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December 2006
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100 Ideas



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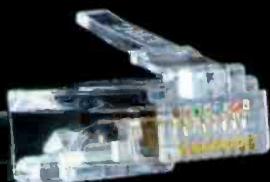


WHEATNET™ — FUTURE PROOF!

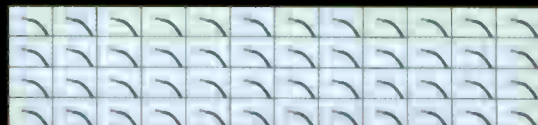
WHEATNET LETS YOU ROUTE THOUSANDS of bi-directional signals at ONCE in just 60 microseconds—all secure, virus-proof and in just 2 rackspaces! WHEATNET leaps way ahead of conventional stacked router or IP-based designs, interconnecting up to 48 studios (each with its own independent mix engines and I/O resources) using just one CAT-5 wire per studio, plus providing systemwide X-Y control from one central location. You can even meter and monitor (in stereo) any signal systemwide.

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WHEATSTONE has a proven track record for digital networking; benefit from our experience!



48 CAT-5 PORTS with 128 audio channels
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THAT'S 6144 TRAFFIC CHANNELS IN JUST
TWO RACK SPACES!



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Harris is your end-to-end radio solution provider.

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High Power AM • Systems and Service • Intraplex Transport

HD Radio™ is a trademark of iBiquity Digital Corporation

Harris PR&E NetWave console with optional networking.
Available in 8-16-24 channel frames, all with fully modular construction.



ZX1000, 1 kW tri-mode FM/FM-HD or digital only transmitter. FM transmitters available from 250 W to 70 kW, in analog or HD Radio.



FlexStar HDx exciter—the gold-standard for FM and FM-HD excitors, featuring RTAC (Real Time Adaptive Correction for best mask compliance) and Engine, the latest iBiquity platform in HD Radio.



Destiny 3DX-50, 50 kW medium wave direct digital drive high efficiency, high reliability AM transmitter. AM transmitters from 1 kW to 2 megawatts, all fully compatible with HD Radio.

Imagine Harris transmitters...
combined with legendary Orban audio processing.



OPTIMOD 9400-AM Digital

No-compromise, independent, multiband processing for analog AM and digital radio—in one box!

For over 20 years, OPTIMOD-AM has dominated the sound of major-market AM radio. Orban's new 9400 offers even better analog AM processing, while its unified analog and digital design substantially reduces costs compared to a two-box configuration.



Contact Harris at 800-622-0022 or email autoconfirm@harris.com

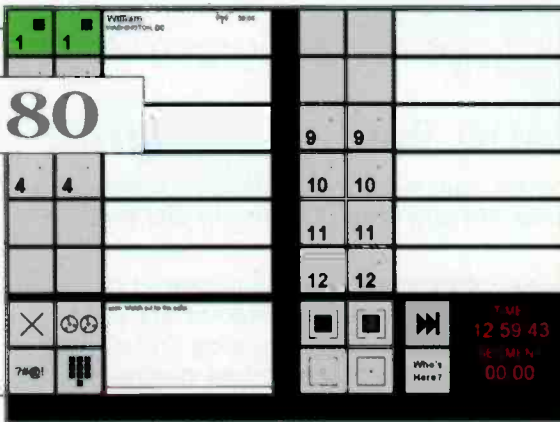


Government Systems • RF Comm • Broadcast • Microwave

www.harris.com

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We celebrate 100 years of radio audio broadcasting, and 100 innovations that have shaped the course of radio broadcasting.

Cover design by Michael J. Knust.



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The most popular consumer electronics gifts for 2006.



Wireless Broadband Internet Remotes

Now Shipping



*Verizon, Cingular and Sprint now offer broadband IP cell phones you can plug into a Tieline codec and deliver reliable, broadcast quality remotes from wherever you're standing



The first time out with the Tieline was a brilliantly simple experience for everyone involved. For lack of a better phrase, the codec just worked.

**-Christian Vang Chief Engineer
Clear Channel St. Louis**



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a **FREE** IP demo www.tieline.com/ip

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www.tieline.com

*Verizon, Cingular and Sprint are trademarks
of their respective corporations

Currents Online

Selected headlines from the past month.

NPR Posts List of Recommended HD Radio Receivers ➔

NPR Labs has released its latest list of recommended HD Radio receivers, which includes four models.

Nautel Launches Live Tech Support

Customers can enter into an online real-time chat with Nautel support technicians to get fast answers to their most pressing questions.

Burk Technology Ships Arc Plus

The system can monitor 1,024 sites via software, a Web browser, telephone or the front panel. The Arc Plus can be added to an existing group of Arc-16 systems.

Content Depot Begins Service

The Public Radio Satellite System (PRSS) began distributing programming through its new delivery system called Content Depot on Nov. 1, 2006.

AAC Option Added to Eureka 147

World DMB has submitted a draft technical specification called DAB Audio Broadcasting (DAB); Transport of AAC Audio to the international standard body ETSI. Eureka 147 currently uses MPEG Layer II to encode the audio in a stream.

FCC Issues NPRM on Effects of Towers on Migratory Birds

This is the next step after the Migratory Bird Notice of Inquiry released in August 2003.



Find the mic and win!

Tell us where you think the mic icon is placed on this issue's cover and you could win a Heil mic courtesy of Transaudio Group.

We'll award a different Heil mic each month during 2006.



This month, enter to win a Heil Sound PR-40.

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Send your entry to

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Include your name, mailing address and phone number.

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Audio Science Becomes an Axia Partner

The partnership allows Audio Science to provide direct audio and data transfer between Livewire networks and third-party PC-based digital audio delivery systems and workstations.

Site Features

Build an AM Loop Antenna

The Engineer's Notebook is full of ideas and tips, including the plans to build your own AM loop antenna.

Industry Links

Looking for information on broadcast history, education or associations? Find listings of schools, museums, associations and more.

Advertiser Links

Want more information? Find contact info for the advertisers in the December issue.

Radio magazine Buyers Guide

Our annual Buyers Guide is inside this issue, but you can also access it online all year.

Industry Events

The *Radio* magazine Industry Events section lists upcoming conventions and conferences. It's on every page of the *Radio* magazine website.



all the audio and communications for broadcasters

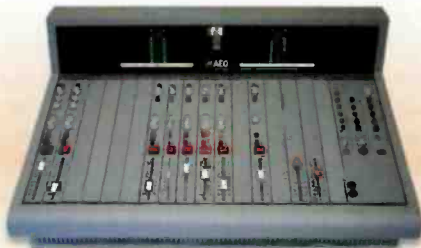
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Ultimate digital audio console.



BC 300
Analogue audio console with built-in telephone hybrid and power amplifier at incredibly low price.



BC 500
Cost effective analogue audio console with built-in digital telephone hybrid.



BC 2500
Top level analogue audio console.

EQUIPMENT FOR REMOTES



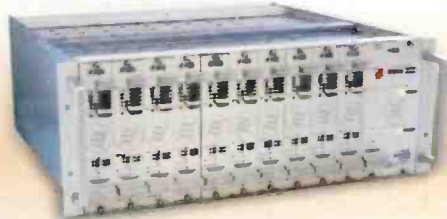
PAW 120
Palm-size digital recorder. New and improved design.



Swing
Portable codec, audio mixer and telephone hybrid.



Eagle
ISDN audiocodec with phone hybrid capabilities at a great value!



Course
The COURSE, a 4-unit chassis, with control software and dual power supplies accommodates up to 10 communication boards: dual channel ISDN codec, Digital Hybrid (analog line) or V35/X21, and soon to be released IP codec.



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www.aeqbroadcast.com



How to make HD Radio succeed: do nothing

Unless you have been in exile, you know that this month marks the 100th anniversary of Reginald Fessenden's Christmas Eve broadcast, which many consider to be the first audio broadcast. In the 100 years that have passed since then, radio broadcasting has changed and evolved, and the latest evolution is taking place right now: the conversion to digital transmission. This issue features a list of 100 technologies that have helped shaped radio broadcasting. These technologies cover a wide range of ideas and concepts, including the digital conversion to HD Radio.

The end of a calendar year is a common time to reflect on the past, so our list fit well with that tradition. In addition, the gift-giving holidays that occur this month give a reason to provide other types of lists. One list that caught my eye was in the November issue of *Popular Science*. This list covers the 100 best innovations of the year, which includes a wide range of devices and interests including various types of personal electronics.

As I watch the progress of the HD Radio roll out, I thought that the *Popsci* list might provide some insight to the consumer side of HD Radio awareness. What I found is not exactly what I was hoping to see; there was no mention of HD Radio.

I found two references to satellite radio devices and one for a media player with Wi-fi connectivity so the user can download songs on the go (which is a derivative of a streaming media appliance anyway). HD Radio is still not making much of a blip on the radar.

I'm not complaining about the absence or claiming that HD Radio is doomed. You should know by now that I'm interested in seeing the successful deployment and acceptance of a wireless digital delivery system for terrestrial radio. HD Radio is the current front-runner in this endeavor.

The HD Radio opponents are quick to highlight the missed opportunity of another holiday season with HD Radio receivers being the top item in every advertising circular or in the prominent position on the shelves of the electronics retailers. The common argument is that other technologies — satellite radio

and media players — have wonderfully marketed their products and services, but broadcasters, ubiquity and the receiver manufacturers have not marketed IBOC so well. The comparison is not the same.

Satellite radio and the leading media player, Apple's Ipod, are single-source outlets. They not only developed their technology, but also fully control almost every aspect of the marketing and sales. This is not the case with HD Radio (or even HDTV if you want to draw parallels). Unifying the HD Radio players has an element of cat herding to it. It's not a simple process.

I know what it will take to make HD Radio a success. It's actually a simple solution.

While the satellite radio and Ipod buzz relates to a new technology, HD Radio is an enhancement to an existing technology. Don't expect consumers to seek a new radio when the old one works just fine or encourage them to buy a model that costs \$100 more for features they don't yet understand. Consumers will eventually buy a new radio anyway, and that's when HD Radio will take off.

The current effort to raise awareness is good and needed, but that's only one step. For HD Radio to succeed, broadcasters should not have to do anything. No marketing, no rebates, no hype. A listener should buy a radio, turn it on, and then realize that it is an HD Radio receiver. No special effort. No convincing him to shell out \$200 for a radio. In other words, do nothing. Every radio receiver needs to be an HD Radio receiver.

That's how HD Radio will succeed.

Chris Scherer

Internet remotes... there's been talk.



➤ Live from 37,000 Feet—No kidding—Live Broadcast from a Lufthansa flight!



... successfully aired his three hour talk show from a commercial airplane [using ACCESS] at 37,000 feet on a regularly scheduled flight between Frankfurt, Germany and New York, US.

Peter Greenberg—Host of the syndicated radio program Travel Today

For the complete story visit
<http://remotebroadcasts.blogspot.com>

➤ Radio Free Asia—Live from the Himalayas



"The results [with ACCESS] were especially reliable considering that Dharamsala has one of mos: "problematic" Internet infrastructures that we have come across."

— David Baden, Chief Technology Officer Radio Free Asia

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➤ Ski Mountain Remote



This picture, really demonstrates what ACCESS is about. This product truly has the ability to cut the wires.

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➤ JAMN 94.5—Walk for Hunger



"ACCESS was used on the air exclusively for JAMN945 at this one. It was all over EVDO with a tremendous amount of active cell phones in the area. The ACCESS was connected to the Verizon wireless Broadband..."

For the complete story visit
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Put Comrex On The Line.

COMREX

Business for engineers

By Kevin McNamara,
CNE

I am a proponent of controlling your own destiny. To maintain that control, people need to constantly evaluate not only their current situations, but also what they would do if their situations changed unexpectedly.

There is no more job security in any industry. In business, the big "O" means outsourcing. The use of non-employee vendors is increasing in every industry. While outsourcing often implies offshore companies where labor rates are cheap, many companies are replacing employees with domestic vendors that can provide local labor and, in some cases, might work on the client premises. It is happening in the broadcast industry, and I expect it to also include engineering functions in the future.

My point is that you should always think of starting your own business as an option. This could be as simple as becoming an independent contractor providing services to a few clients or it could be a more formal business with employees. In any case, it is important to have a good

understanding of basic business concepts.

subjects related to the operation of the business and might also provide paid or subsidized tuition for additional training. This training can provide new or improved skills that are necessary for your growth within the organization.

Even if your company does not offer training, look at what is offered through industry trade organizations for low- or no-cost alternatives. The SBE, through the Harold Ennes Educational Foundation Trust, offers an excellent series of seminars aimed at improving not only your technical skills, but also your management skills. These training sessions are offered in several markets throughout the country, as well as in regional and national broadcast conferences/shows.

Something else to know

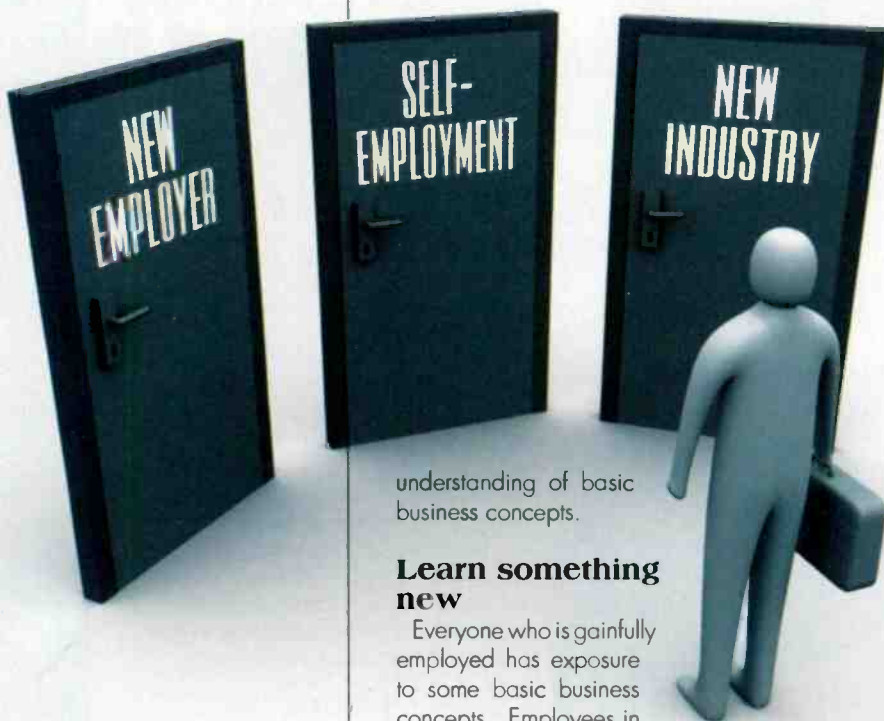
If you go out on your own, know that every business should start with a business plan. This forms the roadmap of why the business was created and how it will grow in the future. These plans can be simple or detailed, depending on the audience for which they are written, i.e. if you are trying to get financing to start the business, then the people or entities that might provide that capital will want to see a fairly detailed plan that includes structure, resources, expertise of the owner(s), marketing plan and projected financial plans. A simple plan might include some basic statements about how the business will be formed and the markets it will serve. There should always be some type of written guideline at the beginning. The plan is always a work in progress and will likely change as the business takes form.

Once the plan is in place, decide the business structure in which to operate. Selecting the proper structure is extremely important because this will directly affect how much you will pay for taxes and particularly what level of personal liability you might be exposed to if you were to be sued. The choices for business structure are sole proprietorship, limited liability company (LLC) or corporation (S or C type.) Each of these has advantages and disadvantages depending on your goals, growth plan, comfort with risk and the particular state in which you plan to operate. Consult an attorney and tax advisor before deciding the structure. Other than sole proprietorship, the other structures

understanding of basic business concepts.

Learn something new

Everyone who is gainfully employed has exposure to some basic business concepts. Employees in a management role typically deal with budgeting, department operations and human resource issues, as well as training in other areas crucial to maintaining compliance with state and federal regulations. You also have experience managing employees and workflow. Many larger companies offer courses for certain



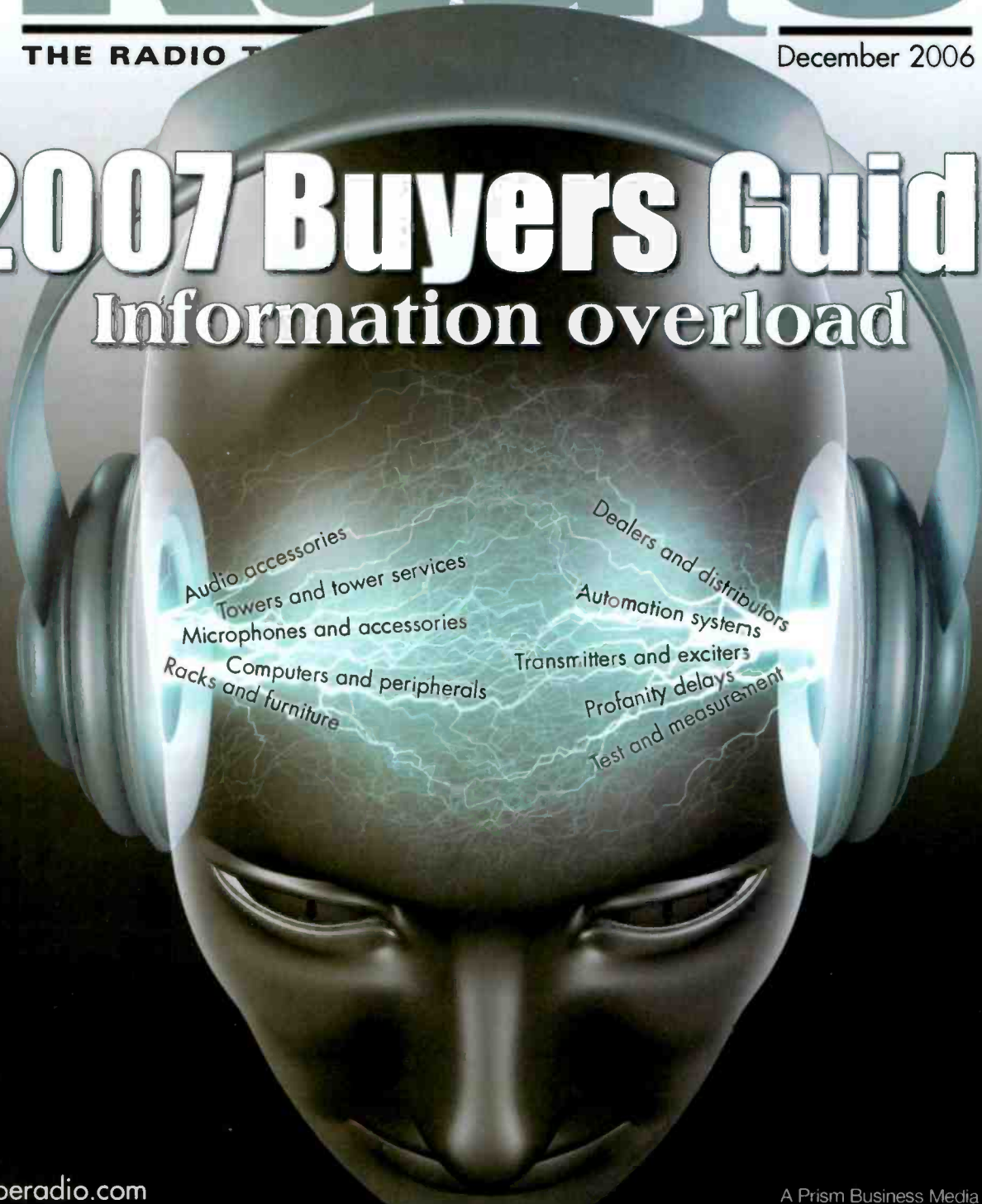
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THE RADIO T

December 2006

2007 Buyers Guide

Information overload



Audio accessories
Towers and tower services
Microphones and accessories
Computers and peripherals
Racks and furniture
Dealers and distributors
Automation systems
Transmitters and exciters
Profanity delays
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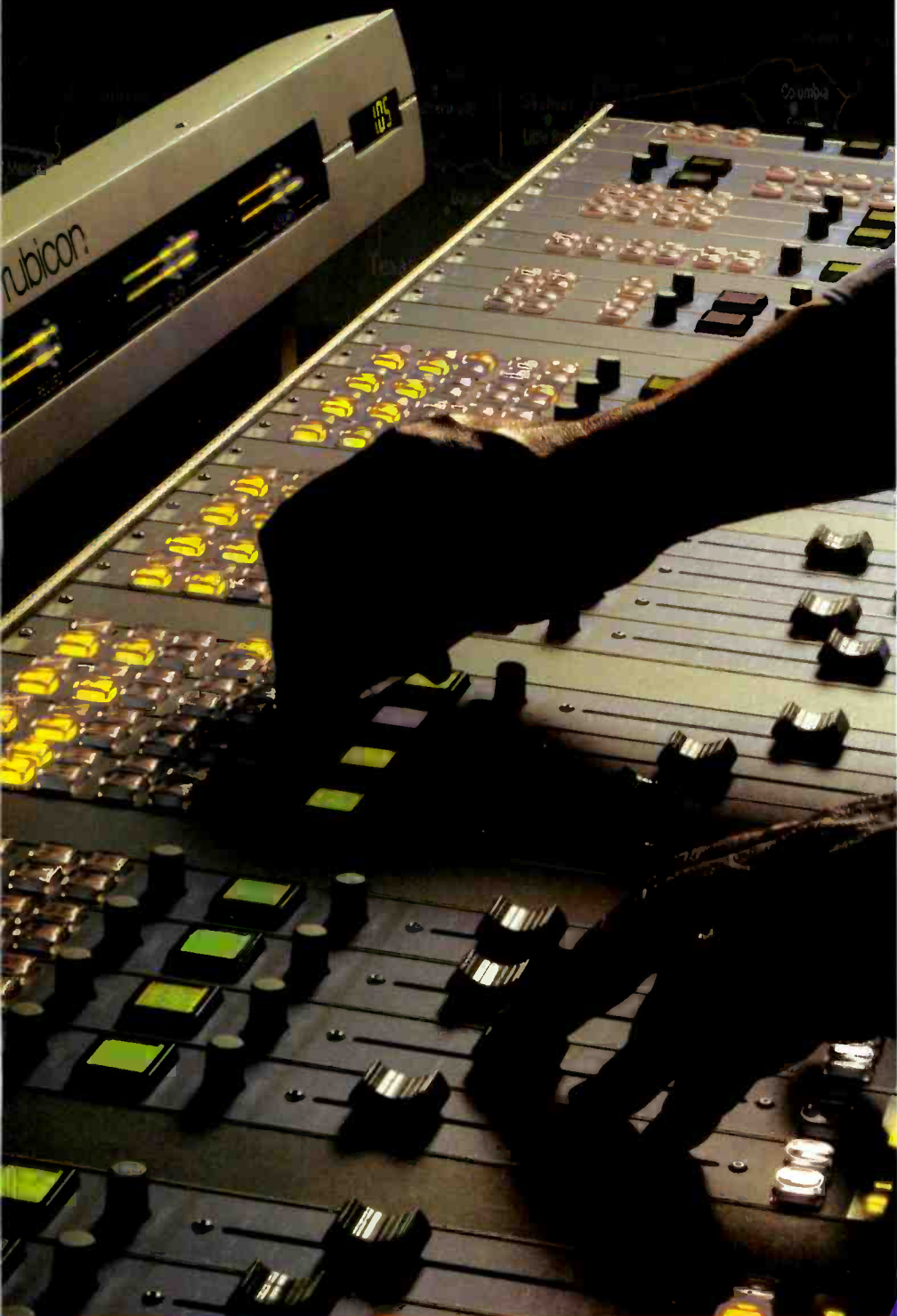
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THE SWITCH IS ON.



Coast to coast.

Border to border.

Broadcasters in markets large and small are switching to the elegant **Rubicon™** family of console control surfaces from Sierra Automated Systems.

In return, Rubicon's power, adaptability, and easy-to-use controls are turning on hundreds of DJs, operators, engineers and programmers across America.

Rubicon, and the versatile new **Rubicon SL**, are the primary user interface of a proprietary system of audio routing, mixing, distribution, intercom, IFB, and automation that we call the **Connected Digital Network™**.

At the network's hub is the **32KD** digital router/mixer, the proven performer in many



Rack mounted 32KD Digital Router/Mixer, RIOLink remote I/O and Rubicon power supply

hundreds of radio, network, and film installations around the world.

RIOLink remote I/O router/mixer now provides stand-alone or backup mixing in addition to interconnection from the studio to the central 32KD.

To learn more about why so many broadcasters are switching to Rubicon and the Connected Digital Network, give us a call, or drop us an email.



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Tuned in

Welcome to the 2007 *Radio* magazine Buyers Guide. This is the fourth annual edition, and this year's version is loaded with the information you need to find the manufacturers and service providers you want. This comprehensive resource is divided into two sections. The first section provides a categorical listing of companies, while the second gives you the necessary contact information. We have solicited information from manufacturers during the past few months to update this information and present it to you in a reference that you can access all year.

While it's likely that you save your issues of *Radio* magazine, we've made it easier for you to access this reference at any time by making it a pull-out section. Store the issue like you always do, but keep the Buyers Guide handy for quick access.

There's more to the *Radio* magazine Buyers Guide than just this printed issue. We have uploaded the information in the 2007 Buyers Guide to the *Radio* magazine website at beradio.com, so you can access the same information anywhere that you can get online. Click on the Buyers Guide link and you're all set.

As always, I welcome your input on this resource. We continually strive to improve it and make it more useful each year.



Chris Scherer, editor

The information in the *Radio* magazine Buyers Guide is provided by the listed companies. Every effort is made to ensure accuracy.

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Wireless Broadband Internet Remotes

Now Shipping



*Verizon, Cingular and Sprint now offer broadband IP cell phones you can plug into a Teline codec and deliver reliable, broadcast quality remotes from wherever you're standing



The first time out with the Teline was a brilliantly simple experience for everyone involved. For lack of a better phrase, the codec just worked.

**-Christian Vang Chief Engineer
Clear Channel St. Louis**



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Acoustics First Corp.

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Illbruck Inc./Sonex
Industrial Acoustics (IAC)
Marketek Video Supply
Noren Products Inc.



Russ Berger Design Group

SE Electronics

Antennas

Acorn RF/Teracom Components
Advanced Antenna Technologies
Andrew Corp.
Antenna Concepts Inc.
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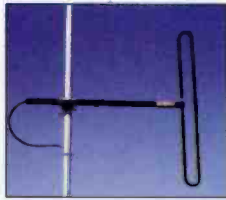
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Telewave Inc.



Telewave Folded Dipoles are an ideal match for LPFM and translator stations. These rugged, fully coated antennas cover 88-108 MHz without tuning, survive the worst environmental conditions, and provide broad horizontal beamwidth with high radiation efficiency. Horizontal and vertical patterns can be controlled via mounting configuration or mechanical/electrical tilt.

Audio accessories

Includes converters, adapters and utility items

Acoustics First Corp.

Audio Accessories Inc.
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Broadcast Devices
Conquest Sound Inc.

Crane Song Ltd.

DM Engineering



STABILANT 22

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Kramer Electronics
LEA Int'l
Littlite
Lucid
Lynx Studio Technology Inc.
Miranda Technologies
Pomona Electronics
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RDL Radio Design Labs
Rolls Corp.
Sierra Video Systems

Sonifex Ltd.

Switchcraft
SystemsStore.com

Tieline Technology

Videoquip Research Ltd.

Audio delay systems

25-Seven



25-Seven's TiVo-like audio processor allows stations to pause a network feed, insert content, then return where the program left off, and seamlessly catch up to real-time. Time compression rates can be adjusted on the fly, or the unit can be used to time shift programs by up to an hour. The front panel offers simple, two-button operation. Remote control is available through an 8x8 GPIO, RS-232, or over a LAN or WAN utilizing a built in web server. Stereo analog and digital (AES) IO break out on XLR connectors, linear audio is processed at 44.1 or 48kHz.

Eventide

Logitek Electronic Systems

Prime Image

Audio distribution, between locations

Includes satellite and IP delivery

APT Audio Processing Technology

ATA Audio

Axia a Telos Co.

Bay Country Broadcast Equipment Inc.

Broadcast Devices
Danagger Audio Works
DK-Technologies America
Energy-Onix
ESE

Harris Networking Solutions

KLZ Innovations Ltd.
NPR Satellite Services

Pulsecom

Riedel
Satcom Resources
Slingspot.com

Sonifex Ltd.

Sundance Systems Inc.

Tieline Technology

Ward Beck Systems Ltd.

Audio loggers

Broadcast Software Int'l
desTools.com

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Mediatron GmbH

OMT Technologies



Pristine Systems Inc.

Sonifex Ltd.

Telos Systems

Audio processing, on-air

Includes stereo generators

Antex Electronics Corp.

Aphex Systems Ltd.

Audemat-Aztec Inc.

AXI

Bay Country Broadcast Equipment Inc.

Broadcast Warehouse Ltd.

CMBE Inc.

Crown Broadcast/Int'l Radio
and Electronic

IDT/Impact Development

Inovonics Inc.

Logitek Electronic Systems

Mooretronix

Neural Audio Corp.

Omnia A Telos Co.

Orban/CRL

Progressive Concepts

TranslanTech Sound LLC

Audio processing, production

Includes production and mic processors

25-Seven

AIRcorp

Aphex Systems Ltd.

AXI

Internet remotes... there's been talk.



➔ Live from 37,000 Feet—No Kidding—Live Broadcast from a Lufthansa flight!



... successfully aired his three hour talk show from a commercial airplane [using ACCESS] at 37,000 feet on a regularly scheduled flight between Frankfurt, Germany and New York, US.

Peter Greenberg—Host of the syndicated radio program Travel Today

For the complete story visit
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➔ Radio Free Asia—Live from the Himalayas



"The results [with ACCESS] were especially reliable considering that Dharamsala has one of most "problematic" Internet infrastructures that we have come across."

— David Baden, Chief Technology Officer Radio Free Asia

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➔ Ski Mountain Remote



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Broadcast Technology
BSS Audio

Crane Song Ltd.

DACS Ltd.
Daking
Dan Dugan Sound Design
Dolby Laboratories
Drawmer

Eventide®
Eventide

Great River Electronics
Korg USA Inc.

Logitek Electronic Systems

Lucid
Miranda Technologies
Modulation Sciences
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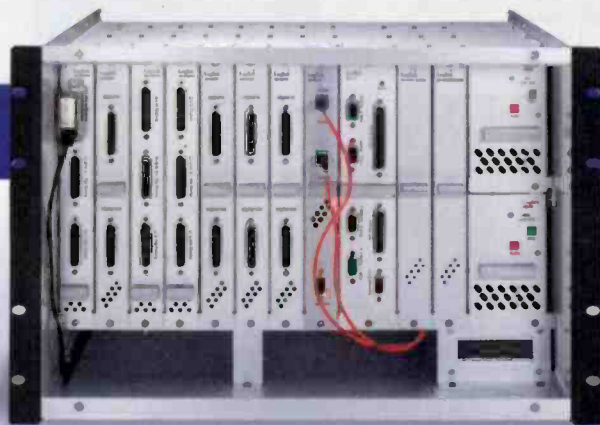
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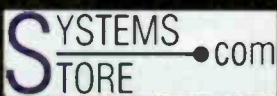
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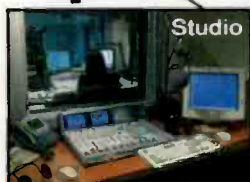
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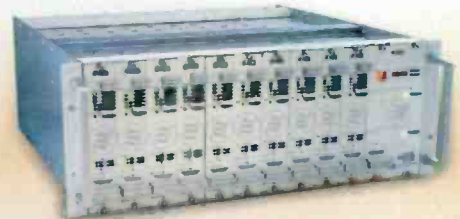
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will need to be filed and accepted in the state you plan to operate. You may also need to file with other states where you plan to do business and receive income.

What's in a name?

If the name you use for the business is something other than that of the owner, you will need to file for a fictitious name (i.e. Acme Consulting) with the state in which you operate. Most states have websites where you can search for business names to see that you are not using an existing name. A "who is" search on the Web might also reveal another entity with the same name in another state or country. While this is not a definitive source of names, it will give you some indication there might be a problem, especially if your selected name has a trademark associated with it.

Once the business is officially formed, get a tax ID number (FEIN) from the IRS. If you operate as a sole proprietorship, that number will be your social security number; the other forms of businesses are treated as separate tax paying entities and, as such, will receive their own tax ID numbers. If you have employees, you may also need a federal employer ID (EIN).

Local and state issues

In addition, you might have to notify and obtain approvals from the local jurisdiction where the business is to be located. Most local jurisdictions require occupational licenses or permits. My experience is that most cities will allow a home office providing it is not intended to be visited by the general public and it will not cause a traffic or parking problem in the neighborhood. Check local zoning regulations for compliance.

If your business performs services for others and plans to charge a fee, check with the Department of Professional Regulation (could be called something else in your state) to verify if the particular service is regulated and whether a professional license is required. Examples of this would be construction (general or specific trades), engineering or real estate services.

Insure your success

Finally, have proper insurance policies in place before performing services. There are several policies that could be required depending on your specific situation. These include health, general liability, theft, accident, errors and omissions and workers compensation. Talk to a few

independent insurance agents that specialize in business. This will give you a good idea of what will be required and the cost, which may vary significantly with different carriers. Investigate industry trade organizations such as the SBE that have negotiated reduced rates for health and other specialized insurance products.

McNamara is president of Applied Wireless, Cape Coral, FL.



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New reporting rules for Internet streamers

By Harry Martin

Interim rules released by the Copyright Royalty Board (CRB) in October wrap up a proceeding related to recordkeeping and notice requirements for digital audio services—referred to as Internet radio, webcasting, streaming or simulcasting—that have been unresolved in terms of streaming services since they became subject to copyright royalties in 2002.


Since April 2004 Internet radio stations were supposed to be keeping detailed records about the songs they were playing. The problem was that the CRB had not specified what, if anything, was to be done with those records. That has now been resolved.

The records, or at least a portion of them, will have to be sent to Sound Exchange, the monitoring agency created by the recording industry to keep track of streaming royalty obligations and payments. This means that copyright holders in musical and other works will be receiving all the information required to receive royalties for these performances, so it is likely that enforcement against online infringers will increase. (Under the

reports of use must contain detailed information regarding each song played on the station, including the transmission category code, the name of the performer, the Sound Recording Identification, consisting of the International Standard Recording Code (ISRC) or the album title and marketing label, and information on the number of performances of that song.

These reports must be filed only for two seven-day periods within each quarter. These seven-day periods do not have to be consecutive to each other, nor do they have to start or end on a Sunday. In the new rules published in October, the CRB specified the format in which these reports must be filed with Sound Exchange. The CRB attempted to create a reasonable system for creating, maintaining and delivering these records to Sound Exchange. Noting that broadcasters were looking for the most expedient and practical means to comply, while Sound Exchange wanted the most useable format, the CRB essentially sided with Sound Exchange on most reporting form issues.

As a result, all filings must be in electronic format. They must be in spreadsheet form (using either Microsoft Excel or Corel's Quattro Pro) and must be encoded in ASCII. This quarterly report can be sent to Sound Exchange by e-mail or other electronic means. Moreover, Internet webcasters must now file with Sound Exchange all quarterly reports of use dating back to April 1, 2004, as well as every quarter going forward.

To summarize, any radio station that is simulcasting its over-the-air signal on the Internet, or creating unique content of any type and streaming it on the Web, must have on file at the Copyright Office a Notice of Use of Sound Recordings Under Statutory License; pay copyright royalties on a monthly basis; file records of use on a quarterly basis consistent with the new format; and comply with the requirements of the Digital Millennium Copyright Act intended to prevent musical piracy, many of which contain strict controls on playlists. 

Dateline

Jan. 10 is the deadline for all stations to place their fourth-quarter 2006 issues and programs lists in their public files. Feb. 1 is the deadline for stations in Kansas, Nebraska and Oklahoma to file their 2007 biennial ownership reports. Feb. 1 is the deadline for stations in the following states to place their annual EEO reports in their public files and post them on their websites: Arkansas, Kansas, Louisiana, Mississippi, Nebraska, Oklahoma, New York and New Jersey.

current legal framework, to play music over-the-air, a radio station needs to deal only with ASCAP, BMI and SESAC. But to play music over the Internet requires a separate payment to Sound Exchange.)

More to the process

Paying is only part of the equation. To accommodate the need for an accurate basis to assess royalties, the Copyright Office permitted Sound Exchange to require radio stations to do the necessary recordkeeping themselves. On March 11, 2004, interim rules were announced that required every radio station streaming over the Internet to compile records of every song played. These

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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Built solid

The foundation of any studio begins with the studio furniture

By Kent Kramer and Marshall Rice

Furniture determines growth potential for additional technology and often times has to last longer than any other piece of equipment in the room. In today's radio station it may also have to support on air and production operations for multiple formats. The furniture must also accommodate the needs and preferences of individual talent.

While the furniture determines the growth potential of the room, conversely, the room will also dictate the type and style of furniture used. Building the room solely for the task for which it is meant serves the immediate need, but considering possibilities many years down the road can prevent the installation from being built into a corner.

Options overview

There are three basic styles of broadcast furniture: knock down, custom built and custom built by a mill worker.

If your budget is the prime consideration in your choice of furniture, you will probably fall into the knock down type of furniture. This type of furniture can also be the most flexible if it is installed in a multi-use room.

The knock-down style is a popular choice because it can be shipped via overnight freight. Repairs, modifications and new parts can arrive quickly to allow for quick reconfigurations. Only the largest pieces, usually the counter tops, may have to ship via truck line.

Knock down is a great foundation for start-up facilities. It can look just as nice as more expensive furniture and be most any color that fits the facility.

There are, however, some limitations to stock furniture. First, it may be more difficult to put it in an existing room. Available sizes may not fit perfectly given the room size and layout, and it may have to be placed against a wall, which makes equipment access more difficult. Also, any small custom changes may cost a premium to implement. Knock down furniture also leaves a considerable amount of debris behind. Because it ships via common carriers, it has to be packaged to be well protected in transit.

Depending on your schedule and ability, one obstacle may be the assembly required for this style. This can be a daunting task but once it's done it's a rewarding feeling.



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Going custom

The second type of furniture is custom built to the room. If the room is really small or if you want a customized look and feel, this might be the right direction for you.

While this furniture still uses some quick-built tactics, the furniture is customized to the room dimensions. This flexibility adds time and effort to the design process, but rack placement, equipment turrets and cable access can be placed almost anywhere it is needed.

Delivery of this type of furniture is usually handled by factory personnel and installed in a matter of days. Minor scratches can be touched up and the furniture is factory fresh when the crew leaves. The installers will probably drill all the needed access holes for cable penetrations while on site as well.

Another benefit of this furniture is the use of multiple types of materials for countertops. Corian by Dupont is one common material, but there are other solid-surface types that are similar. The joints can be welded so that they are nearly, if not completely, invisible. The tops can be resurfaced in the future and holes can be patched when it becomes necessary to modify the room. The repair, such as the sanding and buffing process, can be quite messy but the result is an almost-new top.

The budget will need a bit more money to go this route because the delivery will add significantly to the price. Add more to the cost if the installation crew has to stay for a few days.

A second version of this method is custom-built furniture from a local cabinet maker. This route will also provide exactly what you want, and it may cost less than a broadcast furniture maker, but it will probably be necessary to educate the mill worker on the standards for equipment rack sizes. While this is not a major issue and can be done, it might pay to have the cabinet maker take some measurements and an inside look at some existing studio furniture to make sure he fully understands what happens inside a radio studio. Running studio wiring is different than what happens under kitchen cabinets.

The final option is custom built by a mill worker/cabinet maker. This is similar to the variation above, but this applies specifically to one-of-a-kind furniture. An architect often is involved prior to the woodshop getting involved. This type of furniture will probably have a room built around it. It will generally be a focal point of a show-case facility.

The materials will generally be high quality and the budget is probably wide open for furniture.

There are a lot advantages and disadvantages to a piece of furniture like this. One challenge is that every opening, access panel, grommet and jack must be considered prior to construction. While these can be added later, putting them in during the construction will make sure that everything fits once it's in place and access is ensured where it's needed. The designer can also fit the facility's needs into the design to maintain the aesthetics of the furniture.



KQRC-FM, Kansas City

Built solid

What's inside?

Studio equipment has evolved dramatically in the past few years. Consoles are now control surfaces. Audio is delivered primarily via computers. Air talent and their supporting casts depend heavily on access to the Internet for audio bits, news and other content. As their need for more computers and monitors grow in the studio environment the studio furniture must be designed to address this.

Studio furniture must now have cabinetry designed to hold multiple computers, flat-screen monitors, keyboards, and mice in addition



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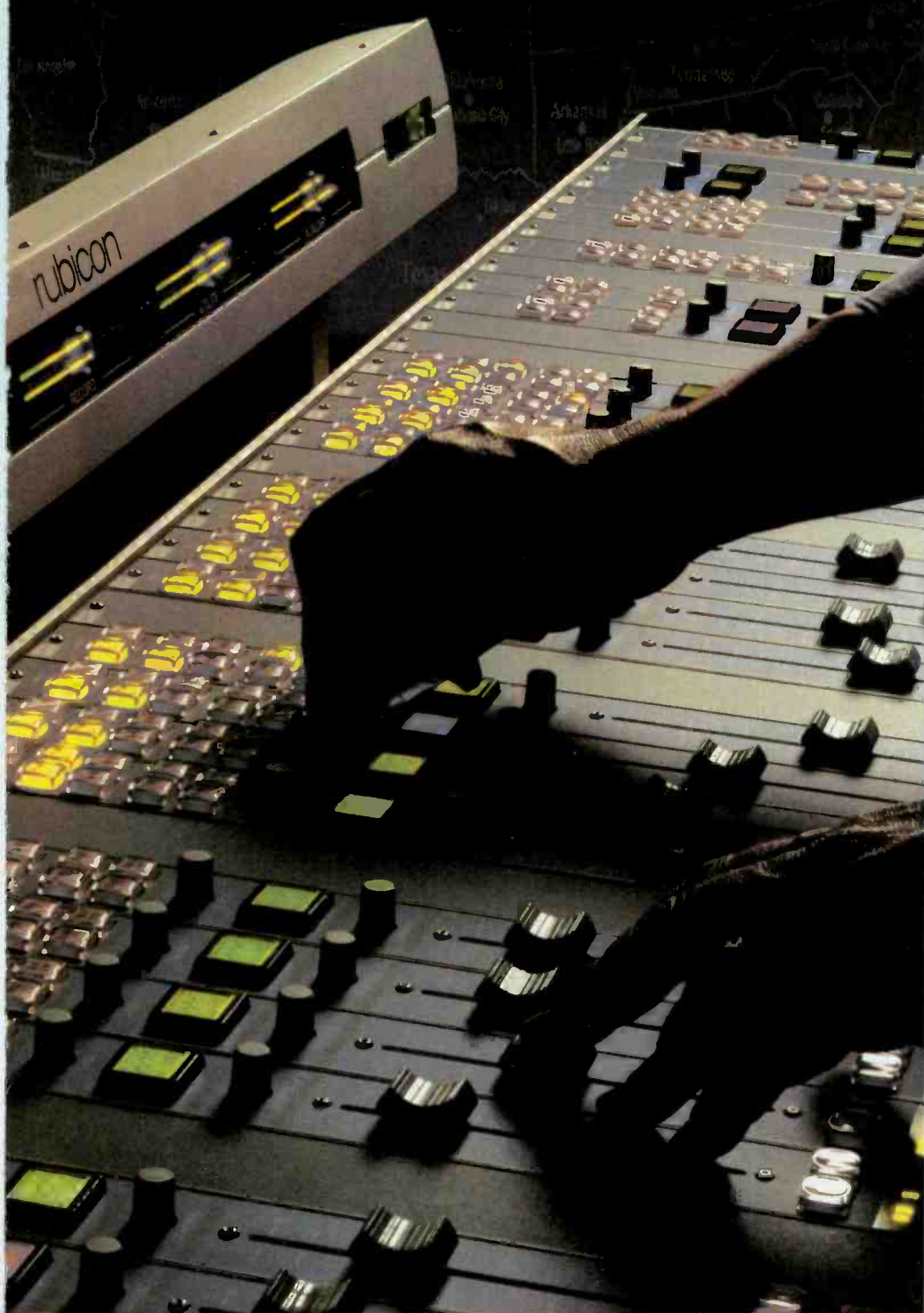
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The steps to join solid-surface materials.

Courtesy of Studio Technology

to the usual collection of broadcast equipment. Where there is a computer there is generally heat and noise. Because it's not always possible to house the computers in the technical center and extend the keyboard, mouse and video we have to provide a stable area for the computer that includes baffling for noise in the room and usually inside the furniture. This requires the computer to be sealed inside the cabinet. Sound-deadening insulation is often added within this space to minimize fan noise, even though current computers have come a long way to minimize noisy fans. Many are now available with passive cooling systems or quiet variable speed cooling fans. Regardless of the cooling system within the computer the studio furniture must provide adequate ventilation for the computer to prevent heat build up and component failure.

The rack or cabinet that houses the computers can provide cooling via passive or active ventilation. Passive ventilation allows the heat to escape through vent holes in the cabinetry. Be sure to keep the warm air from ventilating into areas that may affect other equipment or even the people working around the furniture. Active ventilation uses low velocity fans to force air through the cabinetry. Air from a low-velocity studio HVAC can be ducted into the furniture to provide cooling. This solution usually requires an elevated floor to accommodate the HVAC ductwork.

The computer and all equipment must be accessible in the front and back. Some manufacturers use specially designed drawers that pull out and turn, while others use access panels that are strategically located—usually out of sight—to access the rear of the equipment.

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Cabling to and from the equipment must be taken into account to minimize cable runs. Penetration points should be well planned to keep the cabling neat and unobtrusive.

Size reduction

The widespread use of computers for audio delivery, Internet access and now console and router monitoring has dramatically increased the number of monitors in the studio. Luckily, the bulky CRTs of years past are quickly being replaced by flat-screen monitors. Although flat-screen monitors take up significantly less desktop real estate, they still pose a challenge to the studio designer. The ever-growing number of monitors in the studio can cause serious problems for the talent and their guests. Consider the placement of the monitors. Improper placement can block sight lines between talent and guests. A monitor too far away from the talent will prevent him from being able to read the screen. A monitor too close may be in the way of the console operator. The proper monitor arm can go a long way to alleviate these problems.

There are many brands of mounts available to address specific needs at each position around the furniture. Telescoping and articulating arms are common. As more monitors are added a method of ganging becomes necessary. Monitors can be ganged vertically, one over the other, horizontally, in a curve around the operator if there are more than two, or in a matrix two over two or three over three. The proper monitor mount will depend

on placement, specific use and the operator's preference.

Perhaps the most challenging problem for the inclusion of computers in the studio is the placement and management of the human interface devices

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as well as the automation control devices. Keyboards take up a lot of the counter area just by nature of their size. A smaller, or mini, keyboard can be used for many applications, but these miniaturized keyboards can be frustrating for some people. Keyboards are often mounted on pull-out drawers beneath the countertop, if the console installation or furniture design will allow it. Keyboards can also be mounted on the monitor arms, depending on the style of mount.

Another application that can help simplify the computers in a studio is a touch screen. Modern LCD touch screens are still rather expensive, but can help the operator because it can act in a heads up manner for the operator. Because Windows is probably the most common operating system in use, adding a touch screen to most any computer is as easy as running a serial cable from the touch screen monitor to the computer and installing the proper drivers. RS-232 can run for several hundred feet. New touch screens can provide for serial control as well as USB connections. Also, the touch screen can be used in conjunction with the mouse. The



A variety of flat-panel monitor mounts exist, such as this one from Yellowtec.

mouse now can be left to the side and only used when absolutely needed by the application.

Kramer is director of engineering for Reach Media and The Tom Joyner Morning Show, Dallas. Rice is engineering director for Bonneville International's St. Louis Radio Group.



Pull-out mounts provide simplified front-of-rack access to equipment.



More Online
Useful tips for choosing studio furniture can be found accompanying this article online at www.beradio.com

**Snap, Crackle, Pop?
Dropouts?
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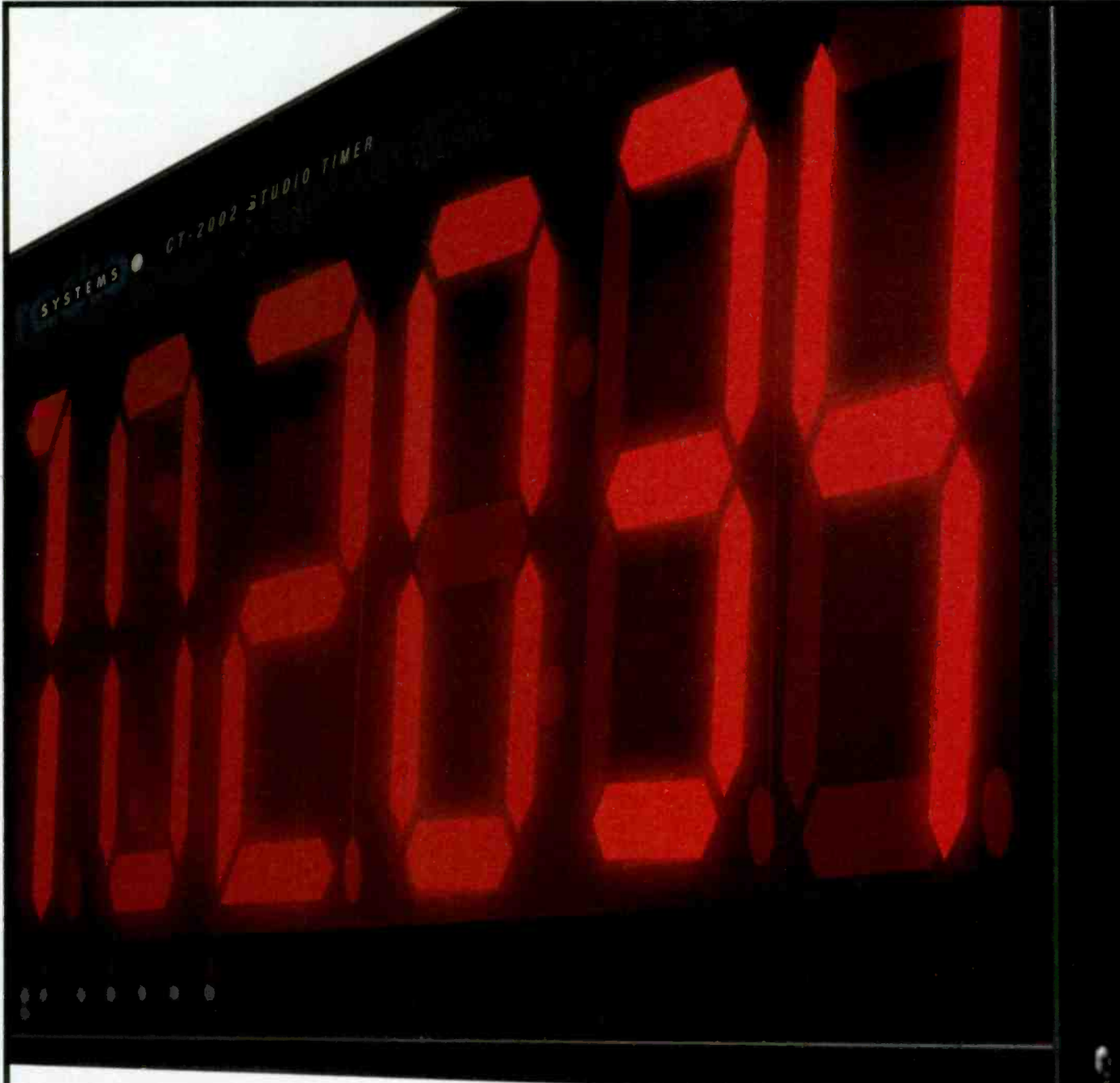
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FACILITY SHOWCASE

Planning for a digital future



photo courtesy of Diaselectra

American Tower updates St. Louis master antenna

By Marshall Rice

This past summer American Tower updated its master antenna installation in St. Louis. The tower site, originally completed in 1986 by EZ Communications, was built to host six class C and C1 St. Louis FM stations. With a center of radiation at 1,120 feet HAAT, the master antenna provided excellent coverage of the St. Louis market and the surrounding area. The Harris CBR antenna performed extremely well for 14 years. In 2000, while in the process of adding two more stations to the system, the antenna suffered a major failure and required a complete rebuild. The antenna was repaired and the two stations were successfully added into the combiner and antenna.



Looking into the mast

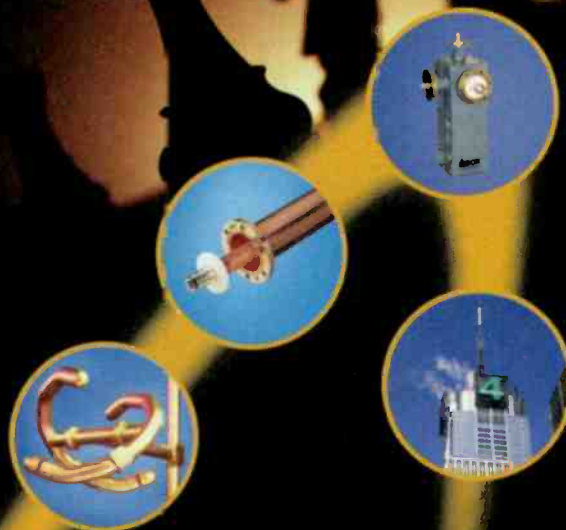
At that time, a new monitoring system was custom designed and built by QEI to monitor and control each of the eight stations transmitting from the antenna in 2000. Considering the amount of power going into the antenna, the monitoring and control of the transmitters is critical to protect the transmission system in the event of a failure somewhere in the combiners, feedline, hybrids or antenna. The total combined TPO into the combiner system was well more than 240kW to produce an effective radiated power of more than 750kW. The rebuilt and modified antenna and combiner system continued to operate until the decision was made to upgrade the antenna again.

In 2005 American Tower, the present owner, was approached by current and prospective tenants to consider modifying the aging antenna and combiners to transmit HD Radio. A major broadcast group in St. Louis was also interested in adding two more stations to the antenna system.

American Tower turned to Dielectric to develop a solution to address the growing needs in St. Louis. A high priority was the inclusion of digital IBOC signals as well as the additional analog signals. Initially, modifications to the combiner system were considered. A four-port hybrid could be added to the existing systems feeding a pair of crossed dipoles. This would space combine the analog and digital signals into isolated right-hand and left-hand polarized radiation. A second feed system would be added to inject the digital signal.

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Planning for a digital future

This approach, although seemingly logical and cost-effective, posed serious problems due to poor isolation caused by cross coupling within the antenna and mutual coupling between antenna bays. Poor isolation would require high power RF circulators that were not realistically available. It also forced the analog or digital VSWR to be



The hybrid combines the analog and digital input signals and then splits it to feed the dipole pair.

optimized at the expense of the other. Another solution was needed.

Another approach

After 10 months of development Dielectric introduced a unique radiator element design for broadband multi-channel applications. The symmetrical element design almost eliminates cross coupling and minimizes interbay coupling. This allows for high isolation and excellent VSWR for the analog and the digital signals. The new design consists of pairs of crossed right-angled equilateral dipoles referred to as Transverse Quadrilateral Technology (TQT).

What's TQT?

An explanation of the technology is available online at beradio.com.

The Dielectric HDFMvee antenna is designed to accommodate analog broadcast signals and their accompanying digital IBOC signals for HD Radio. The primary design challenge was the power level required for the St. Louis installation. The HDFMvee installed in St. Louis is the only multi-channel non-directional antenna in the country to accommodate 10 class C FM analog and digital IBOC signals. The antenna is built into its own mast. The top section of the tower was removed along with the old antenna and the new antenna was installed in its place.

The antenna consists of eight bays at eight levels with three around at each level. The antenna is split into an upper and lower section for redundancy; the upper or lower antenna can be fed separately for maintenance or emergency operation. Each section is fed with a $\phi 1/8$ feedline for the analog signal and a 3" line for the digital signal. RF switches in the combiner room allow for the upper or lower antenna, or both (normal operation), to be fed from the combiner system.

Installation of the new antenna commenced


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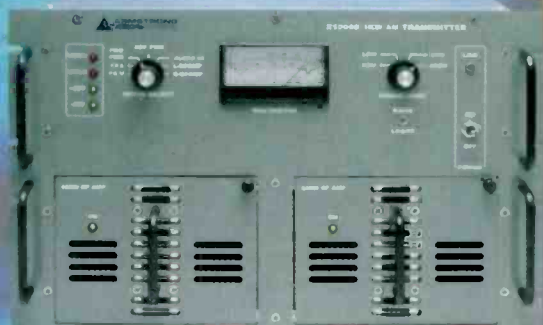
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on July 22. All eight stations were required to operate at 25 percent of their normal power into the upper half of the antenna while the lower half feed line was removed and other preparations to the tower were made for the removal and replacement of the old antenna. On Aug. 20 the stations switched to their auxiliary antennas. All but one of the stations have off-site auxiliary sites. The one station used an auxiliary antenna on the same tower. This station was required to lower power and shut off as needed to accommodate any work in the vicinity of its antenna.

On Sept. 26 testing began on the new antenna. Each transmitter was energized into the system; one by one at half power into the lower and then the upper antennas. When it was determined that everything was normal, each transmitter was increased to full power into the antenna. After this initial testing some final installation work near the antenna had to be completed, so the stations switched back to their auxiliary sites.

Full power operation into the HDFM Vee was initiated on Sept. 29, 2006. All 10 of the analog signals are now broadcasting from the site. At the end of November only two stations are transmitting on IBOC signals, but more stations are installing equipment. So far the antenna and combiner system have performed flawlessly, and all pertinent measurements have been superior to the original antenna and combiner. The new antenna has greater gain that reduces the required TPO from the analog transmitters.

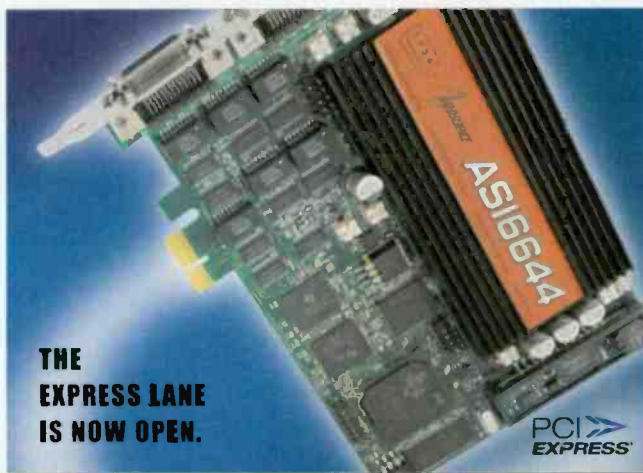
Rice is engineering director of Bonneville International, St. Louis.



The antenna mast halves are ready to be shipped to St. Louis.

More online

The St. Louis master antenna project was profiled in the May 1988 issue of *Broadcast Engineering*. A reprint of that article is linked from this article at beradio.com.



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The technology behind the master antenna



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Dayton Public Radio implemented its HD Radio broadcast utilizing a Dielectric 4.77dB IBOC coupler/injector and motorized coaxial switches. Ideally suited for a split-level combining system, the coupler allows the analog-only and hybrid analog-digital transmitter to feed the antenna, while providing easy switching between main and backup operation with four switchable operation modes. In the case where either transmitter is tasked to operate independently, the motorized coaxial switches bypass the 4.77dB coupler and send the signals directly to the antenna and test load. When mated with a matched load, the 4.77dB couplers combine the two signals while providing approximately 40dB of isolation between the two transmitters. This image shows a typical sub-system with a 4.77dB coupler and three motorized switches.

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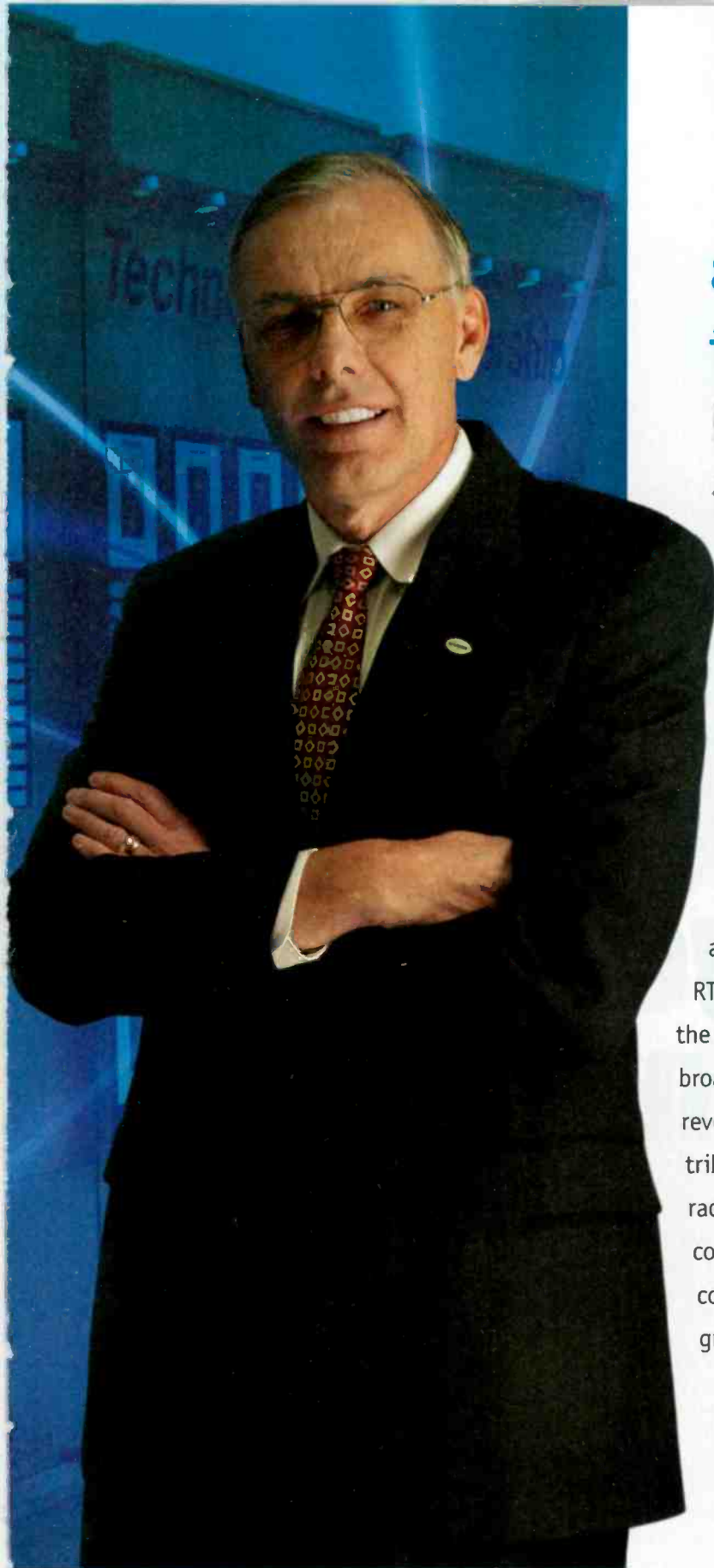
Advertisement

- 1936** Gates enters transmitter market at 1 kW
- 1955** Gates pioneers "Night-Watch", world's first program automation system
- 1969** Gates introduces first FM solid-state and direct on channel FM exciter (improved stability and audio quality, quality stereo performance)
- 1970** Pulse Duration Modulation introduced in AM (major efficiency improvement, lower operating cost, loudness enhanced significantly)
- 1974** MW-1, world's first solid-state AM transmitter, kicks off solid state designs for improved audio and reduced operating cost
- 1977** Harris introduces first ultra-linear, MS-15 FM exciter including overshoot compensation & PLL (vast audio improvement and increased loudness)
- 1987** First Digital AM transmitters(DX series) offer yet further audio quality improvement and far reduced operating costs over tube PDM transmitters
- 1993** Digit Exciter introduced as the first digital FM exciter (audio quality improvements, greater stability)
- 1996** Platinum Z FM solid-state transmitters introduced - the most successful series of transmitters ever made (reduced operating cost)
- 1997** CDLink, world's first uncompressed linear STL sets eliminates quality loss in FM studio-to-transmitter link
- 1998** Intraplex Synchrocast introduced to create first digital FM synchronous simulcasts on same channel
- 2002** DexStar HD Radio exciter introduced as world's first commercial HD Radio exciter to usher in new era in AM/FM radio broadcasting
- 2003** DAX AM transmitters introduced to bring HD Radio to AM at peak performance levels (first transmitter designed exclusively for HD Radio)
- 2004** World's first HD Radio multicast ("Tomorrow Radio") with NPR beginning the technology which is today known as HD-2, HD-3 etc.
- 2004** Split Level Combining introduced for HD Radio to provide up to 12% improvement in combining efficiency to lower operating cost
- 2005** FlexStar FM/HD exciter introduced, first dual exciter including RTAC for improved performance and first to operate "Exgine" platform.
- 2006** HT/HD transmitter introduced along with RTAC provides highest power output at best efficiency (lowest operating cost of any HD Radio transmitter)



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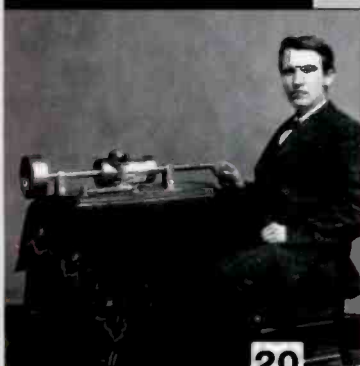
Cylinder recorder

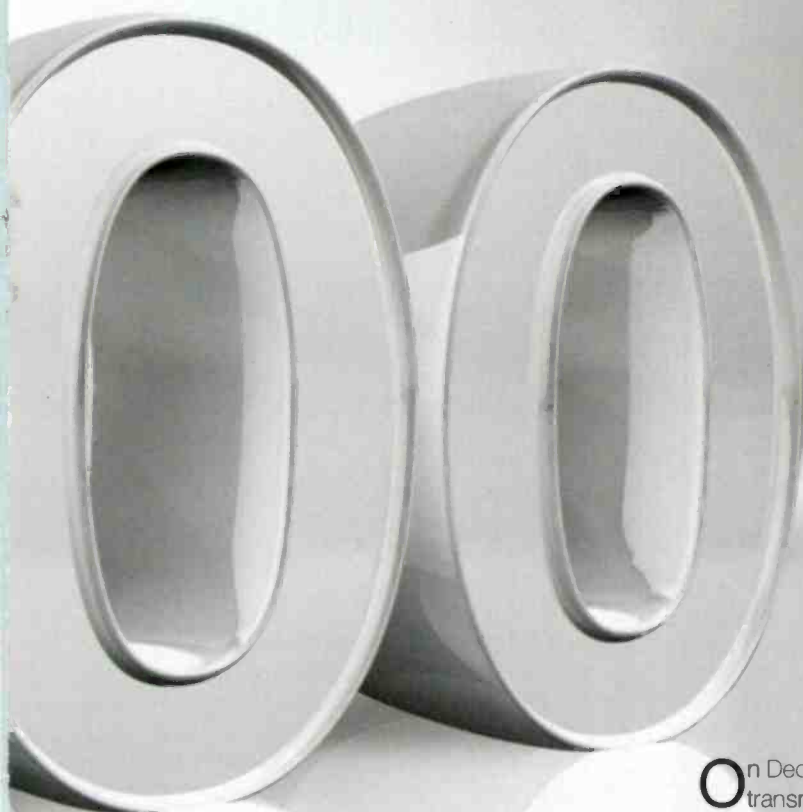
20 While working on a device that would send telegraph messages in an automated fashion, Thomas Edison stumbled on the idea of recording and playing back the human voice. Thus was born the cylinder recorder; the predecessor to all other recording devices and the germ of the technology used by the music business. The device was a hand-cranked cylinder that was covered with tin foil; one diaphragm attached to a stylus was used to etch the track into the foil and another lighter stylus was used during the playback. For the first crude versions, the tin foil itself would only last for a few plays and couldn't be removed from the cylinder. Later the cylinders were made from wax and could be played multiple times. From the turn of the century to the early 1920s, cylinder recordings were quite popular, only to be surpassed later by 78 rpm records. Edison stopped making the cylinders in 1929.

Zenith-GE FM stereo

19 In 1961, the FCC selected the Zenith-GE system as the method that would be used to transmit stereo signals on the FM band. Backward compatibility was very important during this transition—making sure that older FM mono receivers would still be usable. For this reason, FM stereo uses a matrix system. Left and right channels are added together and make up the mono signal (L+R); at the same time, right is subtracted from left, thus forming a L-R signal. When the L+R and L-R are added and subtracted, discrete left and right are recreated.

For transmission, the L-R signal is mixed with a 38kHz signal to form a double-sideband, suppressed carrier signal that is added to the baseband and occupies the spectrum from 23kHz to 53kHz. The development of stereo transmission on FM followed the widespread introduction of stereo LPs in 1958, and played a significant role in the popularization of the FM band.





On Dec. 24, 1906, Reginald Fessenden transmitted an audio broadcast of spoken voice and music to a few listeners. It was a broadcast in that it was not meant as a point-to-point message. Since then, radio has grown in its scope and coverage, and the technology used to create it has provided the tools to improve it and allow it to extend beyond the traditional airwaves.

Last month, we profiled the event and the innovator. This month, we detail the top 100 technical innovations that have influenced radio, as nominated by you, the reader, and organized by a panel of radio broadcast engineers. The entries for 100 through 21 are listed alphabetically. The top 20 are ranked in order. You may feel that we left something out or that something is not being given the ranking that it deserves. If so, tell us about it at radio@prismb2b.com.

— *Chriss Scherer, editor*

Technology descriptions by Doug Irwin

Perceptual audio coding

18 Perceptual audio coding takes advantage of the way human hearing works in the time and frequency domain by not encoding sounds that are ultimately imperceptible, and by efficiently using the minimum number of bits to encode the sounds that are perceptible. The ultimate goal is to fit as many useful bits as possible through what is typically a data-bandwidth limited path between the program source and the far end: the listeners. Lossy Codec is the name for a device that uses perceptual audio encoding to build the data streams that we eventually hear coming from speakers on the other end.

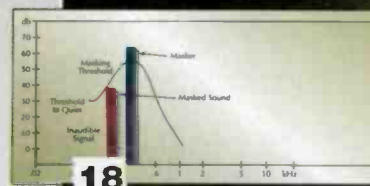
The invention and development of this technology has precipitated a revolution in the way listeners listen to programs and music—and arguably the largest challenge ever faced by radio broadcasters.

Nyquist Theorem

17 In an analog-to-digital conversion, one of the most important considerations is that of the sampling frequency. The Nyquist rate is the sampling frequency; the Nyquist frequency is one half of that. Nyquist in this case refers to Harry Nyquist, a Swedish-born scientist who worked at AT&T between 1917 and 1934. The Nyquist-Shannon sampling theory says that any continuous signal can be completely reconstructed if (during the conversion) it is band limited to one-half of the sampling frequency. At minimum, 15kHz of audio bandwidth would require a sampling rate of 30kHz. A more familiar sampling rate for this audio bandwidth is 32kHz.

Put that together with the invention of PCM in 1937 and you have the foundation for the digital audio revolution that has had such a profound effect on radio, and in turn has created the media that may be radio's ultimate challenge.

Photo courtesy of the AT&T Archives



- ITC 99
- Kahn Communications AM stereo
- Magnetic tape
- Magnetophone
- Mechanical computer
- Mid-Level (split-level) combining for HD Radio
- Modulation Sciences CP-803
- Modulation Sciences Sidekick
- Moseley DSP-6000
- Moving-coil dynamic speaker
- Multitrack tape
- Op amp
- Optical recording (CD-R)
- Orban Optimod 8000
- Orban Optimod-FM 8200
- Paper recording tape
- PDM
- Phantom power
- Potomac AG-51, AA-51
- POTS coders
- Prime Image Cash and 25-Seven ATM
- QEI Catlink
- QEI solid-state FM
- RBDS
- RCA 77
- RCA BTA 1R
- Reed-Solomon
- Reel-to-reel tape technology
- Shaver automation
- Shure 55
- Solid-state memory cards
- Spread-spectrum technology
- Stereo patent (Blumlein)
- TDM audio routers
- Teletronix LA-2A
- Telos 10
- USB
- Voltage-controlled amplifier
- Windcharger towers
- Wire recorder (telegraphone)

100 years innovations



16

33 1/3 rpm record

16 The development of the 33 1/3 rpm record can be traced back to the beginning of motion picture sound. Western Electric synchronized sound with pictures in 1925 using records that ran at 33 1/3 rpm. After World War II, Columbia Records decided to heavily market the 12" 33 1/3 rpm LP (for long playing). Eventually it became the standard for musical albums and remained that way until CDs became readily and widely available. In 1958, the first stereo albums were introduced using the method invented by Alan Blumlein of EMI in 1931.



15

Regency TR-1

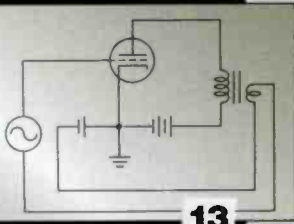
15 Right before Christmas in 1954, Regency (a division of Industrial Development Engineer Associates of Indianapolis) introduced the TR-1, the first commercially available transistor radio. The design was a four-transistor (parts by Texas Instruments), super-heterodyne configuration. About 100,000 units sold in 14 months of production. Interestingly, if you convert the 1954 price (\$49.95) to today's dollars, you come up with a figure that is near to what an iPod costs now.



14

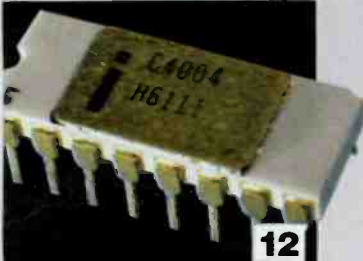
RCA 44

14 The ribbon-type microphone (also known as the velocity type) was the last of the four basic microphone types to be developed (the other three being carbon, dynamic and condenser). RCA introduced the 44A in 1931, and it was an immediate hit because of its smooth tone and its well-defined directionality. The 44B and 44BX followed in 1936 and 1938 respectively. They became fixtures in everything from movie sets to radio studios.



13

The low-frequency response of ribbon microphones makes them popular among voice talent. As we all know, jocks like that larger-than-life sound, and it's always an advantage to get it from the mic itself without having to make it up with outboard equipment.



12

Regenerative feedback

13 Among the early developments in the art of receiver design was regeneration, a design technique in which a particular tuned amplifier is operated with a high amount of positive feedback, thus increasing its gain. Major Armstrong patented this concept in 1914, but Lee de Forest patented it as well in 1916. Thus a contentious, 12-year patent suit began, eventually winding up in the Supreme Court, which ruled in favor of de Forest. Armstrong showed them though; he patented super-regeneration in 1922 and FM later on.



11



10

Computer microprocessor

12 Intel introduced the first microprocessor in 1971. It was invented by Intel Engineers Federico Faggin, Ted Hoff and Stan Mazor. The design was precipitated by a special product order from a Japanese company called Busicom.

Later, Busicom went out of business but Intel had re-purchased their design and marketing rights. Thus was born the original: the 4004. At 1/8" by 1/16", and holding about 2300 MOS transistors, it actually had as much computing power as the 1946 Eniac. Interestingly, the Pioneer 10 spacecraft, launched in 1972, made use of the 4004.

Their functionality has made microprocessors ubiquitous. Still, sometimes I wonder if even the most simple of devices, like a toaster for example, really need a microprocessor.

CBS Labs Audimax/Volumax

11 While it seems that audio processing has been around as long as broadcasting itself, this is not the case. Until the late 1950s "riding gain" on a program was often done manually. This changed when CBS Labs introduced the Audimax in 1959. It was a simple wideband AGC. As FM radio started to come in to its own in the late 1960s, CBS Labs introduced the Volumax, which was an HF limiter. The Audimax and Volumax then worked together as a pair. Some of the last units produced were the TRU Audimax 4450 and the Volumax 4111. The modern era of audio processing for broadcast had begun.

By the late 1970s, the Max brothers had been displaced by the newest FM audio processor, so many broadcasters today have never used them. Interestingly the processing pair still finds use as special effects processors in recording studios around the country.

Tape cartridge

10 The tape format that became affectionately known as carts was introduced to the NAB in 1959 by Collins Radio. The first mono cart machines were offered shortly thereafter, and stereo cart machines with separate cue tracks were introduced later. Pacific Recorders, Broadcast Electronics, ATC, ITC, Fidelipac, Audicord, Harris, Radio Systems and Ampro all built versions of the technology that became ubiquitous in radio stations. By the mid-1990s, however, computer-based systems had gained enough of a foothold in the playback of music, commercials and other audio messages that many new station builds excluded the cart technology altogether. In the late 1990s the old manufacturers stopped making new machines, and cartridge tapes themselves became expensive: one minute of storage cost more than \$5. The days of missed cues, muffled high-frequencies and mono phase cancellation has, for all intents and purposes, finally come to an end. Carts played a major role in radio for 40 years, and the while the technology itself has nearly entirely disappeared, the concept of single-play elements is carried on in its replacement technology.

Photo courtesy of Airborne Audio, Lenexa, KS

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reduction: Eventide’s catch-up and catch-down system, and an exclusive fast-entry-and-exit feature which allows starting a broadcast with the delay already built up to a safe amount and ending it with a rapid reduction of delay.

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100 years innovations



Compact disc

9 In 1979, Philips and Sony decided to join forces in the development of a new digital audio medium: the compact audio disc. Philips brought its expertise in video laserdisc technology to the project, whereas Sony contributed its CERC error-correction technology.

The first compact discs and players were introduced in the Asian market in 1982 and reached the United States the following year. This was the beginning of the digital audio revolution. Many listeners heard CDs first played on the radio in 1985.

The first professional CD players were expensive, and the first CD recorders cost stations more than \$13,000 in 1994. Early recordable CD media cost \$30 per disc.

This entry into portable digital audio storage and playback marked the demise of the analog LP. While the CD is still popular today, it too is being usurped by audio files and portable media players.

Satellite distribution

8 Satellite distribution of TV programs dates back to the early to mid-1960s. The audio portion of the TV program was distributed via subcarriers that were loaded in to the baseband (usually at 6.2MHz and 6.8MHz) above the video signal.

It didn't take long for someone to figure out that more subcarriers could be added to the baseband to distribute other audio channels. Thus began satellite distribution of audio networks.

Soon thereafter came single channel per carrier (SCPC) distribution. NPR used this in conjunction with audio companding.

Other ad-hoc networks were built up as well, many for the purpose of distributing regional programming, such as sports and statewide news networks.

In the early 1980s, satellite distribution of digital audio began with the introduction of the DATS system of non-compressed PCM audio. This was followed by a data-compressed version in the mid-1990s called SEDAT. The Starguide system has practically become the de-facto distribution system of audio networks today, with the exception of the NPR digital SCPC system.

The ease and quality with which network audio could now be disseminated certainly contributed to the success of mass appeal formats and talk radio. To a large degree the state of the industry today can be attributed to it.



Electron tube technology

7 After WWI, two manufacturing groups developed practically all the vacuum tubes of the era: RCA/Westinghouse/General Electric and Bell Telephone. This strong control of the technology of electron tubes relaxed in 1932 when patents began to expire. Companies such as Raytheon, Sylvania, Amperex and Eitel-McCollough soon announced new tube designs.

Through the 1920s and 1930s, as it was discovered by early pioneers in radio technology that higher and higher frequencies could be used for communication, electron-tube designers worked diligently in developing new tubes that could be used to generate power at these ever-increasing frequencies.

WWII spurred rapid development of power tube types, and brought on evolutionary changes that are still in use today: the "beam" tetrode; forced-air cooling; and perhaps the most important (at least for the FM band) the use of cavity type resonant circuits.

The continuing development of electron-tube technology was one of the driving forces in telecommunications from near the turn of the century all the way to the mid-1950s, when junction transistor development started to hit its stride.

Crystal detector

6 Early radiotelegraphy made use of spark-gap transmitters; early radiotelephony made use of high-frequency alternators and the newly invented triode tube.

The complementary receiver technology of the time was that of the crystal detector. In the early 1900s researchers discovered that certain substances (such as lead sulfide or silicon) could be used in the detection of radio signals. Greenleaf Whittier Pickard was awarded a patent in November 1906 for the silicon crystal detector. The device itself was simple: a thin piece of wire (sometimes known as a cat's whisker) was put in contact with the crystal. The crystal detector was placed in parallel with a parallel resonant tank circuit that was tuned for the particular frequency the user wanted. A high-impedance crystal transducer was, in turn, placed in parallel with the crystal detector. The detection of radio waves excited the crystal transducer, which in turn could be heard by the human ear.

Crystal detectors could also be used to demodulate AM. This provided a simple means that the listening public (such as they were at the time) could hear the few nascent broadcast radio transmissions.



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100 years innovations

FM

5 Major Edwin Howard Armstrong was arguably the most important inventor of the 20th century with respect to radio communications. In addition to his earlier inventions—namely regeneration and superheterodyne—he is credited with the invention of frequency modulation.

He first developed FM in 1933, and showed it to the company that held the most licenses of his earlier inventions, RCA. Even though RCA spent a considerable amount of time and effort evaluating the methodology of FM during the 1930s, ultimately it decided not to license it.

Undeterred, Armstrong went ahead and licensed the invention to smaller companies. He designed an entire transmission system from end-to-end—transmitter, antenna and receiver—and worked with the fledgling Yankee Network in New England to prove the technology. On Jan. 5, 1940, a special broadcast test was carried out on the Yankee network. The test originated at W2XCR in Yonkers, NY. It was picked up by W2XMN at Alpine, NJ, rebroadcast and picked up by W1XPW at Meriden, CT. It was picked up again by W1XOJ at Paxton, MA, and then finally ended at W1XOY at Mt. Washington, NH. "This test is most gratifying," Armstrong was quoted as saying.

Boston observers claimed that the program went in to that city with a tonal quality never heard before, and the operators atop Mount Washington reported it as clear as if it were next door. The broadcast went from Yonkers to Mount Washington without using an inch of wire.

Armstrong lobbied the FCC to set aside a segment of spectrum for FM radio (44MHz to 50MHz) and some stations (such as those in the Yankee Network) began broadcasting. During World War II, Armstrong was distracted by the war effort.

Everyone used FM during the war, and Armstrong allowed the military to use his patents royalty-free, a gesture that he was not really able to afford. After the war, the FCC moved the FM band to the 88MHz to 108MHz spectrum where it lives today.

Photo courtesy of CSC Management

Triode

4 Lee de Forest was awarded more than 180 patents during his lifetime, but he is best known for what he called the audion—better known to us today as the triode. This vacuum tube device, an offshoot and improvement on John

Fleming's two-element vacuum tube diode patented

in 1905, was the first successful electronic amplifier and the genesis of today's electronics and telecommunications industries.

In 1910, while working for the Federal Telegraph Company in Palo Alto, CA, de Forest was able to make the triode perform as an amplifier and sold it to the company for use in long distance telephony.

In 1912 de Forest learned that he could cascade the triode amplifiers, thus creating a system that had far greater sensitivity than had hitherto been available for radio receivers. This, of course, was an essential technological development for the fledgling radio and telephony industries.

By 1916 de Forest had learned to use triodes as oscillator tubes, thus generating substantial amounts of RF current for use in transmission.

That triode tubes are one of the most essential elements in early broadcast technology is unquestionable. They were used for everything from mic preamps, to program amps in consoles, to oscillator tubes, modulator tubes and amplifier tubes in the early broadcast transmitters. Many of us still have the pleasure of using them today.

Transistor

It is generally accepted that the transistor was invented at Bell Labs in 1947 (announced in 1948 after patents were applied for and the military was informed) by William Shockley, John Bardeen and Walter Brattain. Though a study of the prior art may cause the claim to be dubious, the fact is that the three shared the Nobel Prize for physics in 1956.

In 1951, Bell Labs made another announcement: the invention of the junction-type transistor, the ancestor to what we are familiar with today.

The properties of the junction transistor—small size, long life expectancy and no need for a filament—overcame many limitations of vacuum tubes. Western Electric (parent of Bell Labs) actively promoted the new technology and licensed the manufacturing rights to more than 30 companies—at \$25,000 each—in 1952. This new invention allowed for the early replacement of tubes in two common electronic devices: the hearing aid and the one that we are so concerned with, the portable radio.

The first commercial all-transistor portable radio, the Regency TR-1, came out in time for Christmas in 1954. By 1957 almost five million portable radios had been sold.

The invention of the junction transistor precipitated the invention of the integrated circuit and later the microprocessor, devices around which nearly all broadcast equipment is designed and built today.

Photo courtesy of AT&T Archives



5



4



3

Electrically recorded records

2 In 1925 Henry C. Harrison of Western Electric's Bell Labs developed a new electrical recording system for 78 rpm records. Using condenser mics and vacuum tube amps (obviously an early proponent of high audio quality) he obtained a frequency response from about 50Hz out to 6kHz—far superior to the 250Hz to 2.5kHz response of the acoustical recording systems that were in use prior to that time.

By 1930 most record companies had adopted the electrical recording system, and during the 1930s many radio stations gained the equipment and ability to make these transcription discs themselves. Radio advertisers soon discovered that they could prerecord their ads, so that they could be played over and over on the air.

NBC allowed its affiliates to make and use these transcription discs on May 1, 1932. In 1935 the new acetate disc was introduced, and on Jan. 1, 1936, NBC announced the formation of its Reference Recording division. CBS acquired similar equipment in 1933, as did ABC when it was split from NBC in 1940.

Radio stations were perhaps the most fervent users of the transcription disc recording technology. The ability to play material back at a later time, or time and time again was obviously an operational advantage.



2

Superheterodyne

1 In the pages of *Radio* magazine, and indeed most other texts regarding technologies used for the transmission of broadcast signals, there is little emphasis on the actual receivers used by the listening audience. Still the case could be made that, no matter how good and sophisticated the transmission technology is, it all would be for naught if it were not for complementary receiver technology. While there were many innovations in the art of receiver design during the 1900s, perhaps no single one was as important as superheterodyne principle.

First, it is necessary to go back to the early 1920s to review a little about the AM broadcast receiver technology that was in use. A typical receiver (known as a TRF—for tuned radio frequency) consisted of a chain of tuned circuit/RF amplifier combinations that terminated in the detector stage. The detected audio from that stage was used to drive a loudspeaker amplifier.

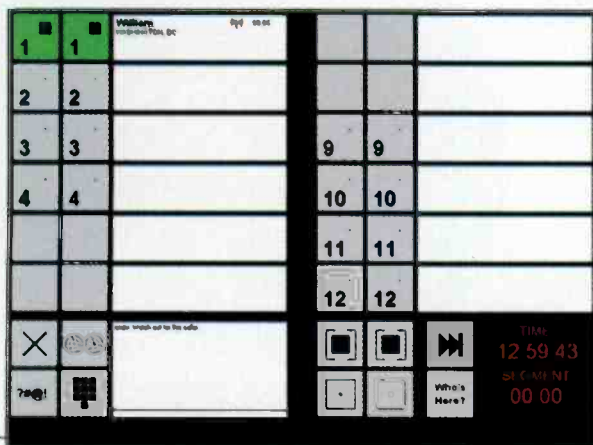
This type of receiver architecture has several major flaws. First, the bandwidth of the tuned circuits (for a given Q) is proportional to the operating frequency. Therefore, as the user tunes up the dial, the selectivity of the receiver diminishes.

Secondly, the sensitivity of the TRF varies with frequency; it gets lower as the receive frequency goes lower.

In response to this problem, Edwin Howard Armstrong developed a new idea that he subsequently patented in 1917. Instead of trying to build the gain and selectivity over a range of frequencies (such as the entire AM broadcast band) he converted the varying input frequency to a fixed frequency—known as the or intermediate frequency (IF). The conversion takes place by mixing (or heterodyning) two signals—the signal trying to be received—and another known as the local oscillator. The arithmetic difference in frequency between the local oscillator and the signal being received is always the same (the IF). The IF amplifier is then designed with the appropriate selectivity and gain, thus eliminating the frequency-variable factors of the TRF receiver. What you had then was a better receiver providing a better experience to those that tune in to AM radio—and the ushering in of a new era in broadcast.



1



Salem Radio Labs Call Commander

by William Harrison

When I first heard about Call Commander from Salem Radio Labs, I knew I wanted to know more about it. I was skeptical about the quality and usefulness of the free software, so I decided to put it to the test.

Salem Radio Labs is a division of Salem Communications, and releases its software under the GNU general public license, so users can do anything with it, and the source code must be made available to anyone using the program. This also means that there isn't any formal support for it except for mailing lists and other users.

Salem's Call Commander software is available in a stable and a beta release; which one you use depends largely on what you want to do with it. Additionally, Call Commander is available as a precompiled binary for numerous versions of SUSE Linux, a precompiled binary for Windows, or as source code so you can build it yourself if need be. For testing we have Windows workstations in the studio and a Telos 2101 phone system, so the best choice for our evaluation was the Windows beta version (1.5.3-1 at the time of this writing).

Installation is straightforward with no options for

record. It also contains a chat window, current time and time segment window. Customization of this screen is incredibly easy, as all elements are defined in a text configuration file.

For example, the default 2101 configuration shows 12 lines, even though we only have eight devoted to a show at any given time. Removing those additional four lines from the screen was as simple as changing a yes to a no in the configuration file. Numerous sample configuration files are included with the package, and many configuration files can be used on a single machine, allowing one configuration for one show in Studio A, and a different configuration for a second show in the same studio.

Install the less than 1.5MB package on additional systems, configured similarly to talk to your phone equipment, and you may begin using it immediately. Out of the box it allows a screener to enter all the information expected from a call screening application, such as name, city, state, ZIP code, caller's comment, gender, age, station, call quality and whether he is using a cell phone (very important these days).

Performance at a glance

Basic functionality
easy to set up

Compatible with
many common
phone systems

Advanced functionality
more difficult,
but very useful

Can be used on
many machines
simultaneously

Source code
available for
alterations as needed

custom settings. Once installed, Salem's Call Commander package consists of three applications: Call Commander (the actual call screening application), Call Manager and Database Manager.

After launching the Call Commander application, the Connection Manager appears, asking questions about the phone system. Answering prompts such as serial port, host name, user name and password allows the software to do most of the configuration for you.

Once a connection has been established, the software opens a default screen with buttons based on the functionality of the phone system, line status, hold, hang up, next call, dump, dialing pad and

Want more?

But what if more functionality is required? What if you want to use things like Caller ID so the software automatically enters that information into the talent screen? What if you want to generate a log of all calls to go back through and search? What if you have a phone system that only allows a single workstation to control it via a dedicated serial port? At present that requires a bit more effort; mainly installing the Linux version of Call Commander to get a few more applications called MCIDMD and MLD.

MCIDMD is a small daemon that runs in the



“Tomorrow arrived today!”

“I’ve built many, many studios all across the Midwest over the years, but our Knoxville Logitek installation was the cleanest, neatest and most advanced layout you can imagine! Almost everything is located in a centralized controlled-environment rack area. The control surface, mics, phone stuff and CD player backups are about the only things left in the studio outside of all the computer controls. The majority of the audio chain takes place within about five feet inside of one equipment rack for each station.

“My biggest problem today isn’t how to set up for daily on-air operations, it’s how to sell off all the old equipment like distribution amps that I don’t need anymore. The Logitek system makes audio ‘patching’ just as easy as plugging in patch cables for everything. You don’t even have to change the type of cable if you change from analog to digital—just re-plug a jumper into an appropriate engine input!

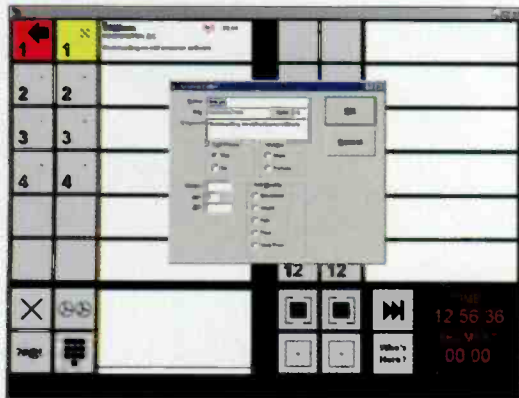
“I’d always dreamed of a studio that worked better for the jock, looked more like what the public thinks a radio star ‘cockpit’ should look like and yet was easy to take care of. The Logitek system made it possible to build it.”

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Mark Lucas, *Chief Engineer*
 Journal Broadcast Group, Knoxville TN



The Screen Caller dialog provides spaces to enter the caller's name, location and discussion topic.

background on a Linux system, acting like an automated call screener. When you receive a call, MCIDMD checks the database against the incoming call's Caller ID information. If it finds information about a matching call (meaning he has called in before), it pushes information about that caller (name, city and state) back to all

Call Commander computers to display on their screens. If MCIDMD does not find a matching call in its database, it uses information from the North American Numbering Plan Administration (www.nanpa.com) database to populate city, state, ZIP code and if the number is a cell phone. MCIDMD is also responsible for logging call information into the database.

Once MCIDMD is running, the Database Administrator creates shows to specify which connection to the phone system to use, and during what times to monitor calls (every weekday from 11 to 12, for instance). Permission to access the logs can

also be set for additional users. This information tells the MCIDMD daemon what, where and how to log calls that come in, all based on when they come in, as well as who can view information about those calls.

The Call Manager application views and analyzes callers based on the entries in the Call Commander database, which records information such as the ring time, hold time and on-air time of a call. It also configures actions for calls, such as blocking certain numbers completely (when a call comes in from a blocked number the system automatically hangs up on the caller), or simply warning the host about a particular number (when a call comes in the system shows the warning message on all screens of the system). Finally, custom

Salem Radio Labs

WEB www.salemradiolabs.com

reports can be created to analyze demographics based on geographic location, gender or age.

To allow multiple workstations to control a telephone interface with only one serial port, the MLD daemon virtualizes that device. For example, the Linux box connects directly to the device via a serial cable, and the workstations connect via TCP/IP to that Linux box. Commands are interpreted and issued as required, and multiple users can access the virtual phone system as need be. To them it is the same as if the phone system accepts TCP/IP communication natively.

Call Commander is a highly effective, extremely capable, elegant call screening application. Installation and configuration are simple for basic functionality, but more advanced functionality like logging and Caller ID functionality requires a Linux machine, and configuration of the daemon may be beyond the reach of some users. Having said that, because the source code is available those users comfortable with programming languages can freely modify the applications, creating the functionality they need immediately. And because it is free, trying it out is as simple as finding enough time to download and install it. 📞

Harrison is a radio broadcast engineer at WETA-FM, Washington, DC.

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.

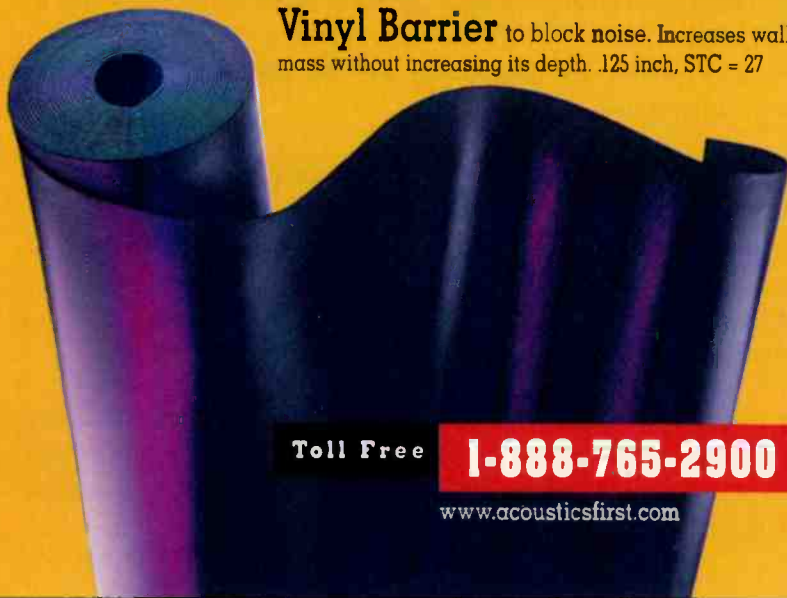
These reports are performed by the industry, for the industry. Manufacturer support is limited to providing loan equipment and to aiding the author if requested.

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WIP Radio, Infinity Broadcasting



AOL Kids Online



KCRW, KCRU, KCRY, KCRI, Santa Monica College

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*Ed Schwartz, VP, Broadcast Engineering
XM Satellite Radio*

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*Thomas Ray, VP, Director of Engineering
WOR, Buckley Broadcasting, New York*

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*Rick Adams, Director
Interactive Children's Entertainment, AOL Kids*

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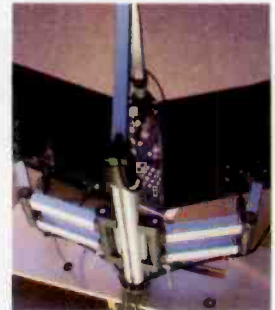
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716-362-1030; www.evenfallacoustics.com
sales@evenfallacoustics.com

UPGRADES and UPDATES

Realtraps has upgraded Modecal, its free graphical room mode prediction software for Windows. (www.realtraps.com)...The USB 2.0-equipped MZ-M200 Hi-MD recorder from Sony is now shipping. The recorder accepts removable 1GB mini discs for as long as 94 minutes of linear PCM uncompressed recording time and as long as 34 hours in the ATRAC3 plus format. (www.sony.com/proaudio)...*MXL Microphones* is now shipping the MXL.006 USB/cardioid condenser microphone. The mic includes a travel case, a desktop microphone stand, a 10-foot USB cable and windscreen. (www.mxlmics.com)

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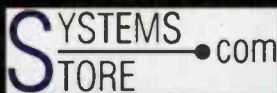
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Find the mic winner October issue

Congratulations to

Pete Cosky

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The mic icon was in the timecode display on the DAW screen.

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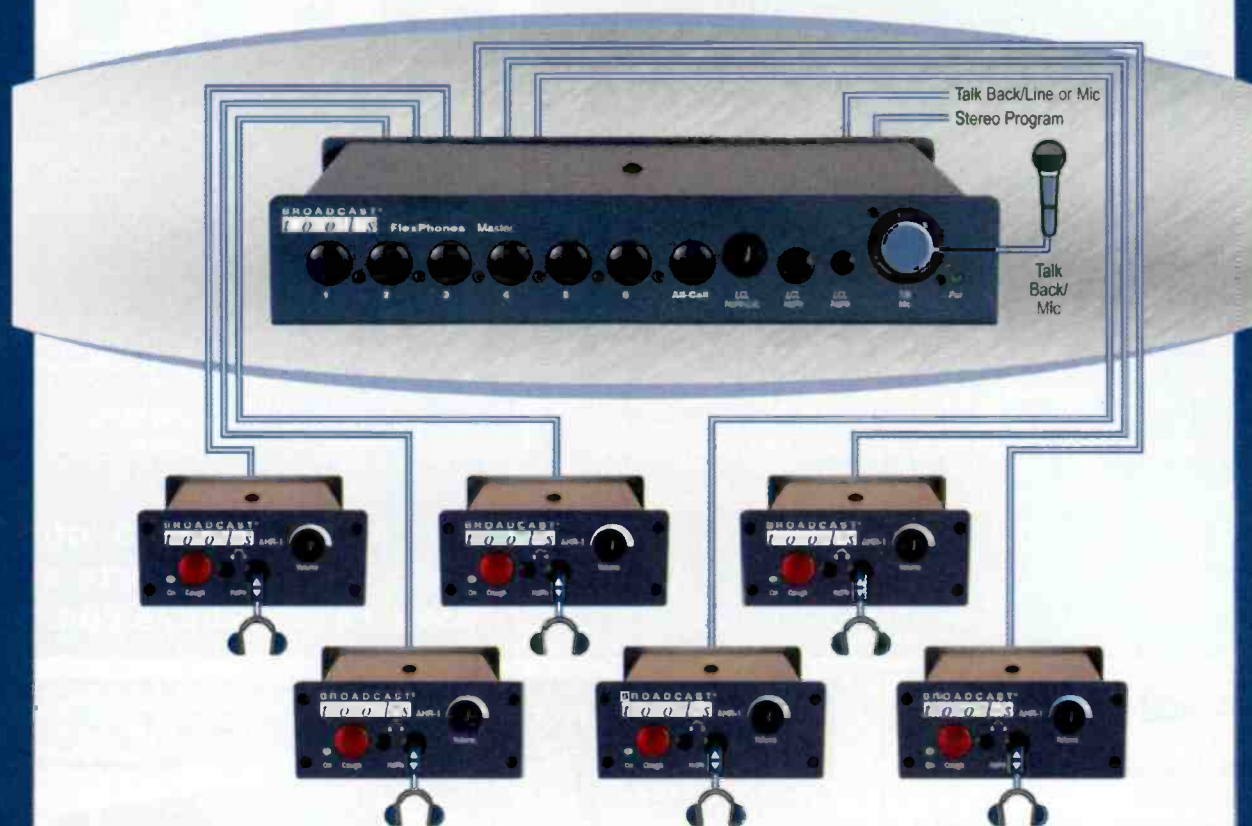
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The FlexPhones Master is equipped with inputs for stereo program and talkback audio. Rear panel program and talkback trimmers are provided to pre-set maximum input levels. The microphone/line level talkback input is available via a rear panel plug-in euroblock connector, while the front panel XLR connector facilitates the use of a user-provided gooseneck microphone or headset. The front panel is equipped with a level control for local headphones with both 1/4" and 1/8" stereo headphone jacks. The six front panel talkback switches allow the user to independently communicate with each AHR-1 listener and can be configured to insert talkback audio into only the left or both ears and dim either or both program channels. Any combination of switches may be pressed, while the "All-Call" interrupts all listeners. The Talkback function can be remotely controlled. Six RJ45 jacks are provided to distribute audio and power via CAT5 cable to the AHR-1's, which conform to the Studio Hub format. Low-Z balanced audio distribution is used to produce audio degradation with long cable runs.

AHR-1 Active Headphone Remote

The Active Headphone Remote (AHR-1) contains a stereo amplifier designed to work with any combination of high-efficiency headphones with impedances between 24 and 600 ohms. The AHR-1 is equipped with 1/8" and 1/4" headphone jacks, level control, user-configured utility momentary pushbutton and LED indicator. Two rear panel RJ45 jacks are provided for connection via CAT5 cable to the FlexPhones Master. The AHR-1 may be desktop mounted, under counter or with the optional HR-1/MP or HR-1/MP-XLR mounting plates, which may be turret or counter-top mounted.



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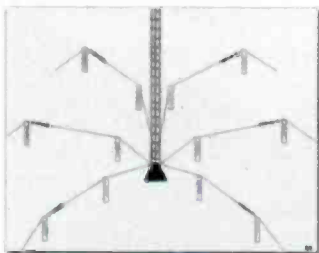
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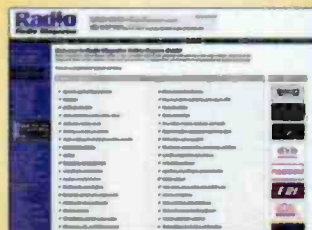
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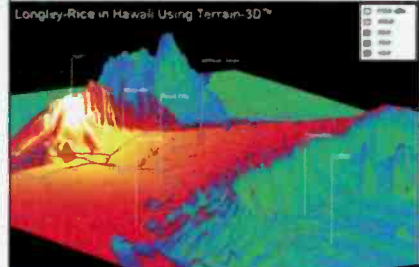
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Contributor Profile

Meet the professionals who write
for *Radio* magazine.
This month: **Field Report**, page 80.



**William C.
Harrison Jr.**
Engineer
WETA-FM
Washington

Harrison's career spans more than a decade and includes theatre, radio, TV, film and the Web. A Red

Hat Certified Engineer (RHCE) and a member of the Society of Broadcast Engineers, Harrison's current major undertaking is building two new studios and replacing the existing automation system at WETA. He has built numerous websites for PBS and other clients, and has written code for numerous sites implementing content management systems.



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Wheatstone	2, 95, 96	252-638-7000	www.wheatstone.com
Wirecad	84	661-253-4370	www.wirecad.com

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

Do you remember?



Around 1964 Ampex began manufacturing the Disc Spot recorder. The device used magnetic discs instead of tape for recording and reproducing sound. The disc was inserted into a slot at the front of the machine and was automatically centered and cued for recording or playback. The record/reproduce head was mounted on a carrier that moved in a straight line across the rotating disc from the outer edge toward the center, mimicking a phonograph.

Playing time of the magnetic disc was three minutes, while maximum cue time was five seconds.

Sample and Hold

What consumer electronics item are you most likely to give as a gift this holiday season?

1. MP3 player
2. DVD player/recorder
3. digital camera
4. laptop and PC
5. TV

Source: 13th Annual CEA Holiday Purchase Patterns, 2006, Consumer Electronics Association.

That was then



This photo accompanied an article about planning a new FM stereo station that was published in *Broadcast Engineering* magazine in December 1962. The picture shows the studio at KMUZ in Santa Barbara, CA. The console enclosure was a one-piece unit fabricated by a local cabinet shop. The audio console was a Collins 212-E dual channel with a full complement of preamplifiers, dual limiters and a monitor. It fed the left channel when any key was in the up position, and the right channel when any key was down.

The small control panel to the left of the console provided switching to turn the clock control on/off and to start/stop the main automation tape decks.

The reel-to-reel recorder was wired to record from the console output, the studio or control-board microphone and special interviews from the telephone.

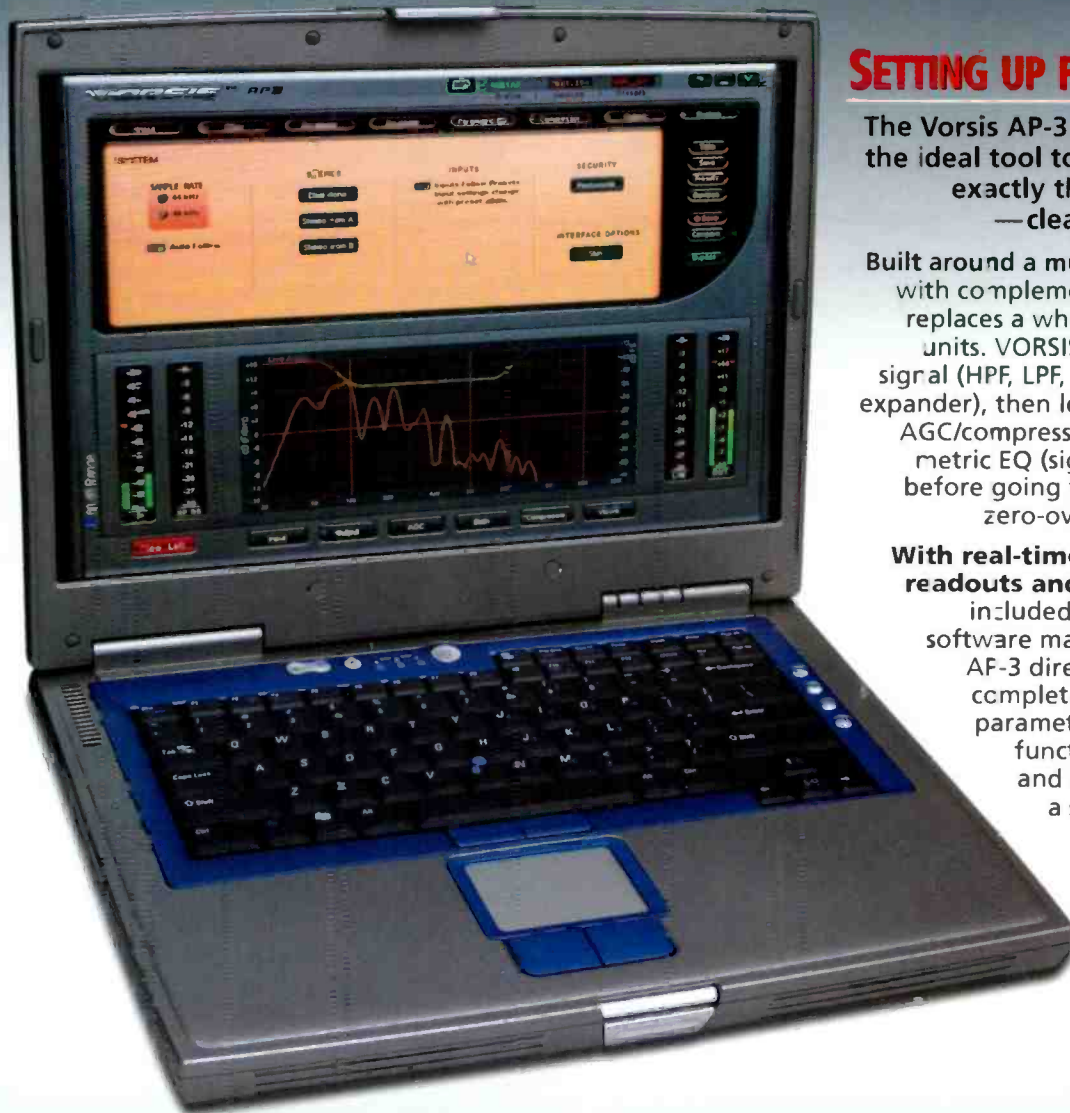
Mounted in the rack below the tape deck is a monitor amplifier, a silence sense deck and a 25Hz generator for cueing the recorded tapes.

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