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ON THE COVER

Sure, the playing is great, but the JALC facilities are top-notch, too. Photo by Brad Feinknopf. Cover design by Michael J. Knust.

Wireless Broadband Internet Remotes

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CONTENTS ONLINE

Currents Online

Selected headlines from the past month.

SBE to Offer New Specialist Certification

The certification will cover digital radio transmission technology and carry the designation Digital Radio Broadcast (DRB).

Enco Integrates Sound Exchange Reporting into DAD

Support for the Sound Exchange reporting is a no-charge feature and is available to any DAD user currently under a technical support agreement.

Government Accountability Office Releases EAS Report

The report notes several shortcomings with the current system and includes observations from the SBE and PPW, but its suggested solutions are vague.

NAB Photo Blog 2007

The sights of NAB2007 are captured by the staff and contributors of *Radio* magazine.

Best Buy Adds Digital Radio Line

All 832 Best Buy stores will carry HD Radio receivers. Best Buy will also initiate a consumer education effort.

Ibiquity Launches Next HD Radio Rebate Program

The $40 rebate applies to most HD Radio receivers and runs from April 29 through July 3, 2007.

Logitek Enhances Artisan, Mosaic Consoles

The enhancements add additional faders, pop-up EQ and dynamics screens, and Vsnapshot.

Site Features

New URL, Same Great Website

The URL for the *Radio* magazine has changed. The old one still works, but now it's easier than ever to find the Radio Technology Leader online: RadioMagOnline.com.

Digital Radio Update Twice a Month

Stay up to date with the source of digital audio broadcasting news and information. The coverage extends to DRM, satellite radio and more. Subscribe today.

Tips in the Engineers Notebook

Got a tip on a fix or an innovative solution? Share it with us for the Engineers Notebook. It includes handy formulas, and ideas to help you around the station.

Advertiser Links

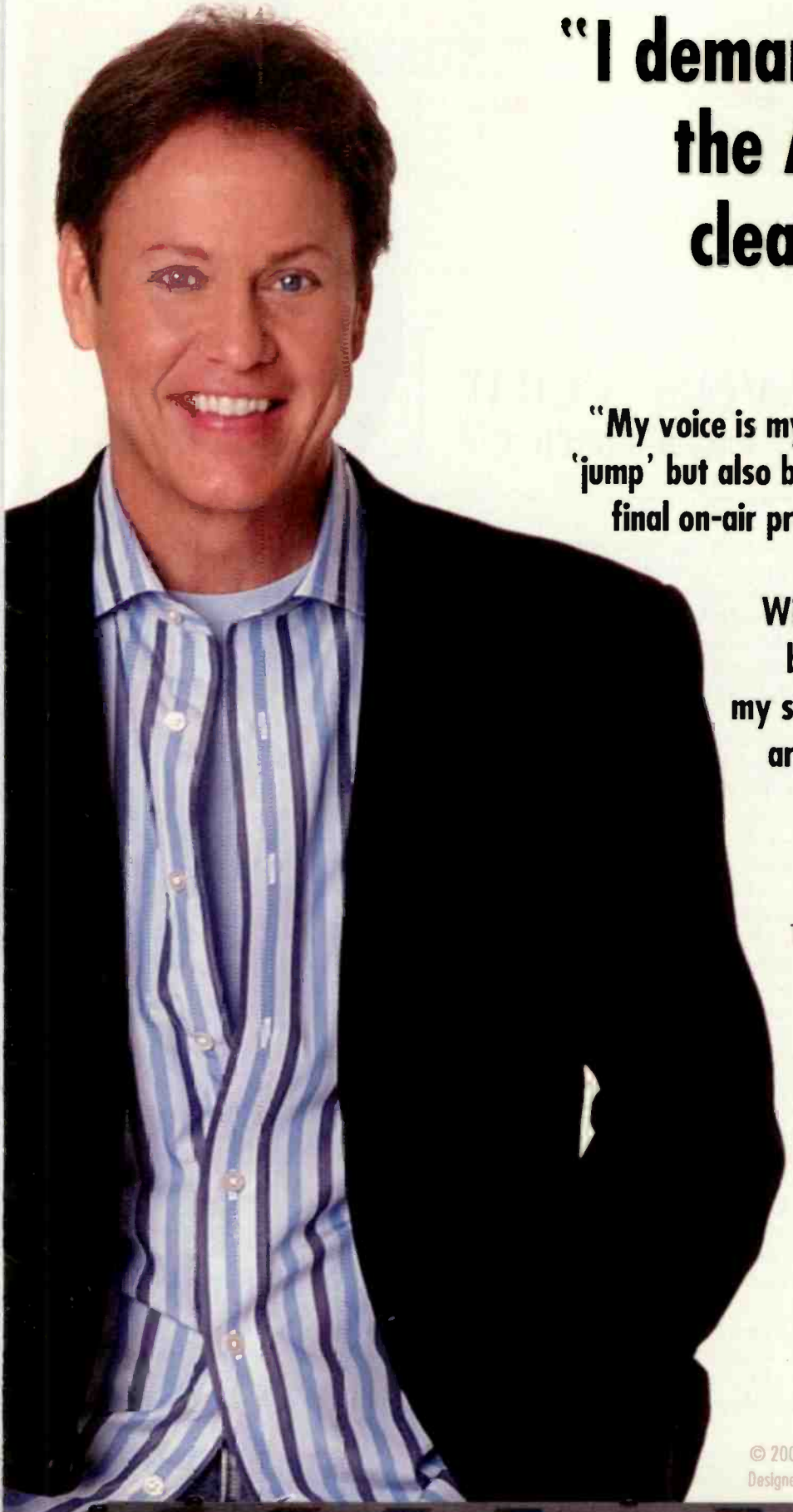
Web links to the advertisers in the May issue.

Industry Events

The *Radio* magazine Industry Events section lists upcoming conventions and conferences. Be sure to send your radio event info to us at radio@penton.com.

Industry Links

Find schools, museums, associations and more.



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How was your NAB experience?

It's behind us now, but overall, NAB2007 seemed to be a good convention for everyone. We're still compiling all the specifics for our June issue, but until then, I'll share some immediate impressions from the annual gathering.

For radio attendees, the most obvious change was in the layout of the North Hall. For several years, the east end of the North Hall has been the radio exhibits area. This year, the radio exhibits were in the west end, and the east end hosted companies mostly focused on production. In addition, more pro audio exhibits were included in the North Hall.

Before the convention, some manufacturers told me that they were not pleased with the layout change. My feeling is that the change wasn't really that big of a deal. Exhibits were shifted a little. As an attendee, you're going to find the companies you want to see no matter where they are. As it is, having audio for other applications seems to have helped draw more booth visitors to the North Hall as well, which usually helps all the exhibitors.

Personally, I still prefer the North Hall. It's a comfortable size, it's well lit and it's not too loud. The Central Hall is a close second. I dread having to go to the South Halls. The exhibits are huge, and the overall noise level is excessive. I will say that the noise level in the South Halls seemed to be lower this year than in previous years.

The big question during and after every convention: what was hot? The easy answer is the *Radio* magazine Pick Hit awards. These 15 products are now part of a tradition that started in 1985. Look for the winners at RadioMagOnline.com and in next month's issue.

Beyond the Pick Hits, there are general observations as well.

There are always new products on display, but was there really a major breakthrough? I'm sure that some exhibitors would say yes, but the general feeling that I heard and experienced myself was no.

Don't misunderstand my meaning, there were lots of innovative ideas. Some included more affordable variations of existing ideas (more punch, lower cost). Some tied two or more existing ideas into a new application. Some just found a better way to accomplish an existing task.

Have we reached a point where everything has been invented? I doubt it. I think we have reached a certain plateau where we know that processing power, data rates and overall efficiency will continue on a curve, and ideas formed today can be targeted to deliver on a predicted point on that curve.

New products right now are based on incremental improvement, not sweeping change. That's a comfortable position in which we have resided for the last few conventions, and it allows us to adapt and adjust. I think we're on the verge of the technology rise, so the coming conventions will likely have some significant breakthroughs.

All that said, what was the prominent focus? Once again, it was IP. It's hard to not find something with some form of networking (usually IP) in it now. This has been gradually increasing each year and includes not just IP control, but audio over IP as well.

HD Radio continues its steady progress. The latest concepts being shown were an electronic program guide and conditional access. Both are not yet ready for implementation, but the ideas are there and the right time will come.

But HD Radio wasn't alone in the digital radio focus. FM Extra continues to attract attention, and a batch of receivers helps to show that it has both sides of the equation covered. Some of the data capabilities were also demonstrated. DRM had some presence, too.

In general, it was another year of incremental advances, but they were important advances nonetheless. The radio broadcasting and digital media foundation continues to be augmented and diversified, which prepares us for the next wave of advances.

Chriss Scherer

Meet Some Real-World Super Heroes...

Mark Ericson and the WOKQ morning team, along with Steve Vanni from Technet, recently used ACCESS to deliver a three hour remote from the top of Mt. Washington. For mere mortals, this would have been an impossible task. The height, the weather, the distance – all conspired to prevent a successful remote. But because they carried ACCESS, they became real-world super heroes.

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- **Cancun:** Sunrise Over IP
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- **Alpena/Tawas City, MI:** Are You Tired of STL-Over-the-Public-Internet Stories Yet?
- **Dallas:** The Ticket
- **Amarillo, TX:** You Gotta Do What You Gotta Do
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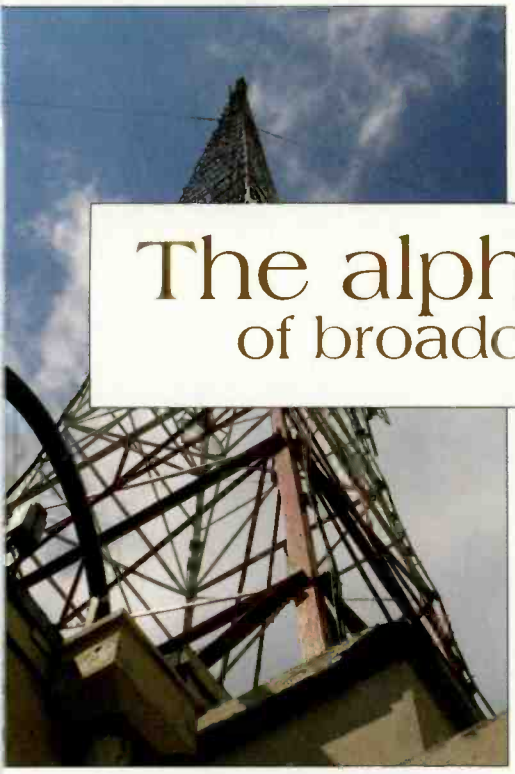

The alphabet soup of broadcast engineering

By John Battison, P.E., technical editor, RF

Most tower projects require complying with FAA regulations.

Nearly 100 years ago the early radio engineers had few governmental and quasi-governmental bodies that they had to satisfy to stay on the air. It seems as though a fearsome array of rules, regulations and requirements has been generated through the years by various new administrations. Today, our early pioneers would have to deal with a plethora of acronyms and initialisms such as the FCC, FAA, state aviation administrations, EPA, OSHA, state boards of engineering, donations to politicians, and probably a few odds and ends like unions and NIMBY.

When the early pioneers such as Alexanderson, Fessenden and Marconi commenced the production of non-ionizing radiation no one limited their RF levels, blamed their antenna towers for the deaths of migrant birds, or complained about ugly towers spoiling picturesque views. As broadcasting prospered and grew, the need for a proper regulatory administration became apparent and in 1927 the Federal Radio Commission was formed. This august body developed basic regulations for the control of radio broadcasting in the United States. As the new industry matured federal control was modified and revamped until, in 1932, the Federal Communications Commission was formed. It originally had seven commissioners; later five commissioners were found to be plenty.

Today the broadcast licensee has first and foremost to deal with the FCC and complete an application form showing compliance with regulations controlling levels of nonionizing RF radiation as well as all the specific engineering rules of the FCC.

Good practice

To digress for a moment, it's interesting to recall that in the earlier days of FCC regulation many of the requirements were listed in a section of the rules with the title *Rules of Good Engineering Practice*. It was essential to include in the engineering report section of the application form (Form 301) a statement to the effect that the operation would conform to the *Rules of Good Engineering Practice*. However, somewhere around 1960 it was no longer required and applications were granted without this promise.

As the broadcasting industry developed and grew, other bureaucratic bodies became involved in the train of mandatory approvals. One of the first groups to impose its influence on the broadcaster was the Federal Aviation Administration (FAA) who began to worry about the impact of random towers on aircraft. And it soon became necessary to include a copy of FAA Form 7460 in most transmitter applications so that FAA safety requirements in the vicinity of airfields could be met.

Included in the FAA requirements are tower lighting specifications that have been incorporated into the FCC's engineering requirements. As time passes additional FAA requirements are continually being added to include transmission characteristics, power levels and positioning of transmitters in the vicinity of airports.

In 1970 the Environmental Protection Agency rapidly became what is probably the most powerful of all the government agencies. There was a time when the IRS was said to be hard-nosed and difficult to deal with. Times have changed and the IRS is now far more humane in its dealings than the EPA, whose power now appears to be superior to those of the IRS.

Almost everything that a broadcaster does appears to involve the EPA in one way or another. Tower siting frequently becomes difficult because of rules involving horticultural and suburban conditions, historical and topographical requirements, non-ionizing radiation limits, tower lights, standby power supplies and fuel systems.

Two major items of many station's inventories are power transformers and power supply capacitors.

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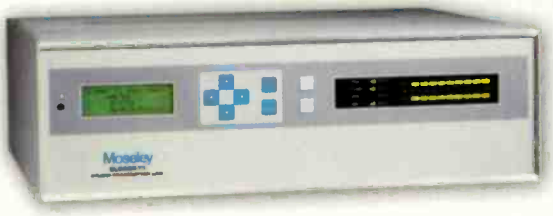

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The oil in the power transformers and the dielectric in power capacitors are on the EPA's no-no list for good reasons. They are strongly suspected of being cancer inducing. The EPA has specific methods for disposal of these items and drastic penalties for failure to observe their regulations.

Although it was originally created to control the disposal of waste products, EPA probers have now spread into almost every iota of life. Like the other administrations that have erupted over the years the EPA has a comprehensive website (all the agencies mentioned have their own complete websites, which can be accessed by searching their names) that is easy to explore for specific information.

The EPA has a hand in many aspects of broadcast operations, such as restrictions on storing fuel for emergency generators.

Other agencies

OSHA has been the butt of many complaints and jokes, but since 1970, when it was established, the Occupational Safety and Health Administration has filled an important part in our country's growth. In the 37 years of its existence it has made great strides in improving the safety of our workers in almost all occupations. Fortunately, broadcast stations in general have fewer accidents than the majority of businesses. On the other hand, when a station does have an accident it is usually a bad affair, such as a tower coming down.

Although the National Electric Code (NEC) does not fall into the category of bureaus that have to be placated, it can be the cause of problems in new transmitter operations. Sometimes dealing with local or regional inspectors can be somewhat difficult. Broadcast engineers occasionally have grounding and wiring ideas and requirements that differ from the national electric code. That can become another item in the list of problems when dealing with the establishment.

Some broadcasters are inclined to feel that the NIMBY group is the hardest to combat. After all, the FCC, FAA, EPA, OSHA and the NEC all have clearly defined requirements, rules and regulations. Though they may lose a hearing, NIMBYs usually manage to find another ambivalent rule or law on which to hang another appeal and further delay grant of an application.

E-mail Battison at batcom@bright.net.

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FCC gives reprieve to AM daytimers

By Harry Martin

AM daytimers enjoyed a reprieve from pre-sunrise/post-sunset power reductions that might otherwise have been imposed on them on March 11, 2007. The reprieve may only be temporary, however; come November and the return of standard time those reductions may return.

By way of background, to prevent interference to nighttime AM service many AM stations are forbidden to operate at night. Eventually the commission concluded that such daytimers could be allowed to operate with low power during pre-sunrise (and, sometime, later, post-sunset) hours without causing interference. The commission calculated the permissible power levels on its own and notified affected stations of their ability, limited though it was, to operate in non-daylight periods. Notations of the pre-sunrise/post-sunset authorizations were added to the licenses of the stations that opted to take advantage of the opportunity.

Dateline

Radio stations in Arizona, Idaho, New Mexico, Nevada, Utah and Wyoming must file their biennial ownership reports by June 1.

Also by June 1, radio stations in the following states must place their annual EEO reports in their public files and post them on their websites: Arizona, DC, Idaho, New Mexico, Maryland, Michigan, Nevada, Ohio, Utah, Virginia, West Virginia and Wyoming.

In 2005 Congress decided to expand daylight-saving time (DST). Accordingly, the start date for DST was moved to the second Sunday in March and the end date to the first Sunday in November. This shift in times, the FCC decided, meant it had to make adjustments to the operating times of all daytime AM stations with pre-sunrise or post-sunset authorizations.

In the context of the existing pre-sunrise and post-sunset authorizations, the change required to accommodate DST would not have been difficult. All the commission had to do was issue a public notice reminding licensees to adjust their pre-sunrise or post-sunset times to correspond to the readjusted DST times. But the commission decided that this would be a good time to tie up loose ends. In particular, the FCC had revised a number of its nighttime protection standards in the years since the pre-sunrise/post-sunset levels had first been established. As a result, those levels do not necessarily conform to the current standards. The commission set about re-calculating the appropriate levels to reflect current nighttime interference protection standards and to make the new values effective on March 11, along with the changes resulting from early implementation of DST.

Through a public notice issued on March 1, the commission tried to do just that. The notice said that the staff had recalculated the permissible power levels pursuant to the current rules, and that all licensees with pre-sunrise/post-sunset authorizations should check the FCC's website for the updated values. It did not take long before licensees complained. As it turned out, unanticipated computer errors led to erroneous power levels for a number of stations.

But the commission's staff reacted promptly. The commission issued a second public notice, on March 7, in which it announced the immediate suspension of the use of the recalculated values. The second notice told AM stations that they should continue to use the powers that they had been using all along (but with appropriate timing adjustments for DST). A further notice is supposed to be issued later this year—once the computer bug has been corrected and accurate recalculations completed.

Of course, when the correct recalculations are made, many AM stations will find themselves with considerably less non-daytime power than they have now.

Martin is a past president of the Federal Communications Bar Association and a member of Fletcher, Heald & Hildreth, Arlington, VA. E-mail martin@fhhlaw.com.

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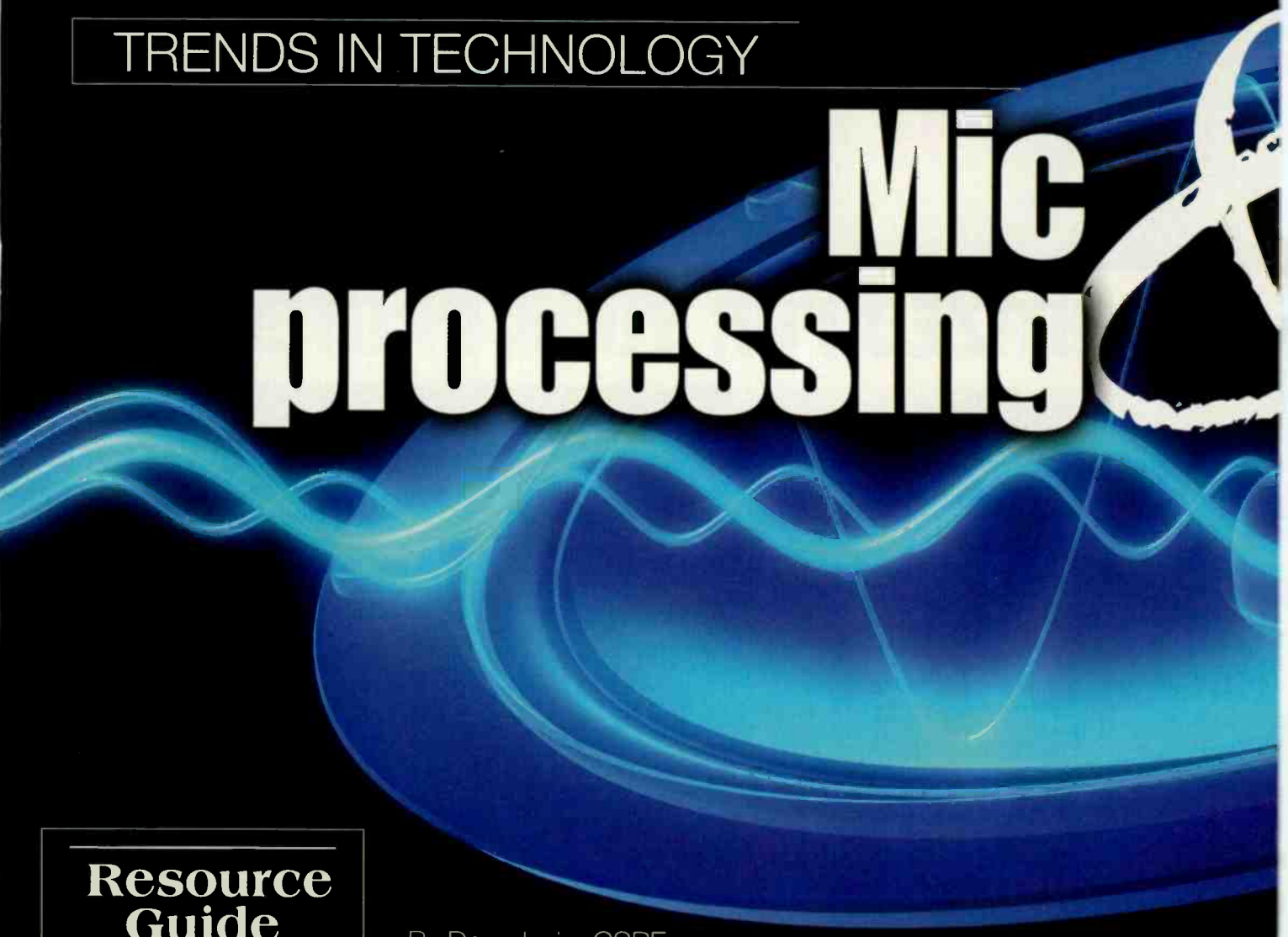

Resource Guide

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www.crlsystems.com

Harris
800-622-0022
www.broadcast.harris.com

By Doug Irwin, CSRE

Periodically, it's good to review the current state of audio processing technology. The manufacturers that we are all familiar with, and some that are new to the business, are rapidly meeting our needs with respect to data-reduced (or simply low bit rate) transmission pathways. In addition to those changes in functionality there are more and more examples of updated input and output protocols.

There is nothing new about the technique of adding separate audio processors for studio microphones. What started off as a way to give jocks a bit of boost in certain characteristics of their voices (most notably low frequency equalization) has evolved slowly over the years and now includes not only EQ, but also compression, gating and downward expansion. Other changes in broadcast technology are reflected in modern microphone processors as well, such as the addition of digital outputs and word-clock inputs.

Aphex has recently introduced the 230, the latest in its long line of mic preamp/processor boxes. This is a single channel, 1RU device that has a vacuum tube (12AT7) mic preamp, parametric EQ, compression, gating, de-essing, +4dBu and -10dBV analog outputs, along with digital outputs (AES, S/PDIF and optical formats) with 24-bit resolution (96kHz sample rate).

Airtools by Symetrix offers the 6200 digital voice processor. This is a two-channel, 1RU device containing two processing chains that will work at mic or line level, in a stereo mode or independently. Standard processing features, such as high-pass and low-pass filters, compressor/limiter, four-band parametric EQ and downward expansion are included. Processing settings are configured from the front panel or from 6200 Designer, a Windows application. After the unit has been programmed, real-time control of the device is available by PC via RS-232, USB or Ethernet. Symetrix also offers the 528E.

TC Electronic manufactures the Gold Channel, a 1RU, two-channel mic preamp and audio processor. The mic preamp in this unit is immediately followed by an A/D converter, which allows for all processing functions, such as compression, expansion, equalization and

On-air processing

de-essing to be done in the digital domain. The user can save settings in any one of 100 memory locations, and the unit comes with 100 factory presets as well. Aside from balanced analog outputs, there are digital outputs (AES, S/PDIF and optical (TOS-link) formats).

Focusrite offers the VMPRO channel strip, a 2RU single channel mic preamp and processor. This unit boasts a (solid state) class-A mic pre, along with the following processor sections available on the front panel: expander; vintage harmonics; compressor; tube sound; and voice-optimized EQ. Analog outputs are standard, digital outputs are optional.

DBX has been in the processing business for years and has recently manufactured the 376 (with digital outputs). This 1RU mic preamp/processor begins with a vacuum tube microphone preamp followed by a (semi-parametric) EQ, compressor and de-esser. The digital output has selectable sample rates (44.1-, 48-, 88.2- or 96kHz) and adjustable word length (16-, 20- or 24-bit) in the AES or S/PDIF formats. Word clock input and output is via BNC connectors.

Aircorp offers the 500PH, which is a single channel, 1RU mic preamp and processor with three channels of graphic EQ; phase rotation; compression and expansion; an insert point; de-essing; mic and line level outs, and a headphone out that allows the engineer to set up the unit without having it actually on air.

Yellowtec manufactures the VIP/Digital, a 1RU device that stores its settings to Smartcards so each user can establish his own presets. It includes mic and line inputs, analog and AES3 inputs, 24-bit A/D-D/A converters, 100 internal presets, an FFT-based de-esser and reverb.

Processing for your content

We are content providers now, as you may recall. In fact, about the only aspect of our content provision that is increasing is the use of streaming audio. For this reason I suggest avoiding grabbing an old processor off of the shelf in the engineering shop (or worse yet, bringing one back from the transmitter) for processing a streaming audio feed. Even though the reasons for processing the streaming audio are basically the same as that for over-the-air signals, the methodology is different in some key respects. For example, clipping is the most basic way to build loudness in an analog system. The reason is that it is easy to get away with, in the sense that distortion products are often either super-audible, or so fleeting in nature that they're almost impossible to notice.

It's not that simple in a data-reduced system; you do not want a streaming encoder trying to allocate bits to distortion products. That results in fewer bits left over for what you really want to hear. Throw that idea out.

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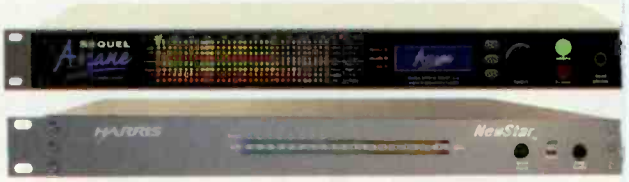
old-fashioned analog systems is by the use of HF limiting. The digital systems we are now using are flat—that is, no emphasis—so the HF limiter idea is of no value there either. And finally, we all know that our analog systems don't necessarily have a rigid brick wall limit through which they can't pass—unlike digital systems, which are all burdened with their 0dBFS limits that cannot be exceeded.

Therefore, the three key aspects of audio processing for

Mic processors have evolved into highly configurable devices, such as the Aphex 230, the dual-channel Air Tools 6200, or the Yellowtec VIP/ Digital with built-in card reader.



Specialized processors fit specific needs, such as accurate leveling with the Tranlantech Ariane Sequel or low bit-rate processing with the Neural Audio Neustar 4.0.

data-reduced paths (whether it is HD Radio or streaming audio) that remain in common with established analog techniques are wide-band AGC, multi-band AGC and peak limiting. Modern processors often use look-ahead limiters as opposed to the peak limiter (fast attack and fast release) that most of us have grown up with. So what's available?

Translantech offers the Ariane Sequel digital audio leveler. This unit uses a digital signal path all the way through. It includes a sum and difference mode with an independent or stereo linked mode available; output peak limiting; sample rates of 32kHz, 44.1kHz or 48kHz (syncs to input); eight user presets; TCP or RS-232 remote control; and peak and RMS readings on input and output sides.

Neural Audio offers the Neustar 4.0, a single rack unit audio processor built specifically for low bit-rate applications such as HD Radio, streaming audio and

"My Number One [illegible]odec Rental is Zephyr Xst[illegible]n"

-Steve Kirsch, F[illegible]e Audio

Rack 'em and stack 'em! The Silver Lake Audio Crew pictured from left to right: Steve Kirsch, Ken Stiver, Kirby Miovac and Jay Shoemaker

"When ISDN equipment rentals began in the early 1990s, we started with an equal number of different companies' codecs. Today, Silver Lake has over 100 Zephyrs in stock, ten times more than any other brand." says Steve Kirsch, owner of Silver Lake Audio.

The reasons should be obvious. Reliability, ease of use, compatibility, great support.

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encoding. Make adjustments from the front
via TCP/IP and a browser interface. The unit
s balanced analog inputs and outputs, AES3
Hz to 96kHz sample rate) inputs and outputs, and
d clock in/out.

Omnia has recently introduced a processor made specifically for data-reduced transmission paths: the Omnia One. This processor features four bands of AGC and four bands of limiting, AES3 inputs and outputs with sample rates from 32kHz to 96kHz; RS-232, GPIO and Ethernet ports for remote control.

Orban's 6300 is a 1RU audio processor that can be used in a number of applications, including HD Radio or streaming audio. It includes a stereo enhancer, wideband AGC, equalizer, a multi-band compressor/limiter and two (stereo) look-ahead limiters available via one stereo analog output and two AES outputs. It also includes a low delay (about 5ms) talent headphone output.

Broadcast Warehouse offers the DSP Xtra, designed

Resource Guide
Continued

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Insight to IBOC
May 2007 Part of the *Radio* magazine DAB Answer Series

Planning for surround

By Steve Fluker

In today's marketplace, radio station programmers and managers are looking for new and creative ways to attract and keep listeners. One way is through new technologies such as HD Radio and the enhancements it brings. Multicasting is rapidly gaining momentum as a way to provide more diverse programming choices to the listener. Another idea, which is not new but has once again surfaced, is the concept of implementing surround sound on FM radio.

Multi-channel broadcast history

Multi-channel audio is not a new concept for radio. The first FM stereo broadcasts began in 1961. In the early '70s we saw the era of Quad come and go, but it never really caught on. The '80s brought FMX, which was thought to be an answer to improved separation and reduced noise, but arguments about multipath distortion effectively put this idea to rest. The '80s and '90s introduced us to new technologies in recording methods designed to create an effect of 3D audio. Some of these effects were amazing, especially when listening through headphones. Some, however, had mono compatibility problems. It seemed like surround was another great idea that wouldn't pan out because of technical issues.

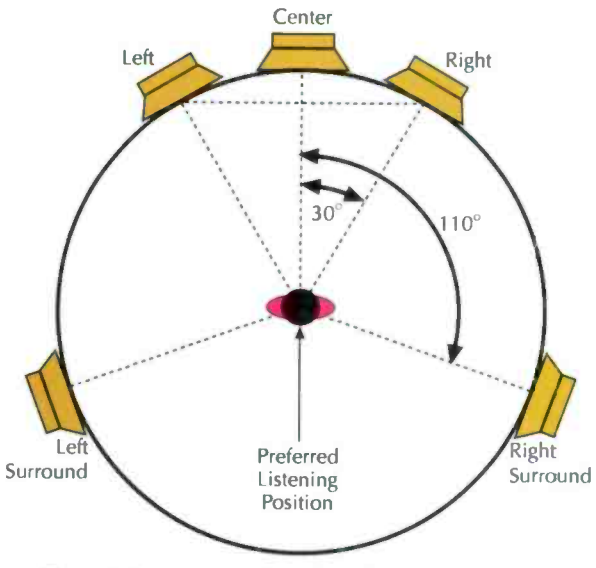

Figure 1. The proper orientation of a surround system.

So with a history like this, why should we try it again? Because the time may finally be right. Today we have come to expect surround sound from our experience with movies and home theaters. The format most compatible for broadcast radio is 5.1 surround. Figure 1 shows the layout of this system.

Surround sound might just be one of the killer applications to attract and keep the radio audience not only for HD Radio, but also for FM analog signals. But what will it take to actually get it on the air? Many stations have already spent huge sums during the past decade rebuilding and consolidating their studios and may not be too excited about spending even more money to add surround. Fortunately, there are several

Open Mic

IBOC history, part 1

by Chriss Scherer, editor

In March, the FCC approved rules that change IBOC from its experimental status to an approved system. The system that is now known as HD Radio can trace its early development to concepts and ideas that were proven to work with mobile reception in 1992. The first successful fixed AM IBOC reception test was held on July 9, 1992, on 1660 AM from the Xetron facility in Cincinnati. The first fixed FM IBOC reception test was held Sept. 29, 1992, on WILL-FM in Urbana, IL.

As HD Radio moves forward, I wanted to take a look back at the beginnings of the system to recall its early phases. I talked to Glynn Walden, who was part of the original team that proved the concept could work, and that set into motion the technology developments that are being implemented on radio stations today.

Walden

Today, Walden is the senior VP of engineering for CBS Radio.

***Radio**: The first steps into developing an IBOC system began more than 15 years ago. Tell me about the very beginning of the system that today is known as HD Radio.*

continued on page 3

Inside

A special supplement to Radio THE RADIO TECHNOLOGY LEADER

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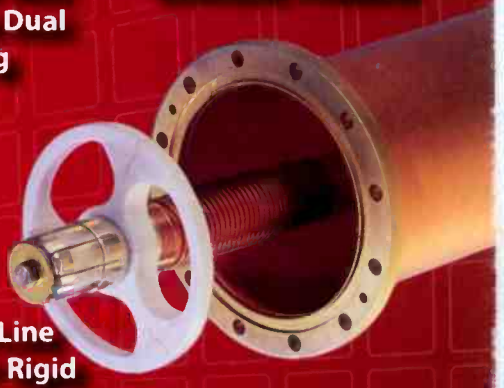

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Planning

options to consider when implementing surround that range from easy and inexpensive to literally changing the entire infrastructure of the studio design. Let's start with the basics.

If the primary goal is to get surround sound on the air and the budget is almost non-existent, consider a music-only implementation, such as that shown in Figure 2. All that is needed is a source with the ability to play back the original discrete five-channel surround material and an encoder. The surround-sound encoder downmixes the multiple channels into a two-channel audio format and encodes the surround information within it. The two-channel signal can then be transmitted via traditional FM stereo. From this point on, the

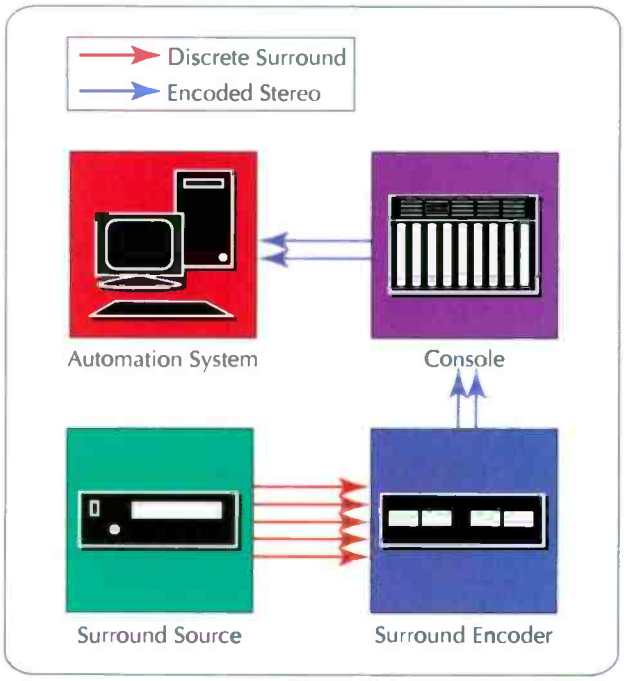


Figure 2. A music-only implementation of surround.

audio infrastructure remains unchanged as a normal stereo signal is fed through the station's air chain to the transmitter. It remains unchanged until the listener's receiver splits it back into 5.1 channels. Listeners who do not have a surround decoder will hear the audio just fine in stereo or in mono because the surround information is ignored.

Don't stop at just the music

This basic method of implementing surround allows a station to claim bragging rights to surround, but stopping there misses out on what could truly be the biggest part of the wow factor. Music in surround is important, but it's the locally produced elements that give a radio station its personality. When a listener hears a great song in surround followed by a sweeper that's not recorded in surround, what happens? The station's sound suddenly falls flat and all of the energy

continued from page 1

GW: It started when Paul Donahue of Gannet and Tony Masiello of CBS experimented with digital audio satellite transmissions. They were impressed with the fact that a digital audio signal on a satellite channel required less power than a comparable analog signal to achieve similar if not better signal-to-noise ratios. They reasoned that a low-power digital signal could be added to an existing analog signal to carry a digital version. This approach was the first in-band, on-channel (IBOC) development. Donahue came up with the acronym IBOC.

They had been working on it for three or four months, at which time they contacted Group W, and I became involved.

Radio: *What was the next step?*

GW: The project was sponsored by Dan Ehrman of Gannett, Nancy Widman of CBS and Dick Harris and Jim Thompson of Westinghouse. Bob Mazer, a communications and technology lawyer, became involved at this time also.

Each sponsoring company pooled some funds and provided all the free time that could be spared by the three of us. I think that this was around 1991. It was September 1992 when the FM IBOC system was first demonstrated. Some of this was also in reaction to the Eureka-147 video demonstration at the NAB Radio Show in the fall of 1990.

Radio: *The first AM IBOC broadcast preceded the first FM IBOC broadcast by two months. Today, the FM system appears to be ready to go, while the AM system seems to have some challenges. What was the course of the development of the two systems?*

GW: The AM development was ahead of the FM for many years. It took time to properly complete some of the FM details. The basic AM system was already planned, and many of the elements needed were already defined. There have been plenty of refinements from the original plan, but today's basic AM system was designed by Barry Carlin. The original system was wider in bandwidth and failed under 90 percent of the power lines. Brian Kroger made some major changes to the AM system, which he essentially completed in 2001.

The FM systems went through a number of incarnations before it was workable. The earliest designs all fell apart in multipath conditions.

Radio: *Tell me about the early FM systems.*

GW: The first FM system used four OFDM carri-

continued on page 4

Image credits:
AM IBOC test photo courtesy of Glynn Walden.

The *DAB Answer Series* is an ongoing series of supplements that covers the technology of digital audio broadcasting.

Insight to IBOC - a supplement to Radio *magazine*, May 2007,

Open Mic

continued from page 3

ers—two on each side [of the main carrier]. It was not at all mobile robust. This was followed with a true multicarrier system that failed to work in a mobile environment. Then we came up with a system that used orthogonal wideband carriers. I call this the Derek Kumar system. This one was mobile robust, but it was not a viable system. The system in use today was primarily designed by Brian Kroeger at USA Digital Radio, which he designed between 1998 and 1999.

The earlier systems were designed as proof of concept systems without an intent that they would be commercially viable systems. The USADR team, led by Kroeger, was charged with designing a system that could be deployed for AM and FM broadcasting.

Outstanding in their field during the first AM IBOC transmission. Left to right: Paul Donahue, Gannett; Ron Rackley, duTreil, Lundin & Rackley; Tony Masiello, CBS; Glynn Walden, Westinghouse; Denny Palmer, Xetron; Barry Carlin, Xetron.

Radio: *So it's really been about 10 years since we have had a working and viable system.*

GW: Keep in mind that around 1996, the radio industry was totally absorbed in consolidation. Westinghouse was buying CBS, Gannet was selling it stations. These companies lost total focus on digital radio. About 1997 we finally got the attention of Michael Jordan, CEO of Westinghouse. Jordan provided enough seed money to have an outside technology company make a determination as to whether IBOC was feasible. The evaluation showed the IBOC was not only possible, but nothing new had to be invented, just careful implementation of existing technology. The initial core of USA Digital Radio development was operated out of the Westinghouse Wireless Solutions offices in Linthicum, MD. In 1998, Westinghouse spun off USA Digital Radio to a group funded by 10 of the top 12 broadcasters.

By then, the framework of the AM and FM systems was established. All that was left were the details. By 1999 we had systems that remain essentially unchanged to date.

In the next installment, we'll conclude our conversation with Glynn Walden as we look back at the beginning of IBOC technology.

Planning

is lost. The local elements such as sweepers, promos and even commercials can provide a show place where the station's production creativity can really shine.

HDTV owners know what it's like when the new set is brought home. They usually look for shows broadcast in HD first and watch programs just because they're in HD. The same holds true with surround sound on radio. Listeners will be so excited over their new toy that if they hear something exciting, they may stay with the station and listen right through the commercials. Think of how happy your clients will be knowing that people are actually listening to their messages rather than changing the station.

To produce local content in surround, a greater investment than that for the basic surround studio is required. Figure 3 illustrates a full surround production room. The heart of the studio, the control console, must be capable of carrying the five audio channels. An older control console may have program, audition and utility buses that can support the five channels. Many newer control surfaces may already have surround capability. The DAW must support the 5.1 channels as well. In the Figure 3 configuration the console output is routed through the surround encoder to create the two-channel downmix. Again, from this point on, the infrastructure remains unchanged.

These two examples are economical ways to convert an existing studio to a surround studio. However, if you are designing a new facility and have the luxury to start from the ground up, consider keeping the entire audio flow in the discrete five-channel format. In this case, the design of the production room is similar to that of Figure 3, except the audio is stored on the automation system in a five-channel discrete format. This requires considerably more hard drive space as well as audio routing switchers with more channel capacity and surround output audio cards in all of the automation workstations. The discrete output of the control room console now feeds the surround encoder, which converts the source to the two-channel stereo mix compatible with the air chain.

Why keep the audio in the full discrete mode? Future flexibility. While our current transmitting facilities can only handle two channels, you never know what the future may bring. In the future we may not be limited to two channels. There are also new methods of transmitting the surround sound information on the way taking advantage of data channels on the HD

Radio carrier. With a data-imbedded discrete system, such as the MPEG Spatial Surround system, the artistic stereo channels are transmitted along with a spatial data bitstream to give the receiver the surround information. If you're building from scratch, don't cut corners or you might be sorry later.

Proper monitoring

No matter how far you decide to go with your studio conversion, it's extremely important to include proper surround monitoring in the design. Surround monitoring doesn't have to be complicated, and can simply be a consumer-style receiver with a built-in surround encoder. Install surround monitoring in the production room and the control room. The station is distributing a special product; let the announcers enjoy the surround experience. The more ears listening to the final broadcast, the more likely that problems will be prevented.

The monitor installed for the production rooms should also have the ability to decode all of the major surround systems: Dolby Pro Logic, SRS Circle Surround and Neural Surround. In the near future you will also begin to see the MPEG Spatial Surround on the market for use with HD Radio. When producing a spot, listen not only to the final product through the chosen surround decoder, but also through the other decoders. The radio station may be transmitting in Neural Surround, but the listener in the car has his radio set for Dolby. You need to know what the listener will hear.

Cross-compatibility listening tests have shown that for the most part the listener will have a pleasant experience whether listening to the proper decoder or someone else's, but don't let your guard down.

Proper training for the production staff is also a must. While many production managers may have been in the business for many years, surround production will still most likely be new to them. Train them to produce elements that will capture the audience.

What about multipath?

Multipath distortion has been responsible for squashing previous attempts to improve audio separation. The varying multipath signals can cause noise and distortion in the received audio signal and can even cancel the carrier altogether. And excessive stereo separation can increase the effects of multipath. Because surround systems encode their surround information in the stereo channels, the L-R channel of the composite stereo signal may increase in level and cause issues with multipath. Tests have shown that, in most cases, the encoded audio has little, if any, affect on multipath. If you suspect an increase in multipath, view the L-R channel on a scope with and without the surround encoding to see if there is a major change in

Planning

the L-R signal. You may actually find high L-R energy in the non-encoded signal to start with. Don't assume the surround is the cause of the problem.

Don't forget multicasting

Multicasting tops the list of the benefits that HD Radio has to offer. If it were to come down to a choice of broadcasting an HD2 channel or broadcasting in surround, the HD2 choice would win. For this reason the surround proponents have been challenged with making their systems work well even at reduced data bit rates. Early testing at rates of 64kb/s and below are showing promising and impressive results. When building new multicast stations don't forget to allow for surround, even if it's not used at first.

The future of radio is not grim, but can be rather exciting if we continue to move forward with new HD Radio channels, new programming formats, new digital features and new improvements to audio such as surround sound. When remodeling a facility, keep all of the new technologies in mind during the design stages so that you will be prepared when asked to turn on a new feature. This will help you win the game and become the hero.

Steve Fluker is the director of engineering for Cox Radio, Orlando.

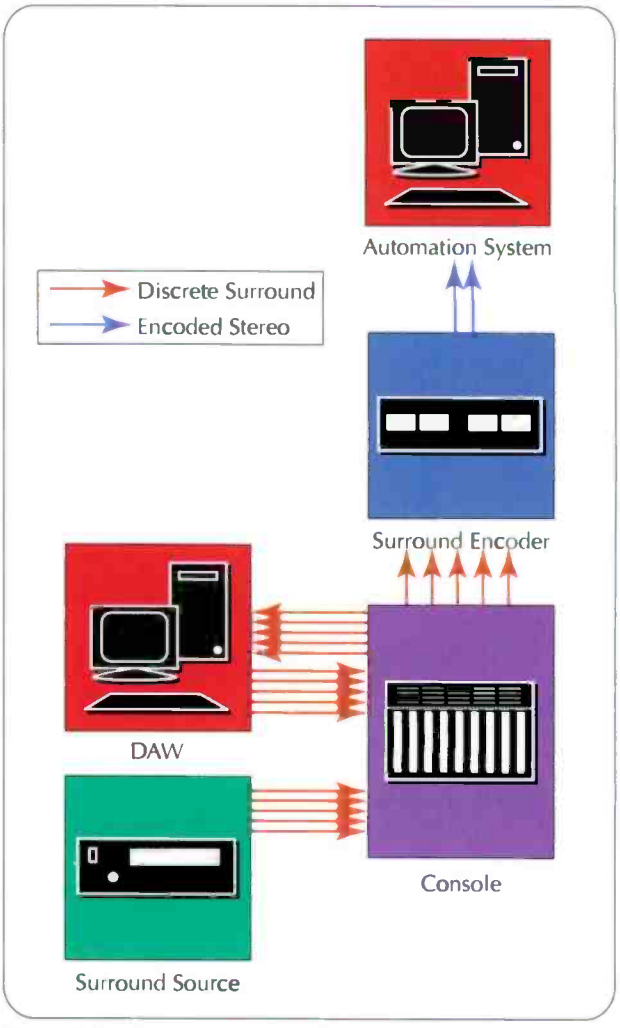


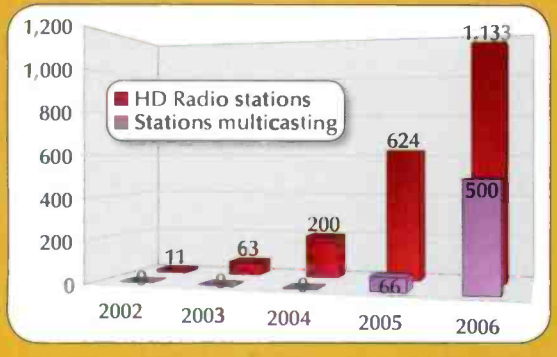
Figure 3. A full-surround production studio implementation.

Sample and Hold

The HD Radio rollout trend

By Chriss Scherer, editor

Since the first stations officially commenced HD Radio transmissions in 2002, the number of stations implementing the technology has steadily increased. At the end of 2006, 1,133 stations were transmitting an HD Radio signal. The number of stations multicasting has also increased so that nearly half of all HD Radio stations provide at least one additional program stream.



Based on the trend shown here, it's likely that there will be about 1,600 radio stations transmitting an HD Radio signal by the end of 2007.

Because multicasting is relatively new, it's hard to predict an exact trend yet, but while the percentage increase in the number of stations adding HD Radio equipment will likely drop, those stations already transmitting an HD Radio signal but not yet multicasting will likely see a steady increase. This is because most HD Radio equipment already installed has multicast capability, but stations may not have had a secondary program source available.

Why the potential slowdown in the HD Radio roll-out? The larger groups have already made their commitments by converting the easier stations first. The remaining stations within the large groups appear to be the more challenging installations.

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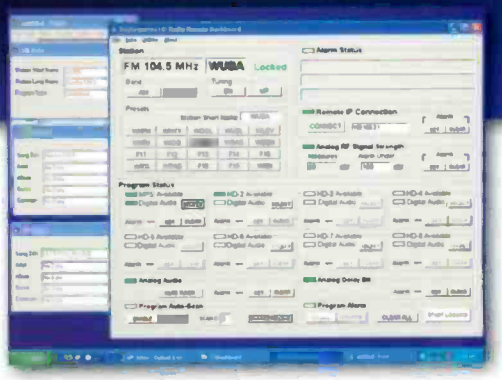

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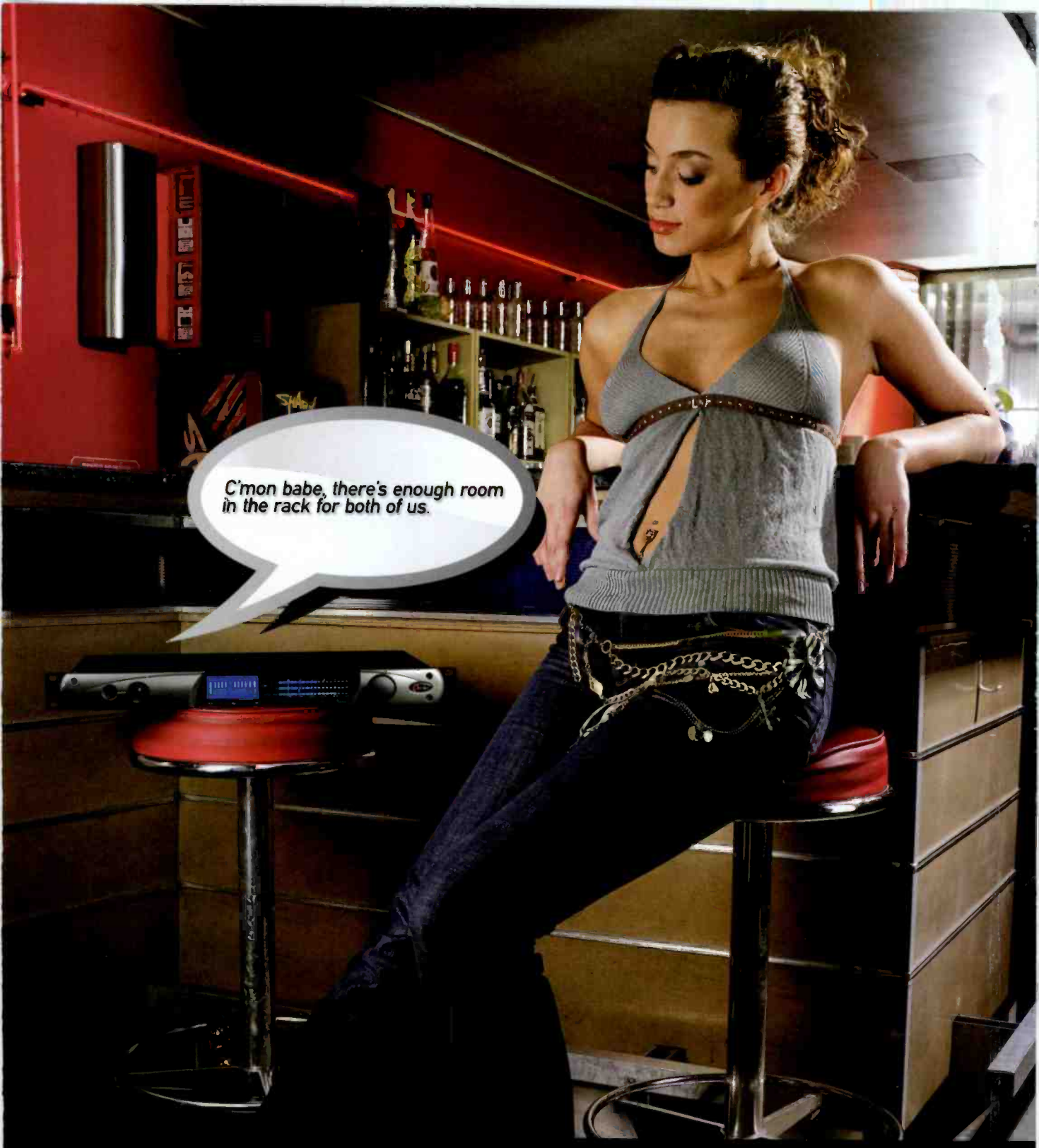

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for processing audio for FM, HD Radio and streaming audio. It includes the Ariane leveler, multi-band limiting and multi-band look-ahead limiting. Adjustments are carried out from the front panel, or via USB, serial or Ethernet. The AES3 input will sync with any sample rate between 32kHz and 96kHz. The unit features a built-in stereo generator as well.

Wheatstone now offers the Vorsis HDP3, a 1RU audio processor with built-in three-band AGC, parametric EQ, de-esser, downward expander and peak limiter. The unit has a built-in IBOC delay. Adjustments are made via the front panel, via local computer control or via Ethernet.

Linear Acoustic recently introduced the Aeromax HDFM, an all-in-one processor for FM, MPS (HD1) and SPS (HD2). It features an AGC, five-band compression and look-ahead limiting, an HD Radio-delay function built-in, an AES3 input for sample rates between 32kHz and 96kHz that locks to incoming signal or word clock input, and RS-422/485 or Ethernet communication. A stereo generator is optional.

Inovonics manufactures the Omega FM, an FM processor and stereo generator. This 2RU device relies on a Pentium-class microprocessor to do all the processing and multiplexing functions. Sports analog and digital inputs, composite and AES outputs with low-latency making this product suitable for headphone monitoring purposes.

Thanks to DSP, processors are more compact but pack a great deal of processing power, such as the Orban 6300, the Omnia One and the Vorsis HD-P3.

Audio processing is one province of the field of broadcasting that remains solidly in the hands of the engineer at a radio station. It's wise to keep up on the latest trends in that art. I also happen to believe it is imperative that we, as broadcasters, do everything we can to keep our leadership position in the dissemination of content—whether in the methods practiced for 80 years or the brand new methods via HD Radio or the Internet.

Irwin is the chief engineer of WKTU-FM, New York City.

Resource Guide *Continued*

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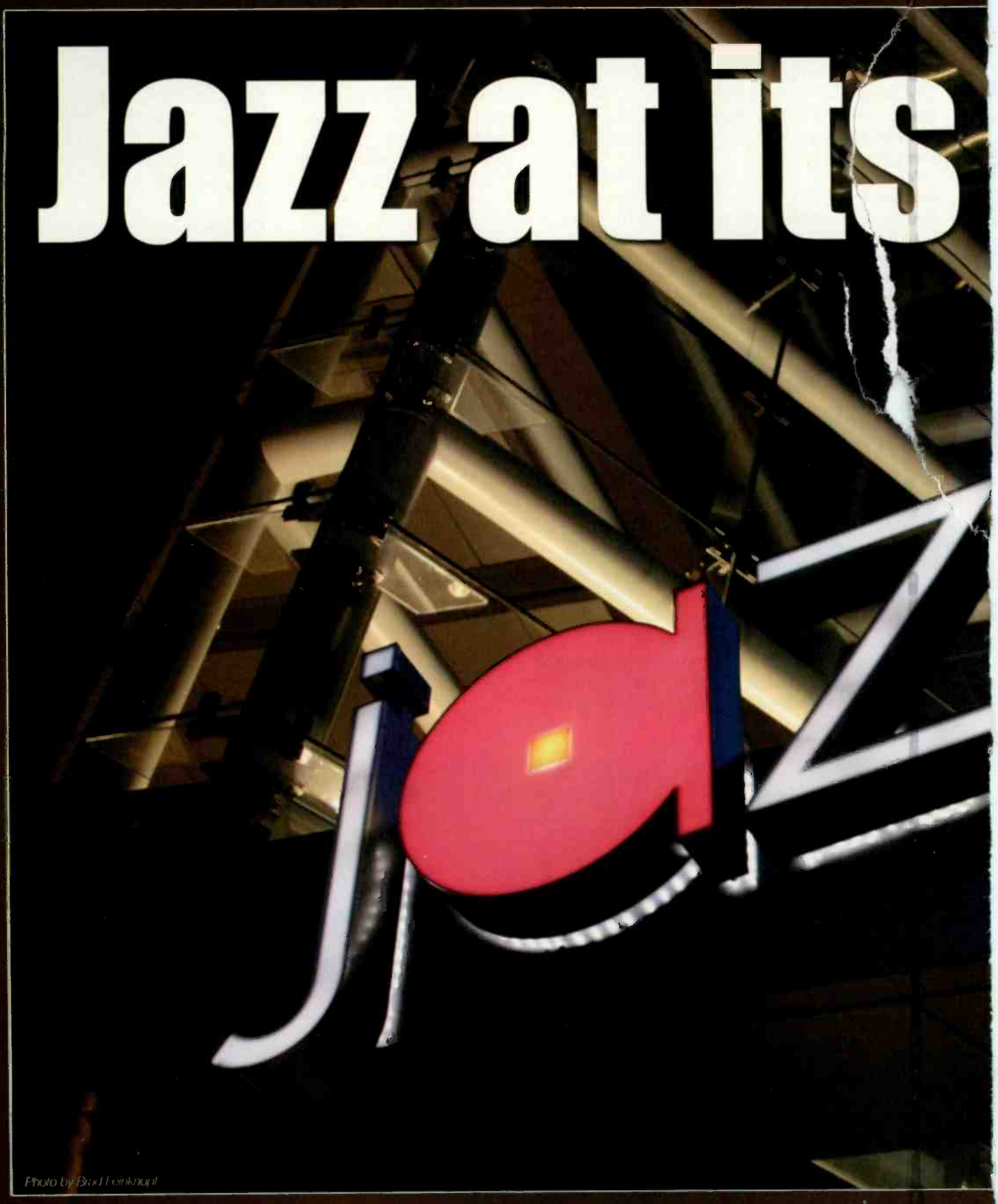
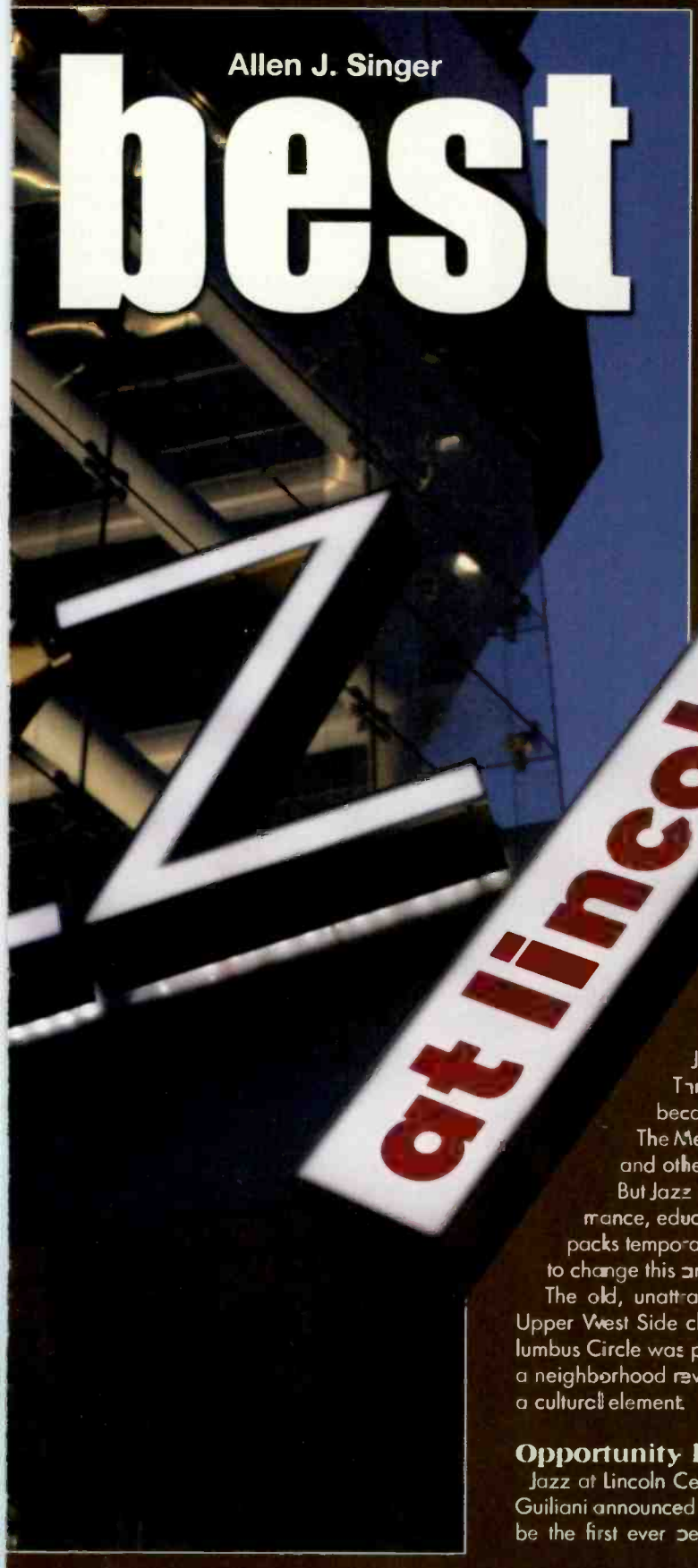


Photo by Brad Feinknopf



Allen J. Singer

best

At Broadway and 60th streets in New York City, the southwest corner of Central Park, is the world's first building designed acoustically for jazz performance. In only two years, thousands of audience members have enjoyed performances by hundreds of world-renowned jazz artists inside Frederick P. Rose Hall, home to the world's largest producer of jazz performances and educational programming, Jazz at Lincoln Center.

It is here that local audiences can enjoy the sounds of the Jazz at Lincoln Center Orchestra with Wynton Marsalis, or special productions featuring Abbey Lincoln, Tony Bennett, Patti Austin, James Moody and Jimmy Heath on any of three stages inside Frederick P. Rose Hall. But jazz aficionados outside New York can experience the music produced by Jazz at Lincoln Center too. Live and pre-recorded performances are broadcast on XM Satellite Radio to an audience of more than 7.6 million subscribers and on Jazz at Lincoln Center Radio, which is broadcast to more than 240 stations across the United States.

Jazz at Lincoln Center (JALC) began as the *Classical Jazz* concert series in 1987. Concerts were produced by Lincoln Center for the Performing Arts in Lincoln Center's Alice Tully Hall. Jazz legend Wynton Marsalis was hired as the artistic director. Throughout the next decade the organization grew and in 1993 it became a full constituent at Lincoln Center equal to The Juilliard School, The Metropolitan Opera, New York City Opera, New York Philharmonic and other famous performance companies.

But Jazz at Lincoln Center had no dedicated venues designed for its performance, education or audio recording. All recordings were produced using fly packs temporarily installed in dressing rooms and green rooms. Marsalis hoped to change this and began looking for a solution.

The old, unattractive New York Coliseum performance house on Manhattan's Upper West Side closed in the late 1980s and was scheduled for demolition. Columbus Circle was prime real estate, and in 1998 Mayor Rudolph Guilian planned a neighborhood revitalization at Columbus Circle and stipulated the project contain a cultural element.

Opportunity knocked

Jazz at Lincoln Center's golden opportunity had arrived. In February 1998 Mayor Guiliani announced that Jazz at Lincoln Center would be that cultural element. It would be the first ever performance space designed specifically and acoustically for the

Jazz at its best

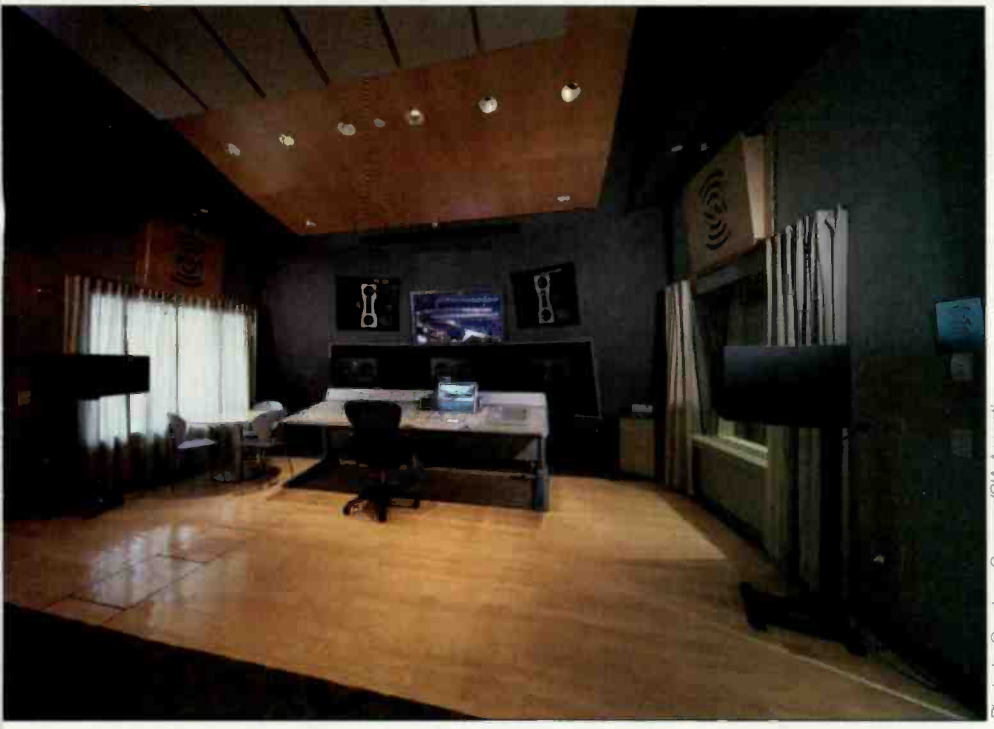


Photo by Courtney Spencer/SIA Acoustics

Control Room A is the heart of the audio recording facility and features a monitor view of the performance space.

sound of jazz. If this project found its way to completion, New York City would host the first place in the world built especially for jazz.

But more than just blueprints and construction materials were needed for the formidable task of creating this unique piece of architecture. Dedication and passion for jazz were requirements for all who were involved. Bovis Lend Lease constructed the core and shell over two years. Then, for the next four years, Turner/Santa Fe Construction built the edifice. Jazz at Lincoln Center's board member Jonathon F.P. Rose and former CEO Hughlyn F. Fierce oversaw construction and kept it on time and on budget. Even the events of Sept. 11, 2001, didn't interrupt the project or fundraising efforts as the JALC dream inched closer to completion.

Marsalis had played at European opera halls whose sound was superior to any American concert house. The performance space for jazz had to be on the same level as an opera house. However, opera houses and concert halls are designed for symphonic music, unlike

jazz that has bass, drums and cymbals playing continuously.

Rafael Viñoly Architects designed Frederick P. Rose Hall while several other specialists were brought in to consult: Russell Johnson of Artec Consultants; John Storyk of Walters-Storyk Design Group; Sam Berkow of SIA Acoustics; and The Rockwell Group, who had designed the Neshui Ertegun Jazz Hall of Fame contained within the space. The acousticians formed the team, "The Sound of Jazz."

The biggest problem for The Sound of Jazz to solve was extraneous sound. The Frederick P. Rose Hall site was surrounded by noise: the subway below, the towers above, and the traffic and street life around it. Sound isolation was the key element in the design of this futuristic venue. In addition, the acoustical designs of the performance spaces had to support amplified and unamplified performances.

The solution was a "floating box-in-box construction" for the largest venue, Rose Theater, with no rigid structural connections to the rest of the hall. Rose Theater, one of the three performance halls, sits on

Photo by Frank Stewart/JALC

Rose Theater, one of the three main performance venues located inside Jazz at Lincoln Center's home, Frederick P. Rose Hall.

Jazz at its best

Photo by Courtney Spencer/SIA Acoustics

The rack room houses all the Pro Tools interfaces as well as some processing and monitoring equipment.

rubber and steel isolation pads to minimize the noise from the outside, creating a quiet and intimate space. Rose Theater achieves a noise control level of N1, which virtually eliminates ambient noise. The design allows for exceptional acoustic isolation making the theater an ideal place to create recordings for live and tracked productions. Also, the natural room sound can be "tuned" by adjusting an acoustic curtain and banner system. More than 50 curtains can be deployed or retracted to adjust the amount of natural ring-time.

Opening day

At the site of the old New York Coliseum, Frederick P. Rose Hall opened on Wynton Marsalis' birthday, Oct. 18, 2004. At a cost of $131 million to build, it is 100,000 square feet in size and includes three performance venues, three control rooms, one recording studio, an an education center and a hall of fame.

The flexible 1,100- to 1,233-seat Rose Theater is designed specifically for jazz, but accommodates opera, dance, theater, film and orchestral performances. It is equipped with a 35mm film projector and a Christie high-definition digital projector, a large projection screen measuring 25' high by 55' wide, custom JBL speakers and Dolby Surround Sound—all designed and donated by Time Warner. Other performance venues include The Allen Room, a 500-seat performance space; and Dizzy's Club Coca-Cola, an intimate 140-seat jazz club for ensemble performances and daytime educational events.

Control Rooms A and B are located in the studio complex

attached to the recording studio and radio broadcast booths. Control Room C is at the rear of Rose Theater. Control Room A was designed by John Storyk of The Sound of Jazz team. It features a live-room feel and transfers to radio and TV. The room is built with hardwood floors, soft-paneled absorbing walls, oak diffusion paneling at the rear, and a raised "living room" sitting area behind the console area with a large plate glass window overlooking 60th Street. It has gained a reputation as one of the finest 5.1 mix/broadcast rooms in the city. Skyline diffusers, low frequency absorption panels and curtain systems are used to control the natural sound in all control rooms and performance venues.

Performances are broadcast live and pre-recorded for radio and TV, and nearly all are recorded for archive. The audio signal path is clean and simple. The microphone signal hits the preamp on the side of the stage and is converted to digital (96kHz, 24 bit) and passed through fiber optics to a router that feeds multiple recorders and mixers in the studios.

Routers can be configured to monitor and mix directly from the stage from the recorders' outputs. The mix created from one of the three control rooms passes back down fiber to an XM Broadcast Operations digital router in the Technical Operations Center, TOC, to provide a digital or analog broadcast. The mix is also returned via fiber to the stage, converted to analog and routed

Photo by Courtney Spencer/GIA Acoustics

Control Room B has a similar equipment complement, but in a more intimate space.

Jazz at its best

to the press pit for media coverage.

Digidesign's Icon (integrated console) and Pro Tools were chosen for all three broadcast control rooms due to their powerful, customizable and universal user interface. High-resolution audio can be recorded, edited, mixed and mastered in one environment, including total recall of all parameters, with a click of a button. The three systems are virtually identical, allowing technicians to recall any session in any room. For example, a sound check in Control C on Thursday, and mixed for broadcast on Saturday night in Control A, requires a simple fiber patch, hard drive mounting and button press. All signal processing is accomplished using software plug-ins. Three control rooms enable three simultaneous broadcasts from all three performance halls.

The Allen Room, a 500-seat performance space in Frederick P. Rose Hall, has views of Central Park through a 50′ by 90′ glass wall.

JALC Partial Equipment List

Adam A7, S3A, S4A, S6A MKII, SUB10
AKG 112, 414 TLII, 414 ULS, 426 Stereo, 535, C12VR, C418 PP, C419 PP, C451 B, CK 97CVR, SE 300B
Aphex 120A
Apogee AD-16x
Audio-Technica AE2500, AE5400, AT4047/SV, AT4050, AT4073A, ATM35
Aviom AN-16i, A-16II
Crane Song Phoenix
Digidesign Icon, Pro Tools
DK Audio MSD600C/5.1 Meter
Dolby 570 Surround Monitoring
DPA 3521, 4006TL, 4011
Empirical Labs Distressor
Eventide Anthology Bundle
Focusrite Forte Suite
Grace M802R
Griffin USB-Audio Hub
HHB CDR830+
Lexicon 960L
Lucid CLK6, SRC9624
Meyer Monitor System M-1D
Middle Atlantic racks
Millennia HV-3D/RP Remote Mic Pre
Neumann KM143, KM183, KM184, KM185, M149, SKM140, TLM 170R
Neve 33609/JD
Royer Labs R-122, Labs SF-24
Sanken CUW-180 Double cardioid
Sennheiser 865, e902, e904, MD421, MKH800
Shure 52 ODX, 55SH, Beta 52, Beta 56, Beta 58, Beta 98 D/S, Beta 98 H/C, MX 412 SE/C, MX 418/C, SM 57, SM 58, SM 58S
Sony MDR-7506, R-500
Studio Technologies Model 65
Tascam DS-D98
TC Electronic System 6000, MD4
TC Master Works
Telefunken U 47M - EF14 tube
Waves 360 Bundle
Yamaha DM2000 Digital Console

All seven Pro Tools recorders and mixers access the 4.2TB SNS fiber channel hard-drive array for media storage. This enables easy access from all points and the ability to share audio from multiple-mix rooms in a large recording/broadcast or post production room. The three Pro Tools Icon systems contain seven HD accel cards for processing and 10 192 I/Os yielding 160 inputs and outputs on the mixers. Each of the four Pro Tools dedicated recorders can be configured for as many as 128 channels of recording. In total, there are 768 I/O paths and 32 accel cards.

There are 96 channels of Millennia HV-3D mic preamps and 96 channels of Grace M802 mic preamps comprising two 48-channel racks of each. Their outputs go into Apogee AD-16X A/D converters synched by Apogee Big Ben studio clocks. The AES signal is then sent into an RME ADI-648 or RME-6432 and converted into a single or multiple MADI stream and sent through fiber. Once in the Machine Room, the streams hit the routers and can be processed, mixed, recorded and passed on to nearly any location in the facility.

Remote-controlled Sony spycams pass their signals down fiber and into the Blackmagic Workgroup SDI Videohub. Pictures can then be routed to any monitor in the facility, as well as the three Virtual VTR Pro machines for archival recording.

Forty-eight Aviom 16-channel personal mixers are used for headphone monitoring in the studio or performance area. Cue mixes are passed to the stage and studio across fiber and into CAT6 cable for monitor distribution.

Shortly after the facility opened to the public, the JALC recording studios won the 2005 TEC Award for Outstanding Creative Achievement from *Radio* magazine's sister publication, *Mix* magazine. Attendees who enjoyed JALC's previous engagements love Frederick P. Rose Hall. The new space offers JALC new opportunities to bring

Photo by Brad Feinknopf

modern audiences to the music, and reach audiences around the world with performances on XM Satellite Radio.

XM started broadcasting from Frederick P. Hall in May 2005. The program line-up included live performances from JALC featuring artists from a variety of formats. It also broadcasts other music channels from Fred erick P. Rose Hall including *Real Jazz, Beyond Jazz, Audio Visions, On Broadway* and *Frank's Place* featuring the music of Frank Sinatra and other standards artists.

Marsalis appreciates this arrangement. "Jazz at Lincoln Center and XM is a perfect fit because of the unlimited range of new music and educational programs."

XM transmits all content originated at JALC to XM headquarters in DC. Joel Singer and Rob Macomber of XM Productions/Effanel Music designed the signal path from the microphone on stage to the recorders and mixers, and on to broadcast operations. Specific equipment was chosen to capture and convert with the highest resolution possible. Single-mode fiber moves all audio and video around the facility. Canare AES cable is used to carry digital and analog audio within the studio complex. CAT6 is used for Aviom personal monitor mixes.

Two AES audio streams from XM Productions pass through sample rate converters to downsample from 192kHz, 96kHz or 48kHz to XM's standard of 44.1kHz. The AES outputs of the converter go into a Klotz audio engine/router, then routed by fiber to the Klotz console in an XM Radio studio in the JALC facility for live broadcast. An AES stream can also be sent to a codec for transmission to Washington, DC. IP streams are integrated onto a Gigabit Ethernet LAN, then passed to Washington via an OC3 on a 155 megabit connection. In Washington a matching codec converts the IP to an AES stream that feeds a Klotz audio engine/router, which routes the audio to the studio via fiber, or to an uplink encoder for transmission to the satellite.

Inside Frederick P. Rose Hall, Jazz at Lincoln Center will provide the world with high-quality jazz performance throughout the next millennium. Like the greatest concert halls found in the United States and around the world, New York City now has an equally comparable—if not better—venue to experience an original American music form.

Singer is a freelance author and former radio engineer based in Cincinnati. Unless noted, photos by Courtney Spencer/SIA Acoustics.

Digital audio

by Glen Kropfuenske

Not always perfect!

Having worked with analog audio and equipment for many years we have gained an expertise and comfort level that is admirable. We can hear noise and distortion and link these audible symptoms to likely causes, making the needed changes. We have our trusty tone generator and oscilloscope for isolating those more difficult challenges. We know how to measure levels, frequency response and distortion to gauge the audio performance.

Unfortunately digital audio changes all this. The old cause and effect relationship we are familiar with is gone. Likewise, our trusty tone generator and oscilloscope offers little help in diagnosing a digital signal or equipment defect.

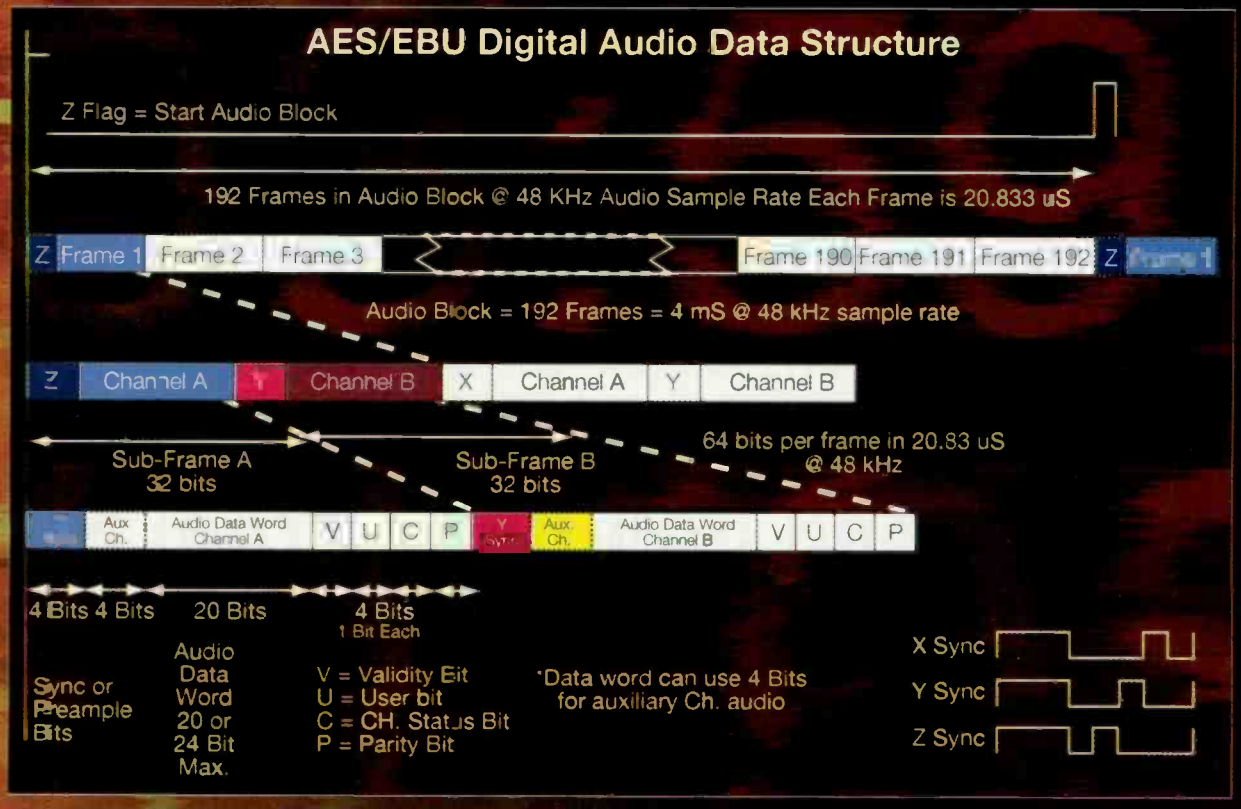


Figure 1. Structure of AES digital audio.

Digital audio

Transitioning from analog to digital audio analyzing and troubleshooting is not as hard as you may think. First, you need to study what is in the digital bits. Second, it is going to require some new and exciting analyzing tests and instruments so you can analyze those digital bits.

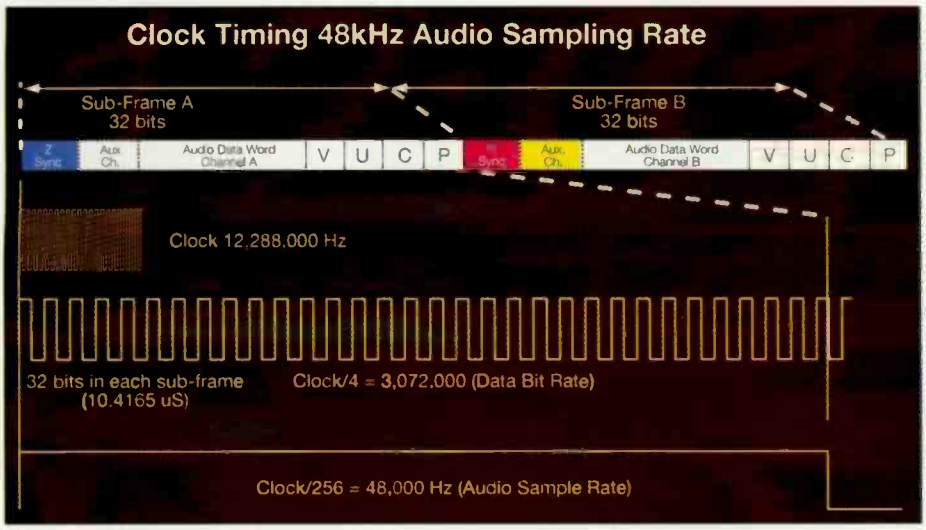


Figure 2. Clock/data/sample rate relationships in a 48kHz digital audio signal. A typical clock is 256 times the audio sample rate and the data bit-rate is 1/4 the clock frequency.

Digital audio bit by bit

An analog-to-digital converter changes the audio signal to digital values by sampling the audio level at fixed intervals of time. Sampling is like taking snapshots of the analog audio signal level over time. Sampling happens at equally separated intervals measured in the number of samples taken every second, expressed in hertz (Hz) or in thousands of hertz (kHz). Digital audio is commonly sampled at 44.1kHz or 48kHz or at doubled rates of 88.2kHz or 96kHz for professional recording.

Assigning a digital value to the audio level at each sample interval is called quantization. This requires that the amplitude range of the audio waveform be divided into level steps. A quantized binary value encoding system, Pulse Code Modulation (PCM), has been adopted for overall improved system performance. PCM quantifies linearly all quantizing intervals by means of a fixed scale over the signal amplitude range. PCM makes use of a two's complement system to distinguish positive and negative binary coded values. (See Figure 3.)

The number of bits used to form the

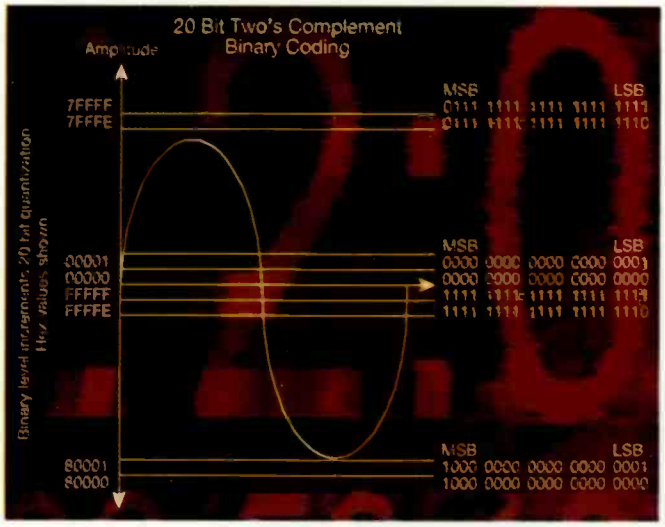


Figure 3. Pulse code modulation uses a two's complement system to distinguish positive and negative binary coded values with word lengths from eight to 24 bits.

PCM digital words (bytes) that are used to represent each of the sampled audio levels can vary from eight to 24 bits. The bit word length determines the number of quantizing level steps (resolution) and the dynamic range. Each bit provides about 6dB of range. An eight-bit digital audio word length provides 48dB of dynamic range (quiet to loud audio range) while 16-bit provides 96dB and 24-bit provides 144dB.

In a digital audio system, the maximum audio level corresponds to 0dBFS (dB full scale), which is assigned the largest digital code word. Manufacturers have adopted the familiar zero VU level equal to +0dBu as a standard operating level (SOL). This level corresponds to -20dBFS, in which the digital values are well below the largest digital code word value. This provides 20dB of range for audio peaks to go above zero VU before digital clipping occurs.

PCM digital data is encoded using a second scheme called bi-phase mark coding (BPM). Bi-phase coding ensures a dc balanced data line, as each bit begins with a transition and ends with a transition. If the data bit is a "1," a transition also occurs in the middle of the time slot. A data "0" has only the transitions at the beginning and end of the time slot and does not have a transition in the middle. Bi-phase coding doubles the data rate or frequency, as each data bit has two time intervals (clock cycles). A balanced line enables the receiver to properly detect logic high and low levels and the transition between them.

Getting your bits in a row

Some form of organization is needed so the receiver can reassemble and identify the assorted bits of information contained in a digital audio data stream. Organization involves assembling the data into blocks. Each block consists of 192 frames of audio. Each of the 192 frames can be divided into two sub-frames for two-channel audio. Each frame is produced at the digital audio sampling rate so each frame contains one digital value. In a 48kHz audio sampling rate, each frame is 20.833µs (microsecond) with each frame lasting 4ms (millisecond).

Each frame can carry two audio channels. In a two-channel mode, the samples from both channels are transmitted in consecutive

sub-frames. Channel 1 is in sub-frame A and channel 2 is in sub-frame B.

In addition to the digital audio word data bits, each sub-frame contains additional data. Each sub-frame consists of 32 bits, which includes 20 or 24 bits of audio word data bits and eight bits of additional data. Each sub-frame includes bits for preamble or sync data, auxiliary data, audio data word bits, validity (V), user (U), channel status (C) and parity (P) data bits. Considering that each sub-frame consists of 32 x 2 bits, occurring in 20.833µs (Fs = 48kHz), the bit rate increases to 1,536,024 X 2 = 3,072,048 bits per second.

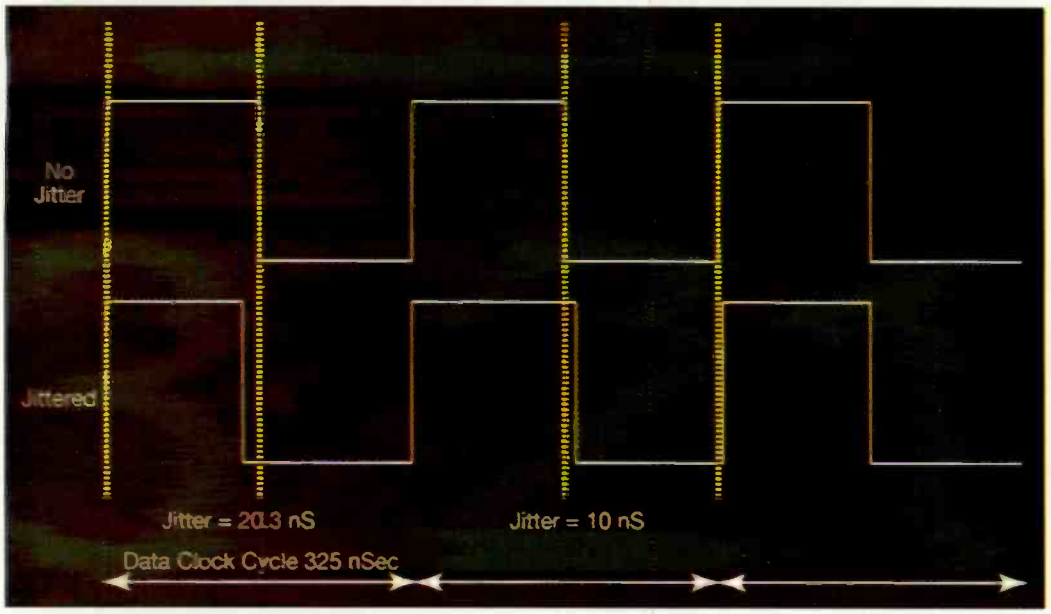


Figure 4. Jitter is variations in the transition times of the clock waveform.

The first four bits of each sub-frame consist of four preamble bits or sync bits. These bits identify the start of a new audio block and each sub-frame. A "Z" sync bit arrangement marks the start of the first frame in the 192 frame block. The sync word "Y" indicates the start of every B sub-frame. The sync word "X" indicates the start of all remaining frames. The sync bit arrangement is used by a digital audio receiver to identify the start of the audio blocks and sub-frames.

Analyzing frequency accuracy

At the heart of any digital system is a clock. This is a crystal oscillator or voltage-controlled crystal oscillator circuit. The oscillator output determines the resulting audio sample rate and audio data rate. A perfect circuit would be exactly the desired frequency and each cycle of the clock waveform would be identical in duration or time.

The clock isn't a perfect circuit, as the crystal is not perfectly accurate. Crystals are rated in accuracy described by a parts-per-million (PPM) rating. This indicates the maximum number of cycles the frequency may deviate for every one million cycles or hertz. A typical crystal rating is ±20 PPM. If the crystal frequency was 1,000,000Hz (1MHz), the generated frequency would be within ±20Hz (1,000,020 to 999,980). The 20 PPM rating is additive. A crystal of 2,000,000Hz could deviate ±40Hz, while a 3,000,000Hz crystal could deviate ±60Hz and so on.

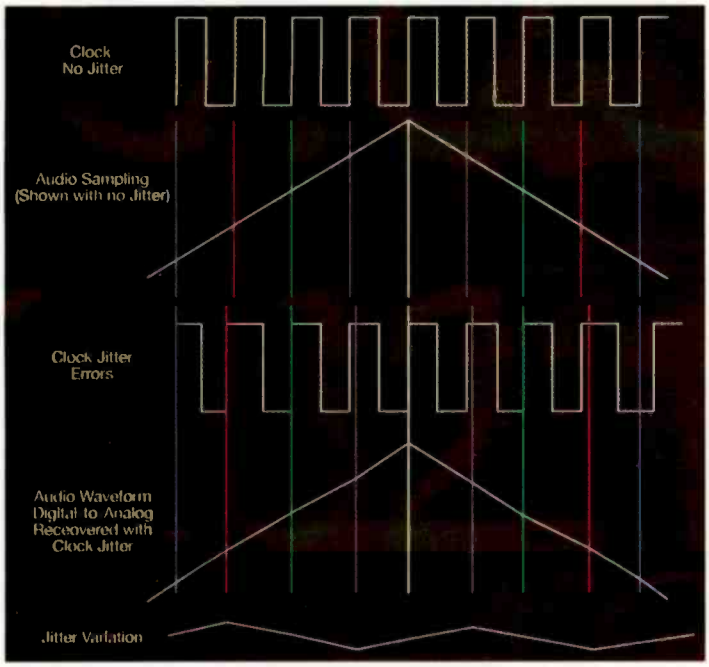


Figure 5. Jitter causes timing errors when the audio signal is reconstructed by the receiver. The receiver locks and regenerates a clock from the incoming digital audio signal.

In digital audio terms, a crystal frequency of 12,288,000Hz is commonly selected. This is 256x the ideal sample rate of 48,000Hz. A 20 PPM error at this frequency calculates to an error in frequency of ±246Hz. Because this is a maximum error, one would expect typical operational errors in PPM or Hz to be much less.

In digital audio systems, some frequency error is tolerable because the clock frequency is imbedded into the audio data stream and used to recreate a matching clock frequency by subsequent digital audio equipment. However, good maintenance and troubleshooting practices should include a frequency measurement of the digital audio signal including the sample rate frequency (F_s) and clock frequency ($256\times F_s$). Periodic measurement ensures that when trouble strikes, you know good from bad.

When multiple AES digital audio signals are created by separate clocks, differences in clock frequencies and sync timing exist. These differences present challenges to digital audio equipment designed to switch between or process multiple inputs. To produce

multiple AES digital audio signals at the same frequency and timing, master clocks or digital audio reference signals (DARS) can be used to synchronize oscillators and sync timing.

Analyzing jitter

Discussion about clock frequency and timing errors would not be complete without talking about jitter. With a perfect clock square-wave each subsequent clock cycle would be identical in time, with positive and negative parts of the cycles the same duration. The clock would be a symmetrical square-wave with each of its transitions occurring in exact time increments from the previous transition.

Again, the clock is not perfect. Clock cycles may fluctuate in time with cycles being slightly shorter or longer than previous cycles. Clock positive and negative times may be slightly longer or shorter causing transitions to occur at slightly different intervals in time. These variations are called jitter.

In a digital system, it's all about timing. Consider how these timing variations can cause audio signal degradation. For example, consider a perfect jitter-free clock digitally sampling a linear rising waveform during the analog to digital conversion as shown in Figure 5. If the waveform is reconstructed by a digital-to-analog converter containing some clock jitter, the linear rising voltage is no longer linear. The digital values correctly indicate the audio level as it was sampled, but because the levels are incorrectly placed in time, the resulting waveform is distorted by the jitter component.

Jitter occurs in a digital audio system at the transmitter from the non-perfect clock or crystal oscillator circuit. This is commonly called transmitter or sampling jitter. The digital audio signal is also adversely affected on the interface transmission line, which contributes to jitter. This is commonly called interface jitter. These

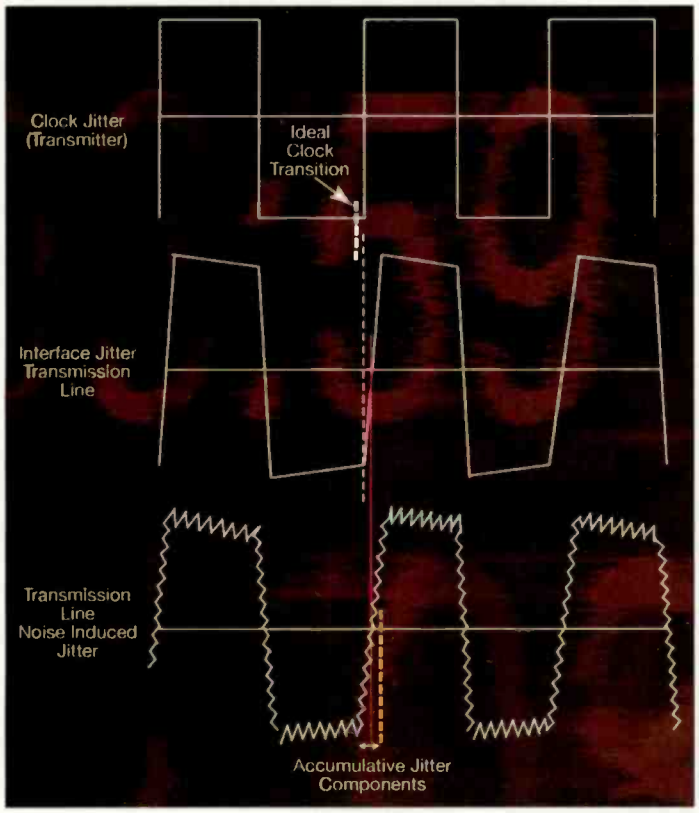


Figure 6. Receiver-generated clock jitter is related to transmitter (sampling) jitter, interface transition variations and transmission line noise. These effects can be accumulative.

jitter elements are cumulative as the digital audio is transmitted and moves through a transmission line to a receiver.

Digital audio embeds the clock signal and sync transitions within the serial digital audio data stream. It is up to the receiver to regenerate an oscillator locked to the incoming digital audio. As in any digital system, the data transitions from high to low have crossover points. These transition points are used to lock and correct the oscillator frequency in the receiver. Influences on these transition points contribute to jitter within the receiver's clock.

One contributor of jitter is the data transmission line, better known as the connecting cable. The cable's capacity and frequency response characteristics can cause waveform shaping and slight DC balance shifts to the digital audio waveform. This causes slight delays or advances of the transition points along the digital waveform input to the receiver. This is interpreted at the receiver as jitter. Noise can also be induced into the transmission line, which further can shift the crossover points.

Measuring jitter is an important step to ensuring a quality digital audio signal. Jitter may be measured by an AES digital audio analyzer. Typical jitter measurements are displayed as small time errors and expressed in nano or pico seconds. Jitter errors are commonly expressed as an average RMS value to reduce the measurement effects of randomly occurring peak jitter errors. The AES/EBU standard specifies that jitter be less than ±20nS. However, it is desirable to minimize jitter to much lower levels to optimize digital sound reproduction.

Kropuenske is an application engineer with Sencore.

Whirlwind AES Qbox

By Jeff Smith
CEA, CBNT

Analog audio has always been easy to check. There are hundreds, if not thousands, of types of test equipment to listen to and verify the quality of analog audio. Many of these devices are small and portable. When the audio changes to AES3 or S/PDIF digital audio, the quantity of easy-to-use, rugged and portable test equipment declines greatly. This is why I was glad that Whirlwind decided to introduce a digital version of its Qbox.

The AES Qbox is loaded with features that make it user friendly. It is also built to stand up to continuous use. Whirlwind designed the control surface to be easy to use, and it allows for quick and easy testing of AES3 or S/PDIF audio and cabling.

The AES Qbox has XLR and BNC inputs and outputs. It allows for three modes of operation. The in/out mode is the normal mode for the unit, and it simply allows audio to be received, analyzed and monitored. When in this mode the system locks the output to the sample rate of the input. The equipment can also generate AES3 or S/PDIF audio at multiple sample rates in this mode. Another mode is a pass through mode, which allows the unit to be used as a wiretap and placed in-line to monitor audio. The third mode is the cable test mode, which does exactly what the name implies. This mode also provides a quick method to test the AES Qbox itself. By simply connecting a short cable between the input and the output all the features of the unit, such as tone generotion, the condenser mic and the internal speaker can be tested and verified.

When the unit is first powered on it runs through a self diagnostic check. The fault indicator, sample rate indicator and lock indicator will sequence on and off and then all the LEDs will flash on and off twice to indicate that the test is finished.

The unit can be powered from an external 6Vdc wall wart or four AA batteries. Battery operation makes the device totally portable and the battery life is respectable. In my experience, batteries have lasted four to six hours for continuous use. The one disadvantage is the lack of a rechargeable battery, but knowing this I carry some spare AA batteries when using the system at remote sites.

Performance at a glance

- Audio tone generator
- Built-in speaker and condenser mic
- Tests XLR and BNC digital audio inputs
- Input sample rate from 32kHz to 192kHz
- Operates on AA cells or power supply
- Signal fault and sync indicators

> When audio changes to AES3 or S/PDIF...rugged and portable test equipment (options) decline.

The unit supports sample rates on the input section from 32kHz to 192kHz. There is an easy-to-read LED display to indicate the incoming sample rate as well as a fault light to indicate any faults in the AES3 or S/PDIF stream.

The unit can generate audio at sample rates from 44.1kHz through 192kHz. The audio generator can provide three output signals. A

stereo tone can be generated with 440Hz in the left channel and 880Hz in the right channel, the line-level stereo aux input can be routed to the outputs, and the unit also contains a built-in condenser mic that can be routed to the outputs. For monitoring audio, the device features a built-in speaker with a volume control. If better fidelity is needed, headphones can be connected to the 3.5mm TRS stereo line/headphone output.

Making the grade

The AES Qbox really proved its value as a helpful tool during some of the HD Radio builds that I have been involved in recently. The unit's ability to generate a tone is useful when testing a line before the programming chain is complete. The ability to generate audio with various sample rates and to monitor digital audio truly allows for complete testing at any point in a project.

I have also been using the system for troubleshooting. Digital audio chains are often so quiet that you are hard pressed to know if there is a problem. Even if no audio exists but AES sync is present, the visual indicator shows that the circuit is good because the sync lock lights.

The equipment also supports the "divide and conquer" principle of troubleshooting. By inserting a Qbox at a problem point in a system, the user can verify signal presence or generate a signal to determine if the problem lies farther down the line. I have also found the built-in condenser mic useful when I needed something other than tone to send down the line.

A manual provides clear explanations of the operating controls and their functions.

The AES Qbox continues to prove itself to me; I have used it extensively for a few months. It has been thrown in tool bags and used in some challenging environments, yet still works like it was new. I would recommend it to anyone who manages a digital facility and needs a simple yet effective way to install, test and maintain AES3 or S/PDIF cables.

Smith is president of JRS Broadcast Engineering, Monroe Twp. NJ.

Editor's note: Field Reports are an exclusive *Radio* magazine feature for radio broadcasters. Each report is prepared by well-qualified staff at a radio station, production facility or consulting company.

These reports are performed by the industry, for the industry. Manufacturer support is limited to providing loan equipment and to aiding the author if requested.

It is the responsibility of *Radio* magazine to publish the results of any device tested, positive or negative. No report should be considered an endorsement or disapproval by *Radio* magazine.

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Henry Engineering Studio Drive

By Michael Patton

Recently, I purchased two Henry Studio Drives for use at two news workstations at a state news network in Louisiana. At each workstation the Henry unit is wired to a PC running Adobe Audition, a small powered tabletop speaker, a router output controlled from the PC, a microphone and a telephone feeder circuit.

There are two pieces to the unit; an audio I/O chassis designed to mount on the rear of a PC or nearby on a shelf or to the wall, and the front panel unit, which can fit inside the standard 5 1/4" drive bay in a PC, or you can install the (included) optional top cover for desktop use. The two pieces connect with an included ribbon cable. In our application, we put the Henry mixer front panel unit on the desktop and the PC on the floor below, with the audio I/O unit mounted on the wall of the studio furniture desk near the PC.

There are six inputs that supply four mixing channels: a mic, the phone/Line 1 input (Line 1 is unbalanced stereo, the phone input is mono, balanced and transformer isolated), Line 2/Line 3, both stereo balanced, and the last channel is for the PC sound output. Most of the inputs and outputs are 1/4" phone jacks and are on the rear panel of the I/O unit; everything we tried worked well, balanced or unbalanced. The headphone jack and a jack for a feed from an MD player or other portable unit are on the front panel of the main unit and are 1/8".

The unit's built-in mic preamp had plenty of gain, low apparent noise and no audible headroom issues. We fed it from a classic Shure SM-58 and it worked just fine. The unit features a "cough switch" capability, a mic processor insert point and even a mute tally output for an on-air light.

There is an air monitor input to the monitor section; in our case we fed it from the network's main feed, so the news people could listen for network errors or failures. In a conventional station, of course, this would be connected to an off-air receiver, giving the tiny mixer all the needed capabilities to actually program a radio station.

Performance at a glance

Mounts inside a PC case

One mic, six line inputs

Multiple outputs including mix-minus

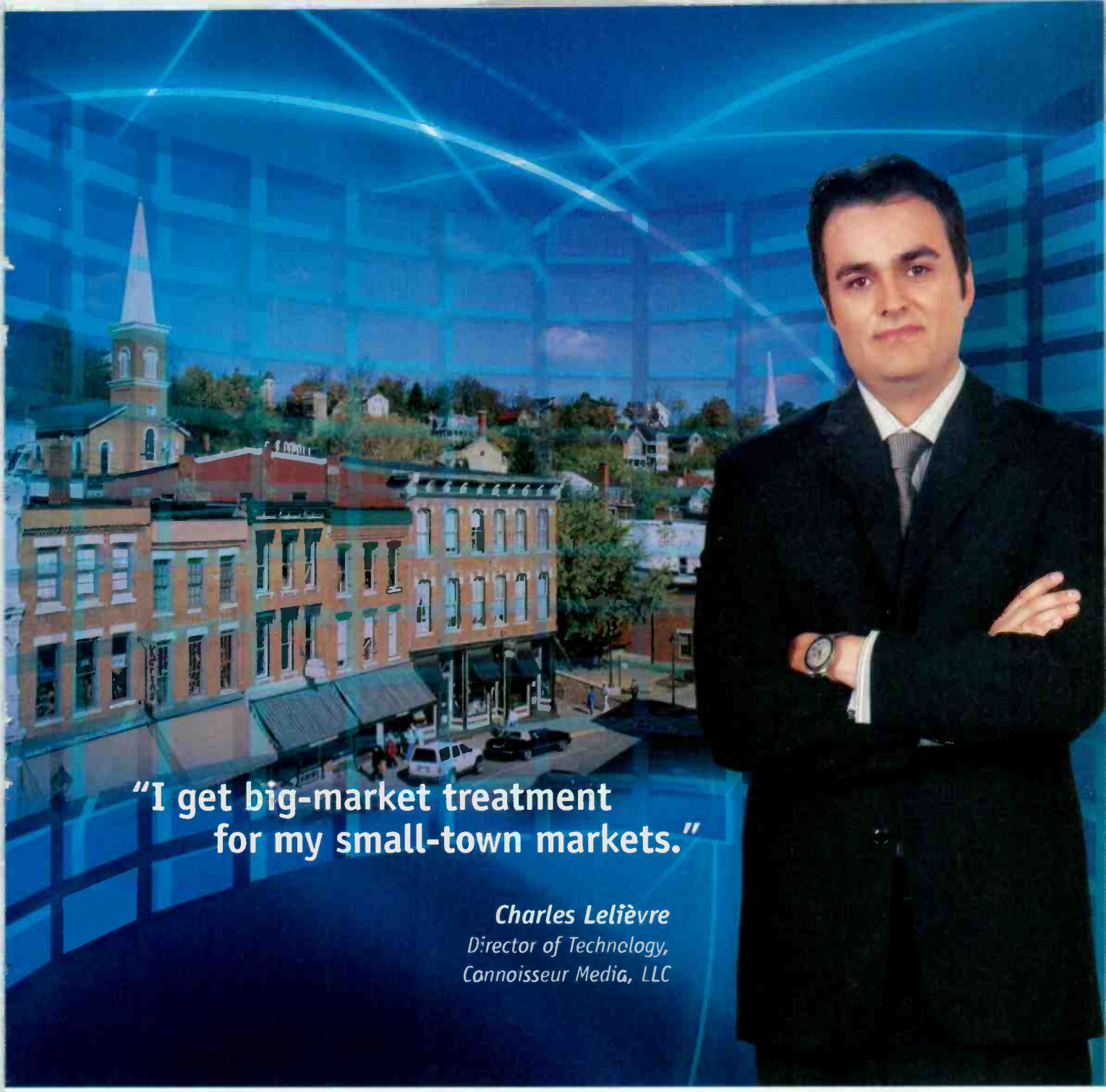
Separate I/O unit

The features

The unit offers all the basics for connecting to a telephone, including a telephone input and a mix-minus output, both mono, but it still lacks a built-in hybrid. Not needing two-way capability, we used them with a simple in/out switch, an isolation transformer and a standard Western Electric 2500 desk phone set. This way we were able to send and receive phone feeds—just not at the same time. The unit is tough enough to connect directly to a standard telephone line and pick off incoming audio; connected to a modern telephone hybrid, though, you can have a full-duplex on-air conversation with the device.

I was pleased by the small form factor and by all the features. The built-in headphone amp is loud enough for even the deafest jock. The LED VU meters are nice and bright. The potentiometer have a solid feel and everything ran in a good, linear range on the controls—not too far up or down.

The only thing I didn't like was that there was



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Phone (800) 622-0022 or email: bcdautoconfirm@harris.com

HD Radio™ is a trademark of iBiquity Digital Corp.

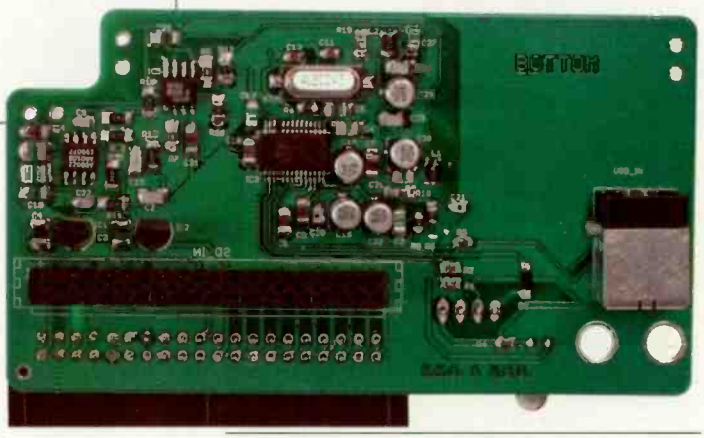
Henry Engineering

P 626-355-3656
W www.henryeng.com
E info@henryeng.com

a fair amount of bleed-through from the line input to the output, even with the potentiometer all the way down. In our application, we fixed this problem by dialing the router to a dead channel when not in use, and I'm told that Henry has fixed with this issue in later units.

USB adds flexibility

Since the introduction of the Studio Drive, Henry Engineering has released the USB Adaptor, which connects the audio mixer to a computer via a USB port. The USB Adaptor is a plug-in circuit board that mates to the Studio Drive mixer unit. It can be installed in about 30 seconds, and can be retrofitted to any Studio Drive system.



Patton is the president of Michael Patton & Associates, Baton Rouge, LA.

Ecitor's note: Field Reoorts are an exclusive *Radio* magazine feature for radio broadcasters. Each report is prepared by well-qualified staff at a radio station, production facility or consulting company.

These reports are performed by the industry, for the industry. Manufacturer support is limited to providing loan equipment and to aiding the author if requested.

It is the responsibility of *Radio* magazine to publish the results of any device tested, positive or negative. No report should be considered an endorsement or disapproval by *Radio* magazine.

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www.bsiusa.com

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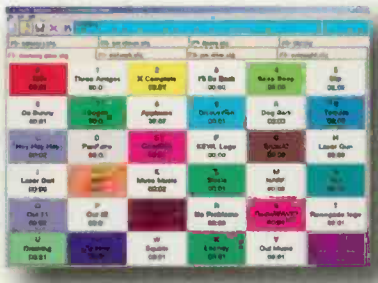
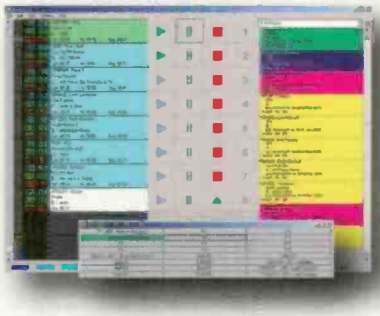
Simian - radio automation and digital play out system

Instant Audio



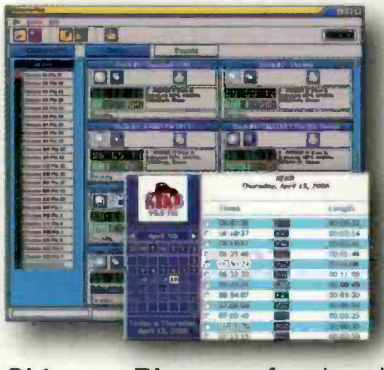
Stinger- instant acess to 288 'rapid fire' audio files

Digital Cart Player



WaveCart - the original on-screen cart machine

Audio Logging



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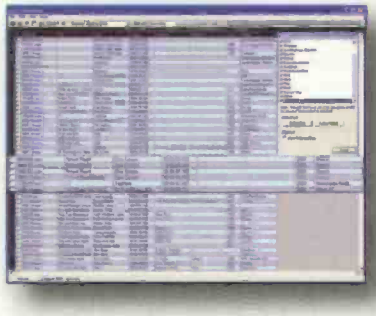
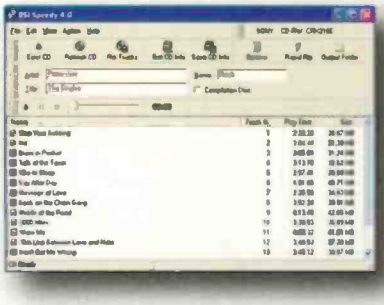


MusicStore - over 55,000 ready to play (tagged) songs

CD Ripping



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www.bsiusa.com sales@bsiusa.com

BSI

Unethical interference

Enjoyed your Viewpoint on Harry Reid, the pirate radio station in Nevada and the FCC [March 2007]. It's amazing how the illustrious Senator Harry Reid proves again he is not the ethical politician he says he is. Questionable real estate deals, now another backdoor deal and most likely more. How much did Moses pay him?

My wife and I own a station in Massena, NY, WYBG-AM 1kW, and if we even thought of doing what Moses did we'd lose our license in the blink of an eye. We do more than fulfill our public interest obligations 10 times over. Even though we are 100 percent talk, and we pay music licensing fees.

Thanks for the info.

Curran Wade
president/GM
Wade Communications
WYBG-AM 1050
Massena, NY

A West wind blows

Cumulus Broadcasting in Topeka, KS, has two FM transmitters on a hilltop southwest of the city. On one particular day the wind was blowing out of the west, and maybe a little south, at a steady 35 mph to 40 mph. Our transmitters are in a 25' x 25' block building with a 2' x 2' air vent on west wall and similar vent on the east wall.

The previous week I replaced the IPA tubes in the Harris 20K with an old soft pair until a new set could be delivered. Then, over the weekend, strong thunderstorms passed through the area, and rain made its way into the antenna line. Reducing the transmitter output and adding a little more nitrogen to the line was the temporary fix.

When I arrived with fresh nitrogen bottles, I had the front door open as I wrestled the tanks into the building. After setting up the first tank I noticed that the 20K had gone off the air. I turned the backup on and began to troubleshoot.

The 20K had no PA filament voltage. I remembered that the contactor had a loud buzz lately and some pretty good sparks would fly when it was energized or de-energized. I figured that maybe it was finally shot, so I begin to troubleshoot around the filament circuit.

A few minutes later, my contract engineer called about another matter, and I used the opportunity to ask him if he had ever seen a problem like this with this transmitter.

"Which direction is the wind blowing?" he asked.

At first I was shocked he would ask such a question. "Steady, out of the west mostly. Maybe a little south. But what does that have to do with anything?" I asked.

"Is the front door to the building open?"

"Sure. I just brought in three more nitrogen bottles."

"Close it!"

Sure enough, when I did the filament voltage came up within three seconds.

I asked, "OK, Tom, what just happened?"

He replied, "The air pressure switch on that transmitter is a bit sensitive. With the wind blowing out of the west, a sufficient vacuum was created in the room to cause the air switch to protect the transmitter. Don't feel bad; it took me about a half a day the first time it happened to me."

It was like the front door was connected to the failsafe circuit or something. When I opened the door the filament meter dropped. When I closed it the meter came up to 6V. Open, off. Close, on. Hmmm.

So I put the station back on the main transmitter and prepared to leave for the day when it hit me: How am I going to get out of here without taking the station off the air again?

I dialed the remote control on my cell phone and got to the point where all I had to do was press the plate on command. Then I quickly exited the building.

Lee Reisinger
chief engineer, Cumulus Broadcasting
Topeka, KS

Thanks for the podcast

I still think IBOC is bad technology (too costly and too complicated) and I still predict IBOC gear will be in the dust-bin in a couple of years. But I think your podcast regarding the FCC's recent decision was excellent [March 26 Highlights from the Headlines podcast]. Keep up the good work on keeping us informed.

Maynard Meyer
GM/CE, KLQP-FM
Madison, MN

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NEW PRODUCTS

by Kari Taylor, senior associate editor

Portable signal generator
NTI (Neutrik Test Instuments)

Minirator MR-Pro: Besides test signals, this generator provides sweeps, fast chirps and offers playback of WAV-based test signals. The unit features minimal residual distortion less than -96dB, a maximum output level of +18dBu, and continuous monitoring of the impedance, signal balance and phantom power. The battery-operated device features a multi-function rotary wheel and function keys ensure fast access to the signal functions and parameter with one hand. Data exchange is via the USB port.

503-684-7050; www.nti-audio.com
info@nti-am.com

Digital recorder
Samson Technologies

Zoom H4: This portable recorder fits in a user's palm and is suitable for recording live musical performances, interviews, podcasts, meetings, classes and seminars. The H4 records linear digital audio up to 24-bit/96kHz and MP3 format with bit rates up to 320kb/s. It features two electret condenser microphones configured in an X/Y pattern for stereo recording, and two combination XLR 1/4" input jacks with phantom power for use with external microphones. The unit also includes onboard effects such as compression, limiting and mic modeling. An 1/8" headphone jack is provided for monitoring. The recorder records on Secure Digital (SD) media, and a 128MB SD card is included with the unit. Files can be moved with the USB interface. The unit provides four hours of continuous recording operation from two AA batteries. An ac adapter, USB cable, windshield cover and tripod adapter are also included.

631-784-2200; www.samsontech.com
info@samsontech.com

FM antenna
Jampro Antennas

JSHD-HD: The dual input HD sidemount antenna system provides linearity and power handling capability and features broadband characteristics. The antenna provides isolated and separate inputs for analog and digital transmitters. This approach allows the digital transmitter to operate at its target power with no power lost in a reject load and no power reduction caused by lossy digital injectors.

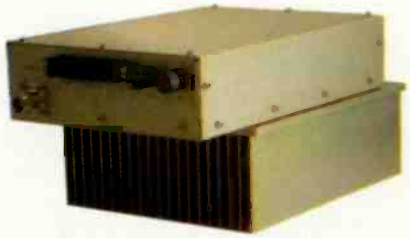
916-383-1177; www.jampro.com
jampro@jampro.com

Audio editor
RML Labs

Saw Studio: The latest version of this product features slower mixer settings scrolling to be less sensitive to small mouse changes, resulting in an overall feeling of more control. The SRP/Rec latch operation has been enhanced to automatically detect a marked area and override the latch function for auto punch-in at the marked area. Also, the SRP punch-in code has been adjusted to help eliminate record buffer overruns under certain conditions on certain systems.

www.sawstudio.com
support@sawstudio.com

RF power amplifiers, exciters
PTEK



700W IP Module: The 700W IPA module is a drop-in replacement for Silicon Valley Gold Module MM&D Blue Module, as used in Continental, Harris and other transmitters. Its gain and phase is matched to the user's existing modules.

888-889-2958; www.ptekpower.com
sales@ptekpower.com

Audio interface
TC Electronic

Konnekt 8: The audio interface features two mic preamps that are switchable to dedicated Hi-Z guitar inputs or balanced line inputs, two analog controlled balanced outputs, two auxiliary line in to monitor external devices, two coaxial S/PDIF (stereo) I/O, sample accurate MIDI and Firewire connectivity. The unit can be used as a standalone mixer. The interface includes Cubase LE to allow users to start recording right out of the box.

818-665-4900; www.tcelectronic.com
info@tcelectronic.com

Digital mic system
Soundfield Research

DSF-2: The DSF-2 produces mono, stereo and digital surround sound, simultaneously if required, all from a single microphone. The processors produce a four-channel proprietary output format known as B-Format, which can then be further decoded by Soundfield hardware or software into mono, stereo, stereo M/S, or surround sound in formats such as 5.1, 6.1 and 7.1. The 1RU controller unit offers live decoding to stereo, stereo M/S and four-channel B-Format. The stereo signal may be output directly from the DSF-2 in the analog or digital domain via rear-panel XLR and unbalanced 75Ω BNC connectors, while the stereo M/S and B-Format signals are available only as digital signals. The processor also offers a user-adjustable gain control, a fixed-threshold recording limiter, on-board four-channel LED metering, a built-in high-pass filter and a headphone jack for monitoring purposes.

+44 1924 201 089; www.soundfield.com
sales@soundfield.com

Duplication, printing system
Primera Technology

Bravo SE: Instead of copying discs one at a time and then printing and sticking labels, Bravo SE automates the entire burning and printing process. A robotic mechanism is used to transport discs into the built-in Pioneer DVR-111 DVD±R/CD-R recorder. After recording, each CD or DVD is individually inkjet printed direct-to-disc in full color at 4,800 dpi resolution. As many as 20 discs per job can be produced automatically and hands-free. Bravo SE attaches to any PC running Windows Vista/XP/2000 through its high-speed USB 2.0 interface. Bravo SE also attaches to any Mac running Apple OS X.

800-797-2772; www.primera.com
sales@primera.com

FM transmitter
Bext

TFX 10000: The first of a new generation of hot pluggable solid-state FM transmitters, this transmitter offers modular architecture, a dual redundant exciter and a stainless steel enclosure. Housed in 1RU, the transmitter is 55" tall (30 rack spaces high). The unit features 70 percent overall efficiency. RS-485 and USB connections for PC readings and control are also included.

619-239-8462; www.bext.com
sales@bext.com

Power strips, power distribution units
APW Mayville

Stantron Power Options: The Power Options family is a full range of isolated-ground and standard-ground power strips and power distribution units that feature a small footprint and isolated ground options for densely-packed cabling installations. The system includes vertically mounted zero-U designs (14 outlets and 20 outlets) and isolated ground 1RU models (12 outlets). All designs offer several power input options, including twist lock, straight blade and flexible BX-conduit for hard-wire installations. The receptacles can be rotated 90° to accommodate transformers, which would otherwise block adjacent outlets on the power strip.

800-558-7297
www.Stantronracks.com

Studio condensor mic
MXL Microphones

190: Featuring a low-noise FET design, balanced transformer coupled output and Mogami wiring, the cardioid condenser microphone offers a frequency response of 20Hz to 20kHz. The microphone's custom chamber has been tuned to complement the capsule's response, delivering an open, airy sound that is transparent without being overly bright. The mic uses a six micron condenser pressure gradient capsule. The mic incorporates a 0/-10dB attenuation switch.

800-800-6608; www.mxlmics.com
sales@mxlmics.com

Neafield monitor
Klein + Hummel

O 300: A triamplified three-way nearfield studio reference monitor, the O 300 delivers is similar to the O 300 D minus the digital input and control hardware. By using a dense, low-resonance material called LRIM, the company has molded the waveguides required for dispersion directly into the baffle. The unit's 8" cone woofer is made of a lightweight polypropylene material. The midrange is handled by a treated fabric dome with a 3" voice coil. The 1" high-frequency driver is equipped with a titanium/fabric dome that combines the transparency of a titanium dome with the low distortion of a fabric dome.

+49 711 45 89 30
www.klein-hummel.de; sales@klein-hummel.de

Analog mixer
Sonosax

SXST: In this version, the battery tray has been removed and replaced by a new front profile. The side flanges are shorter, thus reducing its depth size. The two rails extruded in the front profile allow users to mount accessories or a custom-made hand rest. An internal digital module offers 8x high quality 24-bit A/D converters with a selectable FS from 44.1 up to 192kHz, outputing four AES/EBU lines. A switchable limiter is also provided.

+41 21 651 0101; www.sonosax.com; sonosax@sonosax.ch

UPGRADES and UPDATES

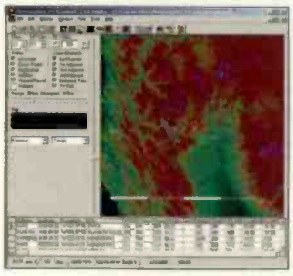
Google Ad Sense for Audio is now supported by commercial systems including Broadcast Electronics Audio Vault, Vault2 and AV100; Enco DAD; and LAN International Viero. (www.google.com/ads/asaudio)...The ***Sony*** PCM-D1 has an added accessory to accommodate XLR mic connections: the XLR-1 adapter. The adapter provides two transformer-balanced microphone inputs with switchable phantom power. (www.sony.com/proaudio)... ***Logitek*** has upgraded its Artisan and Mosaic digital audio consoles to accept more faders (up to 32) and make a pop-up EQ and dynamics screen available on the Artisan and a pop-up fader display for the Mosaic. (www.logitekaudio.com)...Comrex is now shipping its Access portable stereo BRIC IP codec. (www.comrex.com)...***Day Sequerra*** is offering a factory upgrade program for existing M2 and M4 HD Radio modulation monitors and tuners to add the new features of the newer models, the M2.2R and M4.2R. (www.daysequerra.com) ■

Line splitter/mixer
Rane

SM 26B: This product can be a combination 6x2 line mixer, 2x6 line splitter or 6x6 line driver. The equipment is capable of four-pair stereo line splitting or mixing. Mix, pan and level controls with 12dB gain for level matching. The unit features balanced 1/4" TRS connectors.

425-355-6000; www.rane.com; info@rane.com

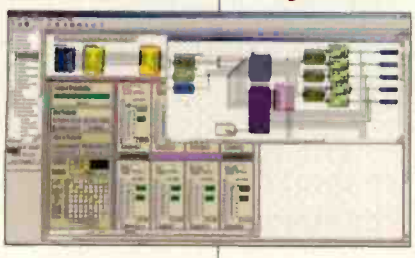
Field strength program
RF Software



RF Investigator v3: A new button on the tool bar selects AM or FM studies without the need for additional software. Multiple monitor support allows the user to move the various windows as he likes to more efficiently display the data and control functions. Maps are resizable to a rectangle. The entire map display can be copied and pasted into another application, such as a word processor or graphics editor.

352-336-7223; www.rfsoftware.com
info@rfsoftware.com

Software upgrade
Symetrix



Symnet Designer 7.0: Version 7.0 of the Symnet Designer application for Windows offers loudspeaker management modules. These modules provide parametric EQ, high-pass and low-pass filtering, delay, gain, invert and mute. There are two versions of modules: Smaart-Compatible and Standard. They are identical except that the Smaart-Compatible version can be directly controlled from SIA Software's Smaart Live RTA software. The software's control capabilities have been enhanced with the addition of a subcategory of DTMF generator/auto-dialer modules for teleconferencing. All Symnet units that have Ethernet ports can now be externally controlled via Ethernet. This upgrade is available as a series of software modules that can be added to a Symnet design at any time based on the system application.

425-787-3222; www.symetrixaudio.com
sales@airtoolsaudio.com

Switching module
DM Engineering

Mic Pro 2: This lighted silent-switching module will upgrade a low cost production mixing board to have the microphone switching features of a professional broadcast console. The on/off buttons enable and disable the mic channel. Microphone channels can now be individually controlled by their own module. The unit is powered by a dc power supply module, the Studio Slave Relay Pack or Superelay. As many as five switching modules can be powered by one power supply module. The unit requires 9Vdc to 12Vdc at 45ma input power.

800-249-0487; www.dmengineering.com
info@dmengineering.com

Rackmount mixer
Sonifex

RB-SSML1:
This 1RU source selector for compressing or limiting an incoming mic or line signal features selectable level metering and headphone monitor outputs. The compression ratio and threshold limits are adjustable via linear potentiometers on the front panel. The threshold can be set between -30dBu and +20dBu. The mic input consists of a low-noise mic preamplifier for converting mic level signals to a line level. There are independent switches to control a high pass filter and to provide phantom power at 48V to the connected mic. The XLR-3 stereo monitor input volume control is fully adjustable via a back panel recessed potentiometer, and has an additional 10dB gain increase via a switch on the rear panel.

207-773-2424
www.independentaudio.com
info@independentaudio.com

Tabletop interconnect box
Altinex

PNP415 Pop 'N Plug: This enclosure, with its custom tabletop surface, becomes flush with the tabletop when closed. Both sides of the unit can hold four single sectional plates. The standard plate, the DS901-120, was designed especially for the PNP415 and comes with two power module connectors, one VGA connector and four snap-in connectors.

800-ALTINEX; www.altinex.com
solutions@altinex.com

Software program
Comquest

Song Sorter: Users of this software can select and display any demo, gender, ethnic or station listening cells they wish. Comquest's Song Matrix shows each song's individual performance in context with all other songs in a test. Full trending capabilities are built in, as well as the ability to import fresh Sound Scan and BDS data, and merge the results with call-out and Internet music research results.

619-659-3600; www.comquestmusictesting.com
ggorton@Comquestmusictesting.com

Direct interconnect cables
Wireworks

Direct Cabling Assemblies: Available in 10' and 15' versions with several XLR connector combinations, including all male, all female, mixed genders or TRS connectors, these assemblies include Tails/Tails, DB25 analog or digital fan-outs, and DB25 trunks supporting analog or digital wiring standards. The system uses 1100 rugged jacketed cable featuring Neutrik black/gold XLRs, TRS and DB25 connectors with metal bodies, captive thumbscrews and gold contacts.

800-642-9473; www.wireworks.com; info@wireworks.com

Antenna system
Sennheiser Electronic

A5000 CP: The wideband design (450MHz to 960MHz) of this system accommodates antenna distribution systems for wireless monitors or wireless microphones across multiple frequency ranges. Due to its three-dimensional radiation pattern, the antenna can be mounted above the talent or venue.

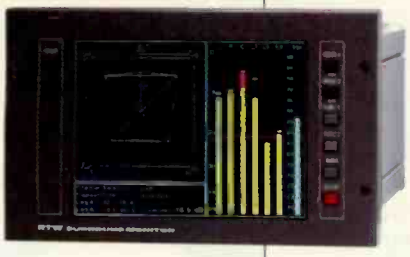
860-434-9190
www.sennheiserusa.com
lit@sennheiserusa.com

Data interface
Unique Interactive

Man DLS: The display text system is a standalone system that is placed between the content generated by the radio station and the actual broadcast. The system enables broadcasters to log into the user interface from anywhere with an Internet connection to edit, manage, schedule and control the cycles of messages for broadcast. The interface also features a storage area for content to be created before being added into a cycle for broadcast. Once the cycles of information have been created, push the content to other digital platforms for additional exposure, such as websites, audio streams and online audio players.

+44 20 7453 1600
www.uniqueinteractive.co.uk

Surround monitor
RTW Radio-Technische Werkstatten



10600-VID: This monitoring instrument for multi-channel radio features an integrated surround sound analyzer. The monitor features display capabilities for stereo and 5.1 surround signals. It has three AES3 signal inputs. Six multi-standard peak level meters, a 10-fold correlator display, RTA, SPL/LEQU and Dial Norm meters, and an informative status monitor are all presented on the unit's VGA display. Information displayed in the graphic include the balance between the front and surround channels and between the front L, C and R channels, phantom audio sources, dynamic display of the loudness center of gravity within the surround field and the phase relationships.

+49 221 709130; www.rtw.de

Power distribution unit
Pulizzi Engineering

PC3365: This new series is available in North American and European configurations. The North American version input power is three-phase 120/208V 30A, via a NEMA L21-30P plug. Power output is at 120V and distributed through 24 IEC C13 computer-style receptacles, providing 8,640VA of power. The European version input power is three-phase 230/400V 20A via an IEC 60309 plug. Power output is at 230V and distributed through 24 IEC C13 computer-style receptacles, providing 11,040VA of power. The power input is located on the rear through an attached 15' power cable along with the power output. This series comes standard with electrical noise power filtering.

800-870-2248; www.pulizzi.com
sales@pulizzi.com

Software
Summit Traffic

Summit Traffic and Billing: The system schedules programs, commercial spots, promos, public service announcements and paid programming. The software produces up-to-the-minute, real-time avails reports, and generates a multitude of sales reports, locally or remotely.

800-771-1827; www.summittraffic.com; Sales@summittraffic.com

Arc and flame detector
Burk Technology

AFD-1: The AFD-1 detects electrical arcs or flame and sends a contact closure for integration with alerting devices or the station's remote control system. The unit can be used near equipment cabinets, transmitters, lightning arrestors or anywhere threatened by high voltage arcs or flame.

800-255-8090; www.burk.com
sales@burk.com

Controller/switcher
SM Pro Audio

M-Patch 2: The M-Patch 2 is a desktop/rack-mountable passive volume attenuator and patch control device. This switcher provides stereo level control for any monitoring or distributed sound application and can attenuate stereo signals from sound cards, CD players, pre-amps and mixers. The unit's front panel rotary controls allow level adjustments for two input sources. The unit features balanced combo XLR/TRS input jacks and XLR outputs, RCA and 3.5mm jack inputs, mono/stereo summing switch, mute switch, A/B output pairs and a built-in stereo headphone amplifier.

+61 3 9555 8081; www.smproaudio.com
sales@smproaudio.com

Power amplifier
Stanton Magnetics

A series: Available in three models, A.900, A.1800 and A.2800, these 2RU amplifiers feature a tunnel cooling system and 21-position detent level control knobs. The units feature power ratings up to 2,800W and support for bridged mono operation. The amplifier's front panel includes six-segment, multi-color LED ladders for visual monitoring of signal status per channel. Rear panel input provisions include the balanced combined XLR and 1/4" TRS connectors, while outputs are handled by five-way binding post and Speak-on connectors. The rear panel also features a high-pass filter switch, limiter switch and a mode select switch for bridged/parallel/stereo operation.

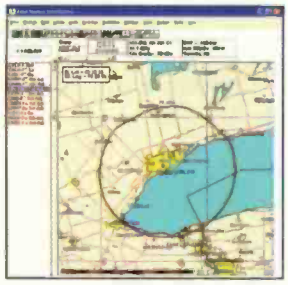
954-929-8999; www.stantonmagnetics.com
info@stantonmagnetics.com

Stereo power amplifier
Kramer Electronics

Model 900: The stereo power amplifier accepts unbalanced stereo on RCA inputs or balanced audio on terminal block connectors and delivers a speaker output of 9W RMS per channel into a 4Ω load. It includes a volume control and has a S/N ratio of 63dB unweighted. The speaker output is on four-pin terminal block connectors. It measures 4 3/4"W x 3"D x 1"H.

888-275-6311; www.kramerelectronics.com
info@kramerelectronics.com

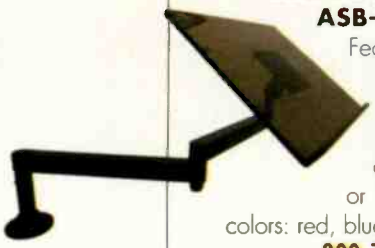
Allocation program for Canada
V-Soft Communications



FM Commander Canada: The Canadian version of FM Commander uses the spacing tables from C 1.4 of the Industry Canada Application and Procedures and Rules for FM Broadcasting Undertakings. Contour-to-contour spacings are evaluated to 800kHz to provide tables and distance to contour allocation maps. All stations are protected to the 54dBu F(50-50) signal contour except for cross-border relationships when class C U.S. stations are protected to the 58dBu contour. The Canadian version includes the same distance to contour and minimum spacings map screens as the U.S. version.

800-743-3684; www.v-soft.com
info@v-soft.com

Desktop script board
RAM Broadcast Systems



ASB-24-4, ASB-24-12, SB-4, SB-12: Features of these boards include articulating or stationary mounting arms, adjustable pan and tilt, a 24" reach, bolt-through desk assembly and a slim profile. Six' extensions are available. The boards are supplied by 4" or 12" risers. The equipment comes in several colors: red, blue, orange, green, yellow and smoke gray.

800-779-7575; www.ramsyscom.com
sales@ramsyscom.com

Audio clip player
360 Systems

Instant Replay 2: The Instant Replay 2 spot player adds Ethernet networking for on-the-fly updates to a stored sound clip library. Audio clips can be transferred to and from a PC by pointing and clicking. Last-minute additions can be retrieved over the Web, instantly uploaded and used for any kind of live entertainment or production application. One-touch back-ups can also be performed. Record better-than-CD-quality audio directly onto hard disk. Built-in editing software enables head and tail trims, fade-ins and fade-outs and gain changes. Fifty hot keys enable on-the-fly instant playback of sound effects from 10 banks of 50 clips, and another 500 clips can be stored on the hard disk. Other advances include WAV file support, 16- and 24-bit recording formats, and balanced and unbalanced audio inputs and outputs.

818-991-0360; www.360systems.com
info@360systems.com

Hard disk recorder
Zaxcom

Deva 5.8: The new Deva 5.8 features eight integrated hardware faders, an internal DVD-RAM drive and a Flash media slot, allowing it to provide recording, mixing and effects capabilities within one package. The system will record to hard disk or flash disk. The unitrecords 10 tracks of audio directly to a compact Flash memory card. The memory card slot is mounted on the control panel for quick and easy transfer of material from the production site to post-production staff. The internal DVD-RAM drive provides users with a recording alternative and saves space by combining two products into one. Additional features include EQ, notch filter, compressor and delay on each channel; the ability to mix to disk or outputs both pre- and post-fader; eight mic/line inputs with 48V phantom power; and support for external Firewire recording drives.

973-835-5000
www.zaxcom.com
info@zaxcom.com

Wireless mic system
Avlex

Mipro Act 81, Act 82: These digital wireless microphone systems feature a full color vacuum florescent display, 24-bit digital audio quality with advanced DSP, a sub-band ADPCM algorithm and full 128-bit encryption. The 81 is the single receiver and the 82 is a dual receiver system.

816-581-9103
www.avlex.com; sales@avlex.com

Software packages
Arctic Palm Technology

Center Stage Studio Suite: Our Center Stage Studio Information Suite is a collection of four software packages and offers more than 30 tools for capturing and moving data electronically. The CS Copy Management software provides copy writers, promotions and programming staff with tools to create, find and maintain recorded or live copy. Once created, copy can be sent via e-mail or an existing LAN fax software to the client for approval. When ready a simple click and the Production Studio schedule is updated and ready for recording or live copy goes directly to the control room for on-air use. The production staff always has a complete list of the latest scripts to be recorded, and the copy can be read directly from the on-line prompter—all without printing or moving a single item of hard copy.

800-268-4081; www.arcticpalm.com

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Contributor Profile

Meet the professionals who write for *Radio* magazine.
This month:
Field Report, page 48.

Michael Patton
Owner/
President
Michael Patton and Associates
Baton Rouge, LA

Patton's radio engineering work began while he was still in high school. He has been a consulting engineer since 1982. His latest project was to assist Entercom's WWL move into its new all-digital facility in New Orleans. He is especially proud of his work with AM broadbanding antenna networks, AM directional antennas, and digital studio design and construction.

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Written by radio professionals
Written for radio professionals

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ADVERTISER INDEX

This index is a service to readers. Every effort is made to ensure accuracy, but *Radio* magazine cannot assume responsibility for errors or omissions

by Kari Taylor, senior associate editor

That was then

In 1966 Scully Recording Instruments featured the studios of WNEW-FM in New York in its advertising. In this picture, Chief Engineer Max Weiner is standing next to the Scully equipment. The caption read "Seven Scully units in our FM control rooms give our recording crew the precision, flexibility and operational ease they demand."

Sample and Hold

Most Desirable Feature in Next MP3 Player

Source: Rock radio consultants Jacobs Media, www.jacobsmedia.com.

Do you remember?

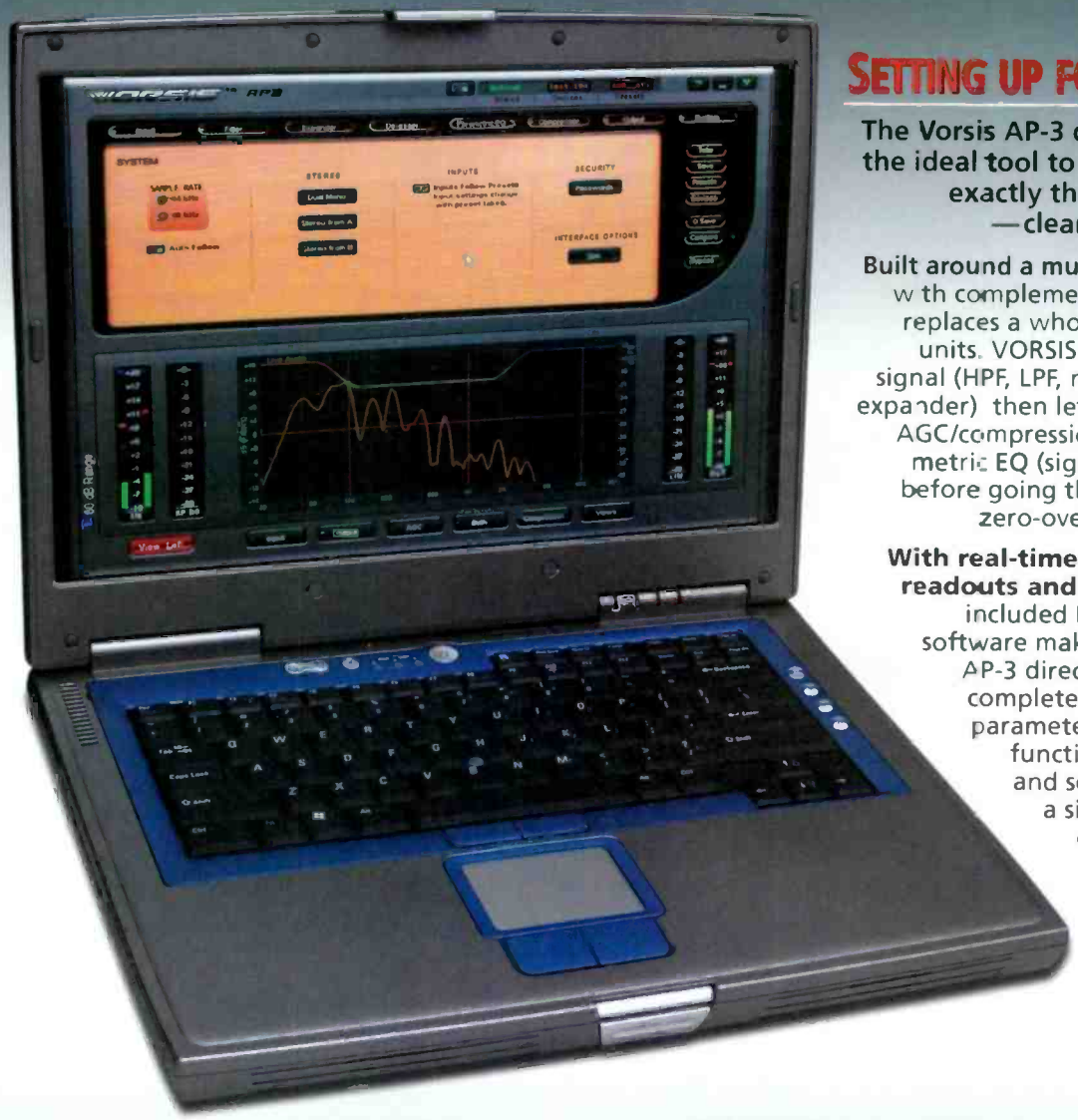
A complete cartridge tape production center in one compact, portable unit, the M-6086 Cartritape Make-Up Console from Gates Radio Company (a subsidiary of Harris-Intertype) included a Cartritape cartridge tape system and recording amplifier, a CB-77 12" turntable with equalized preamplifier, a microphone preamplifier and a UniQue cueing amplifier. By plugging in the console, users had a turntable, microphone, a telephone line input for recording net, and an input for external tap recorder or turntable available for cartridge tape production.

The console could also be used in control rooms as direct programming equipment, providing an extra turntable or Cartritape system.

This Little Unit

Can Do BIG Things!

Our new AP-3 is the perfect HD Processor:



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The Vorsis AP-3 digital processor is the ideal tool to shape your sound exactly the way you want it —cleanly and efficiently.

Built around a multi-band compressor w th complementary AGC, the AP-3 replaces a whole *rack* of dedicated units. VORSIS pre-conditions your signal (HPF, LPF, notch filter, de-esser, expander) then let's you apply 3-band AGC/compression *and* 4-band parametric EQ (signal chain reversible) before going through a final stage zero-overshoot peak limiter.

With real-time spectrum density readouts and full metering, our included PC graphic interface software makes operation of the AP-3 direct and easy, offering complete control of all audio parameters, presets, monitor functions, system settings and security—all through a single RJ-45 ethernet connection that lets you control one or many AP-3 units.

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BUT THE *MISSION* REMAINS THE SAME

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