panel will present itself. Compact, highly-distributed loudspeakers and specially-sprayed enclosures have been designed into a multi-zone system, receiving their feeds from four-channel amplifiers. The columns of the nave provide the principal loudspeaker positions, while auxiliary speakers on the outer sides of the nave are pressed into service when the cathedral is full, with a separate EQ setting.

The greatest challenge for BSS was in setting the correct delays. "Traditionally if a speech was being delivered from the East end of the cathedral, you would delay from East to West – and vice versa. But the problem comes when people start speaking in the middle of the nave. We solved this by putting delays on the inputs. Rather than the traditional technique of mixing mic signals together and delaying each speaker send, John Del Nero's design uses five discrete time delays for each cabinet, utilised dependant on where the signal originates."

The conventional approach would be to hit a MIDI programme recall and change all the delay times - but this would only allow for one of the mic positions to be delayed correctly at any one time. The Soundweb system provides five times the number of delays allowing multiple sources to be accurately localised simultaneously.

Being non-skilled operators, control has been simplified into a combination of LEDs and switches. It's a basic way of controlling Soundweb, but it helps to show the presence of activated mics. These controls are also available on the 'Jellyfish', situated in the choir stalls, and in addition the Remote provides preset recall functions. BSS also use a Fujitsu Stylistic PC touch screen

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working on a radio-wave LAN, which can be operated from any part of the Cathedral. In the present set-up two PCs can be connected and a carbon copy will be produced wherever it's required - an alias screen for the base computer interface. The main page has a plan of the cathedral and dropped onto that are little LEDs to show the status of each microphone - using a similar graphical representation of the loudspeaker zones, we created presets which activate the system components required for a given service."

"We are very pleased with the results, as it has put a bit of theatre back into the Cathedral," stated John, who was highly complimentary about the flexibility of Soundweb, adding that it was a lot more user-friendly than its competitors and extremely adaptable on site.