Successful CobraNet Installations

The following pages contain articles taken from the professional audio press highlighting the capabilities of CobraNet™ as used in many real world applications. The diverse scenarios described below span the audio world of audio applications from fixed performing arts and sports venues to live sound and everything in between. CobraNet has emerged as the de facto industry standard for transporting real-time, professional grade audio over Ethernet. It has proven to be a very robust and flexible system providing excellent performance in many demanding situations. CobraNet™ technology is available as an integral part of products from many industry leading manufacturers. It is also available to OEM’s in module form and in the new low cost and easy to implement CS181xxx family of CobraNet™ chips.

Please enjoy the articles reprinted below with the kind permission of the publishers and manufacturers. You will probably see a successful application of CobraNet™ that demonstrates its capabilities in a situation similar to your own.

Gaylord Palms Convention Center

ORLANDO, FL… At 400,000 square feet, the Gaylord Palms Convention Center is the largest space of its kind in Florida. Engulfing a sprawling floor plan with pre-function, meeting, convention, ballroom, and exhibition space, the facility is enclosed by a transparent glass roof. Allowing brilliant Florida sunshine in
to bathe the building's interior, the latter provides inspiration for marketing types who like to tout the imposing structure as a place where holding "the brightest meetings under the sun" is possible.

Timesaving technology found within the space is designed to make events easier, convenient, and more reliable than ever before. To that end, meeting rooms are equipped with professional-grade video, audio, lighting, and networking systems, and the 4,000 square-foot Orange Blossom Ballroom is outfitted with a permanent Broadway-quality stage plus its own sound and lighting. House audio across the board ranging from the cavernous exhibit space to the smallest foyer was implemented according to the tenets of a comprehensive design penned by a Dallas-based team from Pelton Marsh Kinsella (PMK) led by Joe Booher. Utilizing RAVE signal transport technology from QSC Audio Products, Inc., the PMK blueprint managed audio routing chores in a seamless fashion—saving money and time while conquering the center's great distances as well.

"This was a huge undertaking," Booher says of the project. "When we began the task of creating the design, one of the first things we addressed was how to move all the required channels of audio around without relying on massive bundles of copper. Distances being what they are on the property, we also were searching for a way to shuttle signals from place-to-place without degradation. RAVE provided us with an option that wasn't dependent upon any other sub-system for its operation, and saved the expense of providing additional DSP resources which would have been spread out over the area using more conventional methods."

RAVE, an acronym for Routing Audio Via Ethernet, is a digital audio transport system, which dramatically simplifies installation, increases routing flexibility, and improves audio performance. With RAVE, audio can be transmitted via standard Ethernet hardware and cabling using Peak Audio's CobraNet™ technology. Hundreds of channels of uncompressed 24-bit, 48 kHz digital audio can be routed over a single cable within a RAVE network with no bit-rate reduction processing or other compromises to quality. RAVE additionally supports switched network topologies, within which hundreds of audio channels can peacefully exist side-by-side with asynchronous PC or control system traffic.

When compared to traditional wiring methods, RAVE yields both time and cost savings, as well as reduced cabling, termination, conduit, and installation labor. Available in both analog and digital I/O models, it also can be easily interfaced with a wide variety of analog and digital components without using additional converters. And, because it is Ethernet-based, it can be reconfigured or expanded with off-the-shelf network media and hardware.

"In a certain sense, signal distribution at Gaylord Palms is just as enormous as the building itself," Booher adds without understatement. "And without RAVE as its backbone, the network would be even larger. With convenient RAVE hubs located in key areas all leading back to the central control room, system operators can now distribute audio channels from virtually any source to any other, and even multiple destinations. There's no limit to what can be done—this is truly a fast track route to effective audio management."

QSC Audio Products, Inc. is a leading manufacturer of power amplifiers, loudspeakers, signal processing, digital signal transport, and computer control systems for professional audio markets worldwide.
PORTLAND, OR… It took two days for the Oregon Convention Center to properly celebrate the recent completion of a $116 million expansion project. Luring some 40,000 people with music, fine Northwest cuisine, a beer and wine festival, and extreme sports, the gala bash drew attention to the facility's new digs, which now offer 255,000 sq. ft. of contiguous exhibit space, 50 meeting rooms, and two grand ballrooms, making it the largest space of its kind in the region. Equally impressive in its own right, systems integration for the project includes RAVE (Routing Audio Via Ethernet) signal transport and QSControl network audio equipment from QSC Audio Products, Inc., both of which were implemented by Milwaukee, Oregon's Delta A/V Systems, Inc. using a blueprint penned by Seattle-based Sparling Inc.

Sound reinforcement for the expansion relies upon sprawling, distributed 70V systems throughout. Driven by a total of 27 CX204V amplifiers, the various new systems are linked with the convention center's existing AV capabilities via a CobraNet™ backbone incorporating QSC's RAVE signal transport products.

"The RAVE network plays a vital role in connecting the facility's previously-existing AV control room with the new one," notes Delta A/V Project Manager Jeff Overbo. "With it, system operators are able to tie-in the various patch bays at both ends, go back-and-forth with source materials, and even facilitate recording, which is something they do a lot of for meetings and other special events."

While the RAVE links have been primarily used for shuttling signals between the convention center's old and new control rooms, Overbo is also quick to point out that the same network can additionally be used to transport virtually anything else camping out along the CobraNet™ pathway. "It works great in the exhibit halls too," he says. "When the new exhibit space is opened up to combine with the old, a truly cavernous room is created. For these times, the only real practical way to distribute signals across the entire space is with RAVE routing."
Besides offering comprehensive monitoring and control functions for the entire structure, QSC's QSControl additionally proved useful during system setup, providing Delta A/V with a convenient medium for testing and analysis anywhere in the building with a data access point.

"Both QSC systems did a lot to shrink distances in a very, very large space," Overbo adds on a closing note. "I'd hate to have to attempt a project of this scope without technology of this kind."

On April 18th, the center was honored by the City of Portland for its forward thinking and design with the city's BEST (Business for an Environmentally Sustainable Tomorrow) Award. Located near the Willamette River, the facility is surrounded with expansive views of Portland, and is part of the Lloyd business and retail district.

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Clapton Tour 2001 System Network

Recreated from Prosound Web Article by Chris Kathman
Spectrum Sound's Advanced CobraNet™

To quote Peak Audio - "CobraNet™ is offered as a standard technology for the transport of multi-channel audio and control data. Peak Audio believes that a network carrying audio and data between products of many manufacturers best serves the industry". See CobraNet™ and other links below for more information.

The House System is powered by custom CyberLogic Corp multi channel power amps and is connected the mix position by a QSC / Peak Audio RAVE; a digital audio transport system that routes multiple channels of audio over standard Ethernet hardware and cabling.

Some information from Spectrum Sound's Curtis about the use of network and control technology:

PSW: You are probably the most experienced user of CobraNet™ in the world could you tell us how are you using CobraNet™ on the tour?

We started using CobraNet™ on Promise Keepers when we acquired the original 900 system, it made perfect sense because of the amount of drive lines needed for the amount of control you get. We have since incorporated it into many of our main drive racks for signal distribution in our other systems for some shows..

The 161 unit which is, for lack of a better term, the A/D unit resides (for us at least) at FOH. We connect the CobraNet™ outputs of these units to an unmanaged switch and convert to fiber optic for the long run. (We do keep cat 5 on hand for backup) This signal is fed to the first receive rack on one side of the stage where it connects to another unmanaged switch and from there to the RAVE 160s in that rack and also loops through (via fiber or cat 5) to it's mirror image rack on the opposite side of the stage. You can find a detailed explanation of CobraNet™ at www.peakaudio.com but here is a simple yet crude description. In a normal Ethernet network information is sent in packets. These packets are received in random order and reordered at the other end in the computer. CobraNet™ converts the analog signal to digital and sends it in
packets downstream to the receive unit(s). Unlike Ethernet though, CobraNet™ keeps these packets in order.

PSW: How do you use computers and control networking on the show? (Control, communications, measurement etc...)

Our drive racks come configured with a rackmount computer connected to the processors and attached to an 8 port hub and a wireless access point. With the WAP I can access the drive computer with my laptop. Control is done with PC Anywhere. It really makes it nice to make changes from any seat in the venue and hear it happen in real time. For measurement I ran SIM. The hardware control makes it easier to use since we were out of open channels on the console for measurement mics. While walking the room I would occasionally run SMAART with a portable pre for the mic but mostly relied on ears and taste. Those were also the ruling factors in tweaking the main system, (ears and taste).
Rane Floating on Earth

Rane Corporation’s exclusive UK distributor, Hayden Laboratories Ltd, has supplied Rane NM84 network mic preamps to London-based specialist classical recording company Floating Earth.

The preamps – part of the CobraNet™ range of audio products – were specified by Mark Harrison, technical engineer for Floating Earth’s new OB truck. It’s Floating Earth’s first mobile, so they consulted broadcast and high-end equipment suppliers HHB (UK) re the project, asking them to supply the equipment and systems utilized and after-sales support. Floating Earth then undertook the physical install themselves.

Floating Earth is one of Europe’s premier classical recording companies. Established in 1987 specializing in this exacting genre, offering facilities and expertise to cover all aspects of broadcasting and post production. Naturally, using the best and highest standards of equipment is essential.

The four Rane NM84s were supplied by Hayden to HHB, for whom the project was managed by Steve Angel.

The mic preamps go into the venue and sit at the front end of the location recording – each offers 8 mic/line inputs. They are linked to QSC RAVE digital output decoders in the truck by one small fibre optic cable, providing a neat and convenient alternative to what would have previously used multiple wires. The reduction of the analogue factor also greatly improves audio quality.

Mark Harrison has followed the development of CobraNet™ with interest over the last 2 years. He chose the NM84s because “They were the right boxes at exactly the right time. They are studio-quality preamps, they have remote control facility (via ActiveX controls) and mate perfectly with the QSC decoders.” He adds that the Rane preamp’s return outputs facility has also proved very useful for talk-back and playback.

He’s “Thrilled” with the results so far “They are doing a great job” he comments affirmatively re the NM84s, “The convenience of the fibre and the quality of the sound is superb. The control panels are also very logically set out and it’s easy to see what’s happening”. He adds that they’ve, “Received great product support from both Rane and Hayden.” Harrison has long been a fan of Rane equipment and remarks on its proven reliability and quality.

He’s so impressed with the Rane NM84s that he’s just ordered another two – to give him a total of 48 channels to the truck, and 16 return outputs,

The Floating Earth OB truck kicked off its career with some test shows around town, before starting its busy production schedule with an opera for BBC Wales, Trouble In Tahiti, which was recorded at Asylum Studios in Perviale, Middlesex.
HANGZHOU, CHINA... The HangZhou Theater, located in the capital of China’s ZheJiang province, has adopted the most advanced QSC technology available.

Via the California (U.S.) company’s territorial agents, PCI-China, they have specified and installed full network audio control and signal transport, using QSC’s QSControl and RAVE systems, allowing the venue to monitor the amplifier status over an Ethernet network.

The hub of the installation comprises three CM16a amplifier network monitors and a pair of RAVE-188S units, with total amplifier power provided from the PowerLight and CX Series models. The theater’s arsenal includes eight QSC PowerLight PL1.5, six PL2.0HV, and four PL3.8X amplifiers. From QSC’s CX Series catalog, there are two CX302, six CX502, three CX702, seven CX902, and four CX1102 amplifiers.

A single RAVE network can now replace hundreds of audio cables, dramatically reducing installation time, effort and cabling costs by terminating one cable for every 64 channels.

Each CM16a monitor offers 16 channels of gain control, monitoring, and general amplifier management capabilities. Data communications are routed between each rackmounted CM16a in the remote amp locations and a control room-based system PC running QSC’s QSControl (pronounced Q’s Control) software via an Ethernet network running on fiber.

PCI-China’s Jack Kong reports that the total investment in the theatre was 90 million RMB (US$10.80 million), of which 6 million RMB (US$750,000) was dedicated to the audio system, which includes EAW sound reinforcement.

“A number of companies were asked to present a proposal and we beat all of them to win this project after a lot of hard work,” he said. The system was installed by the project consultants, Eastern Acoustic Development Ltd (EAD), who are also one of the company’s QSC dealers. Prime Connections Inc. (PCI) provided local technical support.

Continued Jack, “It was EAD’s idea to put all the QSC network control capability into this project. PCI had originally proposed this solution to the theater a few years ago and did a lot of promotion on the idea before the job finally happened. At the early design stage, PCI and EAD made presentations to the end user, showing them the whole QSControl system, and helping them understand the advantages. They were happy.
to adopt our recommendations.” PCI also provided EAD with considerable technical support during the bidding process.

HangZhou Grand Theater, located in the downtown of city HangZhou - WuLinMen Square, is the city’s most famous building. Originally constructed on a site in excess of 50,000 sq. meters in the 1970s, it was remodeled in 2002 in order to become the main facility for the 7th Chinese Art Festival. The four-story building contains 1,608 seats in its center auditorium.

On site training was conducted during installation, and several months into its use, the venue reports total satisfaction with both the RAVE and QSControl system.

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A Capitol Idea

by Gregory A. DeTogne

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The Gressette Building was designed in an age when networked systems weren't an architectural concern. "At its present rate of progress, it will someday run real-time gigabits per second on linguine."

— Techno-pundit George Gilder, on Ethernet technology

HARDCORE NETWORKING GEEKS REFER to it as IEEE standard 802.3. Others simply call it Ethernet. Whatever the nomenclature, South Carolina state senators have embraced the high-bandwidth LAN technology as one of the major elements responsible for revitalizing integrated systems within the Gressette Building, an office complex used for hearings and other legislative functions.

Named after legendary local politician Marion Gressette, the building is part of South Carolina's statehouse campus. It houses offices for every state senator, as well as 10 conference rooms for both public and private hearings; and all manners of bills and issues are discussed within the administrative facility prior to formal introduction at the state capitol building.

SENSE FROM SPAGHETTI

Built over two decades ago, the Gressette Building was designed in an age when networked systems weren't an architectural concern. As a result, the structure's needs for technology evolved within a framework outside of any all-encompassing plan.

"To accommodate the numerous systems that have been installed over the years, there is cabling running all over this building from floor to floor in anything that even vaguely resembles a cable chase," said Sid Gattis of Gattis Pro Audio Inc., the Columbia, South Carolina, firm contracted to upgrade the facility. "Out of necessity, a constantly changing wiring scheme has followed the notion that if there's room to shove something through a hole in the floor, do it, so long as it meets code. As you would expect in such a scenario, cable bundles have grown to staggering sizes in many areas."

Last year, when the building received some funds for an extensive audio-visual/multimedia upgrade, administrators called on Michael Schwartz of Boulder, Colorado-based Peak Audio to pen a blueprint that would radically transfigure system functions and possibilities within four heavily used hearing rooms. As the firm selected to turn Schwartz's design into reality, Gattis Pro Audio followed a detailed spec and drawing set that would ultimately bring matrixed mix-minus audio, multiple audio and video teleconferencing systems, automated control and a full gamut of A/V presentation capabilities to the rooms in time for the beginning of the 2001 legislative session.

As part of the design, the Gattis crew would also install a computer-based electronic library to record and archive hearings occurring within the separate rooms as well as proceedings in the nearby Senate chamber. Available to senators and their staff, the library captures audio, video and either captioned or court reporter text, and indexes this data within a timecode-based, hard-disk recording system. Once in the hard-disk system, the data undergoes conversion allowing it to be stored within an online archive or streamed to the Internet in real time. Accessible from any authorized multi-media-equipped PC along the building's extensive PC network, the library is the brainchild of Karim Lakhani from Advance Interactive, Vancouver,
British Columbia. Integrated into the audio, video, presentation, control and backbone subsystems, it is 
operated in each hearing room with one illuminated wall switch, or from a Panja touchscreen.

Since every word in the library is indexed, a search using an Internet browser within the online archive 
quickly yields a number of links. Click on any link, and a tape-recorder-style control panel opens, which 
can then be used to play the stored data back with audio, scrolling text, video stills and a date and time 
counter.

The library, just like the new shared teleconferencing network, room linking capabilities, and automated 
control systems that integrate all of the various subsystems, utilizes digital pathways forged by multiple 
Ethernet networks. The audio portion of these networks is based on RAVE 188 audio-to-Ethernet interfaces 
from QSC Audio Inc.

RAVE (Routing Audio via Ethernet) is a digital audio transport system that employs Peak Audio's CobraNet™ technology. Transmitting audio via standard Ethernet hardware and cabling, RAVE supports up to 64 channels of uncompressed 20-bit, 48kHz digital audio over a single line, thus simplifying installation by reducing the number of necessary cables. Due to recent advances in Peak Audio's CobraNet™ firmware, switched network topologies are now supported by RAVE, within which hundreds of audio channels can peacefully co-exist with asynchronous PC or control system traffic.

**RAVE REVIEWS**

The Gattis crew quickly became ardent boosters of RAVE's ability to dramatically limit the number of 
cables required in the Gressette Building's already cable-strangled environment. Deployed using CAT-5 
cabling, eight RAVE 188 units were used in the building. One unit is found in each hearing room, while 
four corollary devices are located in a master control room. Welcomed at the hearing-room end of the 
equation within an 8x8, 20-bit/48kHz architecture, source signals enter each RAVE unit's decoder, where 
they are packed and then routed to their destination in the central control room. Once in the control room, 
RAVE network decoders unpack the input signals and send them along to the electronic library or wherever else they've been directed.

By using RAVE units as the audio ramp to the network from 
each hearing room, the Gattis crew was able to connect other 
CobraNet™-equipped products called for in the design (such 
as a MediaMatrix system from Peavey) to a centralized 
CobraNet™ backbone. Within the Gressette Building systems 
upgrade, this backbone is used to reliably route signals 
throughout the hearing rooms and to and from the central 
control room, and another control room located in the nearby 
statehouse building. The RAVE/CobraNet™ backbone suffers 
no degradation over distances; and it is significantly more cost-
effective than conventional cabling. “If we had tried to 
complete this project entirely with regular cabling, the quality 
wouldn't have been nearly as high,” Gattis is quick to point 
out. “This would have been especially noticeable in the case of the electronic library, where a highly 
optimized signal source is really a necessity, not a luxury.”

**MIKING THE WORKS**

A total of 94 permanent microphone positions exist within the four hearing rooms upgraded by the Peak 
Audio design, all of which were outfitted with 18-inch MX418C gooseneck mics from Shure. Two of the 
rooms (numbers 207 and 209) are identical, with 19 mic positions spread out around a horseshoe-shaped dais, 
and two more at a witness stand. The largest of the lot, hearing room 105 features a pair of horseshoe-
shaped seating areas situated one inside of the other, with the outside horseshoe at a slightly higher 
elevation. Given over to 15 and 10 mic positions respectively, both platforms face a single mic position at a 
wireless stand. Last among the rooms to feel the effects of Grattis-led improvements, the fourth hearing 
room, number 308, eschews the horseshoe format in favor of a staggered tri-level arrangement of raised,
rectilinear seating areas. With 26 mic positions of its own, it's not quite as large in dimensions as room 105.

Beyond the MX Series gooseneck mics, an SC Series wireless package was also provided by Shure. It “floats” from room to room, generally for use by those in the gallery wishing to comment at an open hearing. Working in a similar capacity, eight of Shure's hardwired SM58 microphones came to the project as well. These mics can be plugged in at various locations as the occasion warrants.

Within any closed environment where scores of open mics in close proximity to loudspeakers are the norm, there are a number of common problems. The potential for feedback looms large. To adequately deal with this and related pitfalls in the hearing rooms, the Peak Audio design relied upon a cleverly crafted mix-minus matrix scheme in which every set of two microphones was given its own zone. Providing the processing to make this scenario work is a Peavey MediaMatrix 208NT mini-frame working in conjunction with multiple MM8830 interface units and A/A-8P mic preamps also selected from the MediaMatrix family of components.

“We can have every mic on in the house, and these systems will work flawlessly,” Gattis says with justifiable pride. “The way we have it configured, when a senator speaks, his or her microphone remains off in their own loudspeaker, while those in adjacent seats are down by various amounts to create a cone of silence. Full-duplex conversations are, however, still provided from seat to seat, as no speaker is ever muted. The house gallery, and all other members not near a given senator's mic, hear that senator at full volume. Each room works so well that the four bands of parametric EQ we have at hand for each speaker were used just to smooth things out a bit. There has never been a need for serious damage control like pulling out big feedback rings.”

All audio is routed in and out of the MediaMatrix mini-frame. Exiting the outputs, signals either travel to the amplifiers and on to the loudspeakers, or take the QSC RAVE/Ethernet highway leading to control room destinations such as the electronic library. Activated via a simple EAO switch found at each senator's hearing room position, the Shure gooseneck microphones can be selectively turned on with the push of a button, which sends sound throughout the house, or muted just as easily when a senator wants to speak privately to a neighbor or legal counsel. Proceedings are heard throughout the audience gallery of each room over a multi-zoned distributed system utilizing CDK model 803, 8-inch ceiling-mounted coaxial speakers. Senators listen in on wedge-shaped monitors enclosed in the baffled, mahogany cabinets mounted at each of their respective positions next to their microphones. As further testimony to the efficacy of the matrix/mix-minus design, these custom-built loudspeakers (which are loaded with 4-inch coaxial drivers) are literally aimed into the rear patterns of the gooseneck mics without producing so much as a squeak, peep or chortle.

VIDEO FEATURES AND TELECONFERENCING

Video presentations in each of the hearing rooms can arrive from several sources, including a portable multimedia cart with VHS/DVD and dual-cassette capabilities, which can be shared between all of the rooms by plugging in a single multipin cable carrying audio, video and control signals. Multiple PC interfaces at strategic areas frequented by laptop-toting Powerpoint fanatics are automatically switched to the display monitors and videoconferencing system. Regardless of the source or room, a 42-inch Sony PFM-510, 1280¥1024 plasma screen serves as the medium for viewing by the senators. For the audience, portable display carts can be plugged in and shared between rooms as required. Each of these is equipped with Sony PFM-42B plasma monitors.

As a way of further facilitating his client's video needs, designer Michael Schwartz gave thoughtful consideration to the realities of teleconferencing. As modern communication goes, senators find this technology especially beneficial for times when their schedules won't allow them to be seen and heard in person. Hardware supporting the Gressette Building's teleconferencing network is comprised of three Gentner GT 1524 units, which, as previously mentioned, rely upon the RAVE 188 Ethernet network for signal transport functions and MediaMatrix units for selective routing between rooms. Video teleconferencing codecs will be added in the near future to facilitate communication between the room and up to four remote users, either over the Internet or ISDN lines.
READY FOR THE FUTURE

Using the QSC RAVE/Ethernet links between all the rooms, Gattis envisions a future with no boundaries at the Gressette Building. “The senators are just now getting their feet wet with the technology we've provided,” he says. “As each day passes, they understand more about what can be done now and what kind of other possibilities exist. It's just a matter of time before they will be streaming video between all the rooms on a regular basis, drawing from the electronic library at will, doing more data networking and using the teleconferencing system in new, creative ways. Fortunately, whatever tomorrow may bring, with the RAVE network in place, we have the infrastructure ready today.”

Gressette Building Controls: Simplicity Itself

CONTROL ISSUES WITHIN THE HEARING ROOMS, AS WELL AS from the control rooms back to the hearing rooms, fall under the central direction of a Panja/AMX Accent 3 Pro mainframe in each room, tied together through Panja Ethernet gateways, and a Panja NetLinx controller, through a dedicated Ethernet network and 3Com switch. These controllers use a combination of IR, RS-232, data inputs and relay contact closures to interface all in-room equipment with illuminated wall-plate switches. To make the rooms come alive, all a staff person needs to do is flip a green switch to power the system up and a red switch to start recording. Both hardwired (at the chairman's and staff person's positions) and wireless ViewPoint touchpanels from Panja/AMX are at hand for more involved source selection, room control and volume adjustments. The control system was chosen for its simple, non-technical user interface and reliability. Eric Bozard of CMC Communications in Atlanta provided programming for the control network, under the consultant's direction.

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The Fast-Working, Flexible Crew
GATTIS PRO AUDIO BEGAN WORK ON THE project in earnest in November 2000, shifting their efforts into warp drive during December. The crew, which, in addition to Gattis, consisted of Bruce Leeper, Scott Shealy and Ken Snyder, put in 14-hour days to keep the job on a fast-forward pace. With the senators back in the building on January 13 for the first 2001 legislative session, the work moved from room to room, with the needs of the politicians overriding construction. “They'd give us notice when they needed one room, we'd clear out our tools and clean up the place, then run out and work in another room for a couple of hours,” Gattis described the crew's somewhat unpredictable schedule. “Then, when they needed that next room, we'd go back where we were before. It may sound trying, but with everyone's cooperation, business went on uninterrupted for the legislators, and we never got tired of being in the same place for too long.”

The job was completed following the successful resolution of some rather troublesome cable-routing issues in hearing room 105, which were worked out with the aid of two of the main Senate liaisons on the project, Craig Smith and Bosie Martin. “Right away, we started getting compliments from the senators on how much better the rooms sounded,” Gattis is happy to report. “The senators were telling us they had been working with less than ideal systems for so long that it came as a shock to experience something of this quality. There really is new life in this building now, and it goes well beyond politics as usual.”

Also lending their talents to the project on behalf of Peak Audio were Deb Britton, Zebeth Parks, Ray Rayburn and Rich Zwiebel. Initiated by former Clerk of the Senate Frank Caggiano and his assistant Hogan Brown, the upgrade was part of a larger 3-year plan that was designed to modernize all the hearing rooms in the Gressette Building. The program continues to receive support from current Clerk of the Senate Jeff Gossette and, as previously noted, is well-appreciated by members of the South Carolina Senate.
Let the Games Begin

By Chris Shuler

From the September '00 Issue of Sound and Video Contractor

The sound-reinforcement system installed at Stadium Australia, home to the 2000 Olympic Games, required both quality and versatility.

In terms of magnitude, events do not get much larger or more spectacular than the Sydney 2000 Olympic Games. From mid-September through October 1, some 10,200 athletes and 5,100 officials from 200 countries will converge to take part in 28 tests of skill, speed and stamina. Approximately 5.5 million tickets to Olympic competitions will be sold, giving many a chance to see the events live for themselves, and thanks to 15,000 members of the media scheduled to be in attendance, coverage of the Games will be provided for a staggering estimated audience of 4.5 billion people around the globe.

When the opening ceremonies of the XXVII Olympic Games kick off on Friday, September 15, the world will focus its attention on the largest outdoor venue in modern Olympic history—Stadium Australia at Homebush Bay on the western end of Sydney Harbor. Also known as Olympic Stadium, the $395 million (US) centerpiece of Sydney’s Olympic Park will be used to host many of the Games’ most watched events, including the opening and closing ceremonies, men’s soccer final and all track and field events.

The facility itself is massive. A continuous lower seating bowl surrounds the 400 m athletic track. Above that to the east and west, six levels of grandstands rise up to meet 7.5 acres (3 hectares) of arced translucent polycarbonate roofing. To the north and south, tall open grandstands stretch out from both ends of the pitch. With more than 110,000 seats, 104 private suites and a large number of other public areas—concourses, banquet halls, restaurants, bars, restrooms and function rooms—a powerful and flexible system to handle the venue’s complex audio needs was of paramount concern.
Sound-reinforcement needs for the Stadium Australia are met by a variety of Bose loudspeakers. The specification for this system was developed by the team of Andy Prager of Flack and Kurtz, New York City, who served as lead system consultant, along with acoustical consultant Bob Fitzell. Following a highly competitive bidding process among Australia’s leading integration firms, The PA People emerged as the choice to implement the system and to supply custom engineering solutions as well.

After being awarded the project, The PA People, based in Sydney and headed up by Managing Director Chris Dodds, met with the consulting team to fine tune the system design, offering several innovative solutions. Backed by Creative Audio, The PA People’s sibling manufacturing division in Brisbane, many of these solutions featured new and custom technology never used in a project of this size.

"As an integrator, The PA People uses products from many manufacturers," said Dodds, "but because of our expertise in the engineering field, if we feel a product doesn’t exist to meet the client’s needs, then we will custom-engineer a solution through our sister company, Creative Audio. Working in close partnership with forward-thinking manufacturers, we are able to deliver solutions for our clients that would be otherwise unavailable."

Challenges
"In Australian terms, the Olympic Stadium is unique," said Dodds. "It’s one of the few venues here that is like an American stadium due to a much higher standard of finish. It’s not simply a soccer stadium that you visit for a game and then leave. This venue has a full complement of facilities common in the United States—conference rooms, luxury suites, restaurants and bars and other amenities. Most stadiums in our country simply don’t offer that sort of functionality. However, since we had been to the Super Bowl and a number of other large events in the United States, we had a reasonable understanding of what needed to be achieved."
The loudspeakers at the Stadium Australia are powered exclusively by a variety of Crown Macro-Tech amps.

After a careful assessment of the venue, Dodds and his team determined the challenges that would need to be addressed. The system needed to deliver audio coverage to a large number of people in many different regions and locations. They settled upon a distributed PA system to cover the stadium bowl and then set about designing a 70 V system to cover more than 150 suites and individual rooms.

Further, the system had to support easy, flexible audio signal routing to any zone, depending on the requirements of a particular event. Crowd mics, paging mics and background music sources would have to be properly routed and managed throughout the site. For example, some pre-recorded announcements would need to be heard in all zones; others would need to be routed to only specific zones.

System control is handled by Peavey’s MediaMatrix set up for use with CobraNet™ and Crown IQ with the new USP2 modules.

Following the Olympic Games and subsequent Paralympics held in October, the temporary open stands on the north and south ends of the field are to be dismantled and replaced with smaller, roofed seating areas. At the same time, the lower tier of bowl seating will be pulled forward towards the pitch. Aside from reducing the overall seating capacity of the venue to 80,000, this eventual setup will be better configured to host future soccer and rugby matches and large-scale concert events. With these upcoming physical stadium changes in mind, the front-of-house bowl system would need to be as versatile as the back-of-house setup.

Audio quality for all coverage spaces was another top priority. A large stadium is rarely the first environment brought to mind when thinking about superior audio reinforcement. The PA People wanted to combat that mentality with a system that provided both outstanding intelligibility and full-range fidelity.

Amps and loudspeakers
Based on a history of success with the product, The PA People installed an all-Crown amp system. A total of 94 Crown Macro-Tech amps and 56 Crown Com-Tech amps are divided among the stadium’s four amp rooms, located on level seven at the north and south ends of both grandstands. The Macro-Techs, made up of three different models based on specific loudspeaker power requirements, drive the FOH bowl system. The east and west grandstands each use eight Bose Panaray LT clusters hung off the leading edge of the roof. These clusters consist of three mid-high boxes and four bass cabinets in a cardioid array. Six more clusters per side are flown from the roof structure to provide additional coverage to shadowed areas. The rear areas of the lower seating tier are covered by 56 cabinets mounted on the underside of the level three overhang.
Loudspeaker clusters for the north and south temporary grandstands are positioned on large lighting trusses on either side of each seating area. Each tower comprises 14 Bose loudspeaker cabinets—four mid-high cabinets at the upper level, two mid-high cabinets at the lower level and eight bass cabinets in a directional column array. An additional 32 cabinets provide coverage to the rear areas of the lower seating tier under level three. Ultimately, the loudspeaker system is designed to reinforce events with a center field focus. Highest intelligibility sound is provided to patrons seated in the east and west stands, particularly for events with an audio source centered on the field’s halfway line.

For added flexibility, the system can also be reconfigured to provide sound reinforcement support for events where the audio focus is in one of the end zones, such as a major concert where a touring sound company would provide its own FOH system. Each cluster in the stadium’s system is capable of being individually delayed to create an audio focus wherever the client desires.

The 56 Com-Tech amps in four different models drive the system’s BOH setup, which features 1,600 various Bose background loudspeakers grouped into 29 zones. Each zone consists of a number of cable home runs and one or more amp channels. Amp channels can be reallocated to five additional zones that are not used in the default state.

The flexibility in the Stadium Australia’s sound-reinforcement system is perhaps its most striking attribute; it had been a traditional analog system—every time the stadium switched over for a different event, it would require a good deal of re-patching and tweaking. This system, however, requires only that a preset be recalled to have all of the re-routing done, zones reassigned and loudspeakers properly delayed.
Control Elements

"Needless to say, designing and installing the sound reinforcement system for the Olympic Stadium brought a new set of challenges," said Dodds. "The consultant nominated a complete United States fiber-optic signal distribution and a separate control system. However, since neither was supported in Australia, we chose to recommend an alternate technology."

One part of the alternative was Peavey’s MediaMatrix, set up for use with CobraNet™. CobraNet™ is a proprietary digital audio protocol introduced by Peak Audio that is one of the standards for delivering audio via 100Base-T Ethernet. With CobraNet™, participating manufacturers can distribute more than 64 channels of full bandwidth (20 Hz to 20 kHz) audio in real time on either Cat5 or fiber-optic cable. The world’s first MediaMatrix install using CobraNet™, its primary function was to serve as the control system’s router, in addition to offering some basic ducking and dynamics functions.

The second major component of the control system was Crown IQ in the first application to use Crown’s new USP2 modules. These modules plug into the back of each Crown Macro-Tech or Com-Tech amp to provide eight bands of parametric EQ per channel plus crossover, delay and load monitoring at the amp itself.

Working in tandem with Crown, Creative Audio also developed a new module that piggybacks one of its custom-built cards onto a USP2 card and allows CobraNet™ to be run directly into the stadium’s Crown BOH amps. Known as a USP2-CN, the hybrid module features dual redundant CobraNet™ ports and two analog audio inputs to enable local audio sources to be brought onto the network.

"With 56 Com-Techs equipped with USP2-CNs, we have 112 BOH channels that travel via CobraNet™," said Dodds. "At the same time, we only have 40 outputs coming out of the MediaMatrix to feed all of those amplifiers. So there are 40 logical paging zones, but we can dynamically allocate different amplifier channels to those zones.

"So, for example, in a sporting event, you would have all of level zero—the whole public entry level concourse—designated as one zone. But for a concert event, if the stage is on one side of the field, they may well want to section off part of that public concourse for VIPs, or they may want to section off part of it as a BOH area. If they want to do that, we can use CobraNet™ and reassign the amplifiers that control those few groups of speakers onto a different paging zone.

"We can reconfigure the whole building’s paging zone structure without needing 112 outputs out of the MediaMatrix. CobraNet™ provided us the ability to easily reconfigure the system amp by amp and zone by zone. In other words, it afforded us a virtual matrix whereby any combination of inputs can be routed to any combination of outputs. It’s a whole new level of flexibility for patching."

Control Specifics

Using a combination of Crown IQ, Peavey MediaMatrix, Peak Audio CobraNet™ and a number of Creative Audio components, The PA People implemented a control system that afforded intuitive operation. Located in the stadium’s control room on level five of the west grandstand, more than 300 feet (91.4 m) up from the track’s finish line, is a MediaMatrix processor and software (v. 3)controlling the routing of all audio. This pairing also provides some initial processing functions, including EQ, delay, limiting and mixing.

Stadium Australia benefits from the latest version of MediaMatrix, which offers CobraNet™ as an option. This version uses a series of RJ-45 connectors on the rear of the product in place of Peavey’s traditional break out box (BOB) interface.
Peavey’s new CobraNet™ Audio Bridge (CAB) boxes provide an interface between MediaMatrix outfitted with CobraNet™ DSP cards and all of the system’s analog inputs and outputs. Unlike Peavey’s previous BOBs, the new CAB boxes can be used remotely to provide either eight analog audio inputs (CAB8i) for paging stations or crowd mics or eight analog audio outputs (CAB8o) for the FOH amps not equipped with CobraNet™.

The CAB boxes are located in the four amp rooms, the communications room at the southeast end of the field on level one, and in the main control room—basically everywhere that analog audio is used. Audio signals are delivered between the CABs and the MediaMatrix hub via Cat5 cable on short runs, such as between the control room and west grandstand amp rooms, and fiber-optic cable on longer runs, including the span between the communications and control rooms.

Another PC in the control room loaded with Crown IQ for Windows software (v. 4) and IQ hardware controls, monitors and tests the amp system. MediaMatrix routes and provides initial processing for the audio signals, and Crown IQ provides control over amp volume levels, loudspeaker load monitoring and digital signal processing—EQ, crossover, signal delay, compression and filters—for each individual channel via the USP2 and USP2-CN cards plugged into the backs of the amps.

"With 150 amplifiers requiring separate processing on every channel," said Dodds, "a traditional system providing everything USP2 provided but driven from the control room would have generated 300 outputs. By using the modules, we created a system that generated only 60 outputs, which is a significant savings Plus, the way we’ve implemented the system using CobraNet™, we have attained several levels of functionality that you wouldn’t get inexpensively in a centrally located process system."

Creative Audio also chose to use Page Server, its proprietary software GUI run on a third computer, this one QNX, which is a 32 bit real-time OS designed for processed control applications, particularly in larger systems. This serves as an interface overlapping IQ, MediaMatrix and all of Creative Audio’s RS-485 devices, including paging stations and wall panel controllers in the suites and source selection panels in the banquet halls.

The actual user interface exists on a PC running Windows NT. Control and monitoring of the system through Page Server is accomplished via a traditional non-audio 10Base-T Ethernet network among the operator’s PC and the three main control room computers. System management is not solely confined to the control room; RJ-45 Ethernet sockets are available in a wide number of locations, permitting a laptop to be plugged in to facilitate system control from many places within the venue.

"The operator’s interface is a client to Page Server. This operator’s GUI provides a central point of control that manages everything one would need in a simple fashion. A graphical layout of the venue featuring cluster positions permits loudspeakers to be turned on and off easily. Pre-recorded messages may be scheduled. Alarm messages are displayed if there’s a failure in any component of the system. The external load monitoring devices, Crown SLM-8s, can be controlled. Music can be routed to different zones. In a nutshell, all of the day-to-day system configuration and operation can be controlled via the GUI."

Although there are engineering interfaces on the IQ, MediaMatrix and Creative Audio servers, this top-level GUI is often the only thing that the operator will have to use. Granted, if an engineer wishes to change the EQ in an amp, he would use the standard Crown IQ for Windows setup, which connects to the same server, communicates with the amps and allows them to create a preset or change it in cue. MediaMatrix RAMM does the same with MediaMatrix, and CA Engineering, The PA People’s engineering application, does the same for Page Server for things like setting paging station configuration. Once changes have been made to any or all of these things, however, the engineer simply saves it as a preset. Then the operator can call the whole system configuration up on the GUI when appropriate.

"In operational terms, we can manage each of the three servers from an engineering perspective, and then the operator simply uses one application," said Dodds. "All that needs to be done to set up the system for a rugby match is to recall the preset for that type of event on the GUI. Then the system is immediately
configured for that application. If the operator wants to add a paging zone, he or she only needs to make a few clicks on a mouse to set it up."

The stadium’s audio complement is further rounded out by a performance audio system for sports presentation centered around a Soundcraft K3 Theatre desk with 16 mono and 8 stereo channels.

"When you’re dealing with events that use playback devices," said Dodds, "you need a number of dedicated stereo channels. The K3 is a true presentation console. It is transformer-balanced on the mic ins, which is critical. By definition, a microphone in a stadium comes from a long, long way away."

**End Results**

Dodds said, "Our control system does everything that the originally specified system would do and more. It has all of the same sorts of features, but it uses genuine Windows applications and RS-485 instead of RS-422 so that you don’t have to do a homerrun for every control port. In fact, we were able to put two complete systems into the job in a redundant pair for close to the same price as the other system would have cost for one."

Certainly essential was the capability for all audio channels to be distributed on common fiber-optic and Cat5 cable rather than on many miles of copper wire. Cable and installation costs are dramatically decreased by going the CobraNet™ route, not to mention the savings that come from not having to purchase and install patchbays and rackmount devices.

More important than the cost issue, the system’s flexibility is perhaps unparalleled for a venue of this size. If this had been a traditional analog system, every time the stadium switched over for a different event, it would require a good deal of re-patching and tweaking. This system, however, requires only that a preset be recalled to have all of the re-routing done, zones reassigned and loudspeakers properly delayed.

This flexibility does not extend to only the control room. Corporate clients renting the stadium’s banquet rooms are able to select from a variety of program options and adjust their volume levels. A healthy number of feeds, provided for media coverage, are available at a variety of locations. Staff members may temporarily install Creative Audio-built paging stations to provide paging facilities and pre-recorded announcements in certain areas when necessary, and intuitive control of the entire system is available from numerous locations around the stadium just by plugging a PC laptop into one of the stadium’s many RJ-45 sockets.

To date, the system has managed to prove itself on a number of occasions. Several rugby matches have packed in well over 100,000 spectators each, with two international soccer events also bringing in the crowds. The San Diego Chargers and Denver Broncos even held a pre-season exhibition game at Stadium Australia. As far as concerts go, the Bee Gees performed the first major show, calling upon the stadium’s system to provide audio for the entire eastern stand while the concert sound company’s FOH rig covered the lawn seats.

"On one of the days that we were first commissioning the system and truly giving it a good listen, the people from Olmstead Productions were on site to see the facility," said Dodds. "OP serves as a game enhancement consultant to the NFL and has produced over 400 halftime shows and sports entertainment events, including the Broncos vs. Chargers game we had here. Peter Dergee, OP’s vice president, commented to us that this was the best sound he had ever heard in a stadium. Coming from a guy of that caliber, someone who has been in as many stadiums as he has, that told us we had definitely done something right."

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For More Information

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www.bose.com

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www.crownaudio.com

Peak Audio
www.peakaudio.com

Peavey Electronics
www.peavey.com

Soundcraft
www.soundcraft.com
New Olympic Stadium Audio System Runs Via Ethernet

By Julius Grafton

From the April '00 Issue of Connections Magazine

Two world firsts:

• One, the Stadium for next years Olympics is ready now.
• Two, the audio runs wholly on Peavey CobraNet™.

It's a sound system of Olympic proportions, the largest public address system yet installed in Australia, and it features world beating unique control technology. The system at Stadium Australia is operational and has just been tested on 104,800 people.

It worked superbly.

Stadium Australia was built in record time, and is the primary venue for the 2000 Olympics, to be held at a massive new site at Homebush - at the western head of Sydney harbor.

The story starts with a tender won by Sydney firm, The PA People, and its manufacturing arm Creative Audio, both headed by Chris Dodds. The original tender was varied when Dodds proposed an alternate system which offered both better features and a significant saving to the
The PA People went on to prove to the consultants and the builders that the alternate system would do everything they required. Now, after 12 months on site, and with over 70 kilometers of speaker cables run, The PA People have delivered the system and defeated the rumors that it wouldn't or couldn't work. If anything, the test was as tough as they come, and came just after commissioning the system. It's a test I wouldn't like so soon after I'd finished configuring a system - because it put the system to absolute limits.

The Mother of All Tests

The Mother of All Tests, that uniquely weird sporting fixture known as a Rugby League match was to be the first function at Stadium Australia. As a season opener, the organizers scheduled a double header on a Saturday afternoon in languid March. They expected 50,000 - a comfortable number. They sold 104,800 tickets and knew they had a full scale test of the entire site infrastructure on their hands. Would all the toilets, flushing at once, overload the pipes? Would 700 kegs of beer all feed at the same time the vast number of bars? Would crowd control and public transport all work? Crucially for Dodds and his team, the event became even more major as entertainment acts were added, and it became apparent the system would be totally utilized.

At the opening event, major musical acts used the system in between the matches. The crowd raised the noise floor as high as it could go, as the players rallied to the spectacle and the vibe of The Huge Crowd. The weather was hot too, which provided an ideal test environment.

The System

The most obvious thing about the system is the largest part - the distributed PA in the arena. Clusters of speakers are logically placed high with sound directed down to the audience, all 110,000 seats.

It must deliver 105 dB SPL by specification - which it now exceeds. The delivered sound is full frequency - there are bass cabinets flown in all the major speaker clusters. On opening nights it produced full fidelity, broad band sound reinforcement - which is beyond what many arena audio systems will do. Often they are designed for vocal/voice projection - from 250Hz to 6kHz - only.

Speaker placement anywhere in an architectural form is crucial to avoid reflections - slap back, or echo. If you put a central cluster of speakers above the exact centre of the field, arrayed 360° to reach every seat, it could be unintelligible due to echo back off the seating area. It'd also be impossible to hang, unless you had a skyhook.
The next design approach could be some clusters around the place, pointed at each stand. These would interfere with each other as the sound from one would reach a seat at a different time delay to one placed elsewhere.

This project benefited from logical design by the consultant, Andrew Prager of Flack and Kurtz, in New York city. The consultants’ role is to maximize the result and to minimize the budget. Hire a good architect next time you renovate your house, and they will save you more than their fee.

The system entails a variety of speaker clusters. There are 20 clusters of speakers rigged under the roof of the main east and west stands, with numerous supplementary speakers underneath the lower grandstand roof and in places where needed.

There are clusters located on the temporary end stand lighting towers, to deal with the two huge temporary stands. These stands will be removed after the Olympics.

Finally, there are speakers distributed on the underside of various stands and in places some fill is required.

The whole philosophy is to direct sound into discrete seating areas with minimal overlap - minimizing any echo and keeping time alignment correct.

There are Four amplifier rooms, and the longest speaker run from these to the most remote cluster is a massive 420 metres. To avoid line loss which happens with all cable, 8mm speaker cable is used (this is rated at 70 amps) which is big cable. This length of speaker cable presents around 1dB line loss with an 8ohm load, according to Dodds. "The impedance goes up, it's the impedance of the cable compared with the impedance of the load that's important - the absolute impedance isn't the issue. The whole design calls for less than 1dB of loss on any one cable".

"For example, if there's two cabinets wired back to one amplifier channel, then there's two cables (back to the amp). If there was one cable, you'd get twice the loss".

The amplifiers used are all made by Crown - 94 MA series for FOH duties, and 56 CT series for BOH - spread equally around four amplifier rooms.

The Speaker System

It's all made by Bose. Originally the specification called for EAW, which is the type that was tendered by all bidders. The P.A. People also submitted an alternate tender, worth about $3.5 million - as much as half the total of some tenders.
To prove that the alternative would work, BOSE provided Modeller and Auditioner analysis to actually demonstrate what a given output from the entire system would sound like in a particular location in the stadium. This acoustic modeling requires the parameters of the venue be loaded into a PC, and a whole lot of number crunching (in Modeller) and auralisation (in Auditioner) later, a given `sound' can be heard on the calibrated Auditioner listening station.

The modeling of the potential results of the alternative PA People tender proved to the consultants and the builders that a BOSE alternative would match or exceed the specification. The reaction in the trade was fairly loud, 'how can this be?' was a common refrain heard here at the Connections Cottage, some ten miles from the Stadium!

Panaray LT cabinets are used in all the main clusters, these are a 2 way weatherproof horn loaded mid/high cabinet, and they are supplemented with Bose 502 BE bass enclosures.

The main cabinets, Panaray LT 3202, 4402 and 9702, are all similar - they are loaded with the equivalent of one or two 10" drivers and one high frequency compression driver. The model numbers denote different dispersion. The 3202, for example, has a breathtakingly narrow dispersion of 27º horizontal by 20º vertical. The PA is an active 3 way system.

"This alternative system differs in terms of certainty of performance" says Dodds, "and this was finally proven this week (at the opening). We knew what it was going to sound like, thanks to the Auditioner process".

**Control**

The control system as supplied bears great similarity in its functionality to the one originally specified by the consultant, Andrew Prager. But it is an alternative.

"We came back with a fully conforming tender, and an alternative speaker system and an alternative control system. The acceptance was based on the alternative speaker system - and during the period of the contract they choose to move to the alternative control system. The original specification called for an IED control system" says Dodds.

"A lot of the control system is our intellectual property, it is based on two third party products, the first being Peavey Media Matrix with CobraNet™. This is the first MediaMatrix installation using CobraNet™ in the world. The control you can achieve with Media Matrix are astounding".

"The second half of the control system, and just as exciting, is Crown IQ - with the new USP series modules which Crown are about to release, and a new card we developed with Crown which makes them the first amplifier manufacturer to be CobraNet™ compatible".

CobraNet™ is a technology owned by an American firm called Peak Technologies. It allows real time transmission of 64 channels of full bandwidth audio on Category 5 Ethernet cable. A 100 Base T Ethernet system, it is recommended that only CobraNet™ be run on any one network. This kind of network is what we have here in the cottage, with blue multi strand cable and RJ-45 connectors on the walls.

It's not dissimilar to your average office Ethernet network, which runs 10 Base T - just faster.

Each Ethernet point runs back to a switch or hub, effectively a node point. In the case of Stadium Australia, and indeed any network covering a lot of floor space, you need to use Fibre Optic cable and transceivers - instead of plain old Category 5 cable.

The wild and exotic aspect of CobraNet™ is that with one cheap and simple Cat 5 cable you can carry 64 balanced audio lines! Try doing that with analogue cable -
you'd have a multicore of about 40mm outside diameter, and almost a week in labor to terminate each end
with 64 XLR connectors.

These days almost every electrical contractor knows almost enough to be dangerous, and even Todd, our
honest but slightly slow electrician here at The Cottage can run Category 5 cable - and almost terminate it
properly. It's easy.

**So where did CobraNet™ come from?**

Remember Lone Wolf and Media Link - that radical new technology first almost seen at ENTECH 1994?
That's right, the demo crashed, and so did the company. But it was a portent of things to come. And it has
little to do with CobraNet™ except for the concept.

Peak Audio invented and licensed CobraNet™ to various pro audio manufacturers, and QSC were first to
market with RAVE - which stands for Routing Audio Via Ethernet. This was shown at ENTECH last year,
and features in another PA People installation, one just completed at the Sydney Opera House.

The RAVE implementation of CobraNet™ is a simple point to point method of shifting audio on cheap and
easy cable. It also potentially allows a card to be inserted into a QSC amplifier, so that instead of running a
balanced analogue audio line to the amp, you stuff an Ethernet cable into it instead. Major advantage: 64
discrete channels on one cable. Choose a channel address at the amp, and that's what it gets.

Possibly inflamed with the power this allows, Dodds and his team at Creative Audio set about engineering
a CobraNet™ card which would fit into their favorite amplifier brand, Crown.

Crown of course own the IQ system, a proprietary method of monitoring and remote controlling a Crown
amplifier.

Dodds figured Crown amps configured with CobraNet™ would/could be linked to Media Matrix, the
Peavey digital audio control and processing system. Peavey probably think the same thing, and are
doubtless developing CobraNet™ cards for their amps too.

At Stadium Australia are two CobraNet™ networks, one for inputs and one for outputs.

**Software City**

To control everything, the system uses a complex but effective overlay of three kinds of software. First in
the chain is version 3 of Peavey's Media Matrix software - on Media Matrix hardware. This is an industrial
strength PC with a central Media Matrix processor, and breakout boxes to handle the analogue audio where
CobraNet™ devices (such as the amplifiers fitted with the new Creative Audio cards) are not used. In this
case, this is the first time in the world that Peavey's new CobraNet™ Audio Bridge (CAB) has been used.
This is a new development for Media Matrix, and allows remote deployment of breakout boxes, something
that couldn't be readily done with the traditional MM BOB - Break Out Box.

Essentially, the CAB boxes are the interface between the Media Matrix fitted with CobraNet™ DSP cards
and the analogue world. A CAB is required anywhere you want analogue audio - either inputs or outputs.
Each CAB is configured for eight analogue audio inputs (CAB 8i) or eight analogue audio outputs (CAB
8o). Between each unit and the MediaMatrix, you run category 5 cable.

Crown IQ software is deployed to operate the amplifiers. Understand that Media Matrix operates in place
of traditional analogue processing devices. Imagine you are at a mixing position. MM will do the EQ,
delay, limiting and mixing role - then send to the amps as many audio outputs as you have hardware for.
But down at the amps the volume of each, and the control parameter monitoring of the amplifiers and the
speaker loads are all outside of Media Matrix. This is where Crown IQ comes in, it does these functions
and provides two way control to a PC loaded with IQ software and IQ hardware.
But two disparate collections of software, no matter how contemporary, do not make an integrated system. This is where The PA People's Creative Audio software overlay kicks in. This is software run on a PC network which provides a graphical user interface upon which can be complex or simplified commands and functions for the customer to utilize. It seamlessly addresses IQ and Media Matrix.

"The way it works is as a client - server network with Media Matrix (V3) and Crown IQ (V4) as servers, and our software as a client. Our box runs our software, code named Creative Audio Stadium Control (CASC) on QNX and is a client of both. The user interface is on another layer, it's a PC running NT and all three systems (ours, MediaMatrix and IQ) are clients."

"Our overlay is the only thing the operator needs to use. The Opera House now use software based on the same core code modules. We can offer to integrate the 'best of breed' software from any other manufacturer into our system."

"We believe our future is based on supplying solutions, in partnership with others. No one can do it alone. We can come up with a package that delivers what the client needs".

This control and monitoring of the system functions using CASC is done on a conventional (non audio dedicated) Ethernet network between the Operators PC (these can be located anywhere in the venue where there is an RJ-45 Ethernet socket) and the main control room computers - Media Matrix, IQ, and CASC. All these are double redundant - meaning there are two of them, and sitting on a hefty uninterruptible power supply.

**If a PC dies, the audio path remains in place.**

The CASC GUI can be set up any way required at an Operators PC. The demo I saw at the Stadium showed a graphic of the whole FOH or BOH systems, with presets for different modes of operation. These modes may involve a particular seating configuration in the stands. Each mode may require different system settings - for example, if the audio focus is to be at one end of the ground, then the time delay for every part of the system needs to radiate in a circle outwards from that very position.

The CASC system can recall a preset the underlying Media Matrix and IQ systems at the touch of a button on screen. The command is sent, Media Matrix and the IQ systems then re-calls every audio setting, equalization, time delay, and limiting - at every amplifier channel.

If the system was to be of a traditional 'analogue audio' type, then an enormous number of signal processors, equalizers, crossovers and line level cables with booster amplifiers would be needed. Even then, the ultimate conventional analogue audio system would be unable to be reset and repatched in anything approaching any less than a working day.

**Tricky Bits: Behind The System**

Peavey would probably say that Media Matrix alone could run the system at Stadium Australia - and in a less than basic sense it could. Media Matrix is a modular digital audio toolbox which does signal processing and mixing functions within a PC - saving patching and acres of rack space.

However the system requirement at Stadium Australia also calls for a phenomenal number of background (back of house, or BOH) speakers - 1,600 to be exact. These are all organized into zones, which can be isolated, and signal processed as required. A significant number of these have discrete audio control, such as in bars, restaurants and suites.

Then there are output splits from audio distribution amplifiers for various purposes at various places around the site, and an input from the Emergency Warning system.
But it's the functionality which makes this into the smartest PA south of the Equator. Example: a paging station. Creative Audio made these to suit the job. A staff person can plug one in somewhere suitable, and assume control of a part of all of, the PA. The microphone in a gooseneck is there for speaking into, obviously. But it's the preset buttons which are trick.

Because of the CASC overlay, the engineer or operator can assign one, several or endless numbers of prerecorded WAV files to one or any button on one or any paging station. A WAV file is a digital audio file, and typically is a noise, chime, or announcement. Hit a button, hear the announcement.

Media Matrix has a flash new feature in Version 3.0, called 'Probe' - which allows you to monitor any stage of any signal path. These 'Probe' outputs can be assigned to any function, anywhere in the system.

Outcome

The main audio control room is up on Level five of the Western Stand. It houses a mixing console (Soundcraft K3), effects, background music generating devices like cassette, CD and tuner, and all the networking equipment.

From here, the engineer or the operator (it may be the same person) can access via PC absolutely ANY part of the sound system in virtually any part of the complex. See on screen what any amplifier is doing. See or hear what signal is going where through the Media Matrix system.

Send different mixes of different things to different places around the largest public venue yet built anywhere in the region. Allow corporate box users to alter their volume or program. Give broadcasters the splits they need, where they need them.

This controllability and functionality is unparalleled, and allows the Stadium owners to schedule virtually any event into the place with certainty that audio is not a problem, now or in the future.

How good is it?

The Bee Gees used the Eastern Stand speaker clusters for delay speakers, secondary to their Meyer system at press time.

About Peaveys CobraNet™

The CAB8i (Peavey CobraNet™ Audio Bridge) has 8 inputs which are software selectable to be mic or line. Gain (before the A/D converter) can also be adjusted by software. In addition to the audio inputs, the CAB8i also has 8 n/o, n/c relays, 8 control inputs (for analogue pots, switches) and 8 control outputs (5v DC for triggering relays, LEDs etc). All of this travels down a single CAT-5 to the next device on the CobraNet™ network. The CAB8i has a single RJ45 port on the rear panel to connect to the CobraNet™ network. In addition, it also has two BNC connectors allowing a second (automatic swap-over) CAB to be connected for redundancy reasons.

The CAB8o is essentially an output (line level) version of the CAB8i. It also contains control ports, relays etc. CobraNet™ uses Fast Ethernet (100 Base T) hardware, not 10 Base T.
The control network on MediaMatrix (using multiple, distributed PC’s to control the system) can run on either 10 Base T or 100 Base T. The audio network however (CobraNet™) must have its own dedicated 100 base T network.

The distance between CobraNet™ devices on the network is limited to 100m on CAT-5, or 2km on fibre (using Media converters at each end to convert from CAT-5 to multi-mode fibre and then back again). A network can have a combination of both fibre and CAT-5.

Each DSP card in the MediaMatrix can support 32 inputs and 32 outputs (or 4 x CAB8i and 4 x CAB8o). Basically, a single CAT-5 comes out of the DSP card (RJ45) and then runs to a Fast Ethernet hub. Each CAB device is then connected to the hub. In the stadium application, there are multiple DSP cards. Each card is essentially supporting it's own CobraNet™ network however all of these networks combine to become one back at the MediaMatrix.

Any combination of inputs can be routed to any combination of outputs.

CobraNet™ is not unique to Peavey - QSC’s RAVE is an adaptation, and more implementations of CobraNet™ technology will arrive Real Soon Now!

**The System Described**

**Speaker System**

**Arena Speakers, Type A**

There are twenty type A clusters distributed along the main front gantry of the east and west stands. There are three sub types:

Type A clusters are located at positions A3 through A8. Each cluster comprises a steel frame loaded with a Bose LT3202 mid/high cabinet, a Bose LT4402 mid/high cabinet, a Bose LT9702 mid/high cabinet and four Bose 502BE bass cabinets.

Type A* clusters are located at positions A2 and A9. Each cluster comprises a steel frame loaded with two Bose LT4402 mid/high cabinets, a Bose LT9702 mid/high cabinet and four Bose 502BE bass cabinets.

Type A** clusters are located at positions A1 and A10. Each cluster comprises a single Bose LT9702 mid/high cabinet. The cluster is permanently mounted to the roof structure.

Type B clusters are located at positions B1 through B5. Each cluster comprises a steel frame loaded with a Bose LT9702 mid/high cabinet.

Type C speakers are located at positions C1 through C26. Each cluster comprises a Bose 502A full range cabinet fitted with a Bose CVT-5 constant voltage transformer. The clusters are permanently mounted to the underside of the Level 3 cantilever.

Type D clusters are located at position D1 and D2. Each cluster comprises four Bose LT3202 mid/high cabinets, two Bose LT9702 mid/high cabinet and a steel frame loaded with eight Bose 502BE bass cabinets. The clusters are permanently mounted to the temporary end stand lighting towers.

Type E/F speakers are located at positions E1 through E8 and F1. Each cluster comprises a Bose 402E full range cabinet.
Back of House Speakers
There are four loudspeaker types employed in BOH areas. They are the Bose Model 8, Bose Model 25, Bose Model 32, and Bose Model 502A:

Model 8’s are used in toilets and areas requiring low level

Model 25’s are used on Level 1, 2, 4, and 6 in public areas amplifiers including dynamics, equalization and delay.

Control of the Modules is via CrownBus current loop derived from Creative Audio CNIQ1 CobraNet™ to CrownBus interfaces adjacent to the amplifiers

Front of House SLMB Load Monitoring
There are 24 Crown SLM8 Speaker Load Monitoring units in the system to monitor the FOH speakers. Six units are installed in each of the four Amplifier Rooms, adjacent to the amplifiers.

The SLM8s connect directly to the MA series amplifiers (audio load side) and to a CrownBus local to the room, to permit load monitoring and reporting.

Control of the SLM8s is via the CN-IQ unit connected to the local CrownBus. Audio from the SLM8 monitor bus is connected to the CN-IQ to permit remote audio monitoring of the MA series amplifiers via the CobraNet™ network.

Back of House CT Series Amplifiers fitted with USP2/CN Modules.

There are 56 Crown CT series amplifiers fitted with Crown/Creative Audio USP2/CN modules in the system. They are located in each of the four Amplifier Rooms.

The USP2/CN modules provide all standard audio functions available from the current version of IQ for Windows including dynamics, equalization and delay, load supervision, and CobraNet™ source and monitoring channel selection.

Control of the Modules is via the CobraNet™ network that delivers audio to the amplifier.

Crown IQ Bridge CN-IQ
The CN-IQ bridge translates control system data from CobraNet™ to Crown Current Loop format. This enables the control system to communicate with the amplifiers and other Crown IQ components.

Peavey CAB8i CobraNet™ Audio Bridge
The Peavey CAB8i translates audio carried on the CobraNet™ back to analogue format for use by the FOH amplifiers and the hard of hearing systems.

There are two CAB8i units in each amp room. The ‘buddylink’ system enables automatic changeover should one network or CAB8i device fail.

CobraNet™ Hubs and Patch Bay
There are two 24 port Fast Ethernet hubs each fitted with a Fibre Optic input, and an associated 24 port CobraNet™ patchbay in each amp room. These Hubs and patch bays represent the A (black) and B (yellow) CobraNet™ networks.
Peavey MediaMatrix

- The system utilizes two MM940 main frames with dual 'hot swappable' power supplies, each fitted
- Model 32's in areas with ceilings requiring higher level
- Model 502A's in high roof areas such as the Banquet Halls, main Foyers, and temporary end stands.

Amplifiers, Signal Processing and Load Monitoring

Signal feeds from the sound control room to the amplifiers are via a fibre optic CobraNet™ distribution system.

Every amplifier in the system is fitted with a signal processing card with the following features:

- eight bands of parametric EQ per channel
- crossover
- digital time delay
- amplifier monitoring and control
- preset configurations

Front of House MA Series Amplifiers fitted with USP2 Modules

There are 94 Crown MA series amplifiers fitted with Crown USP2 modules in the system. They are located in each of the four Amplifier Rooms. The USP2 modules provide all standard audio functions available from the current version of IQ for Windows and possible within MA series with four MM-DSP/CN processor cards.

The Media Matrix units are controlled from either the Operators GUI or the Engineering GUI, and also accept commands from the control system relating to the recall of presets and the routing of audio as requested by the paging system and paging stations. The MediaMatrix will also route audio to and from the .wav player for the replay of messages.

Inputs to the MediaMatrix from the eastern stand are converted to CobraNet™ format in the Comms Rooms located on Level 1 South East, using Peavey CAB8i interface boxes. Inputs to the MediaMatrix from the western stand are converted to CobraNet™ format at the Control Room L5 West using Peavey CAB8i interface boxes. All Peavey CobraNet™ nodes are duplicated and wired in parallel using the sync detect feature to enable automatic changeover should one unit fail.

CobraNet™ Hubs and Patch Bay

CobraNet™ audio is distributed using standard Fast Ethernet hubs. There is one network connected to the Comms Room, and one Network Connected to the Amp Rooms. On the Comm's Room network, there are two 8 port Fast Ethernet hubs each fitted with a Fibre Optic input. On the Amp Room Network, there are two 8 port Fast Ethernet hubs, and two Fast Ethernet modular switches each fitted with four fibre ports and two copper ports. There are also two 16 port CobraNet™ patch bays.

Fibre Patch Bay

There is a fibre patch bay located in the Sound Control room which terminates the fibre cable to/from the Comms Room and the four Amp Rooms. The fibre is then patched directly to the CobraNet™ Hub fibre inputs.
Networks

Networks comprising various serial configurations are used to interconnect controlling devices, interfaces and controlled devices. In some cases control data travels with audio data on the CobraNet™ Networks. Network Elements are as follows:

**CobraNet™ Network**

These Ethernet networks carry both digital audio and IQ control data throughout the stadium. Dual networks provide fail-safe redundancy. These networks connect to the following:

- Ethernet Hubs (Copper and Fibre)
- All USP2/CN modules
- All Creative Audio CNIQ1 CobraNet™-CrownBus interfaces
- All Creative Audio CN232 CobraNet™ to RS232 Interfaces
- All MediaMatrix CobraNet™ ports.
- All Peavey CAB Analog Audio - CobraNet™ interfaces

**10 BaseT TCP/IP Network**

This Ethernet network is for transmission of data only chiefly within the Sound Control Room between Controlling Devices and interfaces.

**RS485 Network**

Four independent RS485 networks interconnect all devices with RS485 control requirements.

**CrownBus Networks**

Five local CrownBus networks link CrownBus devices within each Amplifier Room and the Sound Control Room. Each CrownBus network connect to the following:

- Creative Audio CN-IQ1 CobraNet™-CrownBus Interfaces
- All Crown SLM8 Load Monitoring Units
- All Crown USP2 amplifier modules

**Local RS232 Interconnections**

Local RS232 interconnections will be used in the Sound Control Room to link each MediaMatrix RS232 Port to the CobraNet™ networks (for Crown IQ server access to CobraNet™), and to link each QNX RS232 port to the Remote Access Server.
CobraNet™ Shines in Olympic Park Audio Network
By Keith Clark

While the Sydney 2000 Summer Olympic Games are fast becoming a pleasant memory, digital audio and routing technology implemented for the event portends significant and lasting implications.

Perhaps nowhere is this more in evidence than at the Olympic Park campus, which features an extensive public address system running on a fiber-optic backbone, expected to be in operation for at least another decade. Located in Homebush Bay, often referred to as the demographic heart of Sydney, the campus forms a 2.5km circle surround the Olympic Stadium and it includes a dozen other sporting and exhibition venues developed for the games.

From the outset, the campus was designated to remain a permanent fixture, with extensive residential, recreational and retail areas complimenting the athletic facilities. A commercial center for high-tech industry will also will also emerge, further revitalizing an area that previously had been, among other things, a naval armaments depot and waste dump.

As one of Australia’s premier design and integration firms, The PA People were already busy implementing a complex distributed sound system at the 110,000-seat stadium when summoned by Olympic organizers to have a look at the campus-wide PA system. Chris Dodds, managing director of The PA People, notes that although the fiber optic pipeline had been established to transport audio, lighting and CCTV, along with commensurate control data for each, serious concerns about the audio segment had arisen.

"The client conceived what is best described as a ‘mass transit’-style public address system that would also allow entry of localized source devices to be introduced on the fiber network, with this input distributed to selected zones," Dodds explains. An attempt to attain the first phase of the project by the previous contracting firm can be quickly summed up as analog audio modulated on the fiber system with limited routing to zones via a single 16-input by 16-output matrix, falling short of expectations in terms of performance quality, flexibility and functionality. This direction scrapped, organizers turned to ARUP Acoustics, a leading Australia-based electro-acoustics firm, as well as The PA People a scant 20 weeks prior to opening ceremonies for a more effective approach.

"Our development of a complex control and routing scenario at the stadium, easy in operation, attracted the interest of the client and they wanted us to create something similar for the campus-wide system," Dodds says. "We were merging technologies such as Peavey MediaMatrix, Peak Audio CobraNet™ and Crown IQ with proprietary digital designs from Creative Audio, our sister company, into a comprehensive front-end package. It was fairly obvious that something like this could be adapted quickly for the campus."

The revised bid on the project was broken down into bite-sized chunks, with four main phases.

- Phase one: supply and install MediaMatrix and CobraNet™ hardware and software to replace the existing matrix;
- Phase two: new Crown amplifiers outfitted with CobraNet™-ready Creative Audio modules to drive JBL loudspeakers in existing areas previously installed,
- Phase three: a new control and messaging package to be developed and deployed;
- Phase four: the balance of JBL loudspeakers and Crown amplifiers with Creative Audio modules to be installed.

Chosen to design and implement all four phases under the direction of ARUP Acoustics, The PA People installed speakers in more than 80 individual audio areas throughout the campus. An extensive set of paging priorities and hierarchies would supply live system-wide paging, live paging to designated zones, pre-recorded message and background music, again system-wide or by select zones, and most notably, local inputs and wireless microphone system inputs scattered throughout the campus, available for localized entertainment, presentations and paging.
Open Platform
In basic overview, the system can be described as a central control front-end networked with several distributed "nodes" via the fiber backbone. But in reality it’s a bit more complicated than that. First, this project marks the first real-world application of Peak Audio’s implementation of Simple Network Management Protocol (SNMP) for addressing all CobraNet™ devices on the network.

Further, Creative Audio’s latest generation amplifier control/interface module — accommodating SNMP - has been implemented, enabling the dynamic control of CobraNet™ bundles and channels from the host application.

"Ultimately what this means is that we have an open platform for all CobraNet™ devices. For the previous installation at Stadium Australia we used Crown IQ software for control of the CobraNet™ bundles and channels within the amps, but by using SNMP we’ve streamlined the communication process, cutting a layer that’s no longer necessary," Dodds says. "At a point very soon, I think we’ll also be able to utilize this Peak platform even more efficiently, for example, in terms of matrixing and routing. In this project we have been able to integrate CobraNet™ products from Peavey, QSC (RAVE), and our own Creative Audio amplifier modules".

Conceptually, SNMP is simple, yet that belies its sophistication. It has two basic commands: "get a value" and "set a value". Any CobraNet™ device on the network runs a piece of software called an SNMP agent, which oversees a collection of variables that represent the state of the device being managed. Within the campus system, the SNMP agents are managed via the Creative Audio software at the system’s central control position.

Control Packages
Officially dubbed the Homebush Bay Operations Center (HBOC), the central control position houses "a conglomeration of computers and bits and pieces that make the whole thing work", Dodds says. The main audio routing system is a Peavey MediaMatrix 940 running their version 3.1.1 software and outfitted with six CobraNet™ digital signal processing (DSP) cards.

The heart of the control system, effectively the control server, is an Intel-based PC running under QNX, a ‘real time’ POSIX compliant operating system. This box runs all the processor software such as Creative Audio’s PageServer, which manages all paging requests and priorities, and EventScheduler, which initiates all time-based requests. These two programs also work with the SNMP and MediaMatrix RATC interfaces, which communicate the appropriate requirements to the various amplifier modules and the MediaMatrix itself.

Three additional Intel PCs form the message playback and ‘store and forward’ elements of the system. Each unit is loaded with a new Creative Audio CobraNet™-PCI card, capable of simultaneously recording and playing back full bandwidth CobraNet™ audio. Under control of the WaveDev process, these units supply the playback of scheduled messages and the ability to store and forward live announcements when destination zones are busy. They differ from standard sound cards in that they’re multi-channel and include a direct CobraNet™ interface.

Messages are created as standard .wav files and are stored on the hard drives of the message PC’s. Capability in this regard is quite impressive, with 24 channels of simultaneous playback capability available along with 8 additional channels dedicated to recording for store and forward, providing an ample queue so that live announcements don’t clash with regularly scheduled messages.

The other primary control element consists of a Windows NT computer, which runs a copy of CobraNet™ Discovery software along with Crown’s IQ Server. Discovery is the mechanism for assigning IP addresses and managing and updating CobraNet™ firmware. All of the CobraNet™ devices require an IP address to facilitate communication via SNMP. IQ server allows anyone connected to the network with a copy of IQ for Windows to establish communication with the amplifier modules for system setup and monitoring.
"One of the notable things about this system and the SNMP implementation is that in the field, there are 48 local and wireless mic inputs," Dodds notes. "But in terms of CobraNet™ channels and traffic, and the size of the MediaMatrix system, we’re restricted to only having 12 of them active at any given time. This means that a key part of the whole management software application is the dynamic assigning of CobraNet™ bundles and channels addresses to those 12 inputs/wireless mics in use at any given time."

With the software interface, system operators choose which of these inputs are active, for example, Local Input Node 12 to be active to "x" system zones. When the assignment is made, the software communicates with the CobraNet™ devices in the designated node, and they provide the commanded routing. "Quite likely, this is the first time that this capability has been done, in CobraNet™ terms," he says. "Up to now, everything has been static. But now it’s flexible and dynamic in terms of routing, and this is just the tip of the iceberg, with more to come soon."

The PA People are currently working on projects incorporating similar capability and more. Dodds conjectures that continued progress could potentially eliminate the need for hardware-based routing and matrixing, to be replaced by an actual on-network matrix utilizing CobraNet™.

Analog audio inputs and outputs in the HBOC area are handled by both 8channel and 16 channel CobraNet™ Audio Bridge (CAB) units from Peavey, while I/O in selected venues use Rave 88 units from QSC. All audio interfaces to the MediaMatrix employ CobraNet™, via Peavey’s CobraNet™ DSP cards.

**Distribution & Routing**

Distribution around the campus to each node is accomplished via an existing fiber network, which utilizes 3Com 3300 Superstack network switching. The PA People chose to continue the use of the 3Com equipment for the new CobraNet™ sound system implementation. (There were 21 nodes for the full-blown Olympic system, with about 24 in the final implementation including feeds to and from venues and other facilities). Separate Virtual Private Networks (VPNs) were implemented across the same physical link to separate CobraNet™ audio data from control system data.

In the computer room a set of three Superstack switches was implemented with a 3Com ‘matrix module’ backbone between them (two 8-port 100baseFX Fiber switches for the feeds to the nodes and a 24-port 100BaseTX switch for the local equipment). This was then linked to the actual HBOC area (where the operators sit) via a Gigabit fiber link and a second 24-port 100BaseTX switch. At each of the nodes there are 12-port 100BaseTX switches fitted with dual 100BaseFX fiber modules.

**Node Electronics and Speakers**

Each node houses a 3Com switch and up to six Crown CT- and MA-Series amplifiers each outfitted with the proprietary Creative Audio CobraNet™ USP/CN amp module. From there, the amplifiers deliver the assigned audio programming to loudspeakers mounted on poles, the majority being weatherproofed JBL Control 28T60’s, with JBL Marquis MS105’s, also weatherproofed, and used to cover larger areas. Design of this specific facet of the project fell under the direction of Glenn Leembruggen of ARUP Acoustics, who undertook significant analysis and came up with an electro-acoustic solution that provides hi-fi like reproduction throughout the campus. (A significant quantity of amplifiers and loudspeakers, in addition to extra nodes, were added to the network on a rental basis for coverage to areas such as the Expo during the Olympic Games.)

The Creative Audio CobraNet™ amp modules also offered additional functionality that proved quite valuable. The modules feature two inputs that may be used to place signals on the CobraNet™ network. Remote source devices, such as Shure U4D wireless microphone receivers, can access these inputs via XLR connectors at every node. The inputs also serve as ports for introducing other remote sources onto the network. As an example, several locations have been outfitted with ambient level control noise sensing microphones that access the MediaMatrix via the amp module inputs and the CobraNet™ network.
"All nodes also include an Ethernet access point which enables laptop computers to be plugged in for system configuration and control," Dodds adds. "In such a widespread system, this can be invaluable in terms of convenience, time savings and real-time optimization of any node."

**HBOC Control Room**

The HBOC central control position includes 24 touch screen PC’s running proprietary GUI (graphical user interface) software. Part of the contract requirement was to integrate the control of the PA system with the GUI system that was being employed to operate the CCTV and security systems. To facilitate this request Creative Audio wrote an interface so that it could seamlessly communicate with all audio control system software, including PageServer and EventScheduler. A strata of password protection eliminates unauthorized access to key operation parameters.

System operators use the screens to select zones, play messages to zones, or to monitor zones. Live announcements can also be made, when needed. Operators are outfitted with headset interface boxes, devised and built by Creative Audio, that allow them to communicate via phone lines, utilize two-way radio, or make announcements to and monitor the PA system.

**Engineering Interface**

While the control room operators use the interface described above, the system supervisors manage event schedules and system setup via a special Creative Audio GUI. This GUI allows for the immediate assignment or time based scheduling of messages, local input assignments and background music; preview of a days scheduled events; control of paging and background music levels; a review of system alerts and alarms; and the allocation of physical areas to paging zones. It also has a password protected section featuring a full-system diagnostic log and other CobraNet™ diagnostic tools.

Creative Audio’s software design philosophy revolves around the creation and use of core system processes, however in order to meet clients exact requirements a custom GUI is created where required. For example in this project there are no physical paging stations (these being replaced by the HBOC operator interface), so there was no requirement for a paging station configuration page in the GUI.

**Looking ahead**

"The biggest risk in this particular project was the extremely short time frame available to complete the work. This gets even more crucial when you look at the number of specialized devices that needed to be fabricated by Creative Audio and then successfully implemented," Dodds says. "Software development and interface is also not an easy task. So when you look at it, there were four contracts that had to be fulfilled concurrently, each with thousands of variables and custom development to be successfully completed."

No small charge indeed, yet the system was fully in place and being tested a full eight days before the Olympic Games began. All bugs were eliminated three days prior. About 80 percent of the amplifiers and loudspeakers of the original system remain deployed and in operation, expected to continue into the foreseeable future.

"We see many future applications of what’s been achieved here, particularly for large-scale distributed systems with lots of zones and lots of sources, with potential conflicts needing intelligent system management. Airports and other mass transit facilities, theme parks, Vegas-type attractions — all will benefit from technology of this sort," Dodds concludes. "We’ll continue our refinement process on each project, and Peak Audio/CobraNet™ shares the same commitment. It bodes an exciting future."
Sydney Opera House

The world’s most famous performing arts venue, the Sydney Opera House, relies on a CobraNet™ fiber-optic based digital audio network. Routing audio throughout such a complex, multi-purpose facility, posed several challenges for the PA People, a prominent Sydney-based systems integration firm and Creative Audio, its sister company in Brisbane. The system had to be versatile enough to handle multiple audio inputs and control sources simultaneously; large enough to distribute audio to 65 remote paging zones and flexible enough to satisfy individual production communication requirements of each venue and peripheral support areas. As with all paging systems used partly for emergency purposes, it had to be virtually fail-safe.

With a very close proximity to the main shopping areas in the Harbor area, an extremely high RF environment, the Opera House was highly susceptible to interference. There was also a significant amount of electrical noise radiation within the building, which made the system design even more challenging.

"To meet the design requirements that were proposed, we clearly needed a fiber-optic signal distribution solution," says Chris Dodds, managing director of the PA People. "CobraNet™ was the only viable solution. We have found CobraNet™ and the QSC RAVE / MediaMatrix combination to be very useful in a number of difficult audio signal transport, distribution, and signal processing / routing problems."

The 100BASE-T audio network is basically arranged in a star configuration. At the center of the star is a central control room, which houses two redundant MediaMatrix systems. MediaMatrix handles all audio signal routing for the paging system, as well as signal processing functions. The endpoints of the star topology are eight outlying audio racks located throughout the complex that house various components of the audio and data networks. A fiber-based RAVE digital audio network routes the audio between the control room and the outlying locations. A separate 10BASE-T data distribution network, not connected to the audio fiber network, is used for system control purposes. The entire system is fully redundant in order to ensure that the signal path remains intact if the primary network fails.

The RAVE88’s in the central control room each handle up to eight AES/EBU digital inputs and outputs and interface with the MediaMatrix via an AES / EBU daughter card interface, ensuring that audio remains in the digital realm throughout the network. Outlying audio racks contain a RAVE 188 – each handling as many as eight analog inputs and outputs. Paging audio signals, whether from pre-recorded messages, live announcements, or miscellaneous sounds such as bells or chimes, are routed through the RAVE 188 inputs to the MediaMatrix, where they are processed and re-routed back through the network to the paging amplifiers and loudspeakers.

The SOH paging and communications system demonstrate how a CobraNet™ network, utilizing standard, affordable networking devices, can effectively transmit multiple channels of audio throughout a complex venue. Long distances no longer have to require an expensive, inflexible copper-cabling infrastructure. CobraNet™ networks solve those problems by routing dozens of channels of digital audio – free from EMI and ground loops – over distances of up to two kilometers.
Central Christian Church

Using computer networking technology to distribute audio

By Dave Dugdale                      Acoustical Design Group, Inc

The system was designed by Acoustical Design Group of Mission, Kansas.

There are always a number of challenges when designing a church sound system. Central Christian Church (CCC) in Wichita, Kansas was no exception. Lee Lundgren, the director of audio/visual communications at CCC, knew right from the start what he wanted in their new 3,000 seat sanctuary. He wanted state-of-the-art, cutting edge, audio processing technology in applications that, in some cases, had not yet been developed.

The biggest challenge was to provide nearly universal access, through multiple locations where all microphone and line level inputs are available at the Front of House (FOH), stage monitor mix location and recording room. Lee was also looking for an easy way to move the stage monitor mix portable cart without using large bulky multi-pin connections.

To address this dilemma, Acoustical Design Group, Inc. (ADG), the project acoustical consultant, decided that CobraNet™ technology from Peak Audio was the key. ADG used the CobraNet™ technology to create a "digital snake system." From the stage location, 40 microphone receptacles were routed to each of the three mix positions using five Rane NM84 network preamps located backstage. The NM84's amplify the microphone signals and convert them into packets of data which then are broadcast across the network using Cat 5 cabling and network switches. Two NM84's located at the FOH interface the choir microphones, program source equipment, and wireless microphones.

A number of QSC Rave units take the packets off the network, and distribute them to the FOH, the stage monitor cart, and the recording room.

Lee Lundgren wanted to use a large number of Yamaha O2R consoles which solved the church's need for recalling the reverberation, noise gate and equalization parameters. However, since the Rane NM84's preamplifiers were located at the backstage location, a creative solution was needed to allow operators to adjust them from any of the three mixing locations. With Active-X controls, ADG and Rane developed a screen which allows preamp control from just about anywhere, simultaneously. This is a very powerful feature, considering the only way to adjust them previously, was to walk backstage and make a preamp adjustment manually.

In any live reinforcement situation, the amount of delay introduced into the system must be kept in check. Subjectively, a delay greater than 8 milliseconds in stage monitor loudspeakers could prove distracting to the performers. Paying special attention to the amount of delay introduced into the system during the design process can often save valuable time and effort during installation and commissioning.

The CobraNet™ system proved to be a much greater challenge for ADG to commission than they originally expected. There were problems ranging from incorrect Cat 5 terminations, to a defective switch and many challenges in between. This project quickly pushed ADG from being proficient at troubleshooting in the analog realm, to becoming knowledgeable in the digital domain. They learned that in addition to the tools normally used to guide you through an audio system commissioning, such as an oscilloscope and VOM, network analysis tools are also very useful. Learning how to troubleshoot a network using software, switches loaded with Java Applets, and Cat 5 cable testers became the key to success.
Wembley Stadium in London, England

BACKGROUND

Wembley Stadium, in London's north-western suburbs, is without doubt the world's most famous football (as in soccer) ground. With a capacity of nearly 100,000, it is one of the largest sports stadia in Europe as well as being one of the UK's most instantly recognizable landmarks. It was with some pride, therefore, that specialist UK systems company M+D Design were appointed to update the stadium's sound system in 1999. One of M+D's specialization's is Life Safety techniques, and they have developed their own product line of fault reporting and custom control systems for large venues. The brief was to replace the existing single fibre distribution system (installed in 1989) with a dual-redundant network, incorporating multiple fault detection in each zone, and to replace the many hardware equalizers and limiters in each zone with venue-wide digital domain processing. At the same time, a more sophisticated touchscreen-based paging control system was to be introduced.

MAXIMUM REDUNDANCY

M+D chose to implement the new distribution system using CobraNet™ technology. A total of 14 racks - 2 main and 12 subs - are installed around the stadium. In addition to containing the power amplifiers for the immediate area, the sub racks each contain a Peavey Miniframe 108, and the two main racks a Miniframe 208. These are all networked together via Ethernet for control purposes, and all are fitted with CobraNet™ interface DSP cards. This network of 14 MediaMatrix units provides totally decentralized processing for the system, providing a very high degree of redundancy in that half of them can fail simultaneously and the system still function normally. This installation is believed to be the largest MediaMatrix system outside the USA.

COBRANET™ THROUGHOUT

Two dual runs of fibre cable were laid around the entire stadium, forming two double, concentric, interwoven rings, starting and finishing at the Main Control Room (situated between Wembley's famous twin towers). The sub racks’ connections to the fibre rings was alternated, such that Ring Pair A served the odd-numbered racks and Ring Pair B the even, for maximum redundancy. Furthermore, as each pair used primary and secondary fibres, even greater failsafe protection was afforded.

Each amplifier sub-rack included a two-channel fibre hub, with automatic changeover to the secondary ring in the event of failure of the primary. The hub converts the incoming bitstream to a number of CAT5 outputs; one to each of the 8 channel CobraNet™ output units in the particular subrack; one connects to the CobraNet™ port on the local Miniframe 108; one provides the Ethernet link to the Miniframe. Thus audio and control data are multiplexed within the same bitstream.
CONTINUOUS FAULT MONITORING

Continuous monitoring of every CobraNet™ unit is carried out by M+D’s proprietary SID units, which are interconnected via two concentric CAT5 rings using the same alternate-connection method as the fibre rings. The SID units’ primary function is to monitor the 20kHz low-level trace tone (superimposed on the audio within the MediaMatrix system) at the amplifier outputs, thus detecting the failure of a single channel of amplification. The CAT5 fault detect ring is monitored by the main server in the Control Room.

CUSTOM CONTROL SYSTEM

A unique aspect of the system is that the entire MediaMatrix system is controlled via the Ethernet network from a main network server PC. This system uses Peak Audio’s RATC (Remote Access Terminal Control) system, which permits full control of every parameter of the system with standard TCP/IP protocol. It also means that the user interface can be designed to be absolutely specific to the installation, thus requiring no knowledge whatever of the MediaMatrix system itself on the part of the operators.

This is an area of system design in which M+D Design have become specialists, and for Wembley provided a set of custom paging stations with large LCD touchscreens for the main control desks. These display a very clear, color-coded plan of the stadium, enabling an operator to immediately select a single area, multiple areas or the entire stadium for paging. Fault conditions and non-availability of an area are also displayed on the plan. The paging stations themselves consist of a dedicated life-safety-compliant CPU separately networked to the main server.

The RATC system is impressively fast; when an emergency status is actioned, levels and delays for every amplifier feed in the stadium are altered - over 800 parameters; and their new settings confirmed back the server by the local miniframes, all within half a second.