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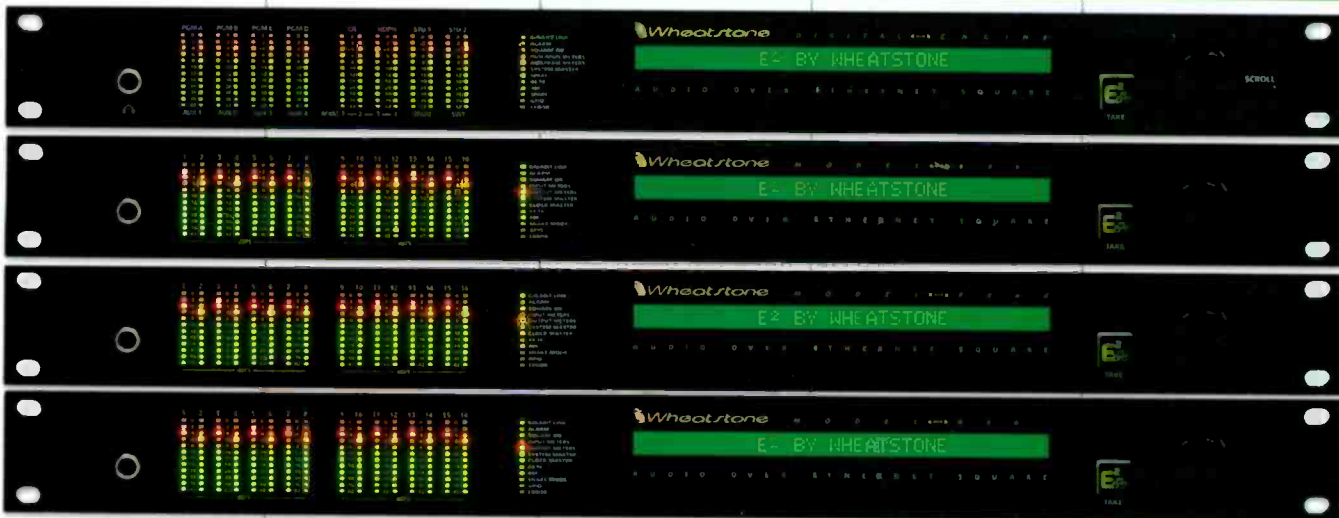


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# THE POWER OF THE SQUARE



AUDIO-OVER-IP ROUTING.  
SOME TECHNICAL STUFF.



## WHEATSTONE and E<sup>2</sup>...

Wheatstone is world-famous for consoles and networked audio routing — tried-and-true technology that has become broadcast's de facto standard. With the emergence of Audio-over-IP as a viable transmission medium, and knowing that existing solutions are cumbersome at best, Wheatstone has turned its attention and resources to developing a superior set of tools that are as efficient as they are effective.

## GIGABIT ETHERNET

Wheatstone chose Gigabit Ethernet (1000BASE-T) because quite frankly, 100BASE-T just can't simultaneously handle the large number of audio channels prevalent today in large broadcast plants without the very real risk of audio not being available when you need it.

## E<sup>2</sup> SQUARES

Three SQUAREs are access points in and out of the network, the fourth is a digital mix engine.

## EASE OF SETUP

E-SQUARE setup is easy, intuitive, and takes only a few minutes until you're on the air. The front panel setup wizard in each SQUARE gets you up and running in moments. Extensive front panel metering and status indicators provide quick confirmation that all is well. E-SQUARE's web interface and E<sup>2</sup> Navigator GUI let you further customize your system, locally or remotely, with input and output names, logic associations, routing and much more.

## 88e E<sup>2</sup> MIX ENGINE SQUARE

Every nerve center needs a brain. The 88e is it, handling all of the mixes from Wheatstone Evolution Series Console Control Surfaces and the Wheatstone Glass-E Virtual Console Control Surface, a PC-based GUI. The 88e SQUARE houses all DSP power for an individual control surface and distributes the four stereo PGM, four stereo AUX SEND, per-channel MIX-MINUS, monitor outputs and other bus signals to the network. Once on the network, they are available as sources and outputs anywhere. This creates an extremely flexible system, where program outputs from one surface can be a source on any other surface; for example a news mixer's program bus as a source on the air studio surface. While the MIX ENGINE SQUARE doesn't house audio I/O, it does include 12 universal logic ports.

## HIGHLIGHTS

- SQUAREs are linkable units that communicate via a single CAT5E/6 over Gigabit/1000BASE-T protocol — Gigabit protocol means all audio everywhere with extremely low latency
- SQUAREs interface seamlessly with Wheatstone's Evolution Series Console Control Surfaces, the Glass-E Virtual Console Control Surface, most of the popular automation systems, and streaming audio
- Install the WHEAT-IP driver on automation system computers to eliminate the expensive sound card and replace tons of audio and control wiring with a single CAT5E/6 cable
- Each SQUARE includes two 8x2 virtual utility mixers that can be used for a wide range of applications
- Front panel headphone jack with source select and level control to monitor any system source
- Silent — no fans — can safely be located in a studio with live mics
- Flexible GPI logic — 12 universal logic ports, programmable as inputs or outputs
- SNMP messaging for alerts
- Silence detection on each output that can trigger alarms or make a routing change



Introducing E-SQUARE Audio-over-IP routing and mixing. Wheatstone's goal was to design a system that is extraordinarily easy to implement without the need for super-complicated network engineering, and where the user doesn't need to be concerned about setting network parameters and priorities to assure that those signals that are most critical are available.

Here we give a brief overview of E-SQUARE, and a few considerations that went into Wheatstone's design of a second-generation AoIP system for broadcasters.

Each of the I/O SQUAREs handles 16 audio channels in and out, plus logic (GPIO). One model is all analog, one all digital, and one is half of each. The relatively small channel count of each I/O SQUARE allows you to conveniently locate them close to your equipment: in your TOC racks and in the control room or studio furniture.

Each of the SQUAREs and each Wheatstone console control surface connects to the network with a single CAT5E/6 cable.

There's also WHEAT-IP, a software "SQUARE" that you install on a Windows® machine — automation computer, news workstation, or a PD/GM's desk computer — to control, play and record audio on and off the network without a sound card, also with just one CAT5E/6 cable.

## RELIABILITY

Keeping you on the air is foremost in the design of E-SQUARE. It's completely self-contained — no PC is required to perform any of the system functions, including routing, mixing, salvos, and logic control. The PC is needed only for configuration changes.

Each SQUARE carries a complete map of the entire connected network in its onboard CPU flash RAM — this allows SQUAREs to be quickly and easily replaced in a network. Assign an ID # to a SQUARE and connect it to the network — it will query the other connected SQUAREs and import all the necessary configuration settings.

## E<sup>2</sup> I/O SQUARES

Each 88 I/O SQUARE provides connectivity for 16 input channels, 16 output channels (switchable 8 stereo, 16 mono, or any combination), and 12 universal logic (GPIO) ports programmable as inputs or outputs, routable throughout the system.

## 88a ANALOG I/O SQUARE

16 analog in/out

## 88d AES DIGITAL I/O SQUARE

8 AES in/out

## 88ad ANALOG & DIGITAL I/O SQUARE

8 analog in/out, 4 AES in/out





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# CONTENTS

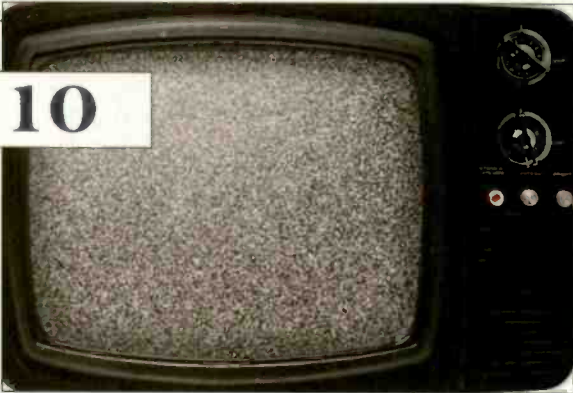
14



## Features

- 14** Trends in Technology: Wind Turbines  
by Doug Irwin  
Smaller wind turbines could save your studio big money
- 34** Tech Tips  
by Chriss Scherer  
Tricks, tips, hints and more

10



## Columns

- 8** Viewpoint  
by Chriss Scherer  
Clean house and get ready to work
- 10** Managing Technology  
by Kevin McNamara  
What's happening at 700MHz?
- 12** FCC Update  
by Harry C. Martin  
When does an omni antenna become a DA?

36



## Departments

- 6** Online  
at [www.RadioMagOnline.com](http://www.RadioMagOnline.com)
- 36** Field Report: KRK Systems Rokit  
by Glenn Shipps
- 38** New Products  
by Erin Shipps
- 48** Classifieds
- 49** Contributor Pro-File  
Meet Chris Wygal
- 50** Sign Off  
by Erin Shipps  
A Webster-Chicago Model 80 Wire Recorder and the top 20 radio advertisers in 2008.

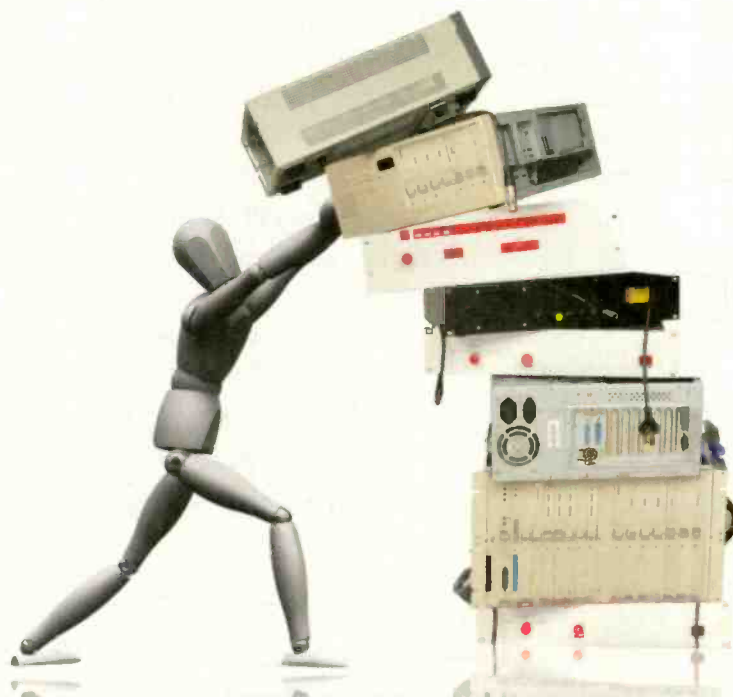
### ON THE COVER

With the global move to be more energy efficient, radio stations can fairly easily get in on the act with small wind turbines. Cover design by Michael J. Knust.





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# Currents Online

Selected headlines from the past month.

## Symetrix Extends Product Warranty

Symetrix, Lucid and Airtools-branded products purchased during or after October 2008 will receive six additional months of coverage, extending its warranty to a full two years.

## APT Promotes Campbell to Sr. VP

Kevin Campbell returns to the company's Belfast HQ.

## PTEK Adds to Technical Sales and IT Team

Lynn Turner is the company's new business development manager, and Jennifer Brown has been appointed marketing IT.

## Gladwell to Present Keynote at NAB Show

Social scientist and author Malcolm Gladwell will present a morning keynote discussion on April 22.

## Dave Ramsey to Keynote NAB Show Radio Luncheon

The money management expert and nationally syndicated radio host will deliver a keynote address on April 21.

## Sound Exchange, CPB Set Terms and Rates Through 2010

The agreement establishes the royalties that CPB will pay for streaming on public radio websites from Jan. 1, 2005, through Dec. 31, 2010.

## Wonder Vision Awards Recognize Several in Radio

The awards recognize efforts that assist people with sight disabilities. Ibiquity, NPR and several others made the list.



**Campbell**

## NABEF Appoints New Directors

Larry Patrick, managing partner of Patrick Communications, and David Barrett, president and CEO of Hearst-Argyle Television, join the foundation's board of directors.

# Site Features

## Monthly Podcast

[RadioMagOnline.com/podcast](http://RadioMagOnline.com/podcast)

Want to know more about the KPAN installation? Get additional insight on the 700MHz issue? How about the details of NPR's work on radio for the blind? They're all in the February podcast, which is online now.



## Digital Radio Update Twice a Month

[RadioMagOnline.com/newsletters](http://RadioMagOnline.com/newsletters)

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

## Advertiser Links

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Access Web links to the advertisers in the February issue.

## Industry Events

[RadioMagOnline.com/calendar](http://RadioMagOnline.com/calendar)

The Radio magazine Industry Events section lists upcoming conventions and conferences.

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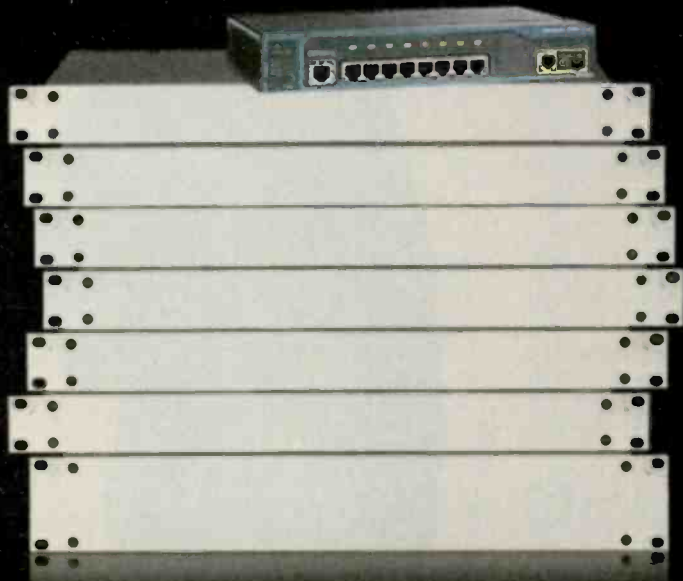


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### Next Generation IP Audio



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## Clean house and get ready to work

**T**he transition from Bush to Obama is seeing its final pieces being put into place. High-profile cabinet positions lead the news each night, although these are only a small fraction of all the posts being filled. The one seat that broadcasters are watching is that of the chairman of the FCC. While Julius Genachowski's name has been submitted, the appointment is still pending Senate approval.

The bad taste of former Chairman Kevin Martin still lingers, but immediate efforts are being made to cleanse that memory. The first step was President Obama naming Michael Copps to be the interim chairman of the FCC.

Copps comes across as a straight-talker. He's a no-nonsense person. Actually, he seems gruff most of the time, but perhaps that's just his low tolerance for misdirected and inefficient effort. (That's a polite way of saying bravo sierra.)

I have watched Copps since he joined the commission, and I have had mixed feelings about him to date. Perhaps it's his no-nonsense attitude that puts me at guard. We're not accustomed to that kind of frankness at the FCC. However, he showed his leadership ability immediately after being appointed to the temporary post. Within minutes of the promotion, he issued statements reaffirming his goals and positions. Acknowledging that there were some significant problems under Martin, Copps said, "[T]he FCC must utilize its resources—especially its human resources—smartly and inclusively. And we must be credible not only in *what* we do, but *how* we go about doing it. But I worry that in some important ways we haven't always been doing that. I am troubled that our lines of communication, both internal and external, seem to have frayed. Our credibility suffers when that happens. So the first thing we need to do as an organization is to improve our lines of communication, enhance the level of transparency in our work, and bring to our daily decisions the kind of openness that gives true credibility to everything we do."

This certainly disassociates Copps' methods from Martins, which is a needed first step. Commissioners McDowell and Adelstein have worked well with Copps, so there is a cooperative foundation already in place going forward.

Separately, the White House issued some guidelines on what it wants to accomplish in the coming years. One item on the technology page relates to the past Martin policies:

Restore Scientific Integrity to the White House: Restore the basic principle that government decisions should be based on the best-available, scientifically valid evidence and not on ideological predispositions.

It almost seems like that was written as a response to the shortcomings revealed under Martin. For the past several years, political agendas have replaced reality. With Obama's technical focus, the incoming chairman's technology background, and the established rapport of the existing three commissioners, the FCC has the potential to make some good and effective policy.

And there's still one more seat open on the commission. I hope Obama makes a good choice there, too.



For more on the White House's Technology agenda, visit [whitehouse.gov/agenda/technology](http://whitehouse.gov/agenda/technology)



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Photo: Jonathan Tichler/Metropolitan Opera



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## What's happening at 700MHz?

By Kevin McNamara

**B**y now most Americans know about the eminent shutdown of analog TV on Feb. 17, 2009. There are still some challengers to extend the date, but it seems likely we have seen the last of analog broadcasts. Low-power TV stations will be permitted to stay on-air until the new licensee (for the specific spectrum) commences operations in a particular market.

The newly cleared spectrum is perhaps some of the most desirable largely due to the fact that radio frequency in this lower range travels farther and tends to penetrate buildings more efficiently. Due to the large demand in broadband wireless services, the FCC made available the spectrum currently occupied by channels 52 through 69 (the UHF band).

In order to make the best use of the spectrum, the frequencies now occupied by these channels were divided into several blocks. Each block defines not only a specific amount of bandwidth, but also associates certain service areas, i.e. metro, regional or national (typically the lower 48) areas the licensee can operate. Ultimately, these blocks were made available to interested operations through a series of well publicized auctions. The auctions for this spectrum are essentially completed with the exception of one block. In all, about \$20 billion were raised, the most in spectrum auction history.

I will breakdown what is going to happen on these blocks; however, keep in mind that not all licensees have announced the definitive plans and technology platforms they propose to deploy on this spectrum.

### Auction 44

Auction for the Lower 700MHz Band was completed in late 2002. It was comprised of 740 licenses, 736 for MSA/RSA (smaller metro areas) and six EAG (larger regional areas). The licenses are designated Blocks C and D respectively. Block C winners get 2 x 6MHz, while block D winners get 1 x 6MHz allocations.

MSA/RSA Block C: (710-716, 740-746MHz)

EAG Block D: (716-722MHz)

The FCC defines the permissible use for these frequen-

cies as "Flexible fixed, mobile and broadcast uses, including mobile and other digital new broadcast operations, fixed and mobile wireless commercial services (including FDD- and TDD-based services) as well as fixed and mobile wireless uses for private, internal radio needs. Could also include two-way interactive, cellular and mobile television broadcasting services."

Take particular note to the last sentence; it pretty much sums up what one of the primary services that Qualcomm, the major winner, intends to deploy. Their plan is to offer wireless television services using Mediaflo technology. In fact, they already have the service running in many markets that don't have an existing channel 55 operating. They intend to turn up other markets once those remaining analog stations leave the air. Other licensees are planning similar offerings as well as alternative broadband access.

Interestingly, only 484 licenses were bid and awarded; 256 licenses were retained by the FCC.

### Auction 49

Auction 49 was essentially a re-auction for those unsold allocations. The auction was completed in June 2003. The end result was that all of the remaining licenses were sold, albeit the total value received for this spectrum was nearly twice what was paid in the previous sale.

### Auction 73

The FCC left the best spectrum, basically the rest of the UHF TV band, for last. March 18, 2008, marked the end of an auction that lasted almost two months and yielded nearly \$20 billion. These allocations were divided into five blocks (A-E):

- Block A: 12MHz (698-704/728-734MHz)
- Block B: 12MHz (704-710/734-740MHz)
- Block E: 6MHz (722-728MHz)
- Block C: 22MHz (746-757/776-787MHz)



# MANAGING TECHNOLOGY

• Block D: 10MHz (758-763, 788-793MHz)  
There are a total of 1,099 licenses offered under this auction:

- Block A: 176 Economic Area (EA) licenses
- Block B: 734 Cellular Market Area (CMA) licenses
- Block E: 176 Economic Area (EA) licenses
- Block C: 12 Regional Economic Area Grouping (REAG) licenses
- Block D: 1 nationwide license (subject to conditions respecting a public/private partnership)

In the end, 1,090 licenses were won, however all of the bidding for block D did not meet reserves. The primary reason being a requirement placed on bidders to provide a certain amount of access for public service use. Bidders perhaps felt the requirement limited their commercial use of the spectrum.

The permissible uses for these blocks are similar to that specified in the lower band; however, the wider bandwidth, particularly block C, will permit the deployment of next generation wireless services called 3GPP LTE. LTE is an acronym for long-term evolution and is a technology that represents the transition into the future 4G platform. LTE can provide download speeds of 100Mb/s, and will therefore be a natural

platform capable of telephone, radio, television and Internet access applications.

The major winner of the auction, including block C licenses that cover all of the lower 48 states, is Verizon, who has announced its intentions to deploy LTE on the spectrum. AT&T, the next largest bidder, announced similar plans. One catch with the C block is that the licensee must operate an open platform providing access to any application from any device. This requirement came out of a pre-bid petition to the FCC which was subsequently granted.

Other platforms that could materialize on these frequencies by smaller operators include Wimax and UMB (Ultra Mobile Broadband), all competing technologies to LTE.

No matter which technologies surface, one thing is certain: You will start to see a new generation of broadband wireless device on the market, possibly by the end of 2009.

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



More on the ramifications of the 700MHz changes in the February Podcast at [RadioMagOnline.com](http://RadioMagOnline.com).

## SHHHHH.....



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# When does an omni antenna become a DA?

By Harry Martin

**I**n a recently-filed petition against an FM station modification, an issue was raised as to whether a proposed omnidirectional antenna should be treated as directional due to pattern distortion resulting from tower mounting and compensating antenna design features.

In support of its claims, the petitioner cited a public notice released in September 1984, entitled "Criteria for Licensing of FM Broadcast Antenna Systems." According to that notice, the Commission assumes that omnidirectional FM antennas have perfectly circular horizontal radiation patterns. The notice then warns that the "use of any technique or means (including side mounting) which intentionally distorts the radiation pattern of what is nominally a non-directional antenna makes that antenna directional and it must be licensed as such." Of course, the licensing process tends to be considerably more complicated and expensive for a directional than an omni, so it would likely be a serious matter for a broadcaster planning on installing an omni to find that the FCC will be treating it as a directional.

antenna should be considered a DA. In support, the petitioner relied largely on claims by the antenna manufacturer that suggested that its specially-designed-and-mounted "lambda" design would effectively directionalize the station's pattern. According to the manufacturer's website, the performance of most omni antennas is determined by free space evaluation, meaning the evaluation is made as though the antenna were magically suspended in space (i.e., far away from the proposed supporting tower, that might otherwise distort the antenna's pattern). But since, as a matter of physics, close proximity to a large metal object such as a broadcast tower will invariably alter the antenna's performance in various ways, the theoretical omni pattern will be subject to distortion as soon as it gets mounted in the real world. Accordingly, the manufacturer devised the lambda system to take into account the distortive effects of the tower and mounting hardware (and other factors) and produce a more accurately predictable signal.

So yes, the lambda system intentionally affects an omni signal in some sense, but only for the purpose of counteracting the unintended distortion that naturally occurs when the antenna is affixed to a tower. If the goal is to correct unintended-but-unavoidable natural distortion, can that really be said to be intentional distortion within the meaning of the 1984 public notice?

The Commission's staff accepted the applicant's, and the manufacturer's, explanations and granted the application. The upshot of the decision is a clear message that the FCC's engineering staff recognizes that mounting an omni on a tower will always cause some distortion, and it simply does not want to study each and every new or old omni pattern to check on distortion levels. The decision could have been more helpful, however, by providing broadcasters, equipment manufacturers and tower riggers with clear guidance as to just what the 1984 notice means, and, if it is still a valid statement of policy, what levels of distortion will be accepted in future cases.

## Dateline

April 1 is the deadline for submission of biennial ownership reports by radio stations in Texas.

April 1 is the deadline for radio stations in Texas with more than 10 full-time employees to electronically file their Broadcast EEO Mid-Term Reports (Form 397) with the FCC.

April 1 is the deadline for radio stations licensed in the following states to place their annual EEO Reports in their public files: Delaware, Indiana, Kentucky, Pennsylvania, Tennessee and Texas.

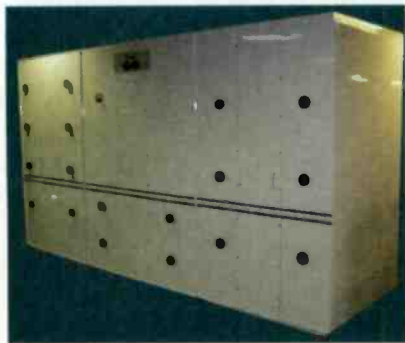
It appears that the 1984 notice has been cited by the FCC only twice in the last 25 years – and not at all since 1992. The Commission does not seem to have even suggested, much less formally held, that the public notice could or should be invoked with respect to standard omni installations, whether the antenna is to be top-mounted or side-mounted. Despite the fact that thousands of omni antennas have been proposed, installed and licensed since 1984, none of them has been declared a de facto directional under the public notice.

Nevertheless, in the recent case before the Audio Division, the petitioner argued that the

*Martin is a member of Fletcher, Heald & Hildreth, PLC, Arlington, VA. E-mail: martin@fhhlaw.com*



# AM Antenna Solutions



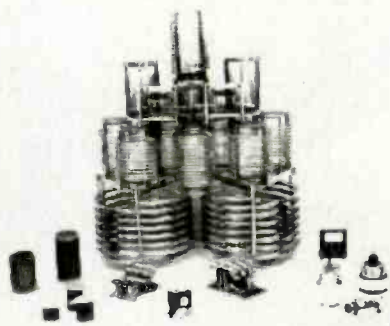
Directional Antenna Systems



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# The

by Doug Irwin, CPBE AMD

# ANSWER...

In the article "Feel the Power" (*Radio magazine*, July 2008) I discussed alternative power generation and briefly touched on the wind-powered generator at KPAN radio in Hereford, TX. This time I'll talk about wind power generation in greater detail (though this will not be a primer on exactly how to implement such a system) so you can form a more realistic idea as to whether or not such a system would work as part of your broadcast facility. I'll also revisit KPAN as a case study.

If you look closely at most power consumers you will find the majority use power with less-than-ideal efficiency; that is likely because over the last 100 years or more electric power has been easy to come by and, for the most part, cheap. There has been little if any economic incentive to maximize the efficiency of electrical usage.

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# Blowing in the wind

But now, as attention in the United States is turned on our own energy independence (or at the very least minimizing our dependence upon foreign sources) and an increasing desire to limit carbon emissions, alternative and renewable sources of energy (while not new) are being looked upon much more favorably. In addition to being clean, they are now becoming more economically attractive; electricity is getting more expensive (thus reducing the payback time for the investment in a wind generator, for example) and many state governments offer tax incentives that offset substantial portions of the investment.

## Basic steps

But where does one start, in determining whether or not a wind generator is a good investment? I have found various manufacturers and users of wind generation equipment agree on the basic steps, which are compiled in the following list.

- ✓ Know your baseline usage
- ✓ Maximize the efficiency of your energy usage
- ✓ Study the available wind resources
- ✓ Pick a system that meets your needs

**Know your baseline usage.** For one thing, the wind generators mentioned later are relatively small; you won't be powering a 50kW transmitter site with them. The largest system I'll mention will provide 10kW peak – with its average being lower. Likely, the best way to determine your usage in kilowatt hours (kWh) over the year is to study your electricity bill. If you are building a new system then make use of your engineering expertise to make your best estimate your needs.

**Maximize the efficiency of your energy usage.** As I mentioned earlier, because electricity has been fairly easy to come by in most cases, there has been little incentive in years past to maximize the efficiency of its use in many cases. However, if your intention is to lower your energy consumption for not only economic reasons, but for other principles

as well, it makes sense before doing anything else to work at using less power, by finding the simplest ways to cut back. In my experience in California in 2001 (during the statewide energy crisis) I noted that once the problem became top-of-mind for many people, 10 percent of energy usage could be eliminated with very little effort by doing things like turning lights off when a room was unoccupied; turning off TV sets that were not being watched; raising the set-points of air conditioners a few degrees, and so forth. The next steps are also simple, such as replacing incandescent lights with fluorescents, and installing more energy-efficient appliances. While these actions may seem more pertinent to home use, they apply to radio stations as well. Turn out lights; turn up the A/C unit; turn off computers and monitors when not in use.

**Study the available wind resources.** Not all locations are suitable for the generation of power from the wind. That's an unfortunate reality. Most likely you have an idea about how much the wind blows at your particular location. There are a couple of things to keep in mind though: First, the wind is stronger as you get higher above the ground, and so your feeling about how much the wind blows is probably wildly inaccurate. Secondly, even if the wind seems to be blowing all the time, likely the average speed is lower than you would guess; and finally, if the wind is too fast (like during a storm) you might be surprised to know that the wind generators will shut themselves down. Too much wind is not a good thing in this case. Visit [www.nrel.gov/wind/resource\\_assessment.html](http://www.nrel.gov/wind/resource_assessment.html); this site will give you a reasonable idea about the wind resource in your particular area. Look at the map to find the wind power class of the area you are interested in.

**Pick a system that meets your needs.** Implicit in that statement is that you know what your needs are after studying your historical power usage and then maximizing the efficiency of your power consumption. If you are in the process of developing a new site, you will



African Wind Power's AWP3.7 turbine has a peak power rating of 1500W at 48V.



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Image courtesy Proven Engineering

**A Proven Engineering 2.5kW turbine mounted on a roof in Ashenden House, London.**

have to do the engineering to make the best estimate of your future needs. Then comes the next question: Just what power resource are you looking for? Will your new site be completely off the power grid (like a mountain top with no power lines, and too far for them to be constructed)? Do you want to use a wind generator to supplement a photo-voltaic (PV) system, for battery charging perhaps? Or maybe you simply want to generate electricity to reduce your reliance upon your current electricity source. Any of these three needs can be accommodated.

## Catch the wind

Wind generators are anything but unobtrusive. To catch the proper amount of wind, they are typically mounted around 50 feet above the ground or higher; and so this requires a tower. Several of the manufacturers recommend at least one acre of ground on which to place the tower. The turbine will need to be above trees and buildings for the most part so that its access to the wind is unencumbered. Unless you are in a rural (or semi-rural) area, that amount of space can be hard to come by. It goes without saying that you must obtain the proper

permissions and construction documents from the local authorities prior to purchasing and installing a wind generator system.

Now let's look at the specific uses I mentioned previously. First, let's assume you are building a new transmitter site on a mountain top, far enough from power lines that it is not economical to actually install a feed from the power grid. One manufacturer's website (out of several) useful for this application is that of Bergey Windpower ([www.bergey.com](http://www.bergey.com)). According to Bergey, if your load draws a continuous power or 50W or less, then a 100 percent PV solution is called for. For continuous loads between 50W and 300W, a combination of PV and wind power makes sense.

Wind and solar power obviously complement each other well; when the sun isn't shining, the wind is often blowing. Likewise, when the wind is calm (like during the summer months) the amount of energy available via direct sunlight is often at its greatest.

In this example, the wind generator and the PV system have dc outputs used to charge battery banks that provide power to equipment via dc, or by way of inverters that make 120Vac out of 24 or 48Vdc. It's clear that the amount of energy stored in the batteries must be enough to carry the entire load of the system for some amount of time during which there is no other energy source for recharging. That amount of time will be determined during the engineering process. If the combination of the wind generator and PV are not enough to keep the system powered, a backup generator may need to be added.

It isn't necessary to have battery banks to use the wind generator and PV combination to supplement ac grid power though.



Image courtesy Proven Engineering

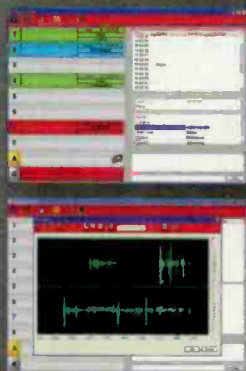
**A Proven Engineering 6kW turbine in a field.**

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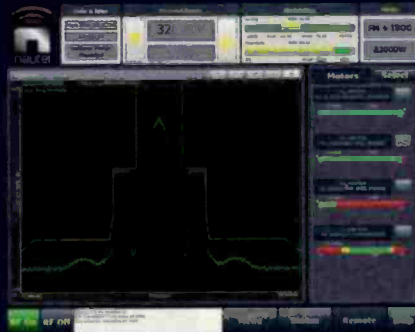


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# Blowing in the wind

Some of the wind generators have 220Vac outputs that can be connected directly to the power grid. A system can be constructed with an ac output from both the wind generator and an inverter powered by PV cells. These inverters sense the line voltage and phase of the grid, adjust themselves accordingly, and then connect themselves so that they provide energy to the load, either supplementing or completely replacing (depending upon the wind and solar resources available at the moment) the power absorbed from the public utility source.

And finally, the wind generator can be installed to operate on its own, providing ac power for the load, supplementing that drawn from the public utility, or depending upon the wind resource available at the moment, completely replacing that drawn from the public utility. That of course is the ideal, and the amount of time during which that actually occurs will depend upon the average wind resource available along with the average load seen by the wind generator.

## Wind generator manufacturers

There are several wind generator manufacturers I want to cover in this article. The first is Bergey Wind (mentioned earlier). The largest wind generator mentioned for this article is the BWC Excel, its 10kW tower-mounted turbine. It comes in a battery charging version – with dc outputs of 24, 48, 120 or 240V. It also comes in the grid-connected version. It's interesting to note that the

peak output is in excess of 10kW in the grid-connected version, while it is 7.5kW in the battery-charging version (30 MPH wind speed). Minimum tower height appears to be 60'. Bergey also offers its XL 1, which is capable of 1,000W, but in a battery-charge mode only.

Proven Engineering is a Scottish firm offering several small wind generators including the Proven 2.5 (2.5kW peak) and the Proven 6 (6kW peak).

African Wind Power is another manufacturer of small wind turbines. Its AWP3.7 will source up to 2kW of power in a grid-connect version.

## KPAN: a case study

KPAN is an AM/FM combination located on the high plains of the Texas Panhandle in Hereford (elevation 3,800'). It's been in the Formby family since its inception in 1948, and today is managed and co-owned by Chip Formby. Late in the spring of this year, KPAN installed a Skystream 3.7 from Southwest Wind Power of Flagstaff, AZ ([www.windenergy.com/index\\_wind.htm](http://www.windenergy.com/index_wind.htm)). When I wrote "Feel the Power", KPAN had just started using the Skystream 3.7; but several months have now gone by. Formby has been able to give me more detailed information about why the station purchased that particular unit, and how the performance has been so far.

Formby has been interested in large and small wind turbines since the energy crisis of the early 1970s. As the manager of KPAN, he had been looking at wind

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**Hoisting the assembled KPAN turbine.**

turbines for either the transmitter or studio site. Having one at the transmitter with enough output to power the transmitter itself just didn't pencil out because of the project expense and also a very long payback time due to cheap electricity there (11 cents per kilowatt hour). But, he was determined to capture some of the free power that blew by every day; he liked the

clean aspect of wind power; and he just wanted to demonstrate that wind power was a viable option. KPAN ended up buying a wind generator for the studio location instead.

I asked Formby why he chose the Skystream, and he told me that it was as much to do with its availability as anything else. He says it's the next generation in wind generators; it's completely self-contained, since the alternator, the inverter and controller are all located within the nacelle itself. There are only two moving parts: the propeller shaft and the rotator ring (which provides yaw so the turbine can point into the wind). A single cable comes out of the unit, providing 220Vac that is meant to attach to the power grid. (Rated output of the Skystream 3.7 is 2kW, measured at 20 MPH. Recently a USDA test unit near Amarillo produced 3.2kW of output in a sustained 35 MPH wind.) SWWP also specifies that very little maintenance is required: Cleaning the blades of bugs, and lubricating the system every 10 years is all Formby expects to have to do.

You can get to the nacelle either by laying the tower over, or by way of a bucket truck (KPAN's unit is on top of a 45' mast). Shortly after the unit was brought online, Hereford experienced a strong thunderstorm, with winds of 70 MPH and large hail. The Skystream 3.7 went through the storm with no trouble at all, save a few paint chips on the blades.







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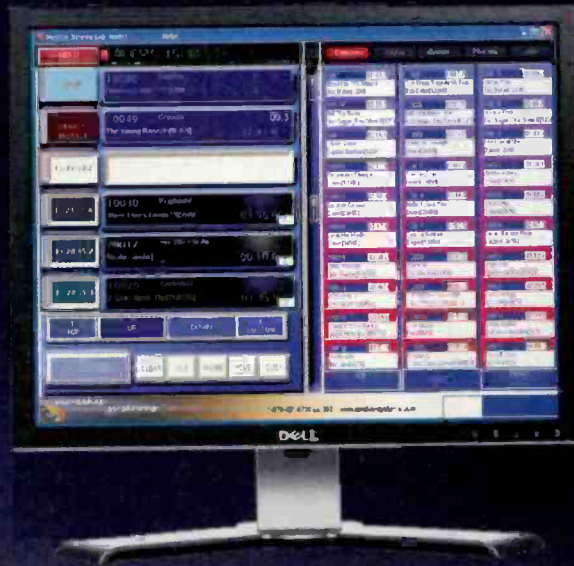
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## Blowing in the wind

I also asked Formby about the performance of the system to date. He told me that it was a little disappointing, since the same unit located at a more rural site nearby had produced about 25 percent more power. He attributes that difference though strictly to the site; KPAN has its Skystream located inside city limits, and it is in the proximity of trees and buildings. Formby expects much better performance of the system during winter, when the trees are without leaves and (of course) the wind blows more consistently. With those performance issues in mind, he expects the payback period for the entire project (which cost a little over \$10,000) to be longer than the typical 10-year estimate (unless electricity prices rise unexpectedly in future). It's also important to consider, when figuring the real cost of the system, to learn what tax incentives are available from federal, state or other local authorities. For example, on its website Bergey mentions that California, New Jersey, New York and Illinois all provide incentives for the installation of wind power. Your local utility provider may offer rebates as well.

Formby tells me the whole project looked better and easier on paper, and that if you were strictly concerned with the dollars and cents aspect, that you'd be better off with your money in a CD for 10 years. At the same



### The wind turbine installed and in use.

time, we know that dollars aren't the only consideration and he feels the time will come when payback won't enter into the equation as much, and that a wind generator (especially in the Texas Panhandle—an area T. Boone Pickens calls the wind corridor of the U.S.) will be viewed as just another part of the facility.

While large-scale wind generation (or the lack thereof) is often brought to our attention in the mass-media, the reality is

that small-scale wind generation has been around and available for years. What's old is new again. Our nation's current concerns about our long-term energy needs have prompted manufacturers to produce new models, to the benefit of potential new users such as broadcasters. The time may be right for your station to generate some of its own power. No one can say for sure the direction energy prices will go; but there certainly is a great possibility that they could make you look like a clairvoyant genius, five to 10 years down the road.

*Irwin is transmission systems supervisor for Clear Channel NYC and chief engineer of WKTU, New York. Contact him at [doug@douginwin.net](mailto:doug@douginwin.net).*



More photos of the KPAN turbine installation are posted online at [RadioMagOnline.com](http://RadioMagOnline.com).



More on the KPAN installation in the February Podcast at [RadioMagOnline.com](http://RadioMagOnline.com).

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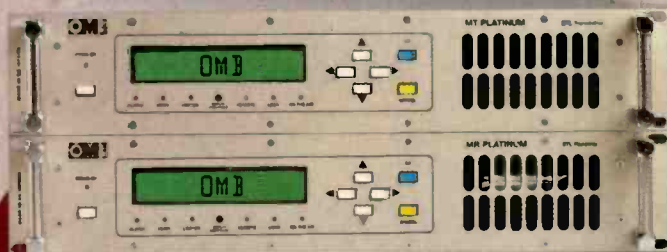




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## Tips, tricks, hints and more

By Chriss Scherer

### Watch out for snakes

**R**obin Cross, chief engineer at KCUR-FM Kansas City, needed a snake for the station's remote kit. The snake had specific needs for types of connection: A commercially available snake would work, but required a greater expense than the station wanted. Also, the KCUR remote kit is just that – a kit. There is no remote truck, so the snake needed to be lightweight. Cross improvised and created a solution.

He used Belden 1804 for the four mic cables. The 1804 has four wires – two blue and two white – within an overall braid, which improves the CMRR of the cable. The outside diameter of 1804 is 0.15".

He also bought four headphone extension cables (1/4" F to 1/4" M). He bought two different sizes of woven expandable sleeving from Grainger in 3/8" (PN-1UXW8) and 1/2" (PN-1UXY1) sizes. Other sizes are available. The reels came in 50' lengths. The smaller size was used to separate a mic and headphone cable. The larger size was used for the overall snake. In working with the sleeving it became apparent that he needed to



**Cross' custom snake**

melt the entire sleeve and then work the wires that were to go inside through the side of the weave. He color coded each mic and headphone cable in pairs with Scotch colored electrical tape and then covered that with clear heat shrink.

### Stay organized

This tip came to us some time ago, but was buried in the pile. David R. Wilson, engineer for the Cromwell Group in Nashville, TN, offered these ideas.

When you have two full-timers and two part-timers to cover 22 stations, it isn't easy to keep up, much less make progress. I have been using a twiki ([www.twiki.org](http://www.twiki.org)) to document what I have been doing, all expenses (eventually), and make a list of hot links to manuals on the Net. I have several things that I attempt to do on a schedule. Due to many surprises that schedule is not always followed to the letter.

I have also had some interesting challenges. One of the stations for which I am the chief engineer has a history of getting knocked off the

air because of equipment failure or abuse by nature. Besides doing a lot of troubleshooting, grounding and minor changes to the equipment, I put in a programmable logic controller (PLC) to control the site several months ago. Things have been much quieter since. When the main transmitter goes down something will usually be on the air in six seconds.

The backup will come up when it is ready. If the main does come back up the PLC will shut off the backup transmitter and put things back to the default status. A power failure will add an additional 8 seconds to the recovery time. If both transmitters are blown up and the PLC is down as a last ditch effort the IBOC transmitter will come up in analog+IBOC by default.

Otherwise, lots of overtime seems to work.

### Clarification

Last month, John Landry offered some tips on finding a cable break by using an inductive tester. He also described a method to use a power amplifier to increase the test signal in noisy environments. In the printed version of the story, he mentioned a situation where he used

an available speaker amplifier. This might have caused some confusion to suggest that the speaker was attached to the far end of the cable. The speaker amplifier was used just like the Crown power amplifier that was described. No speaker was attached, just the output of the amplifier to feed the line being tested.

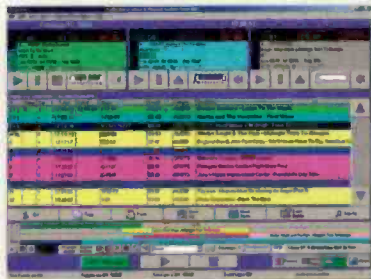
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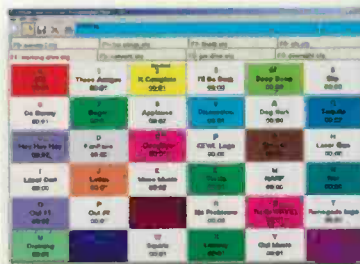
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## Radio Automation



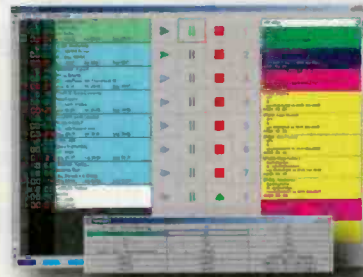
**Simian** - radio automation and digital play out system

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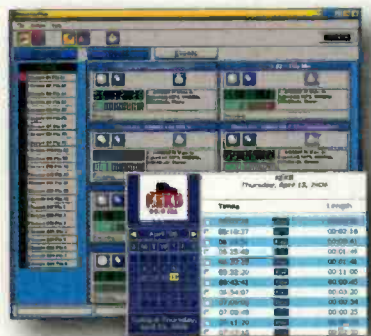
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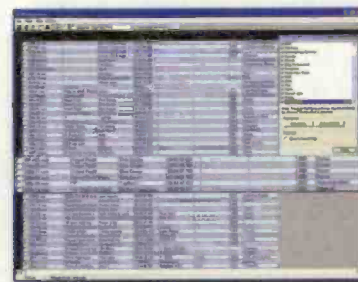
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## Full PC Systems



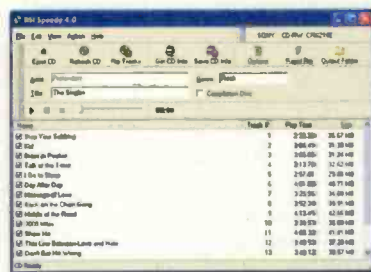
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## KRK Systems Rokit G2

By Glenn Shippis

**W**ith the vast development of sound technology over the last 15 years, quality sound equipment is now more diverse and affordable to just about anyone. In that same spirit KRK has released the Rokit G2 Powered Series. For this review, we will be specifically looking at the Rokit 5 monitors, but the series is available in 5", 6" or 8" woofers.

Upon arrival, the speakers appeared to be well packed in snug cardboard boxes insulated with plenty of foam and corner braces. As I removed each monitor from its respective box, I had trouble avoiding the soft dome tweeters with my fingers when trying to pull them out. My concern for the tweeters was soon pacified as the tough little buggers popped right back out. Phew! The bright yellow cones of the low frequency drivers yielded the 'urban' feel of past KRK lines, while still appearing fresh and sleek in design.

### Features

As I began to integrate the monitors into my existing system for testing, some obvious,

## Performance at a glance

5", 6" or 8" models

Unbalanced RCA,  
balanced TRS,  
or XLR inputs

Soft-dome tweeter

Aramid Glass  
Fiber driver

HF adjustment

practical and beneficial features grabbed my attention – first, the apparent savings in valuable real estate. At a modest 11.1" x 7.3" x 9.1," the biggest spatial dilemma will be too many placement options. Also, I was thrilled to find a thin layer of dampening foam attached to the bottom of both speakers, cutting down on vibration transfer and the additional hefty cost of buying separate foam. Someone was thinking about the customer.

I decided I would set them up alongside my Mackie HR824 near fields for an A/B comparison. I chose to compare the Rokits with those specific speakers, as I know many stations are

familiar with them, and I hoped it would help give a clearer reference point.

Connections were a breeze, the Rokits offering unbalanced RCA, balanced TRS or XLR inputs to choose from. Soon after switching them on and getting some music going, I was able to match the gain structure/level of my Mackies via the volume control on the back of each Rokit. This landed at +4dB, which is admirable when you consider the size and power difference of the two monitors.

I was surprised at the sheer loudness of these monitors. The high end is covered by a 1" soft dome tweeter, while the lows burst from a 5" Aramid Glass Fiber driver. I never did feel like I was pushing them too hard, even at very hot SPLs.

### Performance

The speakers performed quite well for several styles of music at various sound levels. Around 80dB there was a fairly flat response with a slightly audible dip around the 2.5kHz range. This high-mid d'p seemed to benefit harsh, densely mixed music while leaving less-dense mixes sounding a bit empty. However, as I turned the various song selections up to 85-95dB, the mids filled out quite nicely, as did the low end.

I wasn't satisfied with the high end through the Rokits until tweaking yet another great feature: the HF adjustment. Located on the back of each enclosure, this feature is essentially a high-shelf set at 3kHz (on the 5 model)  $\pm 1$  or 2dB. At unity gain, the high end sounded a bit harsh and brittle, kind of like the digital sizzle of a crash cymbal on an MP3; although cutting the crossover down 2dB fixed the problem



completely and the sound was much more flat and smooth to my ears.

Volume appears to be the fuel to get these Rokits blasting off. It seemed the more you got the cones moving, the greater dynamic and tonal detail achieved. There was an apparent lack in dynamics and detail on less compressed tracks such as classic and jazz styles, compared to the Mackies, but in all fairness, the speakers

It is obvious KRK put some work into these speakers, with intuitive features that make the Rokit Series adaptable to many acoustic environments and audio situations. I must say, when you consider the price, the sound and the features, these babies stack up pretty well against the competition. In this age of ever growing and developing sound technology, even those of us out there on a budget can afford a quality product. Good job, KRK.



## KRK

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were just out of the box and hadn't been broken in. Also, if sub-harmonic content is desirable to you, you may want to consider adding the sub KRK has optimized to go with this series of speakers. While the low end of the Rokit 5 is present fairly tight on its own, it did seem to resonate maybe  $\frac{1}{3}$  to  $\frac{1}{2}$  an octave higher than the Mackies.

*Shippis is a freelance audio engineer in Kansas City, MO.*

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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.

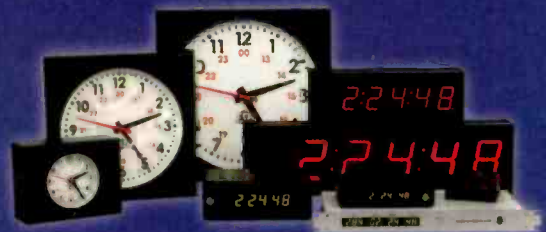
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# ESE

# NEW PRODUCTS

www.RadioMagOnline.com

by Erin Shipps, associate editor

## Headphones Phiaton



**MS 400:** Moderna Series headphones are engineered with a carbon fiber enclosure for accurate response and high quality audio. These flexible fold-and-go headphones fit conveniently into a compact carrying case for travel. They feature studio grade 40mm electrodynamic drivers, 32 $\Omega$  impedance, 98dB sensitivity, max input power of 1W and weigh 6.5 ounces.

866-313-3203; [www.phiaton.com](http://www.phiaton.com)  
[info@phiaton.com](mailto:info@phiaton.com)

## Six-band digital audio processor Axel Technology



**Falcon 50 FM:** The Falcon 50's largest control set allows users to paint a unique and competitive on-air sound, from detailed and flat to heavy and loud. Audio quality is maintained even at extreme settings. A module allows flexible switching between inputs. Fail-safe operation is assured by an internal bypass on all the audio and MPX I/O circuits. Two composite baseband outputs are provided, each with independent level control. The MPX clipping stage is user-enable and adjustable. MPX power can be limited accordingly to ITU R-BS 412 Specification. Two serial RS-232 ports, an USB port and a TCP/IP Ethernet connection permit remote control and monitoring from almost any location through the use of a standard PC and the dedicated control software that comes with the unit.

+39 51 736555; [www.axeltechnology.com](http://www.axeltechnology.com)  
[info@axeltechnology.com](mailto:info@axeltechnology.com)

## In-studio pre-processor



## Omnia Audio Omnia One Studio Pro:

The Omnia One Studio Pro is the first studio processor to include a four-band compressor/limiter. One size does not fit all when it comes to pre-and post-processing. The flexibility offered by the Omnia One Studio Pro's compressor/limiter allows precise and accurately defined individual control while pre-processing music, commercials, remote feeds or sweetening audio. Signal flow processes can be used separately or together as needed. They include: wide-band automatic gain control; four-band limiter; four-band compressor; and bass enhancement.

216-241-3343; [www.omniaaudio.com](http://www.omniaaudio.com); [info@omniaaudio.com](mailto:info@omniaaudio.com)

## Cable tester Clark Wire and Cable

**Pro Aud1:** The Pro Aud1 cable tester generates two test tones (1 kHz or 440kHz) at three levels (+4dBu, -10dBV, and mic levels). Connections include XLR, 1/4" phone, RCA, 1/8" mini, TT and MIDI. It tests for opens, shorts and crossed wires, and features a memory hold function to easily identify intermittent connections. The Pro Aud1 shows which input pins are connected to each output pin by lighting its LED in the cable wiring display. While in cable test mode, pressing Reset stores the current cable wiring display and clears the Intermittent LEDs. If any change occurs in the wiring displayed, the intermittent LED corresponding to any input pin that had the change will light and stay lit until the next time Reset is pressed. The test tone mode is intended for use in checking audio system integrity and the rough setting of signal levels only and not for use as a voltage standard. During this mode, pins two and three are monitored for external dc voltage as commonly supplied to microphones. The phantom LEDs will light at any time the presence of a dc voltage greater than 5V is detected.



800-222-5348; [www.clarkwc.com](http://www.clarkwc.com); [sales@clarkwc.com](mailto:sales@clarkwc.com)



## NEW PRODUCTS

### Portable recorder

#### Tascam

**DR-100:** The Tascam DR-100 portable recorder targets recordists who need a reliable handheld recorder with advanced recording features. Building on the DR-1 recorder, the DR-100 has a pair of XLR mic inputs with phantom power for pro condenser microphones. In addition, the DR-100 has four built-in electret condenser mics – two cardioid and

two omni – and a built-in speaker for playback. It's powered either through an included lithium-ion rechargeable battery or easy-to-find AA batteries. Analog line inputs and outputs are also available, as well as a mic stand mounting hole for recording flexibility. Other production-savvy

features of the DR-100 include a wireless remote control and audio editing features. Playback can be looped or slowed down without changing the pitch, and locate points can be added while recording. The DR-100 records to SD or SDHC cards, and a 2GB card is included with the unit.

323-726-0303; [www.tascam.com](http://www.tascam.com)  
[tascamlit@tascam.com](mailto:tascamlit@tascam.com)



### Online tech courses Society of Broadcast Engineers

**SBE University:** As part of the society's renewed focus on engineer education, the SBE has launched the SBE University. This series of online, on-demand courses is designed to provide instruction on a variety of technical radio and television topics to broadcast engineers. The first three courses offered by the SBE University are now available for enrollment: AM Antenna Modeling, FM Transmission Systems, Matching Networks and Phasing. Additional courses are being developed.

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## Power conditioners and voltage regulators Furman Sound



nologies, providing audio amplifiers with a consistent sound. The P-1800 PF R is also ideal for in-studio setups that use powered monitors for playback of recorded material. Furman's Power Factor Technology reduces ac line impedance by providing a 45-A peak current reservoir. Clear Tone Technology adds

**Prestige Series:** The Prestige Series includes the P-1800 PF R power conditioner, P-1800 AR voltage regulator, and P-1400 AR E export voltage regulator. The P-1800 PF R utilizes Furman's Power Factor and Clear Tone Technologies, providing audio amplifiers with a consistent sound. The P-1800 PF R is also ideal for in-studio setups that use powered monitors for playback of recorded material. Furman's Power Factor Technology reduces ac line impedance by providing a 45-A peak current reservoir. Clear Tone Technology adds an additional level of linear filtration for a lower noise floor. The P-1800 AR provides consistent 120V output from input voltages ranging from 97V to 137Vac. Furman's True RMS Auto Regulation Technology utilizes an ultra-low noise, microprocessor-controlled eight-tap toroidal autoformer, assuring quiet operation for critical listening and recording applications with minimal leakage of stray magnetic fields. The P-1800 AR features a switchable front panel digital voltmeter/ammeter with color-coded voltage range indicator for comprehensive power monitoring. The P-1400 AR E provides all of the technology of the P-1800 AR to overseas markets.

707-763-1010

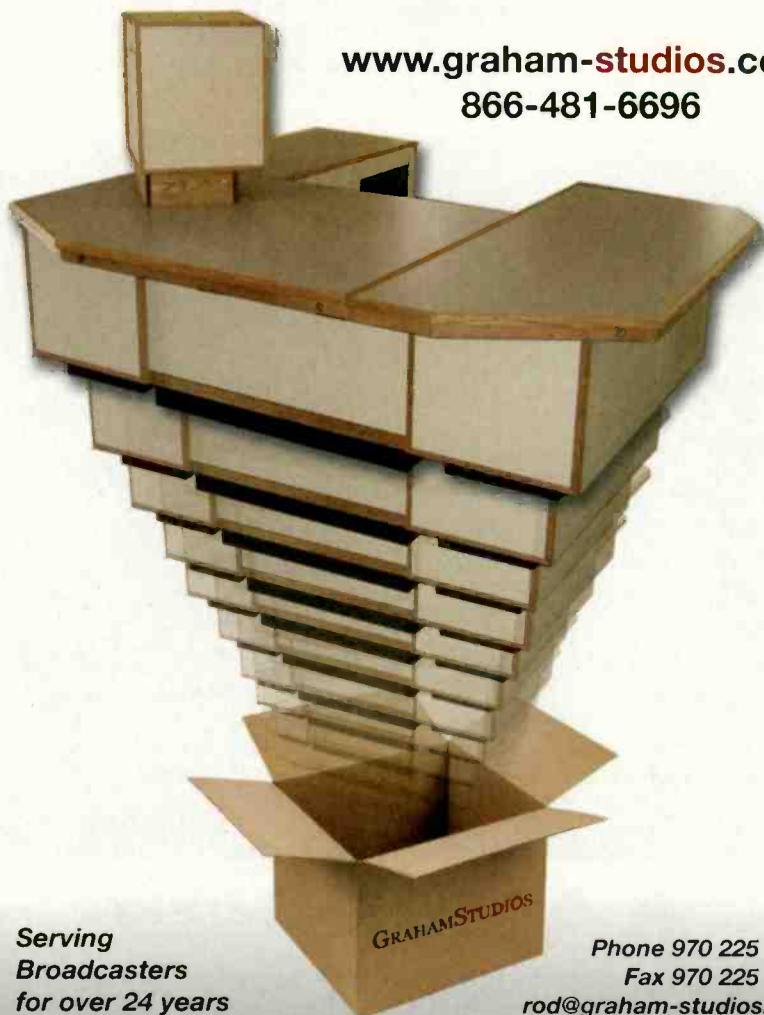
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732-901-9488; [www.neutrik.com](http://www.neutrik.com)  
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**UPGRADES and  
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**Day Sequerra** is now shipping the M2A-FM, an analog FM monitor with world-wide tuning and de-emphasis settings.

The M2A-FM is based on the M2 HD Radio monitor and shares many of its features. ([www.daysequerra.com](http://www.daysequerra.com)).

**Nautel** is entering its 40th year in business and has announced a five-year warranty on the company's NV and NX Series transmitters to kick off the celebration. The extended warranty is offered to customers who purchase the transmitters during 2009. ([www.nautel.com](http://www.nautel.com)).

**RCS** has released G Selector 3.10, which adds several enhancements to the Goal Scheduler including Song Groups, Advanced Search, Quick Filters and Twofers. ([www.rcsworks.com](http://www.rcsworks.com))

**Adam Audio** is now shipping the Sub7 powered subwoofer.

The Sub7 complements the A5 and A7 monitors of the A-Series. It features a compact size and three finishes. ([www.adam-audio.com](http://www.adam-audio.com))

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**Studio condenser microphone  
Nevaton**



**MC420:** The Nevaton MC420 is a classically designed studio condenser microphone that is well suited for voice-over, post-production and broadcast. It is available with cardioid and omni-directional polar patterns. It shares the same 24mm large-diaphragm capsule as the Nevaton MC51, and carries a linear sensitivity throughout its entire frequency range. The amplifier is built to the Class A transformerless standard, and all transistors pass a special selection process to guarantee minimal self-noise levels. The MC420 operates on 48V phantom power, and a gold-plated XLR-connector is used as an output connector. It can handle an SPL up to 135dB without distortion. The microphone's internal components are elastically mounted to lower vibration and handling noise to an absolute minimum.

608-227-2040; [www.nevaton-microphones.com](http://www.nevaton-microphones.com)  
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630-741-0330; [www.d-mpro.com](http://www.d-mpro.com); [info@d-mpro.com](mailto:info@d-mpro.com)

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### Multitrack recorder Zaxcom



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973-835-5000; [www.zaxcom.com](http://www.zaxcom.com); [info@zaxcom.com](mailto:info@zaxcom.com)

### All-in-one FM analog monitor Belar

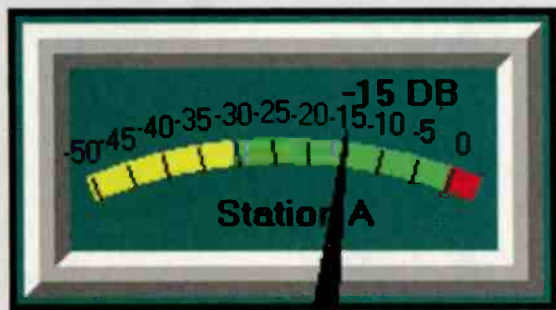
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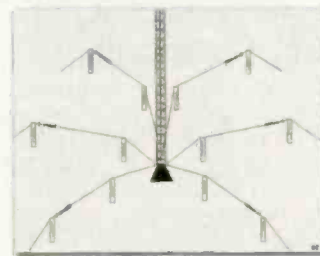
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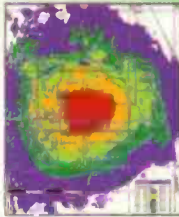
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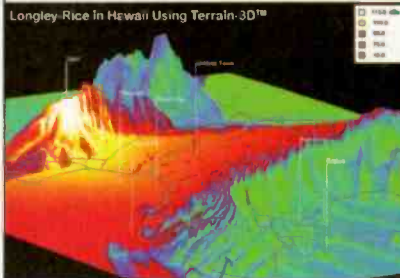
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# Contributor Pro-file

Meet the professionals who write for *Radio* magazine.

This month:

**RadioMagOnline Monthly Podcast.**



**Chris Wygal, CBRE Engineer  
Liberty University  
Lynchburg, VA**

Wygal joined Liberty University in May 2002 as the engineer for the school's 50kW and 120W FM stations. He has maintained

and built several radio/production studios in the Lynchburg, VA, area and for the university. He is the engineer and broadcast director for the Flames Sports Network, which provides radio coverage of Liberty University football. Wygal owns a recording studio as well. He has contributed to *Radio* magazine since July 2005.



Written by radio professionals  
Written by radio professionals

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# SIGN OFF

by Erin Shipp, associate editor

## Do you remember?



Rich Parker wrote to us for information regarding a Webster-Chicago Model 80 Wire Recorder. Rich writes, "It appears to be in decent shape and even has the old Art Deco mic with the Jones plug connector. But even stranger is that there was a box with a couple dozen 'wire' spools, each about 30 minutes. Of particular interest is one marked 'Feb. 6 '49 - WCBS New York Philharmonic - Leopold Stokowski, Conductor, Myra Hess, Piano.' There is also another reel of 'Thus Spake Zarathustra (WCBS)' but no date. And most curious - one marked 'Harold's Radio Interview - WJZ,' again with no date. From other tapes, it appears that Harold (Walsh) was an architect or designer of some kind (there are lectures)."

"I haven't fired it up yet - it needs a bit of dusting and cleaning, but it appears to be in quite good shape. I thought some of the NYC folks might have some idea who this fellow

might be or any other history. There are also several reels marked Jeanne Walsh with various piano recitals on them. Also if anyone has tips on the care and feeding of this beast, that would be most appreciated. I did find one funny link on Google about a guy who used his to encode data on the wire spools - might work for my old TRS-80 Model 100 laptop in place of the cassette recorder."

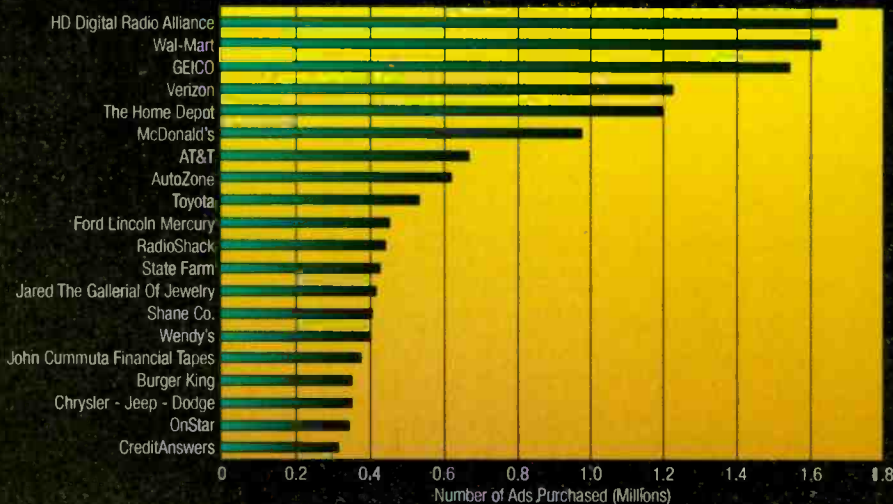
If you have any information on this piece of machinery or the people mentioned, e-mail Rich at [rparker@vpr.net](mailto:rparker@vpr.net) and copy us at [radio@RadioMagOnline.com](mailto:radio@RadioMagOnline.com).

## That was then



Wes Boyd sent us these images of an NAB study guide from 30 years ago when the FCC required all operators to have a Third-Class commercial radiotelephone license with an Element Nine broadcast endorsement. The SBE currently offers Radio Operator certification, which is designed to show operator proficiency in the information he should know. See the full exam online at [RadioMagOnline.com](http://RadioMagOnline.com)

## Sample and Hold Top 20 Radio Advertisers in 2008



The biggest advertisers of 2008 came from a variety of categories, but the top 20 radio list was certainly driven by ads from the HD Digital Radio Alliance, Walmart and Geico. This list was compiled from monitors in 77 radio markets surveyed in the U.S. from Jan. 1, 2008, to Dec. 14, 2008. For the full report, including TV, cable and newspaper advertisers, visit [mediamonitors.com/specialreport.asp?id=1](http://mediamonitors.com/specialreport.asp?id=1).

Source: Media Monitors



# Insight to IBOC

February 2009

Part of the *Radio* magazine DAB Answer Series

## Nautel HD Power Boost – How it Works

**It's all about the (peak-to-average) power**

By Philipp Schmid

Could broadcasters increase IBOC injection levels higher than -20dBc by some means other than purchasing more transmitter power? Nautel has developed a technology called HD Power Boost that uses an intelligent peak to average power ratio (PAPR) technique to address this issue. This technology squeezes more hybrid power from a given transmitter and also achieves increased hybrid-mode efficiency. It wouldn't be fair to expect that -10dBc will be achievable with this technology alone, but this patent-pending technique is currently in development and is being tested on-air at Nautel's own experimental radio station. Initial release is targeted for the NV series products, which provide up to 44kW of solid-state power.

### The basics

IBOC uses orthogonal frequency division multiplexing (OFDM) to broadcast the HD Radio signal. This scheme uses multiple simultaneously transmitted data carriers, which can provide a more robust signal in multipath environments. However, these multiple carriers require highly linear signal amplification to minimize carrier intermodulation and ensure spectral compliance. The amplifier also requires significant input back-off to handle large power peaks inherent in the IBOC signal. The addition of more carriers

drops the average power of the signal by several decibels while maintaining the same power peaks. This can be expressed as the peak-to-average-power ratio (PAPR). With FM IBOC's minimum of 382

carriers, the PAPR can reach 12dB; this would require broadcasters to add 12dB of average transmitter power to handle the load of HD Radio.

Ibiquity Digital provides an optional PAPR reduction algorithm as part of the standard IBOC modulator, which reduces signal peaks from 12dB to 8dB. It has been found that peaks can be reduced further by driving the signal into compression. Depending on the transmitter, this could yield a final PAPR of 5.5dB. What this means is that to achieve a 3kW digital transmitter power output you must install a transmitter capable of delivering 10.6kW of instantaneous power. Without standard

## HD Radio Ad Substitution

By Hugo Latapie and Thomas Rucktenwald

The term "targeted advertising" is a broadcasting buzzword. Potential profiteers talk about targeted advertising because it promises to be lucrative, and it may be promising for HD Radio broadcasters.

Not every listener is going to want to participate in targeted advertising. Our society has raised suspicions about privacy to paranoia proportions. However, there will be those who are unconcerned. There will be those who prefer to hear commercials that match their lifestyle. There will be listeners that desire certain free-but-protected programming and are willing to opt-in to receive premium content.

Participating consumers may never know the commercials they receive are different: They will not hear any more or fewer commercials. They will receive different commercials that have meaning for their lives.

This is based on an ad substitution system NDS created for television. With ad substitution, cost per thousand (CPM) estimates for a targeted television advertisement are 10 times that of a normal broadcast ad. If we can say that this financial return is also true for radio, then just 10 percent listening audience participation will double station advertising revenue. What station will refuse this return?

*continued on page 3*

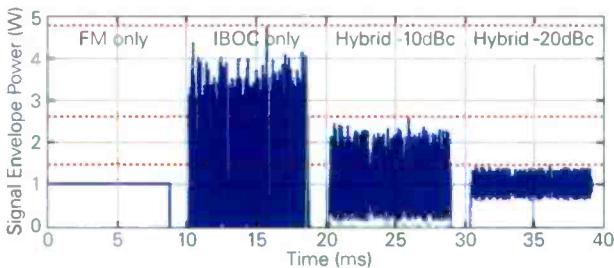


Figure 1. FM + IBOC instantaneous signal envelope power fluctuations at 1W average power

### Inside

HD Radio penetration ..... 6

A special supplement to

**Radio**  
THE RADIO TECHNOLOGY LEADER

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PAPR reduction, a much larger transmitter would need to be installed to handle the signal peaks, even with considerable compression.

With standard PAPR reduction, the algorithm inputs a single-modulated IBOC symbol at a time. Peaks are detected by computing the absolute value of each sample point and comparing it against a pre-defined threshold value. Once a peak is identified, the standard PAPR reduction algorithm clips the peak to a given threshold while maintaining its instantaneous phase value. This clipping introduces distortion into the signal, which must be corrected. To do so, the standard PAPR reduction algorithm demodulates the distorted IBOC signal and digitally processes the signal to basically rebuild it, but with only a partial restoration of the peak. Additionally, a mask is applied to the signal to suppress errors in the non-carrier frequency bins. This allows varying amounts of noise to subside in the IBOC signal without violating the spectral emission mask.

## Adding 10dB

The recent proposals to the FCC that suggest an increase of up to 10dB in digital carriers has generated a great deal of interest among broadcasters. Increasing digital carriers by 10dB only increases the average IBOC signal power from 1 percent to 10 percent of the transmitted FM signal. However, this can have considerable implications for the transmitter, which is limited by its peak-power capability and not the average power capability. Figure 1 (on previous page) shows a power envelope comparison of an analog-modulated FM signal, a digital-only signal, and a hybrid signal at -10dBc and -20dBc injection levels all at the same average power of 1W. While at -20dBc about 40 percent of transmitter overhead was sufficient, with -10dBc carriers we now require more than 160 percent of transmitter power and cannot use amplifier compression to the same degree as is possible with the -10dBc signal. Almost all of the signal must now fall into a linear amplification region, so to produce 8kW of FM power requires a transmitter capable of handling 22kW for -10dBc hybrid operation. An 11kW transmitter would suffice for -20dBc.

Every FM IBOC system in use today uses the standard PAPR reduction scheme developed by Ibiquity Digital. The scheme Nautel uses is almost identical to the standard scheme and transmits an IBOC signal of equal quality to HD Radio receivers while more effectively reducing peak power requirements for a hybrid, low-level combined transmitter.

## The concept

As a program is transmitted on the radio, all the receivers play the same audio. When a commercial plays, and if the business rules state that ad substitution is acceptable, participating radios will play an ad that the listener would prefer to hear based upon his demographics, lifestyle, preferences and interests. The radio receiver, when substituting, chooses among the prerecorded commercials in its memory. These commercials are delivered through the radio station and the targeted receiver records them. Recording never disrupts the listener's experience.

Receivers are addressable and can be arranged into specific target groups. A receiver may belong to many different groups. The receiver will automatically identify the ads it is supposed to receive and record.

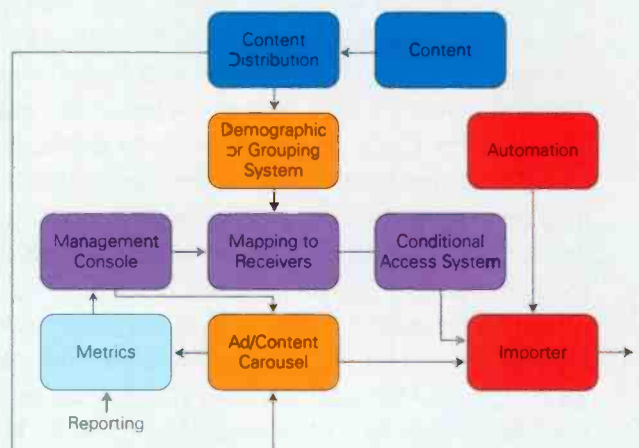


Figure 1. Station installation of a targeted ad system.

A participating station will transmit an HD Radio signal to deliver the commercial content. A broker will organize demographics and groupings. Substitute commercials broadcast as per system scheduling, matching the contract between the advertiser and radio station. The station audio playback system triggers transport stream signaling as per the pre-established business rules.

## Key decision factors

Because HD Radio broadcast bandwidth is limited, parallel streams may not be bandwidth efficient. Therefore, pre-recording substitute material is the chosen methodology. Commercial delivery does not need to be real-time. A narrow pipe delivers a pre-recorded commercial encoded as an HDC file or a data file such as a JPG image in slower than real-time speed, which maintains quality while consuming very little bandwidth. A 48kb/s encoded file delivered on a 5kb/s pipe transmits a 30-second audio commercial in five minutes. If a recording is incomplete, it may be suspended until the commercial is broadcast

continued on page 5

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

Insight to IBOC - a supplement to Radio magazine, February 2009, © 2009 Penton Media. All rights reserved.

# Power Boost

## The Power Boost method

The major difference between Nautel's PAPR reduction scheme and the standard method is a difference in peak detection. Figures 2 and 3 depict a complex plane where the X axis reflects the baseband signal's real (phase - I) component and the Y axis represents the signal's imaginary (quadrature - Q) component. Figure 2 illustrates standard PAPR reduction, which only operates on the digital signal and then adds the result to the analog signal. Figure 3 shows Nautel's method of taking the analog signal into account in detecting a peak.

The output of the FM modulation process produces a constant envelope signal with varying phase. This signal is represented by the white circle. Standard PAPR can only detect a peak based on the digital signal and it does not know whether this peak adds constructively or destructively to the analog signal. This means that this PAPR reduction method unnecessarily performs potentially large peak reductions on destructively added peaks – when the reductions are not needed.

The Nautel PAPR reduction method offers a different approach for determining the correction vector. In Figure 3 the analog vector A is first added to the digital vector D. The resultant hybrid vector H is then limited to the maximum desired peak threshold. Only if the digital signal adds constructively to the analog signal is a large correction required. If the vector addition falls close to the maximum desired peak, a smaller correction is applied and no correction is needed if the result is below the maximum desired peak. By introducing a lower amount of correction, our algorithm can achieve the same maximum desired peak value with a lower degree of distortion in the original signal. This allows us to reduce the signal's peaks further compared to the standard PAPR reduction method.

By not simply clipping the hybrid signal, but keeping the correction vector C separate and only applying it to the digital component, allows us to use the established correction techniques of standard PAPR reduction. It also uses the FM signal only during the clipping decision process and therefore maintains the FM portion of the signal until it is finally added to the digital component to form the hybrid signal stream.

## The results

Our initial tests show an encouraging reduction in the PAPR from 4.51dB down to 3.19dB at an IBOC

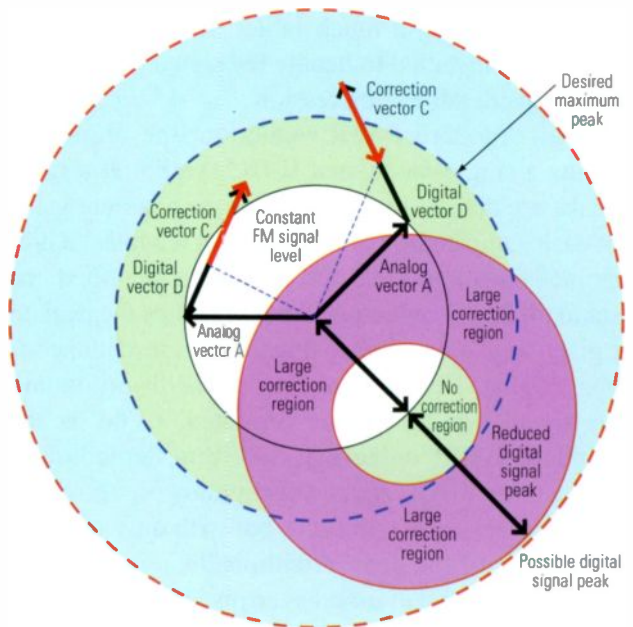


Figure 2. Standard PAPR reduction

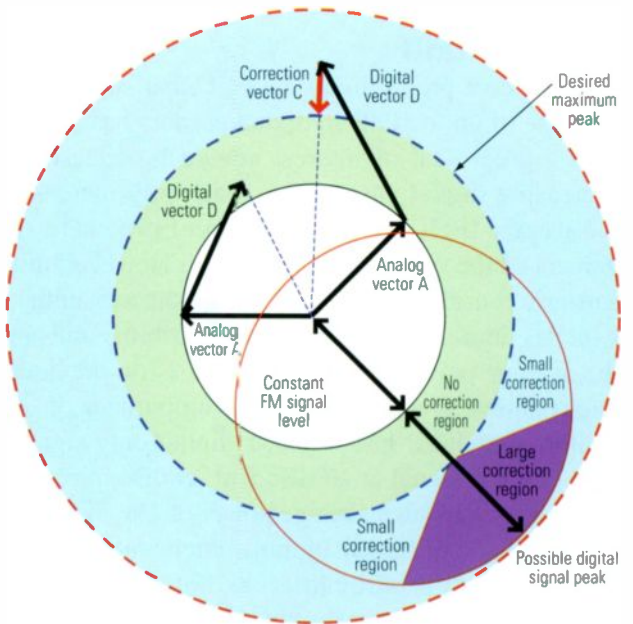


Figure 3. Nautel's Power Boost applied to PAPR reduction

injection ratio of -10dBc. This translates to a significant reduction in peak transmitter power requirements. For a station using a 8kW TPO and Nautel's PAPR reduction technique the transmitter would only need to handle peaks of 16.9kW rather than the 22.6kW peaks using standard PAPR reduction. These gains help make it more affordable for broadcasters to adopt the higher injection levels.

Schmid is digital design engineer at Nautel Limited



## Ad Substitution

*continued from page 3*

again in the content carousel. This ensures efficient recording and more completed deliveries.

The receiver recognizes its entitlements and the content addressed to it. The receiver records commercials and files onto flash memory in the unit. Recorded content plays back as directed by triggers in the transmission transport stream.

Commercials delivered by a radio station substitute for broadcast commercials while the consumer is listening to that station. Commercials delivered by one radio station can substitute when listening to a different radio station if and only if the participating advertiser works with both stations. The receiver must also account for both the tuned station and the delivering station.

## Broadcast architecture

The broadcast architecture includes a data carousel for content playout. The carousel playout logically connects to a data pipe/data channel in the HD Radio Importer. The carousel also provides information into the metrics system, providing transmission accountability.

The metrics or measurement part of the system will also accommodate feedback from the field. The field reporting structure may require direct feedback as well as delayed feedback. Feedback may also include subjective estimates made from listening patterns, expected deliveries and triggered substitution statistics.

The Importer will insert playback triggers that activate radio operation. The signal to insert a trigger comes from

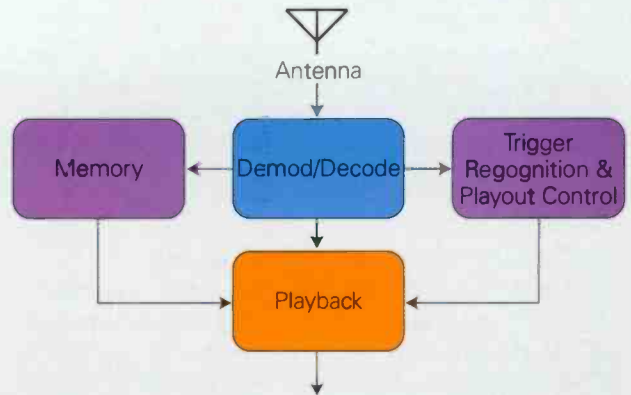


Figure 2. Implementing targeted advertising in a radio receiver.

the automation system. When an ad plays and when the automation system signals, the Importer inserts the substitution trigger into the transport stream. Radio addressability is a key system factor. The system must make a connection between the customer grouping or demographics and the targeted radios.

The connection is made through NDS Radioguard HD Radio conditional access, which includes receiver addressability. Every radio carries a unique identification, serialized at the HD decoder IC level. In addition to the addressability, the Radioguard implementation will enhance the delivery through its security, eliminating possible spoofing.

*continued on page 6*

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## Ad Substitution

continued from page 5

The system translates and automates the demographic and grouping information into addressable entitlements for participating radios. The content is associated to groups, thus defining the delivery destinations. The system packages the content and schedules the deliverables through the carousel layout.

### Radio/receiver architecture

A target radio must have memory storage to accommodate the system. Recorded target advertising will be played back as directed. Content stored in memory is identified by associated metadata. The playback system utilizes that information and organizes a playout priority. When signaled by the radio station broadcast, the substitute advertising will play in place of the aired commercial.

Any ad delivered by and associated with the tuned radio station may be substituted. Ads delivered by another station but still associated with the tuned station are OK, meaning that the advertising participants can and may cooperate.

The radio must identify the station that the consumer is listening to and the source of the advertising content. The metrics system may automatically report, may report later, or may provide assumed information based upon recording, listening and playback statistics. The primary source of this information may be the radio receiver itself.

For this system to become a completed product, several entities must participate, including NDS for conditional access and datacasting, Ibiqity for the HD Radio transport stream and recording, broadcasters, advertisers, ad agencies, a demographic/grouping creator, automation system manufacturers, metrics and measurement services, and radio receiver manufacturers. While this appears to be a lengthy list, most of the required technology pieces already exist. Coordination is the important issue, combining all the technology into one cohesive package. The most difficult portion will be the legal contracts.

Conditional access is only used on multicast channels. The main HD Radio channel is always free-to-air. However, targeted advertising works on any broadcast channel, including the main channel. While the delivered ads may be targeted, encrypted, addressed and delivered by the conditional access system through the multicast only, decrypting and substituting on the main channel is easily accomplished by the radio.

*Latapie is chief technology officer at NDS Americas, and Rucktenwald is the director of data applications sales at NDS Americas, Costa Mesa, CA.*

## Sample and Hold

### Top 10: HD Radio penetration

By Chriss Scherer, editor

How is the HD Radio rollout going? The statistics say there are currently 1,867 stations transmitting an HD Radio signal, with 2,817 total digital streams available. It seems the 2,000-station mark is in sight, but the rate at which stations are activating HD Radio signals has slowed. (In case you're wondering, the 1,000th station to implement HD Radio was WIYY-FM Baltimore on Sept. 18, 2006.) One reason is the looming decision to allow increased power of the digital sidebands.

HD Radio adoption started in larger markets, and two years ago we provided a list of the top 10 HD Radio markets. These 10 markets boasted 271 stations. Of those, 149 were also transmitting multicast signals for a grand total of 420 digital streams.

Feb 2007 Rank	Market	HD Radio Stations	Multicast Signals	Jan 2009 Rank	Market	HD Radio Stations	Multicast Signals
	Los Angeles	38	18		Los Angeles (2)	38	22
2	Chicago	33	21	2	Chicago (3)	37	24
	Denver	28	12	3	Dallas-Ft. Worth (5)	33	17
4	Dallas	27	14	4	Denver-Boulder (21)	29	17
	Detroit	26	15	5	New York (1)	28	22
6	Atlanta	25	16	5	Houston-Galveston (6)	28	20
	Miami	24	12		Seattle-Tacoma (13)	28	20
7	New York	24	13	8	Philadelphia (8)	27	17
9	San Francisco	23	15		Atlanta (7)	26	17
9	Boston	23	13	9	Detroit (11)	26	17
				9	San Francisco (4)	26	17

Two years later, the list of markets hasn't changed much. Two cities have been replaced: Miami and Boston are out and Seattle-Tacoma, Philadelphia and Houston-Galveston are in. (There is a three-way tie for the last slot, so we have 11 stations this time). The remaining order has changed just a little.

Counting only the top 10, the new list accounts for 300 stations transmitting an HD Radio signal, with 193 multicast signals, for a grand total of 493 digital streams.

Data Source: Ibiqity Digital station finder. Numbers in parenthesis indicate current Arbitron market ranking.





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